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EDP MANAGING A NEW ELECTRICITY ERA: THE BIRTH OF OCEAN WINDS

STRATEGIC PARTNERSHIPS AS A TOOL TOWARDS SUSTAINABILITY

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Abstract

When the renewable energy market started to grow at the beginning of this century, EDPR faced the need to expand its portfolio. Like many other business decisions, entering a new market is not easy. The following paper analyzes the strategic decision of EDPR when deciding either to pursue a partnership or to go alone in the brand-new offshore wind energy sector. It examines the considered factors for the partnership decision to understand how the partnership was established and its potential in the fast-growing offshore wind energy sector.

Keywords: Energy Sector, Joint Venture, Partnerships, Strategy, Sustainability, Renewable Energy, Risk Analysis, Technology Acquisition.

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CASE STUDY

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Abbreviations Case Study

ADEME	French Agency for the Environment and Energy Management
CEO	Chief Executive Officer
COO	Chief Operating Officer
CTG	China Three Gorges
EDP	*Energias de Portugal*
EDPR	EDP Renewables
EIB	European Investment Bank
GDF	Gaz de France
Inc.	Incorporation
Km	kilometers
LLC	Limited Liability Company
MOWEL	Moray Offshore Windfarm East Limited
NER 300	New Entrance Reserve 300
OW	Ocean Winds
PPI	Principle Power Inc.
REN	*Redes Energéticas Nacionais*
SERL	Sea Energy Renewables Limited
UN	United Nations
UK	United Kingdom
US	United States
WFA	WindFloat Atlantic

CASE STUDY

EDP Managing a New Electricity Era

After 13 years of renewable energies at EDPR (EDP Renewables), the Executive Board of Directors encountered the decision of following a new market trend that would revolutionize the way green energy was perceived in the company and throughout the world. At the time, offshore wind energy presented an immense potential and a significant opportunity to expand the company in the renewable energy sector, expanding EDPR's portfolio and improving its sustainable-oriented mindset. In this sense, if EDPR intended to become a leader, as it did, it had to become a pioneer in adopting new types of renewables. Therefore, it was time to start thinking about what could become the next best move and how it should be undertaken.

The decision seemed relatively easy. However, João Manso Neto, part of the Executive Board of Directors, knew that a smart short-term decision would lead to a wider range of long-term opportunities and was aware that offshore projects entailed too much capital and time, which would disable EDPR from entering the market alone. Yet, knowing that its long-established partner Engie had the same cost and return expectations as EDPR, both decided to create a joint venture, that later led to OW (Ocean Winds) – the combination of all offshore wind projects from both companies in one.

Birth and growth of Renewables at EDP

EDP (*Energias de Portugal*) was created in 1976 as a result of a wave of nationalizations that dominated Portugal in the period after the 1974 political revolution. The vertically integrated electric utility company – responsible for providing basic amenities, such as water and electricity (Investopedia 2021) – resulted from the merge and nationalization of many smaller firms in the electricity sector, becoming the dominant player in the Portuguese electricity market, namely on the activities of generation, supply, distribution, and commercialization.

In June 1997, after several restructuring procedures happened to assure equal electricity distribution among the Portuguese population, EDP initiated its route towards not being State owned (EDP 2018). Back then, there was an increasing trend for utility companies to stop being owned by governments, so that there were more opportunities in international markets due to fewer regulations (OECD 1999), which EDP saw as a growth prospect.

The process allowed not only new market opportunities and internationalization but also to deepen the focus that EDP had in the renewable energy sector. By 2006, the company started prioritizing investments in the renewable energy sector, due to new market opportunities and undeniable growth, which represented a bold move towards an untested market. At the time, the UN (United Nations) Millennium Development Goals were still in place, and sustainability did not represent a trending topic within the energy sector. Yet, EDP decided to be a pioneer and blindly invest in what would later become a global transformation process towards a carbon-neutral future, with the Sustainable Development Goals already in place. Onshore wind energy was the cheapest in the market, with a relatively fast return from manufacturing and installation (Government 2021), and represented the first-time energy generation did not entail carbon emissions, being a reliable clean power source without pollution during its operation, which presented itself as the best and most straightforward generated energy source to start with.

The renewable energies business that EDP knew back in 2020 was certainly not always like that, but EDP was still able to become a pioneer fifteen years before. As Pablo Lucas, Expert on Partnerships and Structured Finance at OW recalled, some members of EDP were considered "insane" for waiting to pursue such an unknown sector for which the company was undeniably a pioneer. As proof, oil and gas companies only started to move towards sustainable energies when EDP was already seeing its first results in the sector.

Therefore, in 2007, EDP created EDPR (EDP Renewables) as its subsidiary to fully operate in the growing renewable energies market in operations, management and investment phases in renewable assets for its parent company portfolio. In the same year and as part of the internationalization process, the first move into the United States (US) happened with the acquisition of the wind-energy leader in development, management and operations, *Horizon Wind Energy LLC*, from Goldman Sachs. This company's experienced management team, with an immense operational scope and technology capacity, reflected EDP's desire to invest abroad as an established leader in a growing dynamic market, whilst reducing the risk and diversifying its portfolio to onshore wind energy.

Apart from shifting its scope, EDP bought a set of opportunities that would eventually define a new market trend in a "*remarkably interesting geography for the company, since, apart from Brazil, Portugal and Spain, it was extremely hard for an energy company to set the business on a global level*" as Eduardo Moura, Corporate director of Sustainability in Portugal, later explained, adding that EDP had "*bought the solution to all its challenges"* when referring to the Horizon acquisition as the solution to the lack of knowledge the company had on renewables at the time.

The Focal Point | Offshore Wind Energy

When João Manso Neto started to realize there was an evolving opportunity in the offshore wind industry, he concluded that benefits outweighed its downsides. Firstly, the energy production potential was considerably higher than the one onshore wind energy had to offer, as offshore turbines would be larger and have access to more stable and stronger winds at sea, entailing higher rates of energy production for the same level of installed capacity – refers to the maximum power of a system and is measured in watts. This type of energy would also enable companies to grow their renewable energy production portfolio, fostering sustainable businesses while not exhausting limited land space, as onshore windfarms did. Beyond that, the ocean was an unexplored area with great potential for more production per unit of installed capacity.

Not only so, onshore wind projects also had a reduced lifespan compared to offshore, which lasted for an average of twenty years before needing manufacturing and structural updates. Given this, the company could expect fewer costs related to maintenance and less need to change infrastructures when comparing onshore with offshore, making the latter something to be considered as a more favorable opportunity for the future of renewable energies in EDP and Portugal (Direct 2016).

Additionally, another significant aspect to consider at the time was the differences between the two distinct types of offshore wind: fixed and floating. As the name indicated, the first one had its turbines set on the seabed, therefore requesting to be in shallower locations of the continental shelf and, by extension, of the coast (water depths went up to 50 meters) (ESMAP 2021). Such could mean some loss of energy production as a result of the strongest winds happening farther from the coasts and out of reach for some of these turbines. Nonetheless, fixed offshore had historically been easier to build due to its stabilized turbines and fewer engineering obstacles, with an already well established and mature technology even though unitary costs could still decrease more, being more developed than floating.

Regarding the other type of offshore wind, floating technology did not need to be fixed to the seabed and could be placed in more distant locations in the sea, ranging from 50 to 1,000 meters of depth (ESMAP 2021). Thereby it meant that not only could these turbines be placed in ideal locations for wind energy production, but also that they would also face less backlash from local communities as these would be out of their sight. Another relevant factor was that floating offshore wind was expected to be more efficient and smoother to manage due to the ease of installation of turbines themselves and their way of maintenance (Acteon 2020). It was easy for the floating technology to be assembled inshore, in the harbor, and then carried to the place it would start its energy production process. If the production was in the sea, waves could only be as high as 2,5 meters for the turbine installation. Ultimately, floating offshore wind technology allowed to ease the operational maintenance and provided a higher energy capacity, with great improvement potential, presenting itself as a good project for the company's future.

As mentioned by Luis Manuel, EDP director in 2021, EDPR was able to identify fixed structures as a promising opportunity for the expansion towards offshore wind. Yet, floating represented a larger potential for market growth and less environmental impact, which did not undermine the company to still pursue fixed foundations.

Emerging Concerns *| New Wind Energy*

One main challenge that immediately differed from the onshore wind production regarded the investments and timeline of offshore wind projects. Investments in offshore wind had to be considered from a long-term perspective, sometimes from a window of five to eight years from the moment a company started to invest. It was highly relevant for those interested in investing in such projects to be able to sustain a long-term project while being able to support their strategies until they entailed results. According to Luis Manuel, offshore wind presented much more risks than the other types of renewables the company already adopted, not only in the technical and development phases, but also with feasibility studies, maintenance, and expenditure before starting to build the project. Investments would surpass $20 billion and there was still the risk that if something failed, everything would fail, and the investment would go down the drain – some companies were not able to bear such uncertainty.

The undeniably larger dimension of projects did not relate solely to investments but also to risk. As later mentioned by Raphael Herz, Liaison Officer at OW, the renewable energies sector was defined as "*always having stuff going on, things moving on, things moving forward – how trends will evolve will never be static nor certain"*.

Besides, there was a rising effort to reduce offshore wind energy costs (EIT 2014) by increasing the efficiency of the turbines, with higher capacity and energy production rates, due to competitiveness (Direct 2016) and, consequently, competition. Therefore, producers' profit margins could decrease, reducing sales prices (Irena 2020) and increasing sales, calling more new joiners, and increasing the threat of new entrants. Likewise, the turbines were starting to be produced at a larger scale and dimension, increasing the size of the market but extending the challenge of modern technology that had to have more cables to connect to the mainland.

The process to install a fixed offshore wind foundations represented a threat to the environment, as biodiversity would try to go as far as possible due to the elevated amount of noise, which could be noticed from many kilometers away. Bottom-fixed structures would also represent a niche market within a limited area (the Baltic Sea, Nordic Sea, China and some other parts of Canada) of production. Thus, representing a declining opportunity for EDPR as onshore had already surpassed 800GW of installed capacity worldwide and was expected to grow even further. In addition, the installation of fixed turbines could not happen if waves exceeded 1 meter of height, which was very uncertain due to nature's unpredictability. Additionally, offshore installations were new at the time and had their basis in the middle of the sea, which made them more resistant to whichever conditions could be faced (Engineers 2017).

Massive projects entailed larger financial contracts, which in turn led to uncertain cash flows, and the "clock was ticking" as to where to install the windfarms, paying interests and investing capital from the first day the project was brought to the table.

Shifting Mindset

With EDPR having started to maximize onshore wind energy in most of its locations, its strategic department knew the company was quickly reaching a critical point at which it could no longer expand much further in that energy sector. Onshore and solar were very competitive, therefore complicated to diversify and increase returns in such a growing market. The offshore wind energy trend was emerging in terms of technological improvements, cost efficiency and project dimensions, and early indicators pointed towards the removal of trade barriers, rising prices for conventional energy sources, among others (BCG 2018). Furthermore, EDPR did not want to give up its leading position in the market. Then, it also represented a potential solution for controversial problems raised by local communities, namely criticisms regarding landscape destruction and harm and threat to local wildlife, plus occupying much needed and coveted land space. With these issues increasing at the time, whilst EDPR wanted to continue to shape itself into a better position and still with the ambition to grow its business, there was a need to shift the focus of the company's strategy. The Executive Board of Directors at the time decided that offshore wind was indeed the perfect continuation of the legacy created until then, as it would allow the company to continue to leverage its knowledge of wind. Not only so, offshore wind presented some key advantages over the onshore wind that made it convincing not just as a side project for the company but also as a truly ambitious project in which EDPR could aim to grow its business (MDPI 2020).

The constant desire to innovate and to pursue not only an economic but also a social value-driven culture, as well as promoting environmental protection and an equal energy distribution among consumers, triggered a new and evolving mindset in the renewable energy sector. In this sense, the decision to change towards offshore wind was encouraged by the company's previous pioneer experience when moving into renewables – EDPR was looking forward to a new challenge that would enforce its recognition as a leader in the sustainable energies market (along with Norwegian state-owned utility company Equinor, as they were concurring to establish the standard design for upcoming years in the field) (Equinor 2021). Concurrently, the company had already proved its capabilities in onshore wind energy, which further represented a natural transition for EDPR, according to João Salvação Barreto, Senior Manager of Mergers and Acquisitions and Corporate Development at EDP at the time.

Until then, the company had managed to maximize its main energy foundations – solar and onshore wind – and there was a need for change and diversification, to boost its energy production and installed capacities. This would drive the energy transition focus the company aimed at: "... *[offshore wind] was the sane decision – an early one, I might add, before all the players in the market*", Luis reflected after stating that EDPR was growing and accumulating knowledge. In addition, EDPR had the goal of becoming fully renewable while facing external pressure to do so, which forced the company to be fast on change, building its portfolio around solar, onshore, and offshore wind, given that, as highlighted by Marta Quintas, corporate sustainability associate at EDPR in Madrid, "*offshore wind by itself did not complete the portfolio and did not allow EDPR to achieve its goals*". João Manso Neto knew that offshore wind energy presented an extension of wind for which the company had the expertise, representing a crucial factor for it to pursue the new trend.

To tap the market, check which direction was to be taken and the risks that offshore wind adoption would entail for the company, EDP deployed, in 2011, the first wind turbine in Portugal, near

Póvoa de Varzim, in partnership with Inovcapital and Principle Power. EDP evaluated all the aspects of the offshore wind project and concluded that it would entail more opportunities and make its subsidiary EDPR expand, with fewer risks. The pilot project had the goal of testing the turbines on adverse conditions, such as waves as high as 17 meters and winds as strong as 60 knots. Overall, the partnership allowed EDPR's floating offshore wind technology to come to fruition for the future and the combination of skills, that were scarce in the offshore wind market back then, that exposed the company to less risk.

Choosing Portugal for a location of a trial project had more to it than just being the country from which EDP hailed. While some countries, also exploring offshore wind, would have shallow continental waters, Portugal's coast dipped relatively fast, not being ideal for fixed offshore wind projects. This said, deep waters close to the shoreline represented a determinant factor to either building or not a turbine, thus making Portugal a perfect geographical location at the time of the trial offshore wind project. Thus, it made the region ideal for testing floating offshore wind power projects (Forbes 2020), where the turbines could not be fixed to the seabed floor and would still have to experience some adverse weather conditions. The partnership promptly expanded from the pre-commercial phase onto the commercial one in *Viana do Castelo*.

In the meantime, EDP was actively working on prototypes and developing floating wind technology and presented itself as one of the leading utility companies to introduce and utilize w*ind float* technology. Equinor was the main competitor at the time due to their developed floating wind technology, named Hywind. The WindFloat Atlantic (WFA) project was in the pre-commercial testing phase for five years before first being released later in July 2019. WFA project's central point was the use of "*patented damping plates fitted at the bottom of each column minimize wave and turbine induced motion, enabling the platform to stay light while performing*" (P. Power 2021), having tanks set at the bottom of each column giving space for adjustments. These tanks were filled with sea water, once at sea, to improve stability in the overall structure. Lastly, WFA also had a smart system for the time, which consisted in a robust infrastructure that moved water from one column to another in order to compensate for changes and stabilize in an average point the wind speed and direction. This advanced technology allowed not only for power production optimization but also to reduce structural loads (P. Power 2021).

Nonetheless, as previously described, two different types of floating wind technologies were available on the market. To better understand what this specific type of offshore wind technology aimed at targeting, it was essential to master some topics regarding offshore wind energy. Namely, it was particularly relevant to understand the key technical differences between the two wind floating solutions that both EDPR and Equinor had developed. Hywind was a patented floater motion controller that allowed turbines to be stable whilst delivering optimal power production. Additionally, this floater was a combination of other developments from Equinor, such as the Hywind Spar which further ensured reliability and optimized costs. The technology from Equinor was also able to tackle additional costs optimization issues using Hywind with fiber ropes, dynamic cable solutions and cable layouts, in addition to chain solutions to lower costs (Equinor 2021).

Offshore wind energy was starting to rapidly expand worldwide, with the sector growing 76% from 2009 until 2011. By the time EDPR realized it, there was a need to start thinking about the upcoming steps to improve the company’s presence in the offshore wind industry. In particular, João Manso Neto had to think about what was going to be the best strategy to tackle this. On top of this, in 2009, EDP Innovation, an EDP branch, acquired a stake in Principle Power Inc. (PPI), that would later have a value of 33% (EDP 2020), a company that had patented technology for floating offshore wind turbines (P. Power 2021). PPI was a company created by two American engineers keen on producing new technology for the offshore wind market. However, as they were lacking funds, the American investors saw in EDP's early investment and acquisition of shares from Principle Power, the possibility to solve the funding issue. The combination of the partnership between the two companies and the capital injection would later allow for the development and testing of floating platforms, which led to the pilot project in Portugal. PPI would later be present in all EDP's projects but with no financial stake, as it solely entered with technological know-how.

On one side, EDP wanted to build their internal capacity, which would entail higher costs but enable it to have a first-mover advantage, conquering enough market share to constrain its competitors. On the other hand, facing this challenge seemed like a too-long path to cross by themselves. This said, partnering with other companies could leverage their know-how and decrease the overall risk of the project. Furthermore, a partnership could mean increasing the installed capacities for both sides to grow even further within the offshore wind energy market. Concurrently, the decision of either entering a long-term fixed agreement or working on a "project by project" flexible basis also had to be considered.

Manso Neto knew that entering the offshore wind energy market on a standalone basis would be too heavy considering the size of the investments, its growth and the underlying risks. If EDPR decided to work occasionally with random partners, it would have a less efficient structure, even if at the same time more flexible, without a fixed agreement. Consequently, the best decision would be to have a fixed partnership, namely a joint venture, that would enable EDPR to share risks and to grow jointly towards being a top player in the offshore wind market. The question then moved towards which player would be the right fit for the joint venture.

In this manner, Engie came to cross EDPR's path. Both companies were not only a good match in terms of business mindset, but they also shared some experience in projects related to renewable energies (Engie 2020). The utility giant Engie, previously known as Gaz de France (GDF) Suez – a combination between the name of two French utility giants, GDF and Suez SA – came to life in 2008, with the state being its major shareholder. The group was, from then on, involved in different projects, from classic energy sources such as oil, gas and nuclear to renewables. According to João Salvação Barreto, *"It was crucial to look into all the possible types of partnerships as great investments – in order to understand if the partner approached investment opportunities the same way as EDPR*". From the extended portfolio of potential companies to partner with, EDPR had identified Engie as having the same mindset in terms of returns and costs, which made the partner company decision an easy one to pursue.

The Deal of the Decade

In 2013, EDP started working with Engie on an offshore wind tender launched by the French Government, on the outskirts of Normandie and Loire coasts. The aim was to develop a 1GW offshore wind farm. The partnership between the companies was awarded both projects they had been bidding on, in Treport and Noirmoutier, for a total deployment of 124 wind turbines, with an overall capacity of 992MW. The relation with the French company was sustained until 2015, when EDP acquired a 25.3% stake in Portgas from GDF Suez (Investir 2013), allowing it to own almost the whole amount of Portgas – a Portuguese company responsible for gas supply in the north of the country (EDP 2015). However, that did not represent the biggest project both companies would undertake together.

In 2016, a new significant step took place when the French Agency for the Environment and Energy Management (ADEME) launched a tender aiming to develop the newborn floating technology (Engie 2016) (Reve 2016). EDPR and Engie participated in the tender, bidding for the Leucate project and being able to win it. It represented the third phase of floating wind, the effective commercialization and upscale one. At the time, France was joining a small elite of countries already involved in this industry – the UK, Norway, Japan, and Portugal. France had already started a small, explorative project with the utilities' giant EDF, Energie de France, with a floating offshore wind prototype farm, known as Provence Grand Large (Française 2021) (Large 2021). The French government was once again involved in the project, as typically governments would take an important role in projects related to energy.

Going back to 2010, the Portuguese company had already assured a concession to use the seabed in Moray, in the Scottish Northern Sea, from the Crown Estate (Now 2010). Back then, EDP was partnering with SeaEnergy Renewables Limited (SERL), a branch already active in developing domestic seabed renewable energy production, fully owned by SeaEnergy. However, only one year later, SeaEnergy decided to dismiss its subsidiary SERL, which was then acquired by Repsol, in a £40 million deal (News 2011) (Publico 2011). Repsol later found itself with three concession deals in Scotland, with one being shared with EDP. The two Iberian companies decided to form a joint venture to work along with over UK's seabed, while EDP was acquiring stakes in another concession, located in Inch Cape (News 2012), by swapping some quotas from the Moray project. In 2015, following the approval of offshore wind projects in both locations by the Scottish Government, Repsol and EDP decided to focus their strategies on a single project each. Repsol chose Inch Cape, for which it would later sell its entire stake, while EDP became the only owner of the Moray East seabed concession (Farm 2020). Herewith, EDP found itself with an ambitious project: the parliament of Edinburgh granted the possibility to deploy up to 186 offshore wind turbines, able to provide a total combined amount of 1,166 MW, for which the company immediately started to look for a partner to develop such massive concession (Proactive 2021).

In 2016, Engie and EDPR started to discuss the possibilities to cooperate on this project (Engie 2016). Offshore wind was the common path on which the two European companies decided to walk along until then and, therefore, the opportunity of establishing a first joint venture arose, in 2017, when EDPR started to develop a project out of the shores of Scotland – known as Moray Offshore Windfarm East Limited (MOWEL). EDPR kept the majority of the stakes, with 77%, with the rest belonging to the French company. In the same year, the joint venture won a Contract for Differences (a contract that pays the difference in an agreed price between the opening and closing of the trade) (Investopedia 2021) for the length of fifteen years which required an output of 950MW – representing twice the average capacity of the biggest offshore wind installation in 2017 (498MW) (WindEurope 2018). Later in 2018, the joint venture grew, with the entrance of Mitsubishi, through its subsidiary Diamond Green Limited, and the China Three Gorges (CTG) company, one of the main stakeholders of EDP. Mitsubishi acquired 33.4% of the stakes and CTG another 10% from EDP's stake, with EDP losing its previous majority in the project.

Partnership Bumps on the Road | *WFA Project*

It was only in 2015 that Engie and EDPR joined forces on a new business in the floating offshore wind energy market, the so-known WFA. The project counted with three other partners: Repsol and the Japanese Mitsubishi and Chiyoda (P. Power 2015), which allowed taking advantage of the knowledge coming from oil and gas infrastructures' production. These parties decided to create a consortium, the Windplus SA, finalized developing a three-turbine wind farm on the shores of Viana do Castelo. This project would constitute the pre-commercial phase of floating offshore wind, and the project turned out to be successful, although its development had a turbulent growth.

The consortium responsible for the development of the floating wind farm could count on the favor of the Portuguese state, which listed WFA as a participant of NER 300 (New Entrance Reserve

300) (Commission 2021), a European Commission funding program focused on innovative low-carbon technologies. The project won and was therefore appointed a €30 million fund. This money, however, required the project to be launched before a specific deadline, and the consortium started to face uncertainties about complying with it. This was due to REN, the Portuguese company in charge of operating the national electricity grid, struggling to obtain financing for the submarine cable to do the connection between the windfarm and the electrical grid. However, the Portuguese government was the entity that had to approve if REN could make the investment on the connection cable and to concede the interconnection point as they were the ones giving the right for electricity transportation on the grid operated by REN (Expresso 2016). The solution of this conflict was taking time, as the deadline for using European funds was approaching, and the consortium was in an uncomfortable position, as it was excluded from the negotiation between REN and Portugal.

The uncertainty pushed, in 2018, the Japanese companies and Engie to leave the project since the risk seemed too big, leaving only EDP and Repsol that continued to believe in WFA. The shares belonging to the companies who left the Windplus consortium were acquired by EDPR, making the company owning close to 80% of the stakes in the project. Repsol accepted to have a smaller role, leaving the leadership to EDPR and adopting a "silent position". As highlighted by Pablo Lucas, "*Banks and investors were laughing at us. One meeting was stopped after 6 minutes because they were not interested, and floating technology seemed unachievable."* The uncertainty on the project was also felt by Vestas, the turbine supplier for the project, which feared participating because they "*didn't want to see one of the turbines collapsing in the ocean (…) that would have seriously affected their stock market value*".

The project got a new life by the end of the year, when the deadlocked situation became solved as a result of an intervention from the European Investment Bank (EIB), which had accepted to become one of the main sponsors of the project, by financing it through a project finance approach. This translated an overall statement of validity for the project and represented a turning point for the whole floating industry. Engie rejoined the project, and investors started to understand the quality and the significance of WFA, which became more than formulas on papers to a concrete idea with immense potential. Equinor, at the time, had more advanced technology than PPI, given that they had built the pre-commercial phase of the offshore wind project before everyone else. However, in contrast to what happened to PPI, Equinor failed to demonstrate bankability, leaving PPI with a first-mover advantage on the technology for offshore wind and unlocking, for the first time, the idea that offshore was indeed feasible for its investors. Nonetheless, the project was still far away from being run smoothly.

Despite the technical challenges that arose, the construction of the WFA Project started in 2019 and reached the project completion phase, starting its operational life in September 2020. The entire system started to produce energy and serve around 60,000 houses in northern Portugal without suffering any significant issue until the 27th of December. Just a few days after Christmas, Portugal was hit by a particularly intense Atlantic storm named Dora, with winds exceeding 130km/h and creating waves over 14 meters. The farm on the shore of Viana do Castelo did not manage to survive unharmed, with the unexpected scenario of one of the cables connecting the platform to the energy switcher detaching. With the given severe atmospheric conditions, the windfarm had to stop. Nonetheless, the damage only became clear a couple of days later, when the farm was remotely restarted, but electricity was not reaching the coast.

Miguel Lopez, a corporate finance associate at OW, saw his New Year's Eve plan ruined. Being funded through a project finance approach, WFA was supposed to pay back its cost through its revenues. However, a plant shutdown for a force majeure could not provide revenues. A new financial plan, which would have increased leverage, was being discussed. The new situation was not only able to put an end to it but also created significant questions on how to comply with the existing loan.

Overall, the situation only came back to normality later in May 2021 when electricity started to reach shores again. The technical side was difficult to face. The connection cable was lying on the seabed, and, at the time, the damage caused by the storm was complicated to estimate. The financial part was also pointed out as a struggle to overcome since insurance was a crucial aspect of this technological business. Never in history, a floating turbine had suffered damage and requested the intervention of insurances to establish and estimate the refunds. Therefore, it was the consortium that had to anticipate the money, find an agreement with the EIB, and avoid any change in the loan. The negotiation with the EIB had been complex, but in the end, it agreed to cover the whole hedge needed in this phase of the project.

Even considering the long stop, in twelve months WFA was able to produce a total amount of 75 GWh (measure for quantity of production), while facing and working with rough sea for over 500 hours (Sapo 2021).

The Creation of Ocean Winds

A larger project was already profiling on the horizon, as EDPR and Engie were getting more interlaced between them. In 2018, there were several "*rumors of a supposed acquisition of EDPR by Engie*" as stated by Pablo Lucas, with an $8.5 billion offer (Bloomberg 2021). Nonetheless, both companies were planning a more co-strategy partnership to succeed in the offshore wind sector. Thus, in January 2020, EDPR reached a so awaited agreement with Engie to create a partnership in the offshore wind sector, where both entities would own half the joint venture and contribute towards increasing the offshore wind energy presence globally.

The partnership soon expanded towards a new investment opportunity, leading to the creation of OW in July 2020. Linking technological developments to ambitious projects, the new company, headquartered in Madrid, started targeting European, North American and parts of the Asian markets. By 2021, OW operated in North America (the US), Europe (the United Kingdom (UK), Germany, Portugal, France, and Poland) and Asia (in South Korea), with a total of seven projects under development (3.0GW), one under construction (the UK, with 1.5GW in Moray) and two operational projects (Belgium and Portugal, with 1GW each), from which four were floating and six were fixed stations (Winds 2021). The new company later brought back the majority of shares in the Moray Project and, by 2021, the combined Moray (East and West) represented the main project under the guidance of the joint venture. Notably, Mayflower project in the US was carried on in a partnership with oil giant Shell.

Ultimately, the Portuguese utility giant looked at Engie as a company that had not only the needed complementary objectives and business standards but also the same vision towards adopting new technologies and strategies within the offshore wind industry.

In terms of risk, EDPR did not have a specific risk assessment for this partnership. Both companies had their specifications in terms of what they would consider as a risk at the time. Nonetheless, the risk assessment analysis was more directed towards strategy. EDPR was never keen towards risk in its investments, therefore not intending to pursue a partnership where they would face the possibility of not being successful. In the end, "*both parties would have to be comfortable and have a clear aligned performance in terms of prospect for each company's future*", as João highlighted. In addition, Engie was seen as a very performance-oriented company by being focused on its results and goals and had sustainability at the heart of their culture, similar to EDPR.

The joint venture allowed both companies to combine their capital, human resources, and strategic perspectives with a vast international network and footprint, substantially improving each other's technological know-how. In particular, the CEO and the heads of business development, procurement and human resources would be EDPR employees whilst the heads of finance and the COO would belong to Engie – and the team resources were a combination of both companies' workforce and also through external hiring. A joint venture in offshore wind represented a financial plan extremely viable for a company such as EDPR since it offered the opportunity to expand its portfolio with renewable energies whilst boosting the overall company's energy production. Another aspect that smoothed the business venture was the existing previous corporate culture knowledge on the partner, which they already knew from prior partnerships and were comfortable dealing with, knowing that they shared similar mindsets and goals, a key factor towards the success of a partnership.

Concurrently, in November 2020, the European Commission announced an offshore wind improvement investment strategy towards cross-border cooperation among its Member States. Thus, allowing the creation of a supportive legal framework and promoting the generation of offshore wind farms with greater installed capacities, avoiding supply chain issues and unnecessary aggressive moves from the competition (Commission 2020). Yet, even though EDPR and Engie (Engie 2021) concluded that an offshore floating wind turbine could produce twice the energy of an onshore wind turbine, OW' business model was still under development and needed to grow in the upcoming years. Ultimately, the executive board of EDPR could rest and enjoy the decision that had been undertaken, while venturing into new projects to keep up with potential improvements.

A New Era

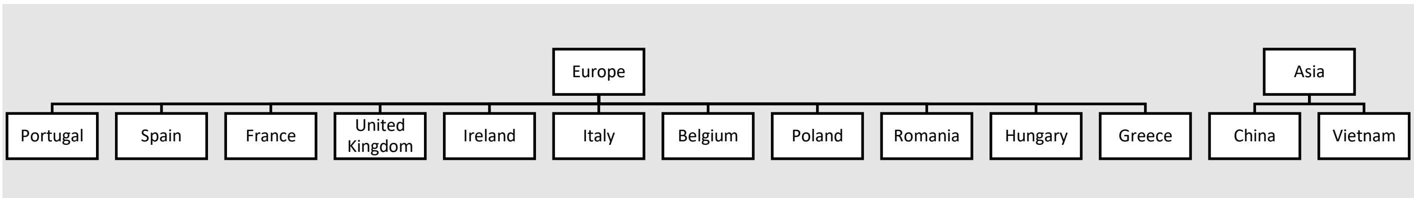
Offshore wind energy was certainly paving the way towards a greener and more sustainable world and EDPR saw an opportunity that would change its route on renewable energy adoption. Its long established business relationship with the French utility Engie was key for EDPR to move forward on this sector and unleash Portugal's potential for floating offshore structures, that would later be replicated to other countries.

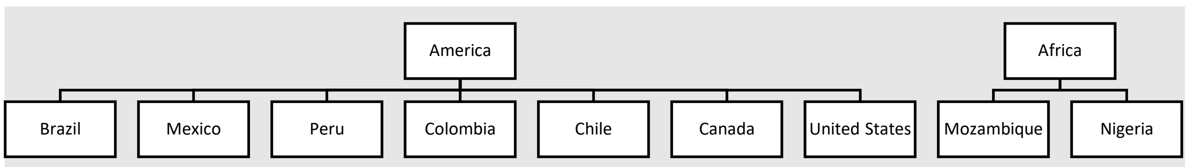
For the upcoming years, targets would encounter phasing-out coal by 2025 and achieving carbon neutrality by 2030, strengthening the OW presence on offshore wind energy and highlighting its uniqueness in accomplishing such goals. But, will EDPR continue to strive on the offshore wind sector? Or expand towards new market opportunities? Was the Portuguese best practice crucial for OW's future further internationalization?

Appendix

Appendix 1 – EDPR in the world

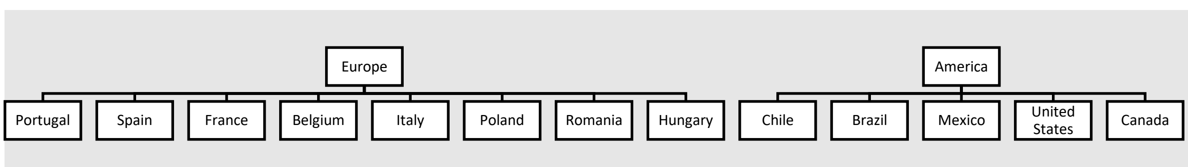
EDP – Energias de Portugal





Source: (EDP 2018).

EDPR – EDP Renewables



Source: (E. Renewables 2020)**.**

Appendix 2 – EDP, EDPR and Engie's main events since their creation

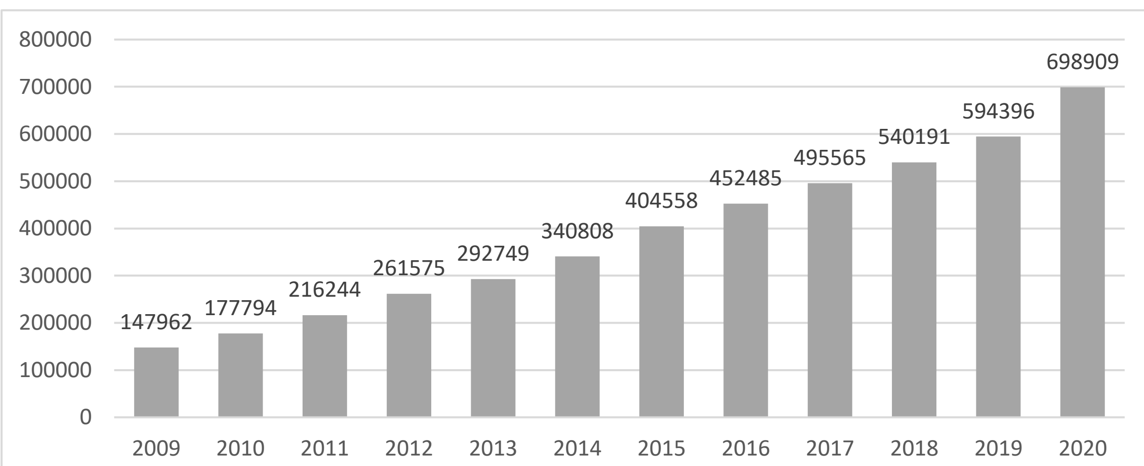
Date	Event
1946	Gaz de France, the French utility giant, was created. The company was active in production and supply of gas at the time.
1976	EDP is founded in Portugal with the goal of electrifying the country, not just big urban areas, distributing enhanced service quality and standardizing

	tariffs; avoiding discrepancies in the way electricity was distributed among regions.
1997	EDP starts its process towards abandoning State ownership.
2006	EDP enters the renewable energy market.
2007	A new law in favor of public companies' privatization is passed in the Parisian Parliament, opening the possibility for a merge. | EDP acquires *Horizon Wind Energy* and creates EDPR (EDP Renewables).
2008	GDF merges with company that wrote the history of trades, Suez, as the homonymous channel, marine connection between Asia and Europe, after the Paris law. Suez had suffered a crisis period since losing control of the trade way, in 1956, allowing it to turn into a financial service provider. GDF Suez would later be called **Engie**.
2009	EDP innovation acquires a stake in Principle Power, the offshore wind technology developer.
2010	EDP acquires a concession to use Moray's seabed, when partnering with SERL from SeaEnergy.
2011	In partnership with Inovcapital and Principle Power, EDP deploys the first floating wind tower in Portugal, near Póvoa de Varzim. | SeaEnergy dismisses SERL that is later acquired by Repsol in a £40million deal. | EDPR starts doing business in Inch Cape. | Engie is one of the two main transalpine utility supplier along with EDF (Energie de France), which was working since 2011 with the French government on a project named Provence Grand Large. The project the started in practical terms in 2016,

	seeing a 3 floating-turbine farm outcome in 2019, base for a larger project to be developed by the mid-20s.
2013	EDP ceases to be State owned and starts collaborating with Engie in projects. | EDPR starts working with Engie on an offshore tender launched by the French Government.
2015	EDP acquired 25,3% in Porgas (*Sociedade de Produção e Distribuição de Gás, S.A*) in Porto, owned by two Engie subsidiaries. | WFA is created by Engie, EDPR, Chiyoda, Respsol and Mitsubishi. | Repsol decides to focus solely in Inch Cape, while EDPR on the Moray Project.
2015	EDP and Engie work together on the WFA project.
2016	ADEME launched a tender aiming to develop the floating technology | Engie and EDPR start to discuss the possibility of working together on the Moray Project.
2017	Engie and EDPR create a JV on the MOWEL project.
2018	MOWEL became larger with the entrance of Mitsubishi and China Three Corges (CTG). | Repsol and EDP launched the WFA project by themselves, since Engie and the Japanese companies left the deal due to cable regulation uncertainty by the Portuguese Government (Engie later joined Respol and EDP on this project). | Rumors regarding Engie acquiring EDPr were circulating.
2019	WFA was released after remaining for 5 years in the testing pre-commercial phase.

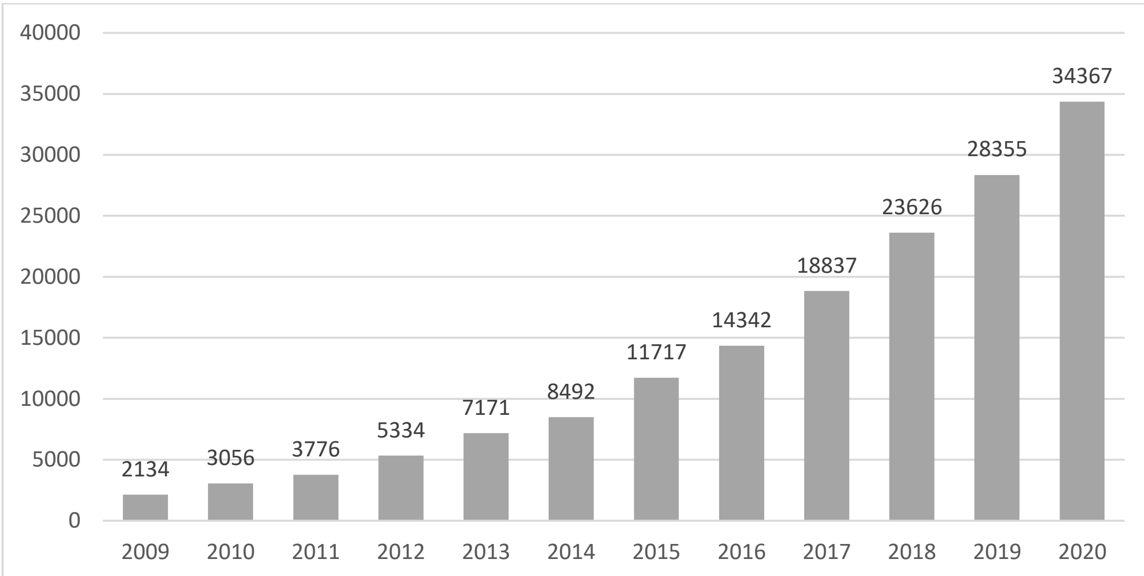
2020	EDP and Engie create a new joint venture, OW, acting on the offshore wind energy production. | WFA, the first floating wind farm in Continental Europe starts its operational life – EDPR in partnership with Repsol, Engie and Principle Power. | On the WFA cables disconnects and stop the project for around 6 months). | The European Commission announced a policy that decreases threat of new entrants. | EDP owned a 33% stake in PPI.
2021	WFA starts operating again. | OW has 7 projects under development, construction and operational ones. | Moray Project represented the main project of OW.
2025	EDP plans on phasing-out coal.
2030	EDP plans on being carbon neutral.

Appendix 3 – Global onshore wind energy installed capacity (in megawatts), 2009-2020.



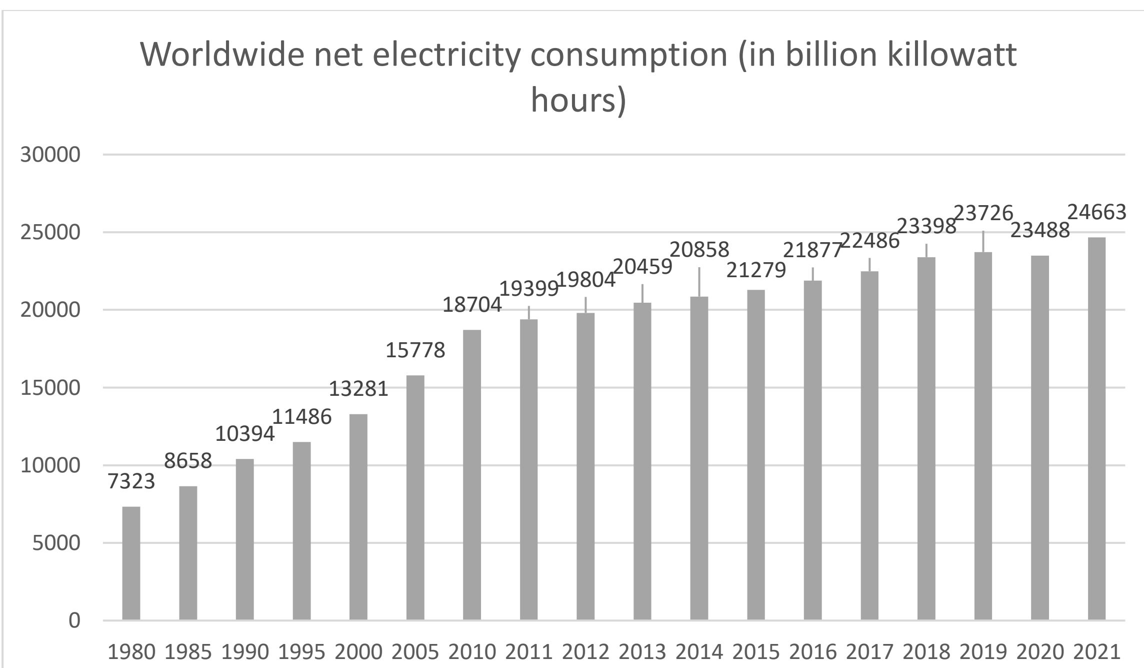
Source: (Statista 2021).

Appendix 4 – Global offshore wind energy installed capacity (in megawatts), 2009-2020



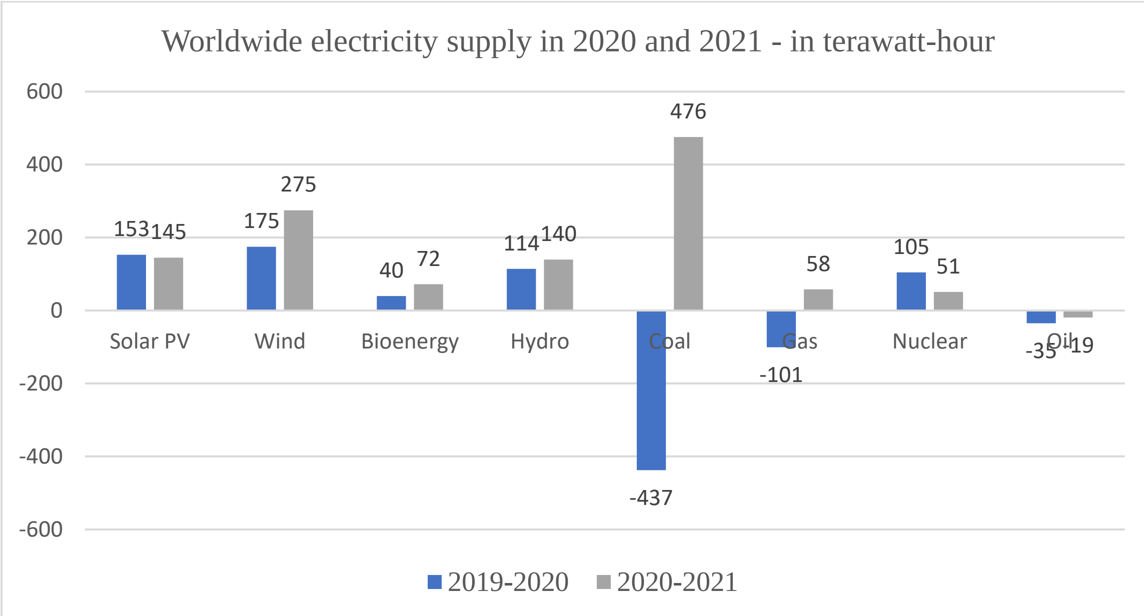
Source: (Statista 2021)**.**

Appendix 5 – Worldwide electricity consumption, 1980 – 2021



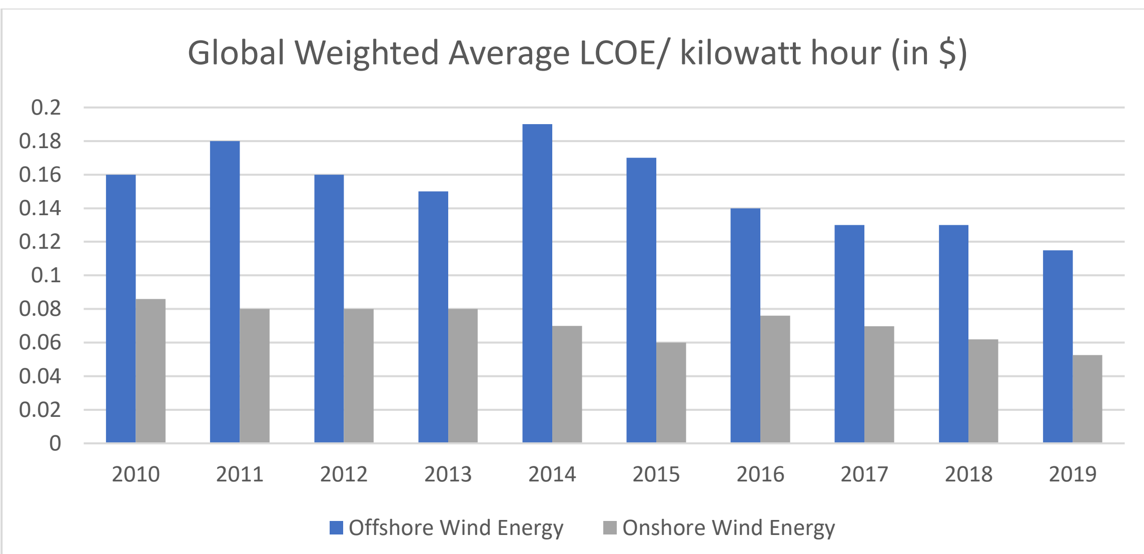
Source: (Statista 2021) (IEA 2021).

Appendix 6 – Electricity Supply, 2020-2021



Source: (IEA 2021).

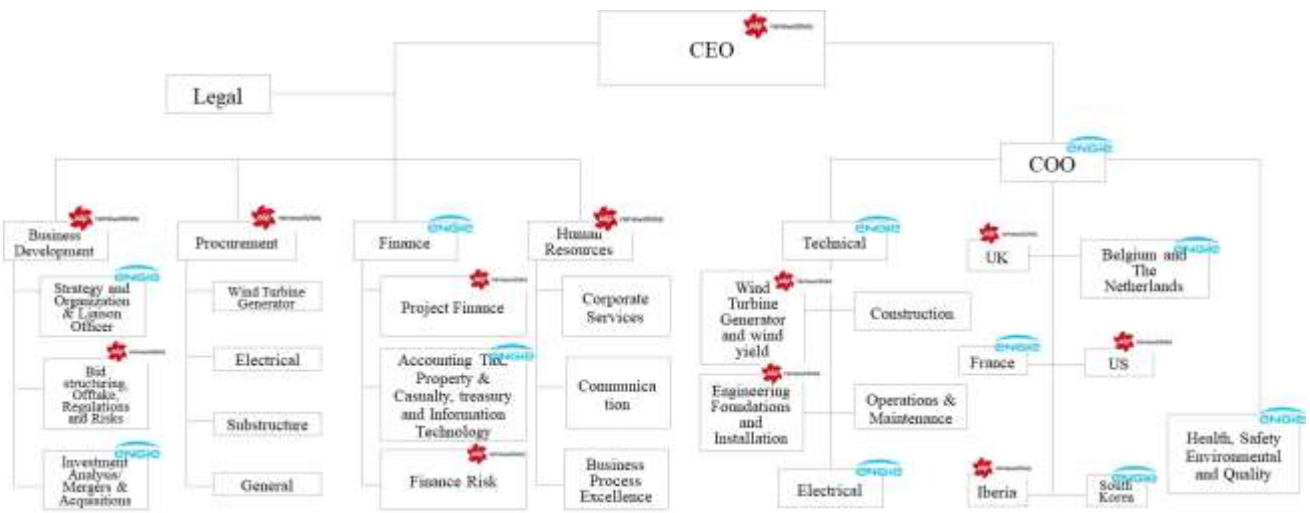
Appendix 7 – Global weighted average LCOE



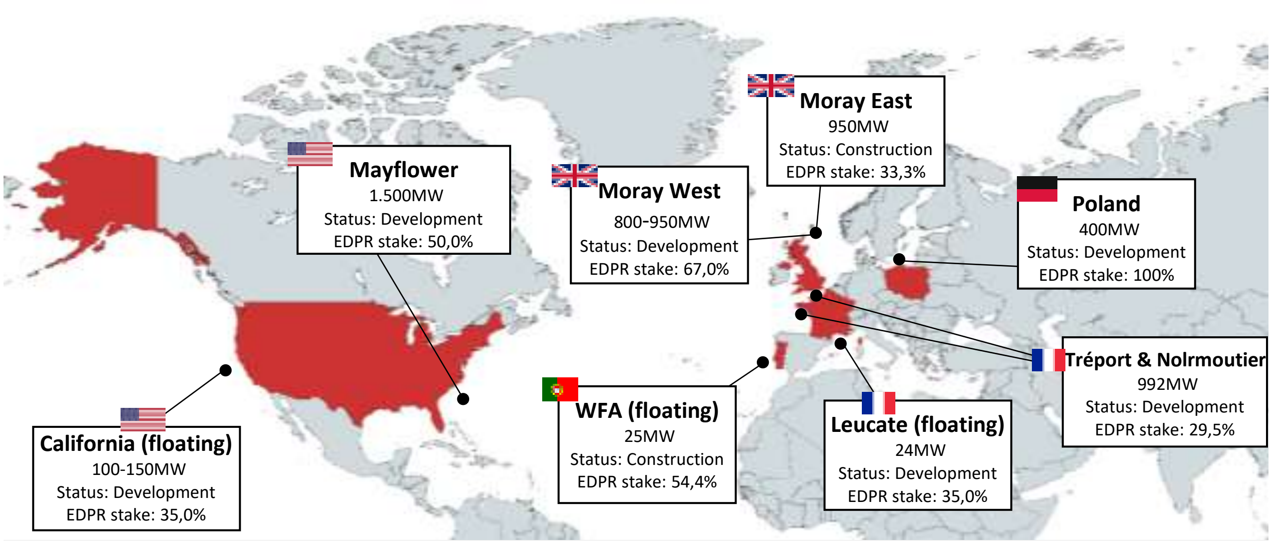
Source: (Statista 2021) (IRENA, Wind Power 2020) (IEA 2021) (Data 2017).

Appendix 8 – Definition of LCOE: average net present cost of all electricity production from a plant, over its lifetime. This metric allows for a comparison between different power sources, such as wind and solar. (Formula: $\frac{\frac{\text{Present Value of Total Cost}}{Lifetime}}{\frac{\text{Present Value of All Electricity Generated}}{Lifetime}}$) (D. O. Energy 2013).

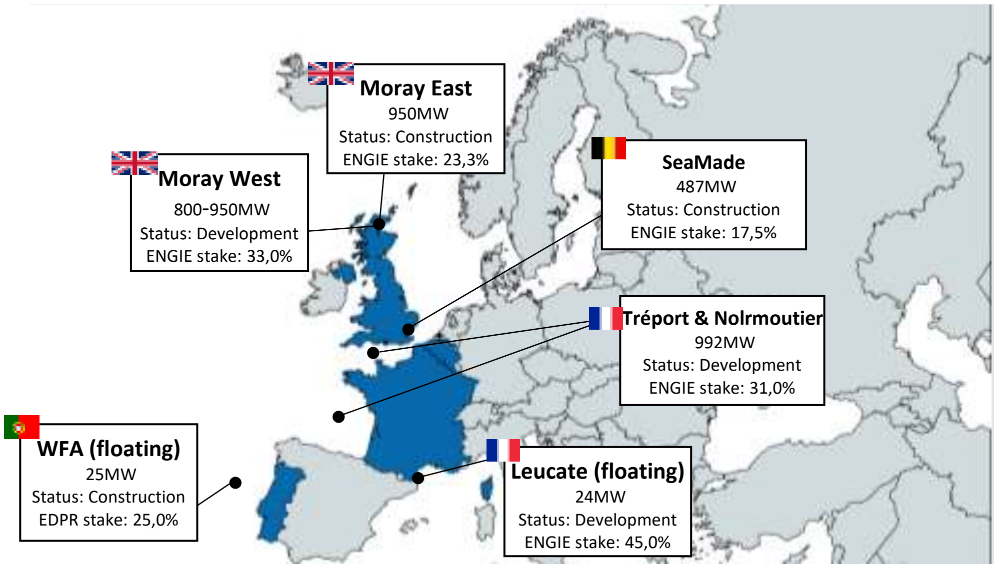
Appendix 9 – Illustrative organizational chart of the joint venture between EDP and Engie.



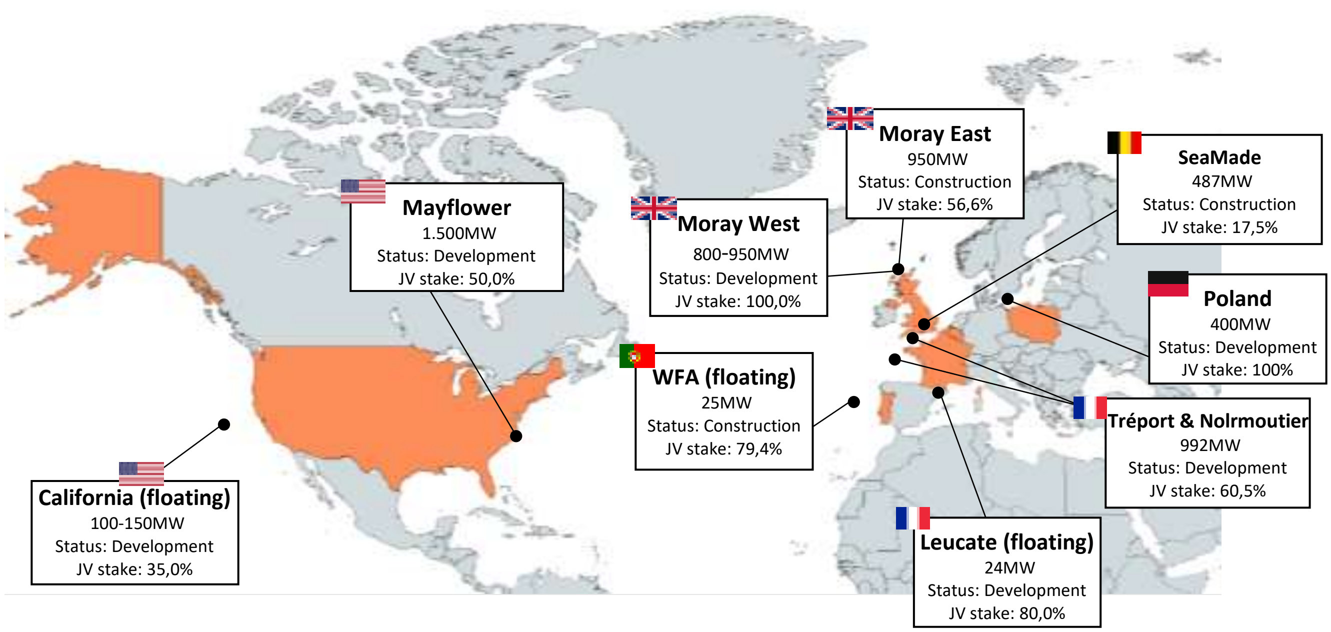
Appendix 10 – EDPR's presence in offshore wind energy before the joint venture with Engie.



Appendix 11 – Engie before the joint venture with EDP.



Appendix 12 – EDPR and Engie's combined projects before the joint venture.



PROJECT EVALUATION REPORT

WHAT ARE THE CRUCIAL ASPECTS EDPR AND ENGIE SHOULD BE INVESTING IN, TO GUARANTEE OCEAN WIND'S SUCCESSFUL DEVELOPMENT IN THE OFFSHORE WIND ENERGY SECTOR?

ANDREA SCANDROGLIO

CATARINA CAVALEIRO

LEONOR TERUSZKIN MATIAS

SUSANA VIEIRA

Abbreviations Project Evaluation Report

ADB	Asian Development Bank
BCG	Boston Consulting Group
BEIS	Department for Business, Energy & Industrial Strategy
BfN	Federal Agency for Nature Conservation
BSH	Federal Maritime and Hydrographic Agency
CAR	Construction All-risk
CAPEX	Capital Expenditures
CCCC	Cloud County Community College
CfD	Contracts for differences
DEA	Danish Energy Agency
EDP	*Energias de Portugal*
EDPR	EDP Renewables
EEZ	Exclusive Economic Zones
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIS	Environmental Impact Statement
EU	European Union
GW	Gigawatt
JV	Joint venture
KPIs	Key performance indicators
LCOE	Levelized Cost of Energy

MMO	Marine Management Organization
MOWEL	Moray Offshore Windfarm East Limited
MW	Megawatts
NER 300	New Entrance Reserve 300
NPV	Net Present Value
OAR	Operational All-Risk
OREAC	Ocean Renewable Energy Action Coalition
OW	Ocean Winds
PPA	Power Purchase Agreement
PPI	*Principle Power Inc.*
PV	Photovoltaic technology
PwC	PricewaterhouseCoopers
R&D	Research and Development
SE4All	Sustainable Energy for All
SEA	Strategic Environmental Assessment
SDE+	Stimulation of Sustainable Energy Schemes
SDE++	Sustainable Energy Transition Subsidy Scheme
SPV	Special Purpose Vehicle
TRC	Thermal Recycling of Composites
UK	United Kingdom
UN	United Nations
WFA	WindFloat Atlantic

Methodology and Analysis

The present research paper aims at analyzing partnerships in the offshore wind energy sector and how they help companies in developing their knowledge and know-how in such a new market, namely answering the following research question:

What are the crucial aspects EDPR and Engie should be investing in, to guarantee Ocean Wind's successful development in the offshore wind energy sector?

The applied research was conducted through interviews made with EDP, EDPR and Ocean Winds' employees, and a professor from Nova School of Business and Economics; online research; and focus groups to two interviewed companies (EDPR and EDP). The purpose was to understand how partnerships in offshore wind energy work, specifically in the case of the joint venture between Engie and EDPR. In this sense, it aims at finding concrete strategies and recommendations for both companies to continue nurturing the existent Ocean Winds (OW) partnership and further growing in the offshore wind sector. In particular, to develop a partnership and grow in the offshore wind energy sector, we intend to focus on explaining the following contents:

1. *Partnership Summary* – the joint venture briefly explained, throughout its history and future strategies and objectives.
2. *Risk Assessment* – a comprehensive set of risks in general partnerships, offshore wind energy and EDPR and Engie assessing which factors can delay and jeopardize the joint venture.
3. *Regulations as the main risk but also an opportunity* – an overview of how regulations can affect the offshore wind energy market, focusing on some specific countries where EDPR

operates or can potentially operate. In addition, considering regulations as an opportunity for EDPR to leverage its projects.

4. *Current Strategies* – a diagnostic, analysis and results approach to what EDP and Engie currently undertake to develop offshore wind energy projects.
5. *Recommendations* – solutions on how EDPR and Engie can mitigate some unnecessary risks and grow together.

Limitations

The present methodology still implies certain limitations. For example, the focus groups had 21 people in total, EDPR with 2 and EDP with 19, plus some individual interviews to Ocean Winds employees, not representing a significant percentage, nor approximated to the whole population of over fourteen thousand employees within the three interviewed companies. (12,180 in EDP; 1,735 for EDPR and more than 200 for OW, in 2020) (EDP 2020) (E. Renewables 2020) (Winds 2020). At the same time, the list of risks in partnerships for offshore wind is not exhaustively known, as this type of energy is still growing when compared to other renewables that have started to be explored earlier. In addition, our research had constraints in terms of lacking data to approach and forecast the high dimension of the projects involved in the offshore wind energy sector. This led to certain restrictions on the suggestion of certain recommendations for the future of the existing projects.

Partnership Evaluation | Joint Venture EDPR x Engie

Something that started as two companies having the same interests in offshore wind energy resulted in what is nowadays known as OW. Such partnership represented a shift for both companies' portfolios and energy production. In a more concrete direction, OW allowed them to emphasize their position as one of the world leaders in wind energy production and worldwide pioneer in pursuing sustainable energies. This pioneer position becomes highly relevant in the energy market given the worldwide increase in consciousness to create a fully decarbonized world in the energy market. It is a reference for any industry prospects such as the '*Paris Agreement'* or, even more specific, the '*Project 2030'* in EDP. With this said, OW allowed EDP to accelerate the movement towards sustainability and assure the right path to becoming carbon neutral by 2030.

The interviewed employee and focus groups find the partnership between EDP and Engie a successful one, given that aspects such as the possibility for sharing existent know-how, the underlined key role that offshore wind energy will have in the future of energy transition, possibility to share risks and the high volume of invested capital in projects are present. Ultimately, part of the sample was able to identify the fact that shared experience of two utility giants could only move towards success: "*The partnership between two leading companies, which have clear bets on new forms of energy, can only result in success*", as stated by an EDP manager.

This partnership has enabled EDP and Engie to mitigate the risks in an '*under construction*' market like the offshore wind energy sector is. When adopting a cooperation posture, both managed to spread the risk involved in this "*gold-dollar industry*", as mentioned by Raphael Herz, Liaison office at OW in one of our interviews. Renewables are a highly competitive industry nowadays and the joint venture brought visibility and credibility to the energy production sector, attracting gas and oil companies who intend to follow the same path in terms of adopted technologies. In extension, this fact is even more relatable now that companies, such as Repsol and Shell, are trying to follow this green movement towards sustainable energies in the offshore wind industry. With this, EDPR and Engie were both able to take advantage of an early mover advantage, which allowed them to become leaders and get market share in an unexplored sector. Still, Engie and EDPR joint venture has been a successful one so far, but can we say the same with regards to the future?

Risks in Partnerships

Partnerships can contribute as an important tool for innovation and adaptability within this digitalized and decentralized era, particularly given the growth the market has suffered in recent decades. Nonetheless, even though partnerships tend to reduce risks for the stakeholders involved - due to combined know-how, thus the risk not being concentrated in one individual - it does not guarantee its triumph. In most cases, the ability of a company to deal with partners successfully strengthens its external image and opens more doors for future value-added agreements.

According to a survey conducted by McKinsey, 47% of executive respondents state that the main factor for success in a partnership entails goals and objective alignment between parties, while good communication and trust and effective leadership and governance entail 44% and 33%, respectively (McKinsey 2019). In contrast, lack of communication represents the most important cause of failure (with 38% in favor), followed by misaligned goals and the absence of resilience in restructuring and evolution.

Companies from the same sector must avoid assuming that everyone stands on the same page and promote active communication among employees. To bypass unnecessary risks, companies should nurture six building blocks: strategy; communication and culture; operations and Key Performance Indicators (KPIs); Leadership and Governance; and resilience. Nonetheless, firms still fall on the vicious loop of hustling achievements, lacking leadership continuity structure and mindset, and having insufficient parent company engagement and inadequate planning to shifts in risk, which increases risk exposure both internally and externally. At the same time, before considering a joint venture, one should invest in getting to know about the partnership scalability and long-term plans of peers, given that it is equally important to plan for success as it is to plan for failure (BCG 2020).

As the trend within this industry points, players in the market can take profit of considering looking towards partnerships as a key plan to grow. Plus, energy companies should invest in strategies that might allow the best risk advantage position by integrating risk assessment and mitigating their strategic decision-making [Appendix 1]. It includes not only risk management as part of the partnership path, to avoid the downsides of uncertainty, but also decreases the impact of highly needed capital. Offshore wind projects have evolved in great dimensions which also translated into a high financial risk involved in every investment. This said, any company interested in pursuing a partnership must assure, for their financial safety, that the other party can cover their share – not only if something goes out of the plan, but also that they guarantee the viability of the project along the way. It is of high importance that both parties can fulfil the needed investments at the beginning of the project, plus as it grows, they need more innovation. Having this in mind, the reason for offshore wind projects to be so expensive entails underdeveloped technology that is improving as the market expands, as explained in the following section.

Offshore Wind Energy Partnerships

OW has been suffering from external pressure, namely new entrants in the offshore wind market, given that it represents a fast-growing industry in an enormous sector. The immense project dimension is not only in terms of risks, but also when it comes to capital and timeline. In regard to the first one, the offshore wind energy industry is one of the most capital-intensive within the renewables sector and it is hard to mobilize a lot of capital, exposing the company to many risks individually. Installations are expensive and have a high risk due to weather conditions' dependency, since they are installed in high sea and are dependent on external help from big ships, which demand a lot of investment upfront. Namely, at the beginning of the year 2021, the average cost of solely installing an offshore wind turbine was $1.3 million per MW (Guard 2021).

Following this, we can present one of the reasons for EDPR to move towards floating installations, namely with the WindFloat Atlantic (WFA) project. If we look at the past, EDPR started to develop its offshore wind related technology historically through acquisitions. Nonetheless, the WFA project was one exception when the company tried to get their hands into the center of this technological development. It happened because EDP believed in the growth of this energy sector, and the company was motivated by innovation as a key factor to add value. Ultimately, EDP looks at innovation as a crucial component that moves partnerships into success. Therefore, this opportunity appeared as an ultimate chance to develop a market niche which was the offshore wind one at the time.

There is an overall trend in the offshore wind energy sector for projects to be financed on a project investment basis, as stated in research from Wind Europe, entity responsible for promoting and establishing wind energy policies in Europe, "*66% of the capital raised for new wind farms*" are financed in such terms. In addition, they also point out how partnerships and consortiums are an ideal system to approach such financing terms.

On the second case, we have the risks regarding timeline management of offshore wind projects. Those are considered as venturesome due to the extensive timeline required for one project to be completed. Even projects like the WFA one had its development divided in three-different phases – which are nowadays the three biggest floating platforms in terms of capacity (8,4 MW) in the world (Sapo 2020). When one company considers its involvement in one offshore wind project it must take into consideration the timeframe of its development. Namely, offshore wind floating installations tend to be made in phases and units, as the WFA one. This said, large dimension projects like this do not come to place from day to night, they involve a considered timeline of developments in order to be installed and capable of serving their purpose.

Another risk related to partnerships within the offshore wind sector comes from new joiners in a newly born competitive market. These new competitors, which are starting to enter the market are mainly oil and gas companies which, even having the technology, do not have enough know-how in the renewable sector in which they are only trying to enter now. Commonly, as one can state from EDPR's experience, offshore wind know-how is acquired from other companies which are more technological oriented. Despite this increasing threat to companies that are already established in the market, such as EDPR and Engie, or even more precisely OW, it also ties the added value of what they have added to the industry before. As the competition increases, business decisions tend to be more aggressive and, therefore, the risk increases. In this sense, adapting strategies accordingly to answer the increasing rivalry among competitors is fundamental in this expanding industry.

One important aspect to keep in mind for the development of this sector is that oil and gas companies are commonly extremely rich industries, thus, as Luís Manuel, current Executive Member of the board of EDP, mentioned: "*It is crucial for these companies to be humble and to understand that the power sector industry can join forces to succeed*". In other words, it is relevant for oil and gas companies to understand that to be successful, they must look at partnerships as something to consider in the future and not something to be left out of option for the sake of them typically being associated as "solo players". If one tries to imagine a future where these giants are already in the renewable energy sector one can imagine the possibility for placed players in this market to be able to follow partnerships with them, and the opposite applies.

In the end, all these risks are outweighed by the advantages that partnerships in the offshore wind sector bring.

EDPR and Engie

The business relationship between Engie and EDP is a long-established one, especially when considering their agreements before the joint venture. Given that, according to the BCG Joint Venture Life Cycle framework (BCG 2017), the partnership between both these companies is under Ongoing Management and Intervention, it is fundamental that employees watch for signs of conflicting interests, especially in strategy and operations and dedicate time and investment to avoid these conflicts, while measuring performance, be it through KPIs or delivering value to stakeholders.

There is intense pressure from newcomers, that forces OW, and the joint venture in general, to rapidly adapt and innovate its business model. However, there are numerous risks when engaging in a partnership with another company and these need to be carefully assessed to be properly mitigated and develop a successful, long-term partnership between enterprises. In this thesis a closer look is being taken at EDPR and Engie's partnership in offshore wind, however many of the risks their partnership faces apply to others in fields that are not renewable energy/offshore wind.

Regulations are one of the most glaring risks that come up in any utility business project, offshore wind partnerships included. As mentioned in the case study, regulations presented themselves as the eventual downfall of a previous partnership in the project WFA.

Finally, the focus groups and individual interviews conducted allowed for a better understanding of risks in this specific joint venture, namely, when asked how they perceived the changes in EDPR culture most answers declare as it not being very affected. However, in terms of company mindset, the answers allow to conclude that some changes were felt in the mindset of the company since the partnership took place, from which around 55% employees agree that the mindset has changed.

Regulations in Offshore Wind

All offshore wind projects are exposed to frameworks and rules when considering undertaking a new project due to exposure to regulatory risks that differ across countries on a governmental, state, or even local level. Partnerships between companies from different countries allow for risk mitigation and dilute regulatory exposure, as there is more margin for error and diversification is encouraged by bolder moves. Concurrently, regulations imply a higher geopolitical risk and require a higher need to balance between stable areas and riskier ones. This represents one of the main reasons for OW strategically choosing to operate in the American, European, and South Korean markets. Also, it is relevant to bear in mind that regulations represent not only bureaucratic risks when joining a new project but also a potential increase in costs associated to the investment – namely in terms of investment and financing costs, administrative costs, or even in terms of timeline development which gets delayed due to regulatory constraints, therefore more expensive for the company.

EDPR, and EDP in general, have created a tendency to undertake projects in geographies considered to be stable in terms of energy sector legal frameworks, namely for offshore wind projects. Specifically for offshore wind energy, EDPR is currently developing projects in France, Portugal, Poland, South Korea, and United Kingdom (E. Renewables 2020) or even, for OW is established in "seven secured markets" which are the same as EDPR, adding Belgium and the United States. All these regions have stable regulatory policies when it comes to approaching wind energy projects. Nonetheless, while having steady frameworks within their country, all of them differ among themselves, which creates a need for a different approach when considering new geographies – not only in EDPR, Engie and OW case but in any company. Therefore, it requires the consideration of the different regulatory policies in a specific region and the creation of legal mechanisms that entail not only a national but also international level (Governance 2021). In more depth, the EU, UK and US general framework will be described and regulatory requirements in some strategic locations that OW already operates, as The Netherlands, and where there is potential to expand, such as in Denmark.

One must mention that all the floating wind energy technologies, before being installed, must have a document that summarizes the conclusions of the impact on the environment related to that project, which is called an Environmental Impact Assessment (EIA) (Iberdrola 2021).

European Union

According to EU law, offshore wind farm projects must fulfil two assessment processes for their development to be approved: the aforementioned EIA and the Strategic Environmental Assessment (SEA). The EIA process aims to identify and assess the potential environmental impact, in addition to analyzing the harm and risks that can be caused to marine and wildlife, such as bird collisions, as it happened at the beginning of onshore wind projects in Portugal, and changes in the wildlife food chain and its ecosystem. Additionally, this assessment must include a marine/ navigational safety assessment which examines the risk of collisions by ships in the developed project. This assessment, EIA, must be done and submitted as an Environmental Statement (ES). The only difference between EU states that might exist for EIA will be the guidance they provide developers to perform this assessment.

Regarding the SEA, one should know that it is a complementary, systematic process to EIA and its aim is to evaluate environmental implications of proposed policies or strategies and provides a way to observe the cumulative effects and address them at the earliest stages of decision making. Ideally, SEA should be integrated into the program in development by the government, and it is necessary for public participation for it to be successful. SEA mostly focuses on providing recommendations at the strategic level and allows for more effective control of cumulative effects. This process can be executed in multiple forms, but it has three main phases: SEA screening (where the decision to undertake SEA occurs), SEA scoping (identification of the issues that must be addressed) and SEA study (a full detailed analysis with a conclusion and recommendations).

Denmark

The Danish Energy Agency (DEA) is the competent authority responsible to approve tenders and to carry out the environmental impact in each project expected location. The installation of offshore wind farms is regulated by the DEA together with other authorities related to environmental and maritime safety, and three different mandatory licenses should be given: "*license to carry out preliminary investigations; license to establish the offshore wind turbines (...); license to explore wind power and an approval for electricity production*". The DEA has specific guidelines for the creation of the EIA. All of this makes Denmark a more stable market and transparent to enter in terms of regulations when compared to other offshore wind markets. Overall, there are two forms of procedures that can happen in the Danish market: tender and open-door procedures (AS 2021).

The first one, tender procedure, represents the most ordinary form of offshore wind projects applicant in the Danish territory, since it entails fewer costs, and performed through a so known Contract for Differences (CfD). The DEA defines the project (dimension, type) and the location where it must be set and invites companies to bid for the given proposal. Here, the DEA is also responsible to have the applicants defining the price they are willing to receive for offshore wind production plus assuring a certain level of security when investing in each project and performing themselves an EIA. Within the open-door procedure, on the opposite side, a company with a given offshore wind project is responsible for having the initiatory position by performing the whole application including – *"description of the project, the anticipated scope of the preliminary investigations, the size and number of turbines, and the limits of the project's geographical siting"*. After submitting the application, it is DEA responsibility to pass the proposal to the Danish Government and to analyze the potential of existing a public interest to block that project, if not, the DEA allows for the application to proceed.

The Netherlands

The Netherlands presents a special case within the European Union regarding their Offshore Wind regulations as the country has focused on offshore wind projects in the more recent years. "*Under the Act, the government takes over responsibility from offshore wind project investor regarding spatial planning arrangements and environmental assessment of the proposed plants. Additionally, the Act stipulates, that the responsibility for offshore grid connection falls on the government, not on the project developer*" (IEA 2016). This offshore wind energy act of The Netherlands also attributes the connecting of offshore wind farms to the electrical grid to TenneT. "*As the formally appointed grid manager at sea, TenneT entails the responsibility for the construction and exploitation of the high-voltage grid at sea*" (Bird 2016).

Additionally, The Netherlands heavily centralizes the control and regulation of offshore wind projects on the government's hands and functions also by means of auctions of tenders. However, the particularity of the country is that they have actions of tenders with zero-subsidy, meaning companies will not get financial support from the sustainable energy transition scheme. "*Vattenfall won the tender with a zero-subsidy bid. Therefore, the regulatory offshore wind energy framework – initially primarily based on an SDE+-combined tender – needed to be reviewed, among others, to enable auctioning and other selection processes (e.g., comparative assessment) as an option to issue an offshore wind farm license*". The Sustainable Energy Transition Subsidy Scheme (SDE++)

is the subsidy that supports qualifying renewable energy and CO_2 reduction projects (Agency 2021). One important consideration is related to governmental subsidies, related to programs such as the Stimulation of Sustainable Energy Schemes (SDE+) which represents an incentive where the Dutch government pays the difference of costs of producing renewable energies when compared to fossil ones.

United Kingdom

In the UK leases for offshore wind project's location are given two distinct phases. Overall, to establish a floating wind energy project, it must go through the '*Marine and Coastal Access Act 2009´* which sets planning needed procedures for the marine life in the region of both Scotland and the UK (Commission 2015). The first phase is the creation of an environmental assessment according to the Department for Energy and Climate Change in the UK (AS 2021). The second phase is made by The Crown Estate and consent is given by the government after examination by the Planning Inspectorate or Marine Scotland. In addition, the Department for Business, Energy & Industrial Strategy (BEIS) is the department responsible for offshore wind energy projects in the UK, but in England and Wales some responsibilities are also delegated to the Marine Management Organization (MMO) and in Scotland to the Marine Scotland Licensing Operations Team. In addition, in Scotland regulations also require third party validation of the floating wind turbines and their support structure including mooring ("a place where a boat or ship is moored"). Meanwhile, in England and Wales this is a common practice for design phase and basis but not a requirement to authorities.

Germany

The Federal Maritime and Hydrographic Agency (BSH) is the competent public institution authority for maritime issues together with the Federal Waterways and Shipping Administration.

The BSH is responsible for spatial planning and approval of energy projects such as offshore wind project ones to activities such as management of navigational risks, issuing of nautical charts, forecasts of tides and water levels. On the other hand, the Federal Agency for Nature Conservation (BfN) is the competent authority for the EEZ.

Additionally, the BSH is the entity that approves offshore wind farm projects in the North and Baltic Seas. They conduct the application procedures for the German EEZ and for territorial waters, regional authorities must give their approval as well. However, the BSH approval may not be legally binding for approvals involving installations on land or in territorial waters. The approval process must also guarantee the safety of navigation as well as of the environment of where the offshore wind project will be located. Furthermore, as Germany is a member of the European Union, it is compliant with its regulations put forward for offshore wind projects, meaning that the EIA process is mandatory to be carried according to the guidelines provided by the BSH.

United States

The United States utilizes their Bureau of Ocean Energy Management (BOEM) to process and analyze the applications for offshore wind farms. "*The Energy Policy Act of 2005 (EPAct) authorized BOEM to issue leases, easements and rights of way to allow for renewable energy development on the Outer Continental Shelf (OCS). EPAct provided a general framework for BOEM to follow when authorizing these renewable energy activities.*" (BOEM 2021). Moreover, BOEM's program has four distinct phases: Planning, Leasing, Site Assessment, Construction & Operations.

This Bureau manages, at a federal level, the general steps of this process, that is a multi-year long process, and engages with stakeholders throughout the entire length of it. The US federal law is applicable throughout the country and the EEZ territorial waters fall within the domain and power of the states. Therefore, they will be able to apply their own state laws to these waters. Another particularity in the US is that the community has an active role in the process BOEM puts forward for the approval of the offshore wind projects, allowing the local communities to have a chance to give their input and concerns as well as giving a platform to native tribes to defend their rights.

Regulatory Risks

Although regulations present themselves as a risk, they are also a mechanism enforced by governments to ensure safety in projects and promote renewable energies. The concerns with climate change have been piling up quickly over the last few years, therefore, governments are more than ever aware that there is a need to shift towards renewable energies, as fossil energies are left behind due to their pollutant nature and limited capacity to regenerate in due time. Ultimately, the recently adopted and implemented regulations can drive the feasibility of non-renewable energy sources further down until the only cost-effective option in the market is renewable energies themselves. These same regulations are also the mechanisms stifling oil and gas companies and their business in the non-renewable sector in a way that also pushes renewables forward.

Additionally, there are other risks present for partnerships on offshore wind, namely around environmental risks for the structures themselves, the ecosystem, geopolitical risks, inherent partner risks, technological risks. In this list of risks, the one that is tightly linked to regulatory risks is the geopolitical risk sphere, given that it concerns governments, and their governance and regulations are mechanisms for these risks. Geopolitical risk is quite low for the specific partnership of EDPR and Engie as most of their projects are placed in politically stable countries. Yet, further up higher in the risks for these partnerships in offshore partnerships are environmental risks and these can be broken down in two: natural disasters and threats to the ecosystem. The natural disaster risks are more regarding the structural damages they can cause to the structures of the offshore windfarms themselves and, ultimately can disrupt their activity and make these incur in heavy costs due to damages. Meanwhile the ecosystem risks are regarding the effect the offshore windfarms can have on marine life, food chains and general wildlife (such as birds) of the surrounding area. These are the risks that are evaluated in the EIA process in the EU, as previously mentioned.

Moreover, financial risks in these types of partnerships can present themselves in multiple ways as these are not short-lived joint ventures. These joint ventures are created with the knowledge that the projects they will engage in, require large and intensive capital investments as well as they are of long duration. This leads to the necessity of properly identifying a suitable partner to engage in these types of partnerships otherwise risks of lack of commitment in the partnership due to low investment, interest or even lack of skill may be faced. First and foremost, working in a joint venture in an industry as specific as offshore wind energy production one implies a need to share the risk and, therefore, mitigating it for the single company itself. Even though EDPR and Engie are big utilities companies, the offshore projects they are embarking on bring along huge capital investments and a discrete timeframe to gather some revenues. The time span of an agreement for the production and selling of energy through windfarms is between 15 to 20 years of usage, implying that the overall Net Present Value (NPV) of a project must be evaluated and predicted for at least 20 years. This includes the initial investment in research and planning, followed by the construction and finally the operational costs, and it can also potentially include an earlier sale of the contract.

Current Strategies | *Diagnostic, Analysis and Results*

The EDPR and Engie joint efforts under the name of OW are focused on reducing the risk faced in approaching offshore wind technologies. Therefore, while operating in such a project it is crucial to have a significant liquidity availability to be prepared to face any potential unexpected variation. The partnership helps to cope with time and investment risks. Sharing this type of risk implies not only lower expenditures, as they are shared, but also to assure a higher potential to cover an emergency in the project – any situation that implies specific risk can be mitigated by portfolio management and diversification.

As presented, both EDP and EDPR, have historically established business in countries with a low geopolitical risk index - Western Europe, the USA, Canada, and South American countries such as Brazil and Colombia being the riskiest markets. Nonetheless, country-specific risk can always take place. An example of this was Brexit since it caused major volatility related to the British pound and uncertainty around regulations for the European markets (Observatory 2021). Yet, EDPR and Engie (EDP 2019) are still studying new markets with significant potential where the JV can expand its presence, namely in The Netherlands, Japan, India, and Ireland.

OW has been rapidly expanding its operating market. The company focuses on developing its existing projects and searching for new projects within the sector. Nowadays, OW has ten different projects across its seven markets. Nonetheless, currency does not represent a significant risk for most countries as stability has been proved throughout the different states and any potential risk can potentially be covered by their stable economies.

The strategy for OW starts with the location decision about where to operate and develop a project. Opportunities come by participating in tenders granting seabed usage rights initially, which are launched by the governments, with specific destination terms such as offshore turbines deployment. Once they win the tender, a seabed portion gets a concrete destination, and OW must start to look for a Power Purchase Agreement (PPA) (T. W. Bank 2020). Afterward, a contract between two parties for the electricity supply on a long-term deal is created, which is commonly based on fixed prices or on a model that establishes prices, therefore reducing the risk for both parties. Once a long-term deal is signed and defined, OW proceeds with the development of a wind farm and the operational side of the project. The process allows companies to mitigate the risk on a long-term basis, as the exchange price is previously estimated and may usually only suffer minor variations. One example of this is the CfD, where the supplying and the buying part agree to pay eventual differences to each other, known as premium prices, along with variations in the commodity market (Investopedia 2021).

Companies need to limit the risk they can potentially face while entering new markets. In terms of financial risk, capital reallocation represents a good strategy. Such can be done by moving it from the main company financial statement so that the investment cannot create a negative impact, namely losses and market capitalization. The OW joint venture represents equal participation for EDPR and Engie, owning 50% of the shares. Therefore, it constitutes a subsidiary of both companies, a specific entity created to develop the entirety of the offshore projects of EDPR and Engie.

At the same time, OW is also a holding. Most of the projects carried on by OW are developed through Special Purpose Vehicles (SPVs). An SPV is an entity created to develop a specific project, isolating the financial risk from the mother company. OW works in this way for most of its projects, namely Windplus is the chosen consortium for WFA. Other companies in the sector do the same: Korean Floating Wind for Ulsan projects (and future development), Mayflower Winds for

Mayflower, MOWEL for the Moray concessions, to give a few examples. SPV always refers to a single project, which is related to a specific asset (CFI 2021). For the OW case, an asset does not refer to the whole windfarm since it also includes tangible and intangible related assets (T. W. Bank 2021). The utilization of SPVs to develop an asset does open the possibilities toward a specifically useful financial instrument for capital-intensive projects: project finance.

Regarding being capital-intensive, projects such as the WFA, as related by Miguel Munõz, Structured & Corporate Finance Associate at OW, are financially guaranteed on a project finance investment basis which is a specific approach to funding. Here it is guaranteed that all the debt coming from that project development will be paid through the future cash flows that the project will generate. For OW case, it allows limiting the risk, as the liabilities are not going to impact on the financial statements of the mother company (Investopedia 2021).

Nonetheless, a failure is always possible but only affects the specific project, allowing to limit the parent company's responsibilities in the repayment of the debt. However, the less a company with a strong financial position is involved in the equity of a project, the more investors will perceive this financing as a risk-carrier since not even the parent company wants to assume the risk of developing the project. It is necessary to find an adequate equilibrium.

Another potential risk in partnerships and joint ventures is related to dissolution. Having happened in the EDP path towards offshore, it is important to consider its possibility and WFA is once again the most significant example. The initial consortium broke up, but EDP believed so much in the project that, to avoid any sunk cost, took over the quotas of the leaving members. To face this inconvenience, EDP had to invest its own money.

EDP could manage cash availability due to asset rotation, a strategy the company was pursuing in 2010. This system allowed EDP to constantly restructure its assets, switching towards more profitable projects without creating new debt to invest in. While this approach did not increase the value of EDP assets, it favored constant innovation in EDP. As we have been explained by João Salvação Barreto, a higher risk is needed to seek more profitability and EDP adopts a cautious geopolitical strategy, therefore the risk has to be allocated on the technological part. Asset rotation also represented the possibility to increase liquidity availability when issues were faced.

The usual leverage ratio to finance a project for Ocean Winds is 80:20, meaning that only around 20% of projects are equity funded. WFA represents a different situation, as the project was considered particularly risky, and banks were not keen to fund it. At the point that the project had to be carried on partly by the European Investment Bank (EIB), which recognized the possibility of further developing a project in the renewable energy sector (Commission 2018) (EIB 2015). The European Commissioner for Research, Science and Innovation Carlos Moedas defined the deal as "Another example of how EU financing is helping to lower the risk of rolling out innovative energy solutions like WindFloat Atlantic." However, EIB only participated with an initial injection of only €60 million, out of an initial estimated cost project of €139 million. €29.9 additional million would have come from the EU NER300 program, whose aim is to develop innovative low-carbon technology. The leveraging of the project was 64%, with the remaining part being funded through Windplus equity.

Once the project reached its completion phase that it turned out possible for Windplus to increase its leverage on it. The project completion is reached once specific productivity milestones are reached, indicating that the construction and testing phase is terminated. In October 2020, Windplus started negotiating a new deal with the EIB to increase the leverage by ten additional million euros, bringing it to a total of €99.9 million.

The leverage in percentage however remained roughly the same, due to some cost overrun the project faced during its construction. Nonetheless, once things were moving in the right direction, the wind farm had to face the detachment of a cable during Dora. Furthermore, the collateral for the financing of the project by EIB was its revenues: a plant in force majeure status does not provide any. The payback of the initial funding from EIB was planned to take place in December and in June. As the farm has been inoperative from the last days of December to May, not even the minimum energy production forecast had been reached, with the project itself being low in liquidity to repay the installment. It was at that point that a new capital injection was needed by the equity owners, raising however a conflict between OW and Repsol. OW has, through EDP, participation in Principle Power, Inc. (PPI), which has a 2% stake in Windplus, without however participating in the capital contribution. PPI part would then be covered by the other parties of the consortium. This was set given that, initially, the American company had had participation by Repsol as well, which was, however, liquidated after the project started. Because of that, Repsol did not agree to inject the capital part of PPI. An equity restructuring was then provided by OW, for the joint venture to cover the injection part, initially supposed to be carried on by Repsol.

Once this was solved, a deal with the EIB was finally reached. Windplus would have received a further capital injection by OW and Repsol, with the condition that once the insurance would have paid the reimbursement, that would have not been used as a reserve for future repayment but would have been used to cover the capital injection by OW and Repsol.

The part played by insurance companies in mitigating risks is essential. Miguel Gomez gave us a detailed overview of how important they turned out to be in the management of WFA. Such an innovative project needed as many coverage policies as possible. The most important policies signed are the Construction All Risk (CAR) and the Operational All Risk (OAR). The CAR is a policy that intervenes during the construction phase of the project, covering all the risks associated with it, including property, assets, and environmental damages, as well as injuries, both for the subscriber and third parties. Alongside, the delay in startup policy role is to cover the financial part of the construction in case any delay to the contract works causes any financial issue (Commercial 2021). Once the project is operating, the OAR policy can be signed and cover any damage to equipment and is usually undertaken along with a Third-Party Liability policy, covering any caused damage to third parties, and an Environmental policy (Marsh 2021), specific to covering any damage to the natural environment (Allianz 2021). Lastly, it is important to highlight the Business Interruption policy that covers the estimated revenue losses due to a production outage (Advisor 2021).

WFA cable detachment issue led to an insurances' intervention, in this specific case the ones covering the issue were OAR, dealing with the physical intervention reimbursement, and business interruption, taking care of the revenue losses, essential given the presence of a project finance funding. The complication and the slowness of their intervention only made the first reimbursement expected from the insurances in December 2021.

Looking at the technology used by OW, there is tentative to imply risk management procedures. The most common fixed offshore wind is the base of the biggest project, namely Mayflower, Moray, and Treport & Noirmoutier. Those represent the first source of revenue for the joint venture, from which it will be able to fund further development for the floating technology. As a recent technology, floating comes with immense possibilities but also entails higher risks. Nonetheless, the risk is shared with technology developers, PPI for the case of OW, since the company acquires technology instead of directly investing in R&D. The concerns related to the development of the technology are therefore outsourced, allowing for lower R&D investment. This highlights the importance of having a strict partnership with them. The same situation happened with EDP when working in implementing solutions in Povoa do Varzim while working with PPI. This said, although technology implies more risks, those can be mitigated by greater stability in revenues coming from established technologies and the relatively smaller scales on which they operate.

The risk of a potential lack of commitment is now low. Both companies have high stakes involved in the joint venture. Therefore, it is most likely that they will be committing themselves to the project. Such is more likely in larger joint ventures or whenever the capital investments have been lower. There are also most likely penalties in case of exiting the joint venture.

In other terms, Covid-19 has brought an increased demand for household energy due to the lockdown (but decreased electricity consumption worldwide) (IEA 2021). Capital expenditure (N. Energy 2021) is beginning to grow in offshore wind energy, the sector is becoming more attractive, contrary to what happened in the oil and gas industries, and now, the former brings more certainty than the latter. Therefore, it is increasing attractiveness for fossil fuel giants to enter the industry and boost competition within it. Oil companies already have experience in offshore wind drilling, bring a lot of expertise, and have larger capital pools than utility companies – these still have more knowledge on the electricity distribution, in this case for the electricity to be brought to shore. Given that the floating offshore wind market is still very unexplored, neither oil nor utility companies have experience in the field, leaving fossil fuel companies in a better position when compared to utility ones.

Offshore wind operators are partnering up with oil and gas giants to develop offshore wind projects, an alliance that might seem controversial at first, due to different mindsets and goals, but that allows for improved synergies and more local know-how for crucial markets (N. Energy 2021). The consortium is an innovative example of research institutions and renewable energy companies like EDP and Enel Green Power. These are starting to build combined turbines that can leverage wind, wave, and solar at the same time (Monthly 2021). The project received funding of €34,8 million from the European Green Deal, allocated in 2020, and is expected to be operational by August 2025. It will be built in two areas: the first in the Belgian Coast, from which 3MW will be allocated to an offshore solar PV and bottom-fixed offshore wind farm, while the second will be located out the Portuguese coast and comprising 1.2MW of wave energy co-located with a floating wind farm.

Hence, regulations are quite variable, and each country will have its own take and authorities that will deal with offshore wind projects. Even in regions such as the EU and the US, we can see some differences between European states in their demands and how they organize themselves, despite having to respond and comply with a common legal framework of regulations for approval of offshore wind projects within the boundaries of the EU. Similarly, the US as a country has a legal framework regarding their EEZ (OECD 2001), however territorial waters fall within the states' command, and these can have some minor differences between them and have the extensive and complex process of analyzing and approving offshore wind farms differ in order to be adapted to the specificities of the state itself, its population and environment. With this in mind, we would like to provide some further recommendations based upon the regulations of the countries observed in this report, along with the current strategies employed by OW.

Operational Considerations

Before introducing targeted recommendations, a background illustration must be given.

First, the concept of hybrid wind farms consists of connecting wind farms to more than one country at the same time through various cables (Orsted 2021). Even though there is still no European legal framework for this, which increases uncertainty about how these projects will unfold, there is high potential based on some studies.

Secondly, the first project of this hybridity concept was created between Denmark (Energinet) and Germany (50Herz (50hertz 2020)), Kriegers Flak Combined Grid Solution in the Baltic Sea, an offshore wind interconnector between two different countries' electricity grids (WindEurope 2020).

At last, The European wind turbines industry forecasts that by 2050, 100 to 150GW out of a total of 450GW of offshore wind energy installed capacity, will belong to hybrid projects. Therefore, the North Sea presents itself as a great opportunity for hybrid projects, not only because reports show that 212GW of installed capacity (WindEurope 2019) should be distributed among the North Sea by 2050 (WindEurope 2017), but also because it has good and stable wind speeds and distances to shore, that are no longer than 200km.

Thus, having all this in mind, including how regulatory frameworks can present both challenges and opportunities for developers of offshore wind projects, we provide the following recommendations.

Recommendations

Given that offshore wind energy entails many benefits, it is important that the JV between EDPR and Engie continues not only to massively invest in this energy sector, but also to improve and take the most advantage out of what it has to offer in terms of market growth and technology. So far, offshore wind is still an untested market and global installations amount only 2% of what is needed by 2050 to avoid the worst climate change scenarios. In fact, the Global Offshore Wind Report 2021 (Council 2021) states that wind represents the renewable energy source with the greatest potential and highlights that 35GW of global installed capacity (which corresponds to 0,5% of current global installed electricity capacity) can avoid 62.5 million tons of CO_2 emissions, the equivalent to taking 20 million cars from the streets. At the same time, worldwide electricity demand is expected to grow exponentially until 2040, highlighting the importance of having additional energy sources, for which offshore wind is a great opportunity [Appendix 3].

In this sense, the JV should invest in certain procedures and recommendations to leverage the offshore wind energy market's potential – a prioritization matrix is presented on Appendix 4 (and a set of open opportunities in new countries is presented in Appendix 5):

1. **Improve current supply chain by existing processes – opportunities in design, procurement, execution, operation and innovative financing.**

When assessing the maturity of the supply chain in offshore wind energy production, to consider entering new projects or allowing integration in the supply chain, OW must consider certain aspects, namely: experience not only in supplying offshore wind energy in its parent companies' countries (Portugal and France) but also in adjacent industries, which can increase the possibility to replicate their knowledge; market volume adaptability and supply chain maturity, and, lastly, increase advantages and synergies from local supply and commercialization possibilities in terms of exports (Tingley 2021). There is an added value when considering a potential to partner up with other companies, namely local partners, along a supply chain, which can be called a "*cross-sector partnership framework*" (Forum 2013).

Supply chain stages for an offshore wind energy producer normally entail a Development and Investment phase, in which benchmark in conducted to determine salaries, recruit licensing and wind energy R&D (Airswift 2020). This is followed by the Engineering, Procurement and Construction processes, that include Health and Safety measures, finding a fabrication lawn and starting construction around it, including turbine design and production. Afterwards, the Offshore Installation phase requires vessel crewing and technician hiring for wind turbine generators and cables. Finally, Services, Technology and Equipment include constant consulting and a full-time contractor service team, with wind farm development and exploitation and its respective maintenance (T. S. Energy 2021).

Studies show that supply chain is one of the most important factors for LCOE in offshore wind to decrease, specifically in areas related to installation, operations, and logistics. In particular, investments in turbines, foundations and towers, installation, operations, maintenance and services and development can be expected to reduce (Associates 2016).

The improvement of stages within the supply chain entails new opportunities in design, procurement, execution, operation and innovative financing. In terms of design and engineering, OW should focus on increasing value creation through targeted, cost-effective and high value-added specifications, namely, it should be considered the possibility to have an integrated structure design. Standardizing the design across different projects for the same company also reduces costs of production and maintenance.

Secondly, contracts and procurement should be carefully analyzed and compared to peers, to produce the best agreement. According to a study conducted by McKinsey, by assessing different risk profiles and cost-efficiency from different contractors while working with great procurement tools, an onshore wind company was able to save at least 15% of the final project costs (McKinsey 2017). All the aforementioned factors can contribute towards integrated performance management that improves transparency among stakeholders and the JV's presence in the offshore wind sector.

Opportunities to reduce costs in operations and maintenance start with acquiring advanced procedures to improve those services, namely monitoring and component substitution. Then, flexible work contracts should be established, to guarantee the balance between internal and external entities/ workers, and vessel logistics (such as sharing technicians and ships with other wind farms, as done in the oil and gas sector).

At last, innovative financing includes investors being aware of the offshore wind energy risk profile and investing in alternative structures like publicly traded, or new ones “combining features such as publicly listed versus private structures, single asset versus broader portfolios, and single-technology focus versus cross-technology” (McKinsey 2017).

2. **<u>Hybrid offshore wind farms (connect to two or more countries).</u>**

As previously mentioned, Kriegers Flak Combined Grid Solution between Denmark and Germany, represents the idea of utilizing a windfarm and connecting it to multiple countries’ electrical grids are something OW should invest in. This also takes into consideration the current lack of regulatory framework around these hybrid projects. However, several EU proposals developed a more connected European electrical grid that presents benefits for the overall European countries and their sustainable targets which may signify a future regulatory framework for this type of project.

However, hybridity is related to international agreements that are set by Governments. With this, OW should claim a Policy Ask, taking countries in the North Sea and their respective country regulations into account. This protocol implies explaining why connecting these facilities to more than one access point in different countries would boost the capacity to accelerate renewable energy, accounting for legal improvements and trying to set up the idea globally.

The introduction of hybrid structures in the market will represent a crucial factor for the European net-zero greenhouse gas emissions target by 2050, bringing socio-economic benefits and cost-efficiency. Apart from this, according to Orsted (Orsted 2020), it increases trade alternatives and CAPEX savings (up to an estimate of 30%). Concurrently, the number of connection points is lower than if the wind farms were separate. In fact, according to a study, 205GW of offshore wind on the North Sea would imply 231 converter stations in comparison to 169 in case the network was combined in the hybrid format (Reve 2016). Additionally, it will increase the probability of meeting supply and demand and reduce the environmental impact on biodiversity that the turbines entail, such as the elevated noise that puts away a lot of wildlife at sea.

Positive characteristics of this type of model also entail space savings while increasing energy flows across the countries (WindEurope 2020). Concurrently, it would allow the JV to create a European linked grid, boosting interconnection between countries and promoting the EU's internal energy foundation which enforces the need to start betting on these types of technological models.

However, the several underlined concerns can lead to failure to comply with such processes. Part of this uncertainty comes not only from hybrid projects being widely untested but also from the need for multiple collaborators and implying the combination of two or more projects into a single one. In this case, it is important that both EDPR and Engie can contribute towards enhancing the importance of such hybrid projects within the EU and invest in understanding how it can improve their stake at a European level (Berger 2019).

A study conducted by Roland Berger shows that, within five projects assessed, the cost savings estimate was between €300 million and €2,500 million, depending on the size of each project, amounting for savings between 5% to 10% of the total project costs (Berger 2019). Actual implementation procedures entail the following steps, that can also mitigate the barriers encountered with the adoption of these hybrid structures:

1. Implement the Hybrid Asset Network Support Agreements, that improve security and certainty for developers through cross-country legal agreements, avoiding company-specific rules and policies possible to increase regulatory and legal risks. For the joint venture EDPR x Engie, as it would be dealing with more than one country in the same project, it continues to be important to mitigate these risks.
2. To avoid the financial burden, the joint venture must apply for the EU’s Connecting Europe Facility, a public funding program that aims at supporting the development of hybrid offshore wind projects with “Projects of Common Interest” status (Projects that connect different countries and are key for the EU’s internal energy market. These aim at providing affordable, secure and sustainable energy to citizens).
3. Agreements, such as the percentage of ownership or length of the partnership, might also be set to clarify the cost burden among the parties, along with the expected benefits, to avoid inequalities regarding the distribution of costs and benefits.
4. Broaden hybridity by combining it with power conversion technology, that allows for energy storage in periods of excess supply or production of other sources of energy, like gas. This will avoid onshore grid congestion, unnecessary supply risks and eventually untie more installed capacity integration aligned with a more sustainable approach.

Ultimately, hybrid offshore wind projects bring great potential for European decarbonization, namely on the North Sea, bringing short term (cost and space savings) and long term (helping on the European energy transition process) benefits.

3. Promote a 100% green offshore wind energy process.

OW is a sustainable-oriented company highly committed to sustainable energies. However, even though offshore wind decreases carbon emissions, it is still not entirely carbon neutral, as EDPR's targets for the Project 2030 and Engie's projects for 2020-2030 (Engie 2020) intend. For instance, in the case of fixed offshore wind foundations that cannot be assembled onshore, engineering and maintenance of offshore wind turbines are moved by fossil fuels and there is still no worldwide framework for the recycling of turbine blades at their end of life.

One of EDPR's key commitments that OW should adopt regards the circular economy and its importance in the business - it should be included not only at the end of a turbine's life but also, in the beginning, meaning that green approaches should be implemented in the engineering and design phases. This can be achieved by minimizing and changing the materials used in a turbine construction (E. E. Energy 2021), while promoting their reuse [Appendix 6]. Moreover, our recommendation must be implemented since the EU is banning all forms of non-reusable turbine blades already by 2025 (WindEurope 2021). However, fiberglass, which is the material used on turbine blades, cannot be recycled and there is no worldwide concrete solution for this issue. Therefore, the recommendation sets terms in OW merging the best practices adopted by the parent companies, including some additional focus on offshore wind-related practices, to have an Ethic Code for Suppliers, in which OW could incorporate know-how, procurement, green certifications, supply chains, circular economy, safety, human rights and reporting from its shareholders – from EDPR and Engie. Being, in particular, careful to guarantee that the code will be respected, as it is easy for a company with a long supply chain, for example, to have its initial production levels become less manageable and more difficult to trackback. In addition, the company should evaluate new potential materials to produce turbine blades.

At the same time, hydrogen-fueled vessels already exist, as happens in the under-development project ULSTEIN SX190 Zero Emission DP2 in Norway, estimated to be launched by 2022 (Explorer 2021). The company is building a vessel that can move through hydrogen and allows reducing the environmental footprint from offshore wind renewables. Large hydrogen storage tanks are still underdeveloped. The Ulstein Group is the largest ship manufacturer in Norway and can easily export this technology to other countries around Europe. This would also allow OW to tackle the International Maritime Organization's target of reducing ship fuel emissions to at least half by 2050 (Organization 2021).

Ultimately, the roadmap for a fully decarbonized future entails more to it than just adopting renewable energies and OW should internalize procurement criteria that asks suppliers for solutions with a lower CO_2 footprint.

4. **Expansion of co-located offshore wind turbines.**

Another great opportunity relies on combined offshore wind turbines, in which the same turbine takes advantage of more than one type of energy production. Both EDPR and Engie already adopted the combination of solar and wind energies but have no structure for wind and waves according to those companies' publicly available information, which is offshore wind turbines' main characteristics.

EDPR should leverage the expertise that is being acquired from the new consortium between research institutions and renewable energy developers like RWE, EDP and Enel, where these companies are producing combined wind, wave, and offshore solar power in Europe (Monthly 2021). EDPR could expand its current constructed offshore windfarms to combined turbines for OW, leveraging from both wind and waves power and maximizing its energy storage whilst delivering it to households, and boosting installed capacity to meet 2030 goals.

5. **Standardize safety, environmental and labor policies.**

In more generic terms, given that change only needs to come from one company, the group recommends that OW invests in a trade association that can standardize safety, environmental and labor procedures for the whole market so that the company not only stands out in comparison to others but also tries to create an international policy for international waters, that do not have national frameworks. For example, to avoid ship collision with the structures, frameworks such as the one created by the Directorate-General for Public Works and Water Management in The Netherlands (part of the Ministry of Infrastructure and Water Management) that establishes paths for the ships to follow (T. S. Energy 2021) should be used as something OW can take ideas from. In this case, the passage is only allowed through specific corridors and during the daytime. This navigational risk assessment would allow for greater efficiency and safety requirements (Link 2018).

Companies are currently adopting policies that represent an extension of onshore wind energy, which should not be the case for OW. Instead, the company should invest in bolder moves that change the way offshore wind is perceived.

6. **Integrating new projects.**

There is an overall potential to use partnerships with external companies to boost floating offshore wind distribution. OW has already taken a step further by announcing in November 2021 a partnership with PPI marking the company first movements towards commercialization (P. Power 2021). The PPI experience, namely in the WFA project, will help to maximize the distribution of floating offshore wind in France. If one considers the potential to expand this partnership, one can see it as a secret weapon towards growth. PPI is at this stage the leading company when it comes to floating wind energy distribution globally (75MW in WFA platforms) and evolved in already giant projects such as one located on the UK coast. This partnership can not only create a higher and faster supply chain for OW but also increase its know how along each stage in the business – as it already did for EDPR and Engie.

Following the lead with PPI, OW can profit from partnering in the Korean market (P. Power 2019), highlighted by the example of Wind Power Korea that has been involved in an offshore wind project for an outstanding total of 1,000 MW capacity. This project counts with the huge incentive from the Korean government due to their high established goals in terms of sustainability by 2050, therefore one can consider that this can become an interesting project for OW to potentially be part of, since it would allow to partner with one of the biggest technology developer countries in the world, and also take advantage from a location with an immense potential in terms of cost for offshore wind projects.

Partnerships not only with companies but also with associations and initiatives that promote the distribution of sustainable energies should be considered. One concrete initiative is the "*The Sustainable Energy for All"* (SE4All) organized by the United Nations (UN) that incentivizes "universal access to modern energy services", where EDPR and Engie are already part of (Se4All 2021). Following the same line of initiatives, OW itself should extend its portfolio of sustainable engagement with initiatives aligned with the Paris Agreement, Sustainable Development Goals, and the escalation of energy distribution for everyone. This type of involvement with initiatives allows improving the company's name in the sector in addition to facilitating its establishment in the distribution market.

One other initiative is the "Energy for all" organized by the Asian Development Bank (ADB) which intends to increase access to modern energies, such as the wind one that OW develops, focusing in poor regions in Asia. This initiative already counts with some partners in the wind energy sector, namely the Korean Wind Energy Association. If one manages to think ahead, this can be a key resource to expand not only the company's portfolio in the Asian market but also the evolvement in sustainability goals. According to the ADB, 1.9 billion people in the Asian continent still depend on traditional biomass energy (2010 data), and 800 million still do not have access to basic electricity services (A. D. Bank 2011).

Another relevant initiative happening is the Ocean Renewable Energy Action Coalition (OREAC) which identifies innovative ocean related solutions, namely floating offshore wind new technologies, to have the potential to fulfill alone almost 50% of the total considered potential of decarbonization tools (Council 2021). The overall vision established a "goal of 1,400 GW of offshore wind generating capacity" to be installed by 2050 at a global level. It counts with several giant partners such as Orsted and Equinor, both sustainability-oriented companies in the energy sector. But also, some gas and oil energy companies, like Shell and Total. This initiative allows increasing market involvement and network with same-mindset partners in the offshore wind industry because it includes access to "stimulus packages" that can accelerate energy growth (Council 2021).

7. <u>Organizational ambidexterity.</u>

To manage the short- and long-term success, OW must manage its current suppliers whilst continuously looking for new technologies to maintain a leading position within the sector. This growing industry entails constant change and excellent adaptability traits, from which OW should be attentive to new and open opportunities.

Having said this, OW should sustain the existent relationship with partners such as PPI or Vestas, without establishing exclusive agreements. In this manner, it is possible to have some freedom in the market and continue looking for better technologies and price deals. Exclusive agreements with companies can restrict the possibility of looking at the competition, therefore limiting growth in the sector. Given that both the industry and OW have unexplored growth potential, the last point is crucially relevant.

OW needs to remain attentive to newly born startups and companies that can potentially have an interesting idea with a feasible application in the offshore wind market, by investing in them while in the early stages of development, as happened with PPI.

Conclusions

After analyzing the overall potential and relevance that partnerships can have in the offshore wind energy industry, one can understand how successful joint ventures can either destroy or make a company, such as EDPR, to outstand in the sector. It is crucial to acknowledge the timeline of a project in order to be able to understand when to get involved in one. Plus, in order to succeed, the parties involved must share the same corporate culture and prospects for the future within their strategies. This said, EDPR and Engie managed, so far, at the right time, to go through a partnership which allowed both companies to become highly successful within the offshore wind energy sector. The two partners are nowadays ideal examples of companies in this industry. If one intends to join the same industry, OW projects, such as floating ones, can be regarded as examples for the sector and technology to grow.

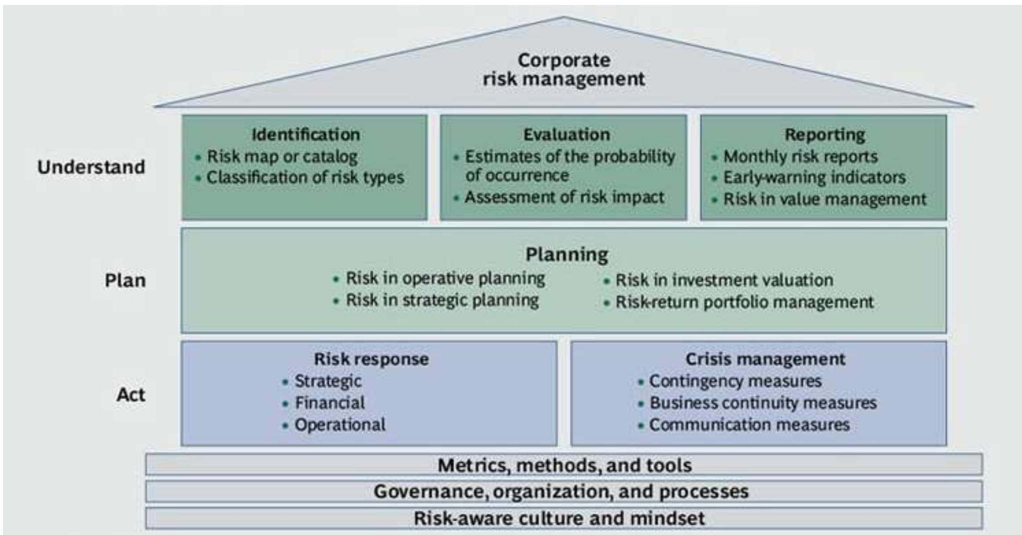
EDPR successfully managed to spread the risk involved in an industry which is expected to be evaluated in more than $56.8 billion by 2026 (Markets 2021). Nonetheless, with a high market value comes a high capital investment. This said, the opportunity to spread the capital-risk involved in the initial projects was an asset from which EDPR nowadays manages to extract the title of one of the world's pioneers. In addition, one can consider a smart decision for the company to intend to create a subsidiary in order to support all the activities related to a new adventure such as the offshore wind energy one. This represents nothing more than a "safe cloud" that not only EDPR, but also Engie created to prevent potential collateral damages to their mother companies. One negative aspect that was considered, and which supported their decision to pursue a partnership, was the potential collateral financial damage that both companies would have to suffer in case of failure. Thus, the partnership was able to mitigate those risks correctly – until today.

Ultimately, partnerships are a safe tool to minimize potential risks, but also the relevance of having a similar party to partner with. One of the key aspects for OW to succeed was indeed the previous background that both parent companies had – not only in financial terms, which presented similar results, but also in terms of goals for what the companies wanted to achieve in the future. This enabled both companies to share their in-house knowledge and capabilities, which allowed the partnership to grow for the company it is today.

In general, we believe that, if EDPR and Engie adopt new measures to improve their growth in the offshore wind sector, targeting concrete goals and establishing strong frameworks, starting with the aforementioned recommendations, the JV will be able to stand out in the market and outperform its rivals (BCG 2018).

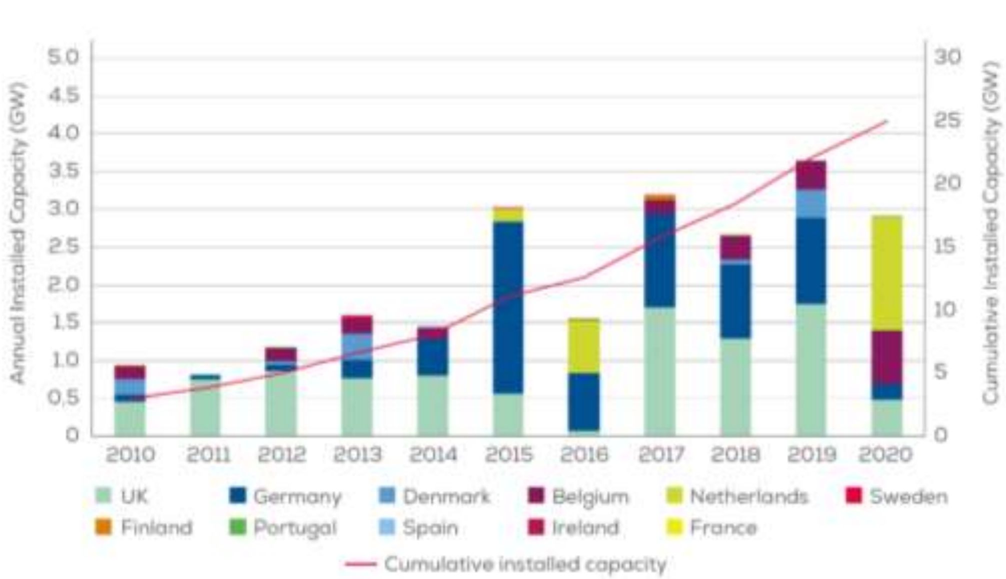
Appendix

Appendix 1 – BCG Integrated Risk-Management System



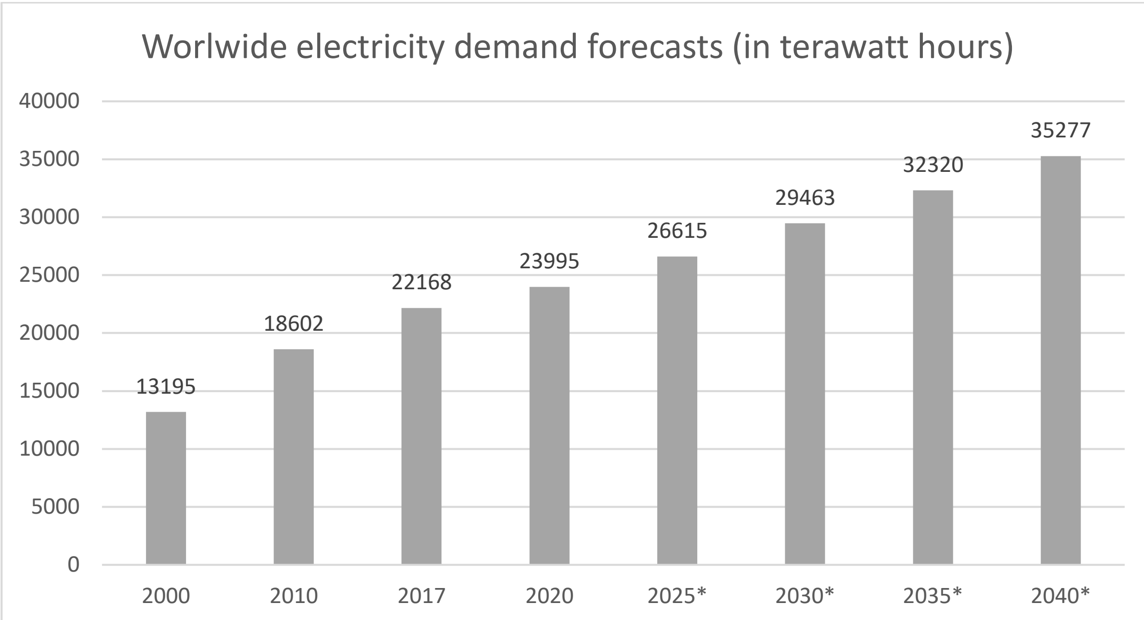
Source: (BCG 2017).

Appendix 2 – Annual and cumulative offshore wind installations between 2010 and 2020



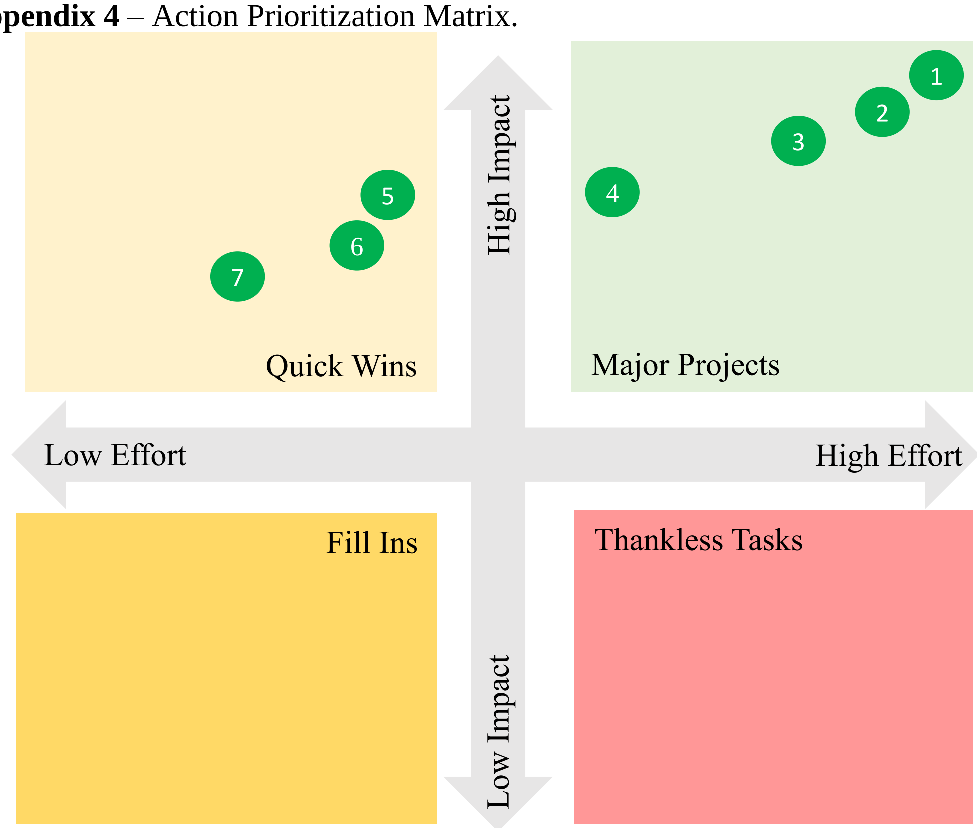
Source: (WindEurope 2020).

Appendix 3 – Worldwide Forecasts for electricity demand**.**

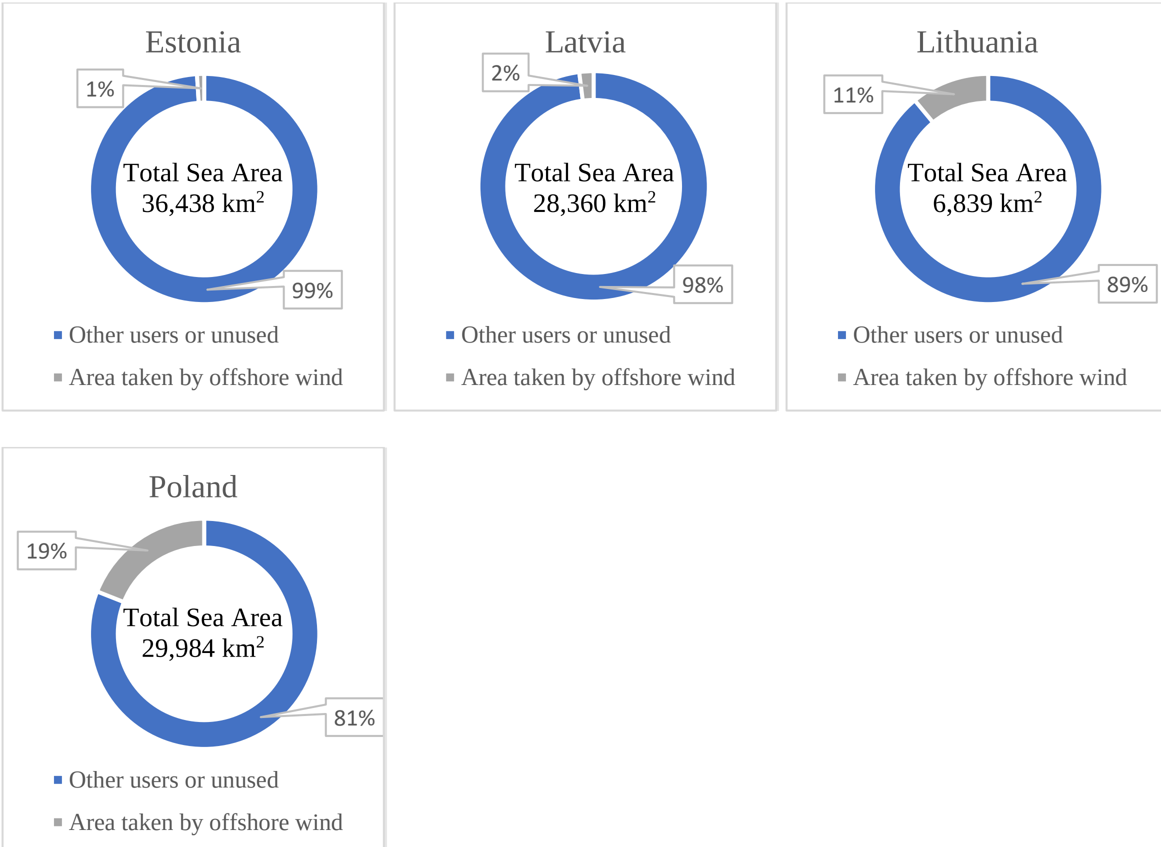


Source: (Statista 2021).

Appendix 4 – Action Prioritization Matrix.



Appendix 5 – Offshore wind presence compared to total capacity in Europe, by country in 2019.



Source: (WindEurope 2019).

Appendix 6 – possible initiatives for OW to leverage from, to promote a circular economy of offshore wind turbines:

EDPR has a partnership with a start-up company named Thermal Recycling of Composites (TRC), that focuses on recycling the blades from turbines that can be transformed for many endings such as "*panels, seats or consoles for trains, urban furniture, bicycles or boats*" as highlighted in the company Environmental report. EDPR also recurs to other companies, namely RECICLALIA, or initiatives such as Cloud County Community College (CCCC), which all have as the end goal to minimize the waste created at the end of a turbine's life and maximize the possibility for them to be reutilized in the industry.

This said, OW and floating technology must be able to replicate the same principles and initiatives in order to minimize the waste in this fast-growing wind energy industry. Actually, the term "*upcycling*" can be brought through a technology named 'R3FIBER' which focus in recycling turbine blades by creating fiber materials to be used in other things.

Source: (E. Renewables 2021).

4. References

Acteon. *Benefits of Floating Offshore Wind.* 2020. https://acteon.com/blog/benefits-of-floating-offshore-wind/ (accessed November 18, 2021).

Airswift. *10 European offshore wind projects to watch.* 2020. https://www.airswift.com/blog/offshore-wind-projects-europe (accessed December 2, 2021).

BCG. *The Art of Risk Management: CFO Excellence Series.* 2017. https://www.bcg.com/publications/2017/finance-function-excellence-corporate-development-art-risk-management (accessed December 4, 2021).

—. *The Private Sector's Strategy for Managing the Risks of Public-Private Partnerships. "Driving Success in Large-Capex-Project Management.".* 2013. https://www.bcg.com/publications/2013/urban-infrastructure-public-sector-strategy-managing-risks-public-private-partnerships.

—. *Will Your Offshore Wind Strategy Sink or Swim?* 2018. https://www.bcg.com/publications/2018/will-your-offshore-wind-strategy-sink-swim (accessed November 28, 2021).

Bird, Bird &. *Offshore wind in The Netherlands - ACM sets regulation for TenneT.* 2016. https://www.twobirds.com/en/news/articles/2016/netherlands/offshore-wind-in-the-netherlands-acm-sets-regulation-for-tennet (accessed December 14, 2021).

Bloomberg. *Engie is said to explore offer for 8.5biilion - EDP Renováveis.* 2021. https://www.bloomberg.com/news/articles/2018-06-25/engie-is-said-to-explore-offer-for-8-5-billion-edp-renovaveis (accessed September 28, 2021).

BOEM. *Regulatory Framework and Guidelines.* 2021. https://www.boem.gov/renewable-energy/regulatory-framework-and-guidelines (accessed November 18, 2021).

Bruegel. *A new integrated-value assessment method for corporate invesment.* 2021. https://www.bruegel.org/wp-content/uploads/2021/09/PC-19-230921.pdf (accessed November 14, 2021).

CFI. *Special Purpose Vehicle (SPV).* 2021. https://corporatefinanceinstitute.com/resources/knowledge/strategy/special-purpose-vehicle-spv/ (accessed October 21, 2021).

Commercial, Marsh. *Spotlight on: Delay in start-up (DSU) insurance.* 2021. https://www.marshcommercial.co.uk/articles/delay-in-start-up-insurance/ (accessed October 19, 2021).

Commission, European. *Boosting Offshore Renewable Energy for a Climate Neutral Europe.* 2020. https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2096 (accessed October 27, 2021).

—. *EU loan helps kick-start construction of floating wind farm off the coast of Portugal.* 2018. https://ec.europa.eu/info/news/eu-loan-helps-kick-start-construction-floating-wind-farm-coast-portugal-2018-oct-19_en (accessed October 18, 2021).

—. *NER 300 programme.* 2021. https://ec.europa.eu/clima/eu-action/funding-climate-action/ner-300-programme_en (accessed November 13, 2021).

Commission, European. "The regulatory framework for wind energy in EU Member States." 2015.

Council, Global Wind Energy. *Green Recovery Data and Analysis.* 2021. https://gwec.net/green-recovery-data-analysis/ (accessed December 7, 2021).

—. "Ocean Renewable Energy Action Coalition." 2021. https://gwec.net/oreac/#about (accessed October 31, 2021).

—. *World installs 6.1GW of Offshore Wind in 2020, led by China.* 2021. https://gwec.net/world-installs-6-1gw-of-offshore-wind-in-2020-led-by-china/ (accessed October 21, 2021).

Cowi. *Accelerating Offshore Wind through Partnerships.* 2021. https://www.cowi.com/insights/accelerating-offshore-wind-through-partnerships (accessed November 5, 2021).

Data, Our World in. *Onshore wind cost per kilowatt-hour, 1983 to 2017.* 2017. https://ourworldindata.org/grapher/onshore-wind-lcoe (accessed November 20, 2021).

Direct, Science. *A Review and Comparison of Floating Offshore Wind Turbine Model Experiments.* 2016. https://www.sciencedirect.com/science/article/pii/S1876610216309146 (accessed November 6, 2021).

EDP. *EDP acquires 25.3% stake in Portgas.* 2015. https://www.edp.com/es/noticias/2015/11/06/edp-acquires-253-stake-portgas (accessed October 27, 2021).

EDP. "EDP e Egie unem forças para criar Líder Mundial na Energia Eólica Offshore." Contract and Presentation, 2019.

—. *Media Press Kit.* 2018. https://www.edp.com/en/media/press-kit (accessed December 10, 2021).

—. *Privatização da EDP.* 2018. https://www.edp.com/pt-pt/historias-edp/privatizacao-da-edp (accessed September 14, 2021).

—. *Relatório e Contas 2020.* 2020. https://www.edp.com/sites/default/files/2021-03/210x297_RC20_EDP_PT.pdf (accessed December 4, 2021).

EDP. "Strategic Update 2021-2025." 2020.

EDPR. *OW Ocean Winds.* 2020. https://www.edpr.com/en/news/2020/07/21/ocean-winds-born-new-company-specialized-offshore-wind-power-called-become-a-global (accessed November 12, 2021).

EIB, European Investment Bank. *WindFloat Innovfin FDP.* 2015. https://www.eib.org/en/projects/pipelines/all/20150240 (accessed October 27, 2021).

EIT, Knowledge and Innovation Community. *Future renewable energy: offshore wind.* 2014. https://eit.europa.eu/sites/default/files/KIC_IE_OffshoreWind_anticipated_innovations_impact.pdf (accessed December 3, 2021).

Energy, DOE Office of Indian. *Levelized Cost of Energy (LCOE).* 2013. https://www.energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf (accessed November 19, 2021).

Energy, Energy Efficiency and Renewable. *No Time To Waste: A Circular Economy Strategy for Wind Energy.* 2021. https://www.energy.gov/eere/wind/articles/no-time-waste-circular-economy-strategy-wind-energy (accessed November 29, 2021).

Energy, NS. *Why offshore wind partnerships are proving so attractive to oil and gas companies.* 2021. https://www.nsenergybusiness.com/features/oil-companies-offshore-wind/ (accessed November 30, 2021).

Energy, Top Sector. *Holland: Our Portal to Offshore Wind Power.* 2021. https://www.topsectorenergie.nl/sites/default/files/uploads/Holland_your_portal_to_offshore_wind_power.pdf (accessed November 2, 2021).

Engie. *ENGIE and EDP, a long-term partnership.* 2020. https://www.engie.com/en/engie-edp-long-term-partnership (accessed November 28, 2021).

—. *Engie Key Figures.* 2020. https://www.engie.com/sites/default/files/assets/documents/2021-09/ENGIE-ChiffresCle2021-EN-WEB_0.pdf (accessed December 8, 2021).

—. *ENGIE x floating offshore wind turbines in Portugal.* 2021. https://www.engie.com/en/business-case/engie-x-floating-offshore-wind-turbines-portugal (accessed November 26, 2021).

—. *ENGIE, EDP Renewables, Caisse des Dépôts et Eiffage s'unissent pour répondre à l'appel à projets «fermes pilotes éoliennes flottantes» de l'ADEME.* 2016. https://www.engie.com/journalistes/communiques-de-presse/eolien-flottant-ademe (accessed October 17, 2021).

—. *Environmental Policy.* 2020. https://www.engie.com/sites/default/files/assets/documents/2020-07/2020%20-%20ENGIE%20-%20Environmental%20policy%20%2B%20annex%20vdef_0.pdf (accessed December 6, 2021).

—. *Mission - Let's decarbonate regions.* 2021. https://www.engie.com/en (accessed December 17, 2021).

—. "Registration Document p.182." 2016. https://www.engie.com/sites/default/files/assets/documents/2021-03/registration-document-2016.pdf (accessed December 4, 2021).

Engineers, The Institutional of Structural. *Offshore engineering: what are the challenges?* 2017. https://www.istructe.org/resources/blog/offshore-engineering-what-are-the-challenges/ (accessed December 5, 2021).

Equinor. *Hywind Tampen: the world's first renewable power for offshore oil and gas.* 2021. https://www.equinor.com/en/what-we-do/hywind-tampen.html (accessed December 10, 2021).

—. *The future of offshore wind is afloat.* 2021. https://www.equinor.com/en/what-we-do/floating-wind.html (accessed November 28, 2021).

ESMAP, Energy Sector Management Assistance Program. *Offshore Wind Technical Potential | Analysis and Maps.* 2021. https://esmap.org/esmap_offshorewind_techpotential_analysis_maps (accessed December 3, 2021).

Explorer, The. *Green, hydrogen-powered offshore construction support vessel.* 2021. https://www.theexplorer.no/solutions/green-hydrogen-powered-offshore-construction-support-vessel/ (accessed November 13, 2021).

Expresso. *Primeiro projeto eólico offshore em Portugal conclui fase de testes.* 2016. https://expresso.pt/economia/economina_energia/2016-06-02-Primeiro-projeto-eolico-offshore-em-Portugal-conclui-fase-de-testes (accessed November 19, 2021).

Farm, Moray East Offshore Wind. *Moray East - Offshore Wind Farm Project.* 2020. https://www.morayeast.com/project (accessed November 14, 2021).

Finance, Yahoo! "StockBeat: Engie, EDP Play Catch-Up in Energy's Big Growth Sector." 2019. https://finance.yahoo.com/news/stockbeat-engie-edp-play-catch-050300223.html?guccounter=1 (accessed November 23, 2021).

Forbes. *The Winds Of Change Are Blowing Further Offshore – With Floating Turbines.* 2020. https://www.forbes.com/sites/mitsubishiheavyindustries/2020/12/08/the-winds-of-change-are-blowing-further-offshore--with-floating-turbines/?sh=5572c65ed163 (accessed November 21, 2021).

Forum, World Economic. *Scaling Up Energy Access through Cross-Sector Partnerships.* 2013. https://www.pwc.com/gx/en/sustainability/publications/assets/pwc-wef-scaling-up-energy-access-through-cross-sector_partnerships.pdf (accessed November 13, 2021).

Française, République. *Provence Grand Large.* 2021. https://librairie.ademe.fr/recherche-et-innovation/286-provence-grand-large.html (accessed November 23, 2021).

Gate, Research. *Michael Porter's Value-Chain Model of a Firm.* 2021. https://www.researchgate.net/figure/Michael-Porters-Value-Chain-Model-of-a-Firm_fig1_265348580 (accessed November 21, 2021).

Governance, Geneva Center for Security Sector. *Regulatory Frameworks.* 2021. https://securitysectorintegrity.com/standards-and-regulations/procurement-monitoring-evaluation/ (accessed November 3, 2021).

Government, Local. *Benefits and potential impacts of wind energy.* 2021. https://www.local.gov.uk/benefits-and-potential-impacts-wind-energy (accessed November 30, 2021).

Guard, Weather. *Wind Turbine Cost: How Much? Are They Worth It In 2021?* 2021. https://weatherguardwind.com/how-much-does-wind-turbine-cost-worth-it/ (accessed November 30, 2021).

Iberdrola. *Do you know how offshore wind farms work?* 2021. https://www.iberdrola.com/environment/how-does-offshore-wind-energy-work (accessed November 15, 2021).

—. *Do you know how offshore wind farms work?* 2021. https://www.iberdrola.com/sustainability/how-does-offshore-wind-energy-work (accessed December 6, 2021).

IEA. *Actual and forecast onshore wind costs, 2016-2025.* 2021. https://www.iea.org/data-and-statistics/charts/actual-and-forecast-onshore-wind-costs-2016-2025 (accessed November 20, 2021).

—. *Change in electricity generation in 2020 and 2021.* 2021. https://www.iea.org/data-and-statistics/charts/change-in-electricity-generation-in-2020-and-2021 (accessed October 29, 2021).

—. *Global electricity demand is growing faster than renewables, driving strong increase in generation from fossil fuels.* 2021. https://www.iea.org/news/global-electricity-demand-is-growing-faster-than-renewables-driving-strong-increase-in-generation-from-fossil-fuels (accessed October 19, 2021).

—. *Global electricity demand is growing faster than renewables, driving strong increase in generation from fossil fuels.* 2021. https://www.iea.org/news/global-electricity-demand-is-growing-faster-than-renewables-driving-strong-increase-in-generation-from-fossil-fuels (accessed December 1, 2021).

—. *Netherlands Offshore Wind Energy Act (Wet Wind op Zee).* 2016. https://www.iea.org/policies/6121-netherlands-offshore-wind-energy-act-wet-wind-op-zee (accessed October 28, 2021).

Investir, LesEchos. *Neoen Marine rejoint le consortium GDF Suez-EDP pour un projet dans l'éolien.* 2013. https://investir.lesechos.fr/actions/actualites/neoen-marine-rejoint-le-consortium-gdf-suez-edp-pour-un-projet-dans-l-eolien-914507.php (accessed October 23, 2021).

Investopedia. *Contract for Differences (CFD).* 2021. https://www.investopedia.com/terms/c/contractfordifferences.asp#:~:text=A%20contract%20for%20differences%20(CFD)%20is%20a%20financial%20contract%20that,in%20FX%20and%20commodities%20products (accessed November 2, 2021).

—. *Project Finance.* 2021. https://www.investopedia.com/terms/p/projectfinance.asp (accessed October 18, 2021).

—. *What Is the Utilities Sector?* 2021. https://www.investopedia.com/terms/u/utilities_sector.asp#:~:text=The%20utilities%20sector%20refers%20to,%2C%20dams%2C%20and%20natural%20gas.&text=Investors%20typically%20treat%20utilities%20as,steady%20income%20for%20their%20portfolios. (accessed October 3, 2021).

IRENA. *Future of Wind - Deployment, investment, technology, grid integration and socio-economic aspects.* 2019. https://www.irena.org/-/media/files/irena/agency/publication/2019/oct/irena_future_of_wind_2019.pdf (accessed December 7, 2021).

Irena. *Renewable Power Generation Costs in 2019.* 2020. https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019 (accessed December 10, 2021).

IRENA. *Wind Power.* 2020. https://www.irena.org/costs/Power-Generation-Costs/Wind-Power (accessed November 20, 2021).

Large, Provence Grand. 2021. https://www.provencegrandlarge.fr/ (accessed October 2, 2021).

Link, Springer. *Improving the coexistence of offshore wind farms and shipping: an international comparison of navigational risk assessment processes.* 2018. https://link.springer.com/article/10.1007/s13437-018-0149-0 (accessed November 11, 2021).

Markets, Markets and. *Offshore Wind Market.* 2021. https://www.marketsandmarkets.com/Market-Reports/offshore-wind-market-253452593.html (accessed November 29, 2021).

Marsh. *Environmental Risk.* 2021. https://www.marsh.com/uk/services/environmental-risk.html (accessed November 12, 2021).

McKinsey. *Improving the management of complex business partnerships.* 2019. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/improving-the-management-of-complex-business-partnerships (accessed November 18, 2021).

—. *The value of value creation.* 2020. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-value-of-value-creation (accessed December 14, 2021).

—. *Winds of change? Why offshore wind might be the next big thing.* 2017. https://www.mckinsey.com/business-functions/sustainability/our-insights/winds-of-change-why-offshore-wind-might-be-the-next-big-thing (accessed November 3, 2021).

MDPI. *Viability of Creating an Offshore Wind Energy Cluster: A Case Study.* 2020. https://www.mdpi.com/2076-3417/11/1/308/htm.

—. *Viability of Creating an Offshore Wind Energy Cluster: A Case Study.* 2020. https://www.mdpi.com/2076-3417/11/1/308/htm (accessed November 2, 2021).

Monthly, Wind Power. *EU backs project to make case for hybrid offshore wind.* 2021. https://www.windpowermonthly.com/article/1726254/eu-backs-project-case-hybrid-offshore-wind (accessed November 21, 2021).

News, BBC. *Inch Cape wind farm future 'secured' by £1m investment.* 2012. https://www.bbc.co.uk/news/mobile/uk-scotland-tayside-central-13667830 (accessed October 7, 2021).

—. *SeaEnergy sells offshore wind unit to Repsol for £40m.* 2011. https://www.bbc.com/news/uk-scotland-scotland-business-13667838 (accessed November 12, 2021).

Now, Renewables. *Crown Estate may step in for RWE in Inch Cape project – report.* 2010. https://renewablesnow.com/news/crown-estate-may-step-in-for-rwe-in-inch-cape-project-report-70071/ (accessed December 12, 2021).

Observatory, Economics. *How has Brexit affected the value of sterling?* 2021. https://www.economicsobservatory.com/how-has-brexit-affected-the-value-of-sterling (accessed November 4, 2021).

OECD. *Exclusive Economic Zone (EEZ).* 2001. https://stats.oecd.org/glossary/detail.asp?ID=884#:~:text=An%20Exclusive%20Economic%20Zone%20(EEZ,band%20extending%20200%20miles%20from (accessed November 5, 2021).

—. *Privatisation of Public Utilities: the OECD Experience .* 1999. https://www.oecd.org/daf/ca/corporategovernanceofstate-ownedenterprises/1929700.pdf (accessed December 2, 2021).

Organization, International Maritime. *Cutting GHG emissions from shipping - 10 years of mandatory rules.* 2021. https://www.imo.org/en/MediaCentre/PressBriefings/pages/DecadeOfGHGAction.aspx (accessed November 27, 2021).

Orsted. *Regulatory set-up for hybrid offshore wind projects.* 2021. https://orsted.com/en/about-us/whitepapers/regulatory-set-up-for-hybrid-offshore-wind-projects (accessed October 18, 2021).

—. *Regulatory set-up for hybrid offshore wind projects.* 2020. https://orstedcdn.azureedge.net/-/media/www/docs/corp/com/about-us/whitepaper/orsted-note-on-eu-framework-for-offshore-grids.ashx?la=en&rev=8ba187dc7ab3432f8dede75e7695141e&hash=A3056A194DC5FB25AF4030BB06842C2F (accessed October 13, 2021).

Power, Horizon Wind. *Horizon Wind Power.* 2021. http://horizonwindpower.com/ (accessed November 23, 2021).

Power, Principle. *EDP Renewables, Mitsubishi Corp., Chiyoda Corp., Engie and Repsol create a consortium to implement a floating offshore wind farm in Portugal using Principle Power's WindFloat Technology.* 2015. https://www.principlepowerinc.com/en/news-press/press-archive/2015/11/16/edp-renewables-mitsubishi-corp-chiyoda-corp-engie-and-repsol-create-a-consortium-to-implement-a-floating-offshore-wind-farm-in-portugal-using-principle-powers-windfloat-technology (accessed November 15, 2021).

—. *Korea Floating Wind.* 2019. https://www.principlepower.com/projects/korea-floating-wind (accessed December 7, 2021).

—. *Ocean Winds and Principle Power announce collaboration for France's first commercial-scale floating offshore wind tender.* 2021. https://www.principlepower.com/news/ocean-winds-and-principle-power-announce-collaboration-for-frances-first-commercial-scale-floating-offshore-wind-tender (accessed December 23, 2021).

—. *Performance.* 2021. https://www.principlepower.com/windfloat/advantage/performance (accessed October 23, 2021).

Proactive. *SeaEnergy may increase stake in Inch Cape offshore windfarm after RWE npower pulls out.* 2021. https://www.proactiveinvestors.co.uk/companies/news/13759/seaenergy-may-increase-stake-in-inch-cape-offshore-windfarm-after-rwe-npower-pulls-out-16778.html (accessed October 12, 2021).

Program, Energy Sector Management Assistance. *Offshore Wind Technical Potential | Analysis and Maps.* 2021. https://esmap.org/esmap_offshorewind_techpotential_analysis_maps.

Program, United Nations Development. *Sustainable Development Goals.* 2021. https://www1.undp.org/content/oslo-governance-centre/en/home/sustainable-development-goals/background.html.

Publico. *EDP Renováveis faz parceria com a Repsol.* 2011. https://www.publico.pt/2011/06/07/jornal/edp-renovaveis-faz-parceria-com-a-repsol-22227003 (accessed November 30, 2021).

Renewables, EDF. *EDF Energies Nouvelles awardee of the call for projects "pilot floating wind farms'' of the ADEME.* 2016. https://www.edf-renouvelables.com/en/edf-energies-nouvelles-awardee-of-the-call-for-projects-pilot-floating-wind-farms-of-the-ademe/ (accessed December 1, 2021).

Renewables, EDP. *Annual Report 2020 - Message from the CEO.* 2020. https://www.edpr.com/es/node/21136 (accessed November 17, 2021).

—. *EDP and ENGIE join forces to create a leading global offshore wind player.* 2019. https://www.edpr.com/en/news/2019/05/21/edp-and-engie-join-forces-create-a-leading-global-offshore-wind-player (accessed November 12, 2021).

—. *EDP Renewables, Mitsubishi Corp., Chiyoda Corp., Engie and Repsol.* 2015. https://www.edpr.com/en/news/2015/11/16/edp-renewables-mitsubishi-corp-chiyoda-corp-engie-and-repsol-crea (accessed October 17, 2021).

—. *EDPR announces the sale of a 23% stake in UK wind offshore project.* 2017. https://www.edpr.com/en/news/2017/07/07/edpr-announces-sale-a-23-stake-uk-wind-offshore-project (accessed October 29, 2021).

—. *EDPR reached an agreement with ENGIE to create a 50:50 joint-venture for offshore wind.* 2020. https://www.edpr.com/en/news/2020/01/23/edpr-reached-agreement-engie-create-a-5050-joint-venture-offshore-wind-0 (accessed October 23, 2021).

—. *EDPR, DGE and ENGIE announce the signing of financing agreements for Moray East.* 2018. https://www.edpr.com/en/news/2018/11/29/edpr-dge-and-engie-announce-signing-financing-agreements-moray-east (accessed October 21, 2021).

—. *Ocean Winds, the 50/50 JV owned by EDPR and ENGIE, starts energy generation at Moray East.* 2021. https://www.edpr.com/en/news/2021/06/07/ocean-winds-5050-jv-owned-edpr-and-engie-starts-energy-generation-moray-east (accessed October 29, 2021).

—. *Offshore.* 2020. https://www.edpr.com/pt-pt/offshore#descricao (accessed October 12, 2021).

—. *Offshore wind power: GDF SUEZ, EDP Renewables, Neoen Marine and AREVA.* 2013. https://www.edpr.com/en/news/2013/12/03/offshore-wind-power-gdf-suez-edp-renewables-neoen-marine-and-areva (accessed October 25, 2021).

—. *Our company - Company Structure.* 2020. (accessed November 12, 2021).

Renewables, Moray Offshore. *EDP Renováveis and ENGIE consortium is awarded.* 2017. https://www.engie.com/sites/default/files/assets/documents/2019-09/moray-cfd-press-release-110917_engie_g_uk.pdf (accessed November 3, 2021).

Reve. *ENGIE, EDP Renewables, Caisse Des Dépôts and Eiffage Join to Respond to ADEME's Request for Proposals for A 'Pilot Floating Wind Farm'.* 2016. https://www.evwind.es/2016/04/04/engie-edp-renewables-caisse-des-depots-and-eiffage-join-to-respond-to-ademes-request-for-proposals-for-a-pilot-floating-wind-farm/55799 (accessed November 18, 2021).

Sapo. *Windfloat Atlantic 100% operacional no mar português. EDP tem projeto para hidrogénio a partir de eólico offshore.* 2020. https://eco.sapo.pt/2020/07/27/windfloat-atlantic-100-operacional-no-mar-portugues-proxima-fase-e-o-hidrogenio-a-partir-de-eolico-offshore/ (accessed December 7, 2021).

—. *Windfloat, o parque eólico que sobreviveu à fúria da tempestade Dora no mar português.* 2021. https://eco.sapo.pt/2021/08/25/windfloat-o-parque-eolico-que-sobreviveu-a-furia-da-tempestade-dora-no-mar-portugues/ (accessed November 11, 2021).

Se4All, Sustainable energy for All. *SDG7 takeaways from COP26.* 2021. https://www.seforall.org/ (accessed December 6, 2021).

Statista. *Electricity demand worldwide from 2000 to 2040 (in terawatt hours).* 2021. https://www-statista-com.eu1.proxy.openathens.net/statistics/1118777/electricity-demand-worldwide/ (accessed November 13, 2021).

—. *Global offshore wind energy capacity from 2009 to 2020.* 2021. https://www-statista-com.eu1.proxy.openathens.net/statistics/476327/global-capacity-of-offshore-wind-energy/ (accessed October 21, 2021).

—. *Global onshore wind energy capacity from 2009 to 2020.* 2021. https://www.statista.com/statistics/476306/global-capacity-of-onshore-wind-energy/ (accessed December 5, 2021).

—. *Net consumption of electricity worldwide in select years from 1980 to 2018 (in billion kilowatt hours).* 2021. https://www-statista-com.eu1.proxy.openathens.net/statistics/280704/world-power-consumption/ (accessed October 19, 2021).

—. *Weighted average levelized cost of electricity for offshore wind worldwide from 2010 to 2018 (in U.S. dollars per kilowatt hour).* 2021. https://www-statista-com.eu1.proxy.openathens.net/statistics/1027721/weighted-average-lcoe-of-offshore-wind-worldwide/ (accessed November 20, 2021).

Tingley, Jeff. *How Does an Offshore Wind Supply Chain Work? (Learning from the Experts)* (2021).

WindEurope. *Hybrid offshore wind farms are already being built – the Offshore Energy Strategy should reflect this.* 2020. https://windeurope.org/newsroom/news/hybrid-offshore-wind-farms-are-already-being-built/ (accessed November 13, 2021).

—. *Offshore Wind - Key trends and statistics 2017.* 2018. https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Offshore-Statistics-2017.pdf (accessed December 8, 2021).

—. *Offshore wind: Ocean of Opportunity.* 2020. https://windeurope.org/policy/topics/offshore-wind-energy/ (accessed November 12, 2021).

—. *Our energy, our future - How Offshore will help Europe go carbon-neutral.* 2019. https://windeurope.org/wp-content/uploads/files/about-wind/reports/WindEurope-Our-Energy-Our-Future.pdf (accessed November 30, 2021).

—. *The EU's big goals for offshore wind are achievable – with the right grid investments and spatial planning.* 2019. https://windeurope.org/offshore2019/news/the-eus-big-goals-for-offshore-wind-are-achievable-with-the-right-grid-investments-and-spatial-planning/ (accessed November 30, 2021).

—. "Unleashing Europe's offshore wind potential - A new resource assessment." 2017. https://windeurope.org/wp-content/uploads/files/about-wind/reports/Unleashing-Europes-offshore-wind-potential.pdf (accessed December 4, 2021).

—. *Wind industry calls for Europe-wide ban on landfilling turbine blades.* 2021. https://windeurope.org/newsroom/press-releases/wind-industry-calls-for-europe-wide-ban-on-landfilling-turbine-blades/ (accessed December 5, 2021).

Winds, Ocean. *Generating the future of.* 2021. https://www.oceanwinds.com/ (accessed October 22, 2021).

—. *Ocean Winds is born, the new company specialized in offshore wind power called to become a global leader.* 2020. https://www.edpr.com/en/news/2020/07/21/ocean-winds-born-new-company-specialized-offshore-wind-power-called-become-a-global (accessed November 29, 2021).

YouTube. "The Astonishing Potential of Offshore Wind | Elizabeth Turnbull Henry | TEDxKenmoreSquare." 2019.

References

- History of Ocean Winds, 2021.

  https://www.oceanwinds.com/our-history/

- '*Strategic Update 2021-2025*', EDP Renewables.

  https://www.edpr.com/sites/edpr/files/2021-04/CMD_EDPR.PDF

Recommended Readings

- Jermyn C., 2021, '*The Winds of Change: Investing in Floating Offshore Wind Development*'. In the *NYU Environmental Law Journal*, originally edited from by the "*Environmental Law Review Syndicate*".

  https://www.nyuelj.org/2021/03/the-winds-of-change-investing-in-floating-offshore-wind-development/.

- Airoldi M., Chua J., Gerbert P., Rilo R., and Justus J., February 26th, 2013 '*The Private Sector's Strategy for Managing the Risks of Public-Private Partnerships*', Boston Consulting Group.

  https://www.bcg.com/publications/2013/urban-infrastructure-public-sector-strategy-managing-risks-public-private-partnerships

- August 2013, '*Scaling Up Energy Access through Cross-sector Partnerships*', World Economic Forum in collaboration with PriceWaterHouseCoopers (PwC)

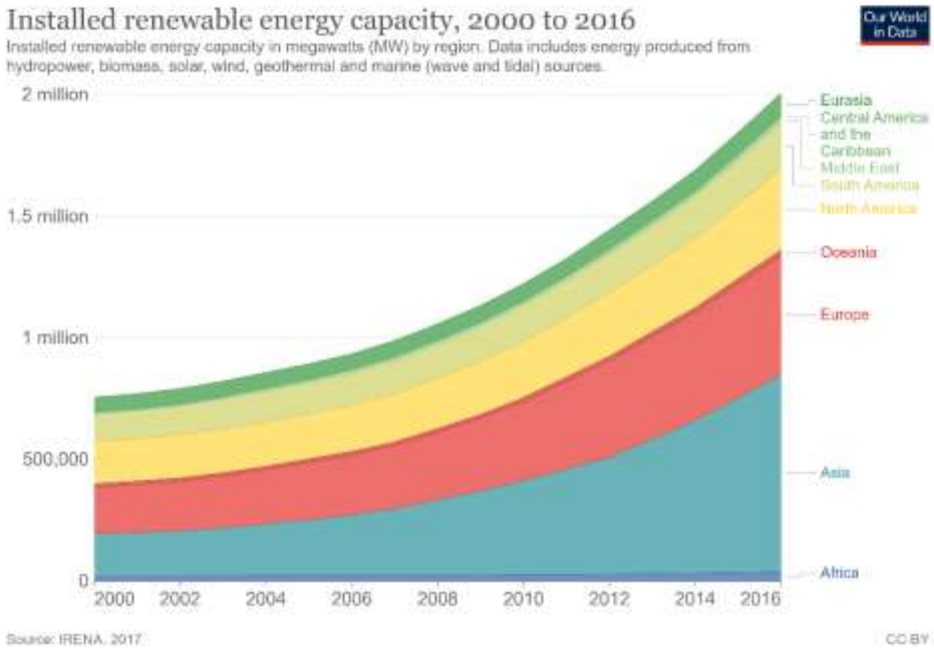
  https://www.pwc.com/gx/en/sustainability/publications/assets/pwc-wef-scaling-up-energy-access-through-cross-sector_partnerships.pdf

- '*Transforming our world: the 2030 Agenda for Sustainable Development*', 2021.

  https://sdgs.un.org/2030agenda

Appendix

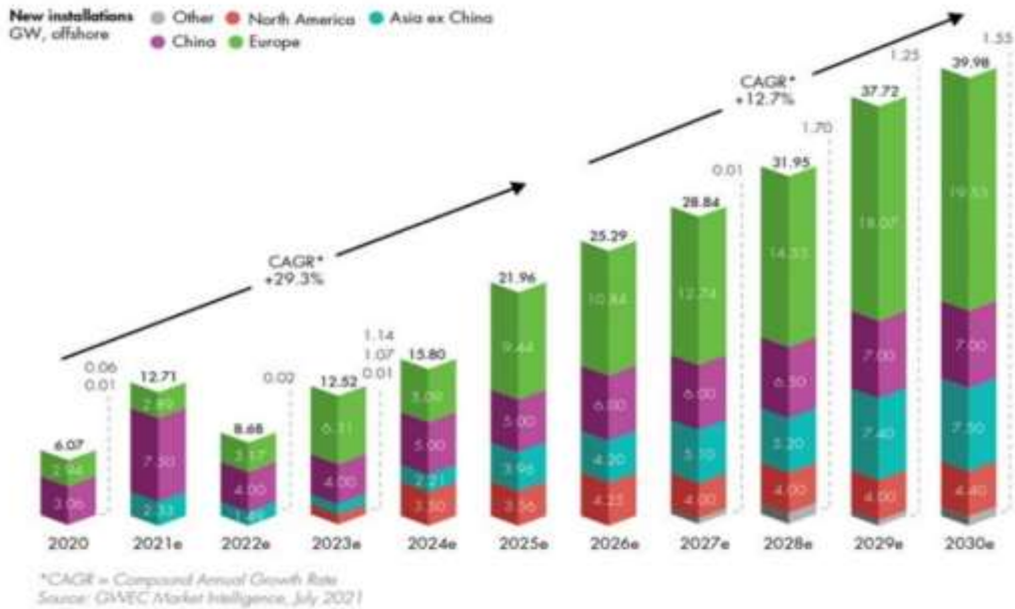
- **Appendix 1**



Source: Our World in Data

https://ourworldindata.org/grapher/installed-renewable-energy-capacity

- **Appendix 2**



This chart indicates offshore wind installations 2020-2030 globally. Photo Credit, all images: GWEC Market Intelligence, July 2021

Source: Composites World

[*https://www.compositesworld.com/news/global-offshore-wind-report-2021-forecasts-235-gw-installed-over-next-decade*](https://www.compositesworld.com/news/global-offshore-wind-report-2021-forecasts-235-gw-installed-over-next-decade)