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Offshore Wind Farm Between Mykonos and Ikaria

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Το έργο που εκπονήθηκε και παρουσιάζεται στην υποβαλλόμενη διπλωματική εργασία είναι αποκλειστικά ατομικό δικό μου. Όποιες πληροφορίες και υλικό που περιέχονται έχουν αντληθεί από άλλες πηγές, έχουν καταλλήλως αναφερθεί στην παρούσα διπλωματική εργασία. Επιπλέον τελώ εν γνώσει ότι σε περίπτωση διαπίστωσης ότι δεν συντρέχουν όσα βεβαιώνονται από μέρους μου, μου αφαιρείται ανά πάσα στιγμή αμέσως ο τίτλος.

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Summary

With a focus on the region between Mykonos and Ikaria and its potential for wind farm projects, the thesis investigates several facets of offshore wind energy development. It focuses at the geopolitical potential and problems that come from utilizing energy resources across international borders, especially between Greece and Turkey. While disputes exist around marine borders, potential remedies are put up, including collaborative ventures. The thesis emphasizes effective instances of international agreements that defined marine borders and made resource sharing easier, such the one between Israel and Lebanon. It also examines at the Timor Sea Treaty, which managed resources well in spite of early conflicts. In the case of offshore wind farms, the study emphasizes the significance of international legislation, collaboration, and equitable growth. Furthermore, it tackles technical and environmental concerns, such as choosing the right location, making the project financially feasible, and incorporating offshore wind energy into national energy plans.

Acknowledgements

With the completion of my thesis, I would like to thank the people who have supported me and been by my side during the preparation of this thesis. Firstly, I would like to thank my supervisor, Mr. Petros Liacouras for his valuable guidance, his advice and the knowledge he provided me with during the implementation of this thesis. I owe the biggest thanks to my parents and friends for the moral and psychological support, for their great patience as well as for their unconditional support that they have shown throughout this journey.

Contents

Chapter 1: Introduction

The demand for energy consumption is rising as Earth's population increases. Natural energy resources such coal, oil, and gas have a limited amount and become exhausted as the world's population and economy expand. This limitation, combined with rising energy consumption standards and environmental concerns, lead to research into renewable energy sources as potential future energy sources.

Renewable energy is energy from natural sources that is replenished at a higher rate than consumed. Renewable energy sources or "green energy" are defined as energy sources that are abundant in the environment and whose use does not pollute it, compared to fossil fuels (lignite, oil). Renewable energy sources are abundant and are all around us. The main forms of renewable energy are solar, wind, geothermal, biomass, hydropower, ocean and bioenergy. Renewable energy sources are abundant and are all around us. (Nations, 2016).

Figure 1.1: Different sources of renewable energy.

Source: www.power-and-beyond.com

There are numerous benefits to using renewable energy sources. The following are the most crucial of these:

Environmental benefits: Reduced Greenhouse Gas Emissions: RES operating with little to no emissions of greenhouse gases, which helps to lower overall carbon emissions. This diminishes the effects of climate change. (IPCC, 2011)

Sustainability and Resource Availability: RES, including solar, wind, and hydroelectric electricity, rely on naturally regenerated resources, providing long-term sustainability. (U.S. Department of Energy, 2023)

Energy independence and security: Incorporating RES improves energy security and lessens resilience to supply impacts by decreasing reliance on limited fossil fuel supplies. (Council, 2016)

Economic expansion and job creation: The RES industry supports local economic development and employment creation by generating positions in manufacture, installation, maintenance, research, and related disciplines. (IRENA, Renewable Energy and Jobs Annual Review, 2021)

Innovation in Technology: RES investments encourage innovation in energy storage, grid integration, and efficiency enhancements, which in turn promotes technology development. (U.S. Department of Energy, 2023)

Benefits for Public Health and Reduced Air Pollution: RES generation generates far fewer air pollutants than fossil fuels, improving both public health and air quality. (EEA, Air Quality in Europe, 2021)

Reduction of Energy Price Volatility: The deployment of RES diminishes exposure to price shifts in the markets for fossil fuels, leading to more stable energy costs over time. (IRENA, Renewable Power Generation Costs, 2020)

Rural Development and Community Benefits: RES projects frequently result in job creation, better payments on land leases, and improved economic activity for rural areas. (NREL, Jobs and Economic Development Impact (JEDI) Models., 2013)

1.1 The Turn of Europe to Green Energy

There are numerous significant reasons why Europe has decided to adopt initiatives that will promote the growth of green energy. First off, 80% of the greenhouse gas emissions in the European Union come from energy derived from conventional sources (coal, lignite, etc.). In comparison to 2011, the EU's imports and consumption of coal (hard coal and lignite) grew by about 9% in 2012. 2012 saw a 28% rise in coal use in Spain and England. The increase was 16% in France and 3% in Germany. The biggest increases were seen in Portugal, where coal consumption reached 38%, and Ireland, where it doubled within the same time period (EWEA, 2009).

Additionally, where fossil fuels have a high carbon content, importing them is getting more and more expensive. This is a result of tariffs, levies, and taxes imposed by the

Member States of EU as well as pressure from the expanding global demand for resources and the costs connected with the aging infrastructure, which is become more expensive to maintain. Furthermore, there is a significant energy reliance across countries. Over the previous two decades, Europe's reliance on imports has grown and is anticipated to reach 80% by 2035 in the case of oil and gas. For 80% to 100% of their gas consumption, certain Member States depend only on one supplier and frequently just on one supply route. This implies that they are subject to any pricing effects brought on by their sole supplier, who quite likely does not always set its rates in accordance with market logic (EWEA, 2009).

The growth of renewable energy has been significantly aided by European governments. The supply of subsidies serves as the strongest indication of their participation. Investors, however, are uncertain when these support systems undergo abrupt adjustments (EWEA, 2009).

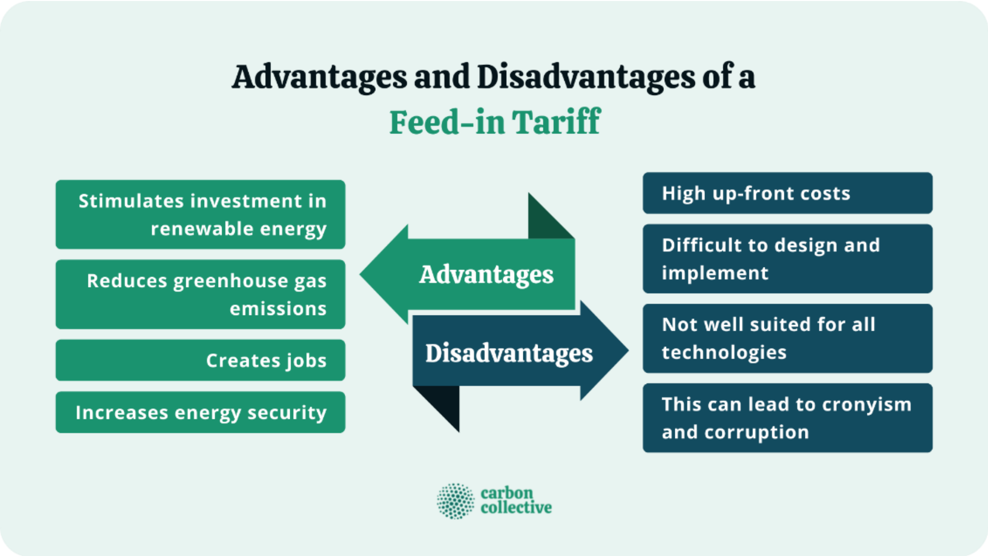

Figure 1.2: Advantages and Disadvantages of a Feed-in Tariff

Source: www.carboncollective.co

The "Feed-In-Tariff" is another policy that Europe has introduced to boost investment in renewable energy technologies. This strategy for promoting renewable energy is based on long-term agreements with providers of renewable energy, whereby states purchase energy at a defined price determined by production costs. The return on investment can be ensured in this way. In the United States of America, this approach was first put into practice in 1978. Germany was the first country in Europe to apply it, and Spain and Denmark followed suit in the following decade (EWEA, 2009).

1.2 Historical Review of Wind Energy

At least three thousand years have passed since wind was first used for human benefit. The first windmills were constructed in the region of today's Iraq in 3000 BC, and in Europe in 1180 BC, mainly in France. The Egyptians controlled wind power for navigation for the first time in 3500 BC (EWEA, 2009).

The first effort to create energy with a wind engine was made in the 19th century AD and produced 12 kW from wind flow. It was built by electrical engineer James Blyth. In America, wind turbines and windmills for rural areas were built in the 1920s and 1930s. Around 600,000 windmills were installed during this time, indicating how popular they were there (EWEA, 2009).

Simultaneously, a vertical axis wind turbine with a very straightforward design was created in Europe by Finnish architect Sigurd Johannes Savonius. The greatest horizontal axis wind turbine in power generation was created by Smith and Putman in 1941 and was capable of producing MW. In 1931, Frenchman G.J.M. Darrieus also constructed a vertical axis wind turbine (EWEA, 2009).

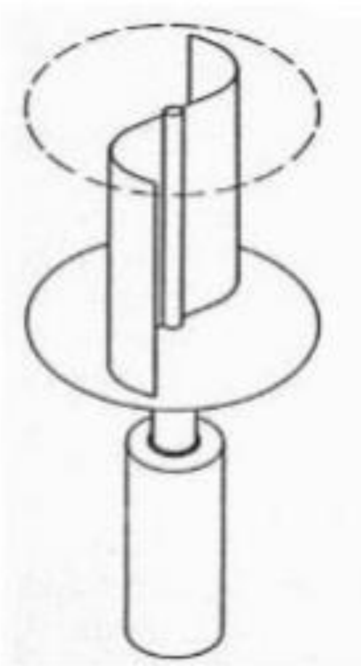

Figure 1.3: Vertical axis wind turbine Savonius type

Source: www.researchgate.net

Figure 1.4: Darrieus type wind turbine

Source: www.researchgate.net

1.3 The Wind Turbines Today

The majority of today's technology is based on horizontal wind turbines with two to three blades, with each turbine producing between 50 kW and 3.6 MW of electricity. Because wind energy does not require any specific processing to produce electricity, as was previously explained, its operation is not extremely complicated. The following parts make up a horizontal axis wind turbine (NREL, National Renewable Energy Laboratory, 2023) :

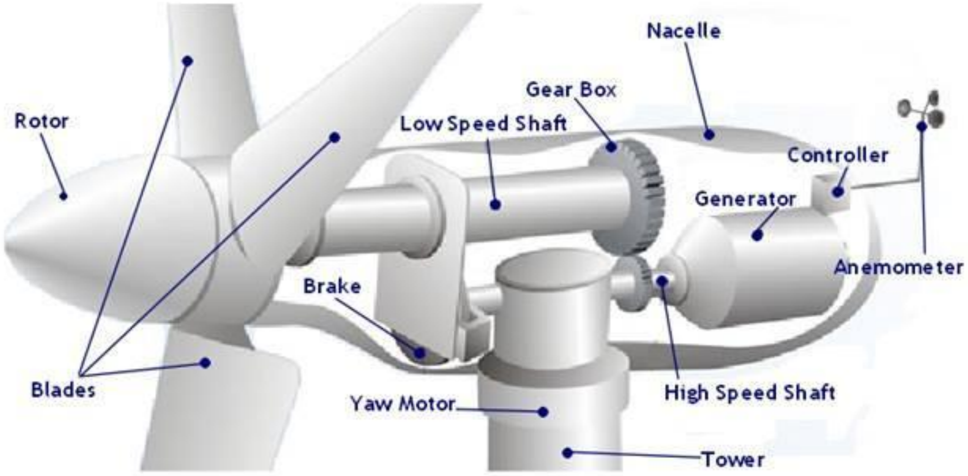

Figure 1.5: Horizontal axis wind generator

Source: eepowerschool.com

1. The rotor, characterized by two or three reinforced polyester blades. The hub to which the blades are fastened might be either fixed or able to rotate around its longitudinal axis.

2. The transmission system, made up of the main shaft, its bearings, and the speed multiplier box, which modifies the rotor's rotating speed to match the generator's synchronous speed. Throughout routine machine operation, the rotation speed is constant. In order to reduce the amount of wear and tear as well as prevent damage to the blades, there is a brake that avoids a sharp rise in blade rotation if the wind intensity gets excessively strong.

3. The electric generator, either synchronous or induction with four or six poles, which transforms mechanical energy into electrical energy and often resides on the wind turbine tower, is connected to the output of the multiplier using a rubber or hydraulic coupling. Additionally, there is a braking system that consists of a standard disc brake installed on either the main shaft or the generator shaft.

4. The rotor's axis is constantly forced to rotate in a direction parallel to the wind by the orientation system.

5. The tower, which holds up the electromechanical installation mentioned above.

6. The control panel and electronic panel, which can be observed at the tower's base. The control system supervises, plans, and directs all wind turbine activities to ensure a smooth operation.

The generator generates power at 25,000 volts while it rotates. The transformer elevates the electrical resistance of the electricity to 400,000 volts before it reaches the power plant. Copper or aluminum is used to make the wires that carry electricity in order to reduce resistance to current flow. This is important because a wire with a higher resistance will heat up more and lose some of its electrical energy as a result. In order for electrical appliances to function, the power transmission wires arrive at a substation where transformers change the high voltage to low voltage (NREL, National Renewable Energy Laboratory, 2023).

The benefits of this type of wind turbine are its high height, which allows it to benefit from higher wind speeds, ease of assembly, and high aerodynamic coefficient. There are certain benefits to vertical axis wind turbines versus horizontal axis wind turbines.

They have a simpler construction, can take advantage of wind from every direction, and as a result are less expensive and noisier. Their employment is nevertheless constrained by the fact that horizontal axis wind turbines perform significantly better and require less upkeep for specific mechanical components (NREL, National Renewable Energy Laboratory, 2023).

Figure 1.6: Horizontal axis wind generator

Source: greek.solar-mountingsystem.com

Figure 1.7: Vertical wind turbine axis

Source: www.sciencedirect.com

1.4 Wind Energy Exploitation in Europe

The world's first wind farm was constructed in Greece's Kythnos region in 1982. Five 20 kW wind turbines made up the original installation, which was later expanded with the addition of the first photovoltaic park to provide 75% of the necessary energy solely from renewable sources. The park is no longer in use now due to efficiency reduction (PAE, 2023).

For more than ten years, Europe has made investments in wind energy. The majority of wind farms are on land. But certain nations in north-western Europe, like Denmark, the Netherlands, and the UK, have also prioritized the construction of offshore wind farms (PAE, 2023).

The period between 1990 and 2015 had the biggest expand, with an average 30% increase in wind energy generation. The amount of electricity generated by wind farms increased consistently and yearly between 2000 and 2013. The region of Europe's installed wind turbines had a total capacity of 128,751 MW by 2014 (PAE, 2023).

1.5 International Offshore Wind Farms

Denmark built the world's first offshore wind farm in 1991. Eleven wind turbines on the farm, which was constructed in a depth of two to five meters of water, supplied electricity to almost 2,000 families (Ewing, Offshore Wind – A Brief History, 2019). In the subsequent three decades, there were several investments in offshore wind farms. Leading offshore wind markets include the Netherlands, Denmark, the UK, Germany, China, and other offshore wind farms that are now under development (Energy G. , 2021). By 2020, Europe's installed offshore wind energy capacity of 25GW will account for 3% of the continent's electricity consumption (Energy W. , 2021)

Figure 1.8: The first offshore wind farm in Denmak, in 1991.
Source: www.researchgate.net

Built in 2016, the US's first offshore wind farm has a 150 MW capacity and provides energy to 17,000 people. More offshore wind farms are anticipated to go online starting in 2021 as a result of the initial farm's success and the nation's potential wind capacity (Carr-Harris and Lang, 2019).

Over the past ten years, China has also been making use of its offshore wind potential (Chen, 2011). China accounted for 23% of the world's offshore wind energy capacity at the end of 2019 (Hub, 2021). China added 3GW of new offshore wind facilities in 2020; by 2030, 52GW more offshore wind power capacity is anticipated to be added (Ewing, Offshore Wind – A Brief History, 2019).

Wind farms that are now in operation mostly feature fixed-bottom wind turbines. According to Hanania et al. (Hanania J., 2015), this implies that the wind turbine is built on a platform that is attached to the seabed at a maximum depth of 50 meters. Fixed-bottom foundations are no longer economically feasible for sea depths more than 50 meters. In this instance, mooring lines are utilized to secure the floating offshore wind turbines to the seabed (Zountouridou E. K., 2015). A floating foundation would likely be needed for an offshore wind venture in Greece due to the Mediterranean Sea's depth of water.

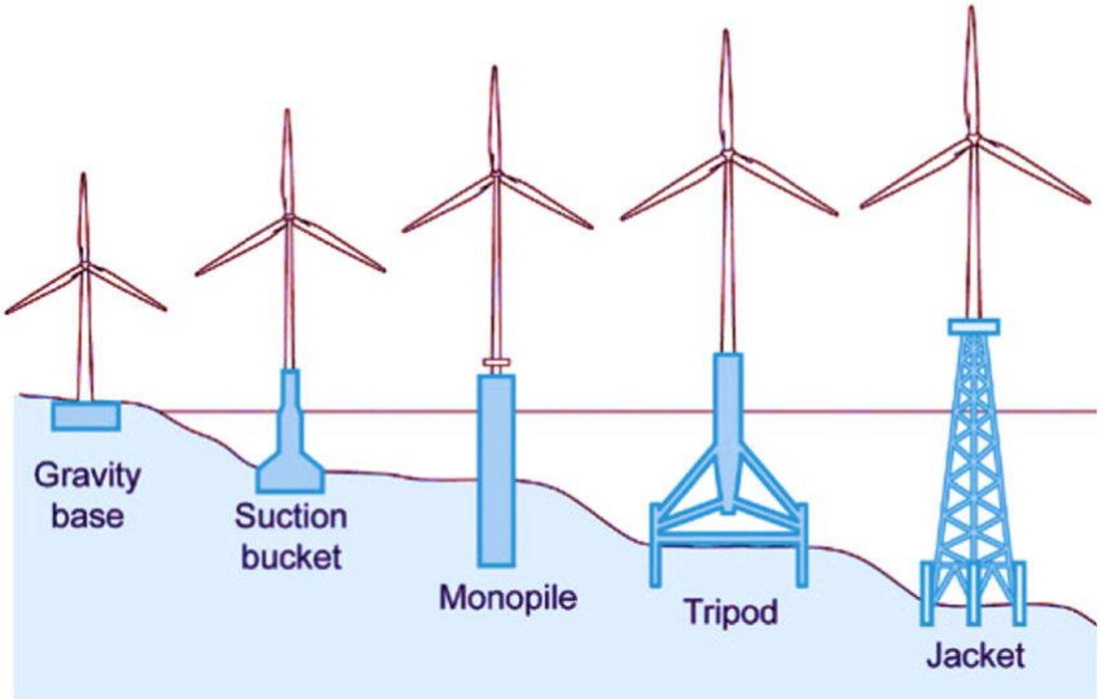

Figure 1.9: Fixed bottom wind turbine foundations

Source: www.researchgate.net

1.6 Offshore Wind Farms in the European Area

As previously stated, a few European nations have expressed a keen interest in offshore wind farms. Compared to onshore wind farms, offshore wind farms provide a variety of benefits.

The following are a few of them (IRENA, Renewable Energy and Jobs Annual Review, 2021):

1. Wind speeds in offshore areas are typically higher than those on land. A slight increase in speed can result in a significant increase in output of power.

2. A marine wind farm is a more dependable source of energy than a wind farm on land since the wind speed there is typically more consistent than on land.

3. Wind farms that are placed farther away from populated areas make less disruptive noise when they operate

Nevertheless, compared to those on land, the costs of installing the equipment are significantly greater for the development of an offshore wind farm, requiring greater funding investment.

In the European area there are at least 135 offshore wind farms, in 13 countries. The table below shows them by country:

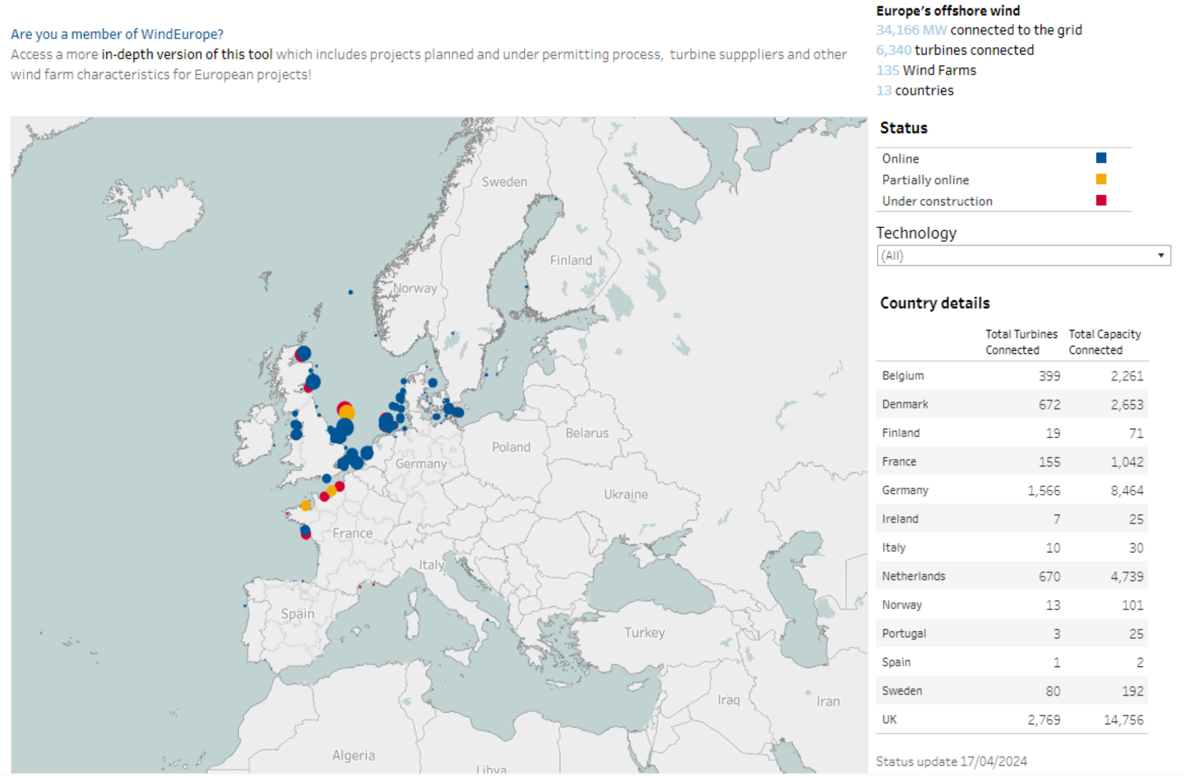

Figure 1.9: Europe's offshore wind

Source: windeurope.org

Greece has not yet had any offshore wind farms built, although in 2012, the Energy Regulatory Authority approved two permits for the construction of two offshore wind farms, one south of Alexandroupolis and the other in a sea region off Lemnos. The implementation of these, however, has not yet begun (PAE, 2023).

1.7 Study Reports

Several studies on the establishment and sustainability of offshore wind farms have been conducted in Europe and beyond. The viability of marine wind farms in the Italian province of Puglia was investigated by Pantaleo A. et al. (Pantaleo, 2002) from the University of Bari. The project's cost and energy efficiency were evaluated for four potential locations, and its profitability was assessed using the Net Present Value and Internal Rate of Return methodologies.

A feasibility analysis for a marine wind farm in the Izmir region was developed by Ozerdem et al (Oh, 2011) from the Izmir Institute of Technology. In order to appraise the project, he estimated the Net Present Value, Internal Rate of Return, and Capital Payback Period using the Retscreen software. A 500 MW offshore wind farm in a Nigerian marine area was subjected to an economic study by Effiom S. et al. from Cross River University, Nigeria (Kim, 2013). He constructed a mathematical model as his study's conclusion, using which he determined the cost of energy under various situations.

Finally, a feasibility study for Turkey's first 90 MW offshore wind farm, specifically off Bozcaada Island, was presented by Satir M. et al. (Satir, 2018) from the University of Dublin in Ireland. In order to pick the most energy-efficient location, they examined two scenarios for the island's northwest and southeast. Utilizing WindPro software, the technical study estimated the Net Present Value and capital payback period in order to assess the project from a perspective of an investor.

Chapter 2: Wind Power in Greece

This chapter examines Greece's energy production as of right now as well as its potential for producing green and renewable energy in the future. Evidence regarding the expenses and advantages of foreign offshore wind investments is examined in the second part.

2.1 Energy Production in Greece

The Independent Power Transmission Operator S.A. (IPTO) provided evidence demonstrating that in March 2021, Greece produced and imported 4,206GWh of power (IPTO, Independent Power Transmission Operator S.A., 2021). Natural gas produced 32% of this electricity, lignite produced 15%, hydropower produced 7%, and other renewable energy sources produced 33%. Greece currently uses biomass, waste, geothermal, wind, and hydroelectric power as renewable energy sources (Europe, 2020). According to the same study, between 2006 and 2017, the share of renewable energy resources in Greece's gross final energy consumption more than doubled. The reason for this increase is the sharp rise in Greece's investments in wind and solar power as well as the decline in energy use over the preceding ten years.

Although the proportion of renewable energy in Greece's energy mix has increased, its output's erratic nature still poses a challenge. These systems rely on meteorological factors, such as sunshine and wind speed, therefore improper climatic conditions may cause erratic drops in the power supply. Using alternative energy sources, such as lignite, natural gas, or hydropower, to make up for drops in energy production is necessary when there are unexpected variations in energy outputs. Nevertheless, Greece is unable to achieve the EU target of having no carbon emissions by 2050 because the energy generated by lignite is accompanied by CO_2 emissions. Furthermore, the nation's energy dependency is increased by the importation of natural gas due to its utilization (Panagiotakis, 2021).

Storing energy to ensure that it is available from renewable sources when demand outpaces supply is another way to address possible shortages. In 2020, European Parliament members proposed using green hydrogen (Deign, 2020), thermal storage, or new battery technologies to store energy from renewable sources and ensure a steady and adequate supply (Parliament, 2020).

The Greek Energy and Climate Plan for 2019 states that electricity must be converted into renewable gas, or "green hydrogen," in order to store energy from renewable sources and use it as a fuel in the energy mix (Energy M. o., 2019). A consortium of Greek enterprises presented the EU and the Greek government with the "White Dragon," an 8 billion euro plan for creating a green hydrogen project in Greece, in May 2021. The plan calls for the replacement of lignite power plants by 2028 and the electrolysis of hydrogen using renewable energy sources (Kathimerini, Kathimerini, 2021).

2.2 Renewable energy sources in Greek islands

Greece is located on the Balkan Peninsula's southern tip. There are about 6,000 islands and islets in the nation (Greece, 2020). Certain Greek islands, referred to as non-interconnected islands, lack a connection between their energy distribution network and the mainland network. The Cyclades, a collection of islands in the South Aegean, are better connected to the mainland system thanks to the efforts of the Independent Power Transmission Operator. As of right now, the islands of Tinos, Mykonos, Paros, and Syros are all connected to the mainland (IPTO, Cyclades Interconnection, 2023). Even so, 29 islands continue to have independent electrical networks. The majority of them use a mix of oil power plants and renewable energy sources to generate electricity (RAE, Regulatory Authority for Energy, 2023).

The non-interconnected islands' energy production mix includes 21% renewable energy sources, according to the Institute of Energy for South-East Europe (IENE, 2020). There are worries that this percentage won't rise if, for example, there is little money spent on setting up and maintaining energy storage and renewable energy sources. These investments, nevertheless, won't happen unless connecting to the land proves to be unfavorable from a financial point of view.

There are two notable examples of islands where the local electrical demands are being met by renewable energy sources, either now or in the future. Based on the Directorate General for Energy et al. (European Commission. Directorate General for Energy., 2020), Tilos, a Dodecanese island located in the southeast Aegean Sea, is an island that can sustain its energy needs on its own. An onshore wind turbine, a photovoltaic park, and a battery for energy storage comprise Tilos' hybrid energy system, which is based on solar, wind, and storage power (Notton, 2017). In the upcoming years, Astypalaia, another Dodecanese island, plans to become energy self-sufficient and “Smart Green. Until today, the island has established a hybrid energy system based on renewable energy sources in addition to using electric vehicles for both private and public transit (Kathimerini, Astypalaia is turning green, 2021).

2.3 Wind power in Greece

By building onshore wind farms in island locations like Crete, Euboea and the Aegean Islands, Greece is taking advantage of its wind potential (RAE, GeoPortal, 2023). As of right now, the nation's 4GW worth of onshore wind farms can supply 12% of the country’s electricity needs (Energy M. o., 2019).

Greece would need to develop 7GW of wind generating capacity by 2030 in order to satisfy its environmental commitments, according to the country's National generating and Climate Plan (Energy M. o., 2019). Also, Greece has enormous wind energy potential, particularly for offshore wind energy, and this could potentially enable islands to become self-sufficient.

The latest Greek legal framework for offshore wind energy was established by the Law on the Protection of the Environment, which was published in the Government Gazette on July 30, 2022. This law marks a significant turning point in the development and operation of offshore wind farms. Offshore wind farms are a component of the overall framework for our nation's maximum potential energy autonomy and simultaneous independence from fossil fuels, which will be precisely attained through the exploitation of Renewable Energy Sources. The legislation was released after a public consultation jointly organized by the Norwegian Wind Energy Association (NORWEA) and the Hellenic Wind Association (ELETAEN) to investigate legal and strategic planning concerns related to the establishment of offshore wind farms in Greece (ELETAEN, 2020).

It should be mentioned that community acceptability of onshore wind farms is a major source of worry. A case in point is the Cyclades, where locals oppose the construction of onshore wind farms due to worries over how the investment will affect the island's natural beauty, biodiversity, and tourism. It's not only a Greek thing. The "Not in my Backyard" campaign, according to Kaldellis et al. (Kaldellis, 2016), is a global expression of grassroots opposition to onshore wind farms because of their noise and visual disturbance. The study emphasizes that while public perceptions will undoubtedly be influenced by the location, it is still too early to say if offshore wind farms are socially acceptable.

2.4 Costs and benefits of offshore wind power

It is anticipated that offshore wind power will continue to grow in the upcoming years. In this context, a growing body of research is examining the economic feasibility of offshore wind farms and weighing their advantages and disadvantages in relation to other energy production methods, such as onshore farms and fossil fuel-based plants.

Snyder and Kaiser (Snyder, 2009) conducted a well-cited analysis that compares the economics and environmental effects of a hypothetical offshore wind farm in the US to conventional onshore power production. The energy capacity of each turbine, the distance from shore, the level of the water, and the years of construction are just a few of the technical parameters of the farm that the authors take into account when calculating investment expenses. They discover that investing in offshore wind energy has the potential to be more costly than in onshore wind. It has been demonstrated that an offshore wind farm can have both positive and negative ecological effects, such as lowering greenhouse gas emissions and harming fish, animals, and birds. On the other hand, some contend that modern technologies and careful site selection of the farm can lessen the adverse effects on the environment.

The potential for offshore wind in Asia is examined in more recent studies. The costs and advantages of an offshore wind farm in a Southeast Asian region with unfavorable weather are the main topic of Nian et al.'s study (Nian, 2019). The authors compute the carbon footprint of farms in various Southeast Asian locales as well as the lifespan costs of offshore wind generation. They contend that advances in offshore wind power technology can maximize the financial benefits of this type of investment by lowering investment costs and raising the offshore wind power load factor.

A Cost Benefit Analysis (CBA) of the Hywind Tampen, an offshore wind farm in Norway scheduled to begin operations in 2022 and supply power to two gas and oil drilling platforms, is carried out by Multiconsult (Multiconsult, 2019). The CBA model accounts for both the financial resources needed for the investment and the expenses related to running and maintaining the farm. It also includes the farm's decommissioning costs. It calculates the costs of natural gas (assuming that the gas needed to run the platforms can be sold in the market) and the benefits of lower CO_2 and NO_x emissions. After weighing the costs and advantages, the authors come to the conclusion that the investment's total net present value, or total benefits less total costs, might be anywhere from negative values (€220 million) to positive values (€96 million). The project's duration, the discount rate, and the trend of the carbon price all affect its overall value. The authors also explore the cascading impacts of investing in offshore wind power and the knowledge and innovation externalities that such an undertaking can generate. Depending on Norway's participation of the supplier market, they might include a €905 million to €1 billion GDP contribution and the creation of 8,000 to 15,000 full-time equivalent (FTE) employment.

A research by Universidad de las Palmas de Gran Canaria (Canaria, 2018) , supported by Equinor, investigates the financial implications of an offshore wind farm with a capacity of 200 MW in the Canary Islands. The authors contend that the farm can primarily be built in Spain, creating up to 4,000 FTE jobs, based on an input-output paradigm.

2.5 The case of Greece

The advantages and disadvantages of offshore wind farms in Greece are not well covered in the published works. In a research published in 2015, Zountouridou et al. investigate the viability of offshore wind farms in the Mediterranean Sea's deep seas. She talks specifically about investing in a floating offshore wind farm with a 12 MW capacity that is situated 15 km off the coast of Santorini, an island in the eastern Mediterranean Sea, and at a water depth of 540 m. The energy produced by oil-based plants is expected to be replaced by the farm. The financial advantages of this investment are examined, including the savings from fewer oil imports and CO_2 emissions. The study also clarifies the welfare benefits that result from a cleaner environment. It is emphasized that because the Mediterranean Sea has deeper seas than the Northern countries, offshore wind technologies in the Mediterranean are different from those in other regions (Zountouridou E. K., 2015).

In a more recent analysis, Spyridonidou et al. pinpoints possible offshore wind farm locations in Greece and projects the associated investment costs. Contrary to the writers, the following factors will be taken into consideration when choosing locations for offshore farms: (i) laws pertaining to National Territorial Waters; (ii) wind speed; (iii) water depth; (iv) military areas; (v) zones with seismic hazards; (vi) underwater cables; (vii) distance from ports; and (viii) distance from high-voltage electrical grid. The authors determine the investment costs and strategic value of 16 potential offshore wind projects located in various parts of Greece. With just 60% of the total investment capital needed, 12 offshore wind projects can produce socioeconomic advantages (Spyridonidou, 2020).

There are 59 offshore wind farm projects in Greece, but none of them are operational at the moment, none of which have advanced to the point of connecting the turbines and producing power, none of which are in the build phase, and none of which have received permission or sought for permission (TGS, 2023).

Chapter 3: Theoretical Framework

3.1 Definitions

Some of the most significant terms discussed in this thesis will be examined in this chapter.

Wind Farm: A group of several wind turbines arranged in a particular way to produce electricity from wind power is known as a wind farm (Manwell, James F., Jon G. McGowan, and Anthony L. Rogers, 2010).

Offshore wind farm: An offshore wind farm is a group of wind turbines placed in oceans or seas in order to gather wind energy and produce electricity (Bryden, Ian G., and Reza Hashemi-Nezhad., 2016).

Green energy: Green energy, typically referred to as renewable energy, is energy generated by abundant, renewable resources with a negligible negative impact on the environment and a notably lower greenhouse gas emission rate than fossil fuels. These renewable energy sources come from a variety of technologies, including geothermal, biomass, solar, wind, hydropower, and wave energy (Boyle, 2012).

Renewable energy resources: Natural resources that can be restored or renewed in a short amount of time are known as renewable energy sources. These energy sources are almost limitless in the long run for humans and come from natural processes. They also emit fewer greenhouse gases and other pollutants. Wind, geothermal, wind, solar, biomass, hydroelectric, and geothermal energy are a few examples of renewable energy sources (Boyle, 2012).

EEZ: An “exclusive economic zone,” or “EEZ” is an area of the ocean, generally extending 200 nautical miles (230 miles) beyond a nation's territorial sea, within which a coastal nation has jurisdiction over both living and nonliving resources (UNCLOS, 2023).

3.2 Legal Framework

A set of rules and regulations from the European Union (EU) regulate how offshore wind parks are developed. The objectives of these rules are to safeguard the environment, encourage the development of offshore wind energy among EU member states, and promote renewable energy sources.

3.2.1 International Agreements

The necessity to create strategies to manage and safeguard the marine environment and its resources arose in the 1950s and the early 1960s. As a result, the necessity to safeguard coastal and marine habitats was discussed at the first World Conference on National Parks in 1962.

It was necessary to create a legal framework to address sovereignty and jurisdiction on the seabed in accordance with the rights of the state, going beyond the three miles of territorial sea that had previously been in effect. As a result, four conventions dealing with the law of the sea were adopted in 1958 and are known as the Geneva Conventions [1].

The high seas accords served as the foundation for the 1959 founding of the Intergovernmental Maritime Consultative Organization (IIMC01), the predecessor to the International Maritime Organization (IMO), organizations that are involved in the creation, application, and oversight of measures to reduce ship pollution (IMO, 2023).

The Third United Nations Conference on the Law of the Sea, which lasted from 1973 to 1977, was held in response to the growing technical ability to utilize deep-sea fishery resources as well as the seabed's mineral potential. As a result, various governments took action, including ones pertaining to fisheries regulation and the conservation of biological resources on the continental shelf within 200 nautical miles. This has given authorities a legal foundation upon which to act in order to

[1] Continental Shelf Convention.
Convention on the high seas.
Fisheries Convention.
Convention on the Conservation of the Living Resources of the High Seas.

create marine protected zones and preserve marine resources outside of territorial waters (UNCLOS, 2023).

The nature of environmental issues affecting maritime resources was finally recognized in the 1970s, which prompted the creation of two further conventions during the following two years. The Ramsar Convention (also known as the Convention on Wetlands of International Importance) was established in 1971 in Ramsar, Iran, with the intention of safeguarding and conserving wetlands of global significance. Following the signing of the Convention for the Protection of the World Cultural and Natural Heritage in 1972, the United Nations Environment Program (UNEP) became operational to address issues pertaining to regional seas and develop action plans with a focus on safeguarding marine biological resources from overuse and pollution (UNEP, United Nations Environment Program, 2023).

The IUCN (International Union Conservation of Nature) hosted a conference on protected areas for marine life in Tokyo in 1975 and is developing in the same direction as UNEP with regard to marine and coastal protected areas. A well-managed system of marine protected areas should be established as a representation of the marine ecosystems on our globe, according to the conference report, which emphasized the escalating pressures on the marine environment. The Global Conservation Strategy, which was issued in 1982 in partnership with UNEP and the World Wide Fund for Nature, highlighted the significance of the maritime environment and ecosystems for the achievement of sustainable development (IUCN, 1980).

Additionally, during the same year in Bali, Indonesia, the IUCN Committee on National Parks and Protected Areas (KNPPA) announced a guide for managers and planners of protected areas that may be used by protected areas all over the world through a series of workshops at the 3rd World Congress (IUCN, 1980).

The initial World Conference on Biosphere Reserves was held in Minsk, Russia, in 1983 recognizing that, if they adhere to the scientific, management, and social tenets outlined in the UNESCO framework, biosphere reserves may have a direct interaction with the maritime environment and marine protected zones (UNESCO, 2023) .

In 1970, there were a total of 118 marine protected zones in about 27 countries. By 1985, 69 countries had designated 430 marine protected areas, and additional 298 marine protected area suggestions were being taken into consideration, according to Silva et al. in 1986 (UNESCO, 2023).

The UNEP's "Perspectives on the Environment to the Year 2000 and Beyond" report, which was approved by the United Nations General Assembly, was published alongside the World Commission on Environment and Development (WCED) report "From One Earth to One World - our Common Future" in 1987 (UNEP, Environmental Perspective to the Year 2000 and Beyond, 2002). These publications, along with others, have emphasized the serious hazards facing marine conservation zones around the world.

The following are included in the legislative framework of the European Community:

- the European Network of Protected Areas (YPEN, 2023). It consists of two types of sites: "Sites of Community Importance" (SCIs), as defined by Directive 92/43/EEC, and "Special Protection Areas" (SPAs) for birdlife, as set by Directive 79/409/EC.

- The Council of the European Communities adopted Directive 92/43/EEC, "on the conservation of natural habitats and of wild fauna and flora," with the goal of protecting biological diversity by preserving natural habitats and wild fauna and flora on the territory of the European Union (EEA, 2023).

- "on the protection of wild birds" Directive 79/409/EEC, which demands that Member States conserve and preserve not only species of wild birds residing in the wild, but also an adequate amount of habitat variety to achieve their preservation (79/409/EEC, 1979).

- the 2008 treaty in Barcelona on the protection of the Mediterranean coast and marine environment (UNEP, 2008)

- the Madrid 2008 ICZM Protocol (Integrated Coastal Zone Management) for the management of Mediterranean coastal zones (UNEP, 2008)

- the Directive 2009/28/EC, known as the Renewable Energy Directive (RED) puts into the legislative framework to support offshore wind and sets legally-binding targets for renewable energy use by EU member states. By 2030, the EU is expected to obtain a minimum of 32% of its energy requirements from renewable sources (Directive 28, 2009)

- Directive 2014/89/EU, often known as the Maritime Spatial Planning Directive, attempts to establish a framework for maritime spatial planning in EU member states to guarantee the sustainable and cogent use of marine resources, including regions designated for the development of offshore wind generation (Directive 89, 2014)

- Before approving a project, including an offshore wind farm, member states must complete environmental impact studies (EIAs) in accordance with the Environmental Impact Assessment (EIA) Directive (Directive 92, 2011)

- The goals of the Clean Energy Package, which consists of a number of directives and laws, are to accelerate the shift to clean energy, improve the integration of renewable energy sources, and promote a more integrated and competitive domestic energy market (EC, 2019)

- To aid in the growth of energy networks, the Trans-European Networks for Energy (TEN-E) Regulation recognizes energy infrastructure projects of interest to the EU, including offshore wind electricity transmission infrastructure (Regulation 347, 2017)

- The State Aid Guidelines for Environmental Protection and Energy (EEAG) set forth requirements for member states to finance offshore wind projects without creating barriers to competition. They offer guidance on state aid measures in the energy and environmental sectors (EC, 2023)

3.2.2 Hellenic Legislation

Greece has established institutional and administrative frameworks for the establishment of integrated management of coastal and marine ecosystems and areas due to the threat of potential habitat loss for species. The protection regime for marine parks included provisions for the adoption of suitable measures, the establishment of necessary safeguards for the preservation of the marine environment, and the exclusion of any project that was not essential to the operation of the site (Papageprgiou G., 2000).

The Bern Convention was finalized in 1979 by the international community as a result of the necessity to maintain wild flora and fauna, particularly endangered species. Greece committed to putting this Convention's (1335/83) provisions into action by developing a national plan for the preservation of wild plants, animals, and their natural habitats. The monk seal Monachus monachus is one of the faunal species listed in Annex II to the Convention. In our country, no comprehensive strategy has yet been created to effectively safeguard marine parks. Adopting a broad legislative framework that covers all protected places is not sufficient in and of itself. The state has thus far restricted itself to the delineation of a small number of protected areas, even though the current legislation stipulates three stages for the establishing of an incorporated protection system, namely boundaries, enactment of management and operating regulations, and the establishment of a management body (Bern Convention, 1979).

N.1650/1986

The major Greek law regulating the establishing of protected areas since 1986 is Law 1650/1986, which also contains directives and regulations for environmental preservation. To provide the opportunity for people, both as an individual and as a member of society, to live in a high-quality environment where his health is protected and the development of his personality is promoted, it is necessary to "establish fundamental rules and to determine criteria and mechanisms for ensuring the security of the environment." (N.1650/1986)

It refers to the "protection of the coasts of the seas, the valleys of rivers, the bottoms of lakes, and the islands as natural resources and ecosystem components" is specifically mentioned in relation to the protection of nature, the landscape, the atmosphere, the water, and the soil. The management of protected areas is discussed in Articles 18 and 19, along with definitions of the many types of protected areas (national parks, protected natural areas, maritime parks, nature reserves, etc.). The specification of the requirements and processes for determining the boundaries of protected areas are covered in Article 21 (N.1650/1986).

According to paragraph 1 of the article and in accordance with the revision of the law by Law 3937/2011, "1. a) By presidential decree, delivered by the Minister of Environment, Energy and Climate Change, following the opinion of the "Nature 2000 Committee" and the Secretary General of the relevant Decentralized Administration, in application of a special environmental study (E.P.M.), the designation of protected areas 1, 2, and 3.1 of Article 19, as well as the delimitation of protected areas, The Minister of Environment, Energy, and Climate Change will determine how to proceed with the commissioning of the E.P.M.'s preparation and its long-term approval (N. 3937/2011).

N. 2244/1997

Law N.2244, which was published in the Government Gazette on October 7, 1994, was the first law governing the production of energy from renewable sources that was put into effect in Greece. In accordance with this regulation, independent producers who would only supply their energy to the PPC were for the first time permitted to use private initiative in the production of energy from renewable sources (N. 2244/1997).

N.2773/1999

Law N.2773 was passed in 1999 (Government Gazette 22/12/1999) constituted the Energy Regulatory Authority (RAE), which would now be in charge of overseeing the domestic market for energy produced from traditional fuels, renewable sources, and natural gas as well as the licensing of renewable energy projects (N.2773/1999).

Directive 92/43/EC and 79/409/EC

The European Union has a legal structure for protection, with the European NATURA 2000 network's primary pillars being Directive 92/43/EC on environments and Directive 79/409/EC on wildlife. In order to " make a contribution to the protection of biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States where this Treaty applies," the Council of the European Communities adopted Directive 92/43/EC "on the conservation of natural habitats and of wild fauna and flora" (Directive 92/43/EC).

Greece has to guarantee strict and unrestricted compliance with the responsibilities resulting from Article 12(1)(b) of Directive 92/43/EEC concerning the conservation of the species Caretta caretta, according to the Commission, even though Directive 92/43/EEC has not been transposed into Greek legislation. The Caretta caretta sea turtle is listed as one of the species of Community importance, necessitating stringent protection in accordance with Article 12(1), in Annex IV to Directive 92/43/EEC (79/409/EC).

NATURA 2000

Sites that are members of the European Ecological Network known as Natura 2000 host habitats that are significant on a European scale. It consists of two types of sites: "Sites of Community Importance (SCIs)" as defined by Directive 92/43/EC and "Special Protection Areas (SPAs)" for birdlife as specified by Directive 79/409/EC.

SPAs are automatically added to the Natura 2000 network once they have been recognized by the Member States and are managed in compliance with the guidelines in Article 6 of Directive 92/43/EC and Article 4 of Directive 79/409/EC. Instead, based on the outcomes of the ecological unit biogeographic seminars, the inclusion of SCIs is subject to scientific evaluation and negotiation among the Member States and the European Commission. The list of Assets of Community Importance for the Mediterranean region, to which the entire country of Greece belongs (L259 vol. 49 21/9/06), has been finalized and published. The Member States must designate these locations as Special Areas of Conservation (SACs) no later than six years after the SCI list has been finalized.

A team of about 100 scientists was specially formed for this task as part of the European LIFE project (1994–1996) titled "Inventory, Identification, Assessment and Mapping of Habitat Types and Species of Flora and Fauna of Greece (Directive 92/43/EEC)" to inventory the sites that meet the criteria for the presence of habitat types and species of Directive 92/43/EC in Greece (296 sites – "Scientific List"). The 'Scientific List' contained almost all of the previously preserved places at the national and international levels.

Greece has currently declared 239 Sites of Community Importance (SCIs) and 151 Special Protection Areas (SPAs) (together, the "National List"). In terms of their subject matter, the two lists overlap. In actuality, 31 sites have been simultaneously proposed as SCIs and designated as SPAs.

N.2941/2001

Law 2941 (Government Gazette 12/9/2001) then specifies the locations where renewable energy installations are permitted or not permitted. The Preliminary Environmental Assessment and Evaluation (PEA) and Environmental Conditions Approval (EO) processes for RES projects are governed by the Government Gazette (26/5/2006) (N.2941/2001).

Directive 2008/56/EC and Law N. 3983/2011

The Barcelona Convention, which is implemented by the Mediterranean Action Plan and lays out strategies and policies for the protection of biodiversity and the marine and coastal environment, is a treaty that the European Union and the nations bordering the Mediterranean Sea are signatories to (Barcelona Convention, 1995).

The Barcelona Convention countries joined the Protocol on Integrated Coastal Zone Management (ICZM) for the Mediterranean in 2008 in acceptance of the significance of climate change for the Mediterranean region, making adaptation to climate change a top priority. The serious effects of climate change on ecosystems and resources are addressed in the Marrakesh Declaration, which was endorsed at the Barcelona Convention in November 2009 (Barcelona Convention, 2008).

Directive 2008/56 of the European Communities on the Marine Strategy was incorporated into national legislation with the Law 3983/2011 "National Strategy for the Protection and Management of the Marine Environment - Harmonization with Directive 2008/56/EC of the European Parliament and of the Council of June 17, 2008 and other provisions", which constitutes the environment as the foundation of the future policy of the European Union on this issue (N. 3983/2011). By 2020, it will strive to maintain and improve the marine environment's good environmental state (Directive 2008/56/EC).

This goal must be accomplished by carrying out particular sets of tasks in accordance with a rigid timetable. The law defines marine waterways, marine regions, and marine strategies, as well as acceptable environmental status, environmental goals, and marine environment pollution. The following are the main components of this Directive and the associated Greek law:

- Marine environments are a priceless cultural legacy that must be safeguarded, preserved, and, when possible, restored in order to eventually preserve biodiversity and sustain the diversity and dynamics of the oceans and seas.

- The preservation of marine ecosystems should be a goal of the Marine Strategy's creation and execution. This strategy ought to include regions that are protected from any human activities that have an impact on the maritime environment.

- Each Member State should create a marine strategy for its coastal waters, which should represent the overall perspectives of the relevant maritime region or subregion while also being specific to that Member State's waters.

- Given that the marine environment comprises transboundary, Member States should work together to establish marine strategies in coordination for each maritime region or sub-region.

- this Directive ought to support the Community's steadfast stance taken under the Convention on Biological Diversity. The ability of Member States to designate NATURA 2000 sites in accordance with the Birds and Habitats Directives will be a crucial factor in this process.

- The common fisheries strategy, including any future revisions, should consider the effects of fishing on the environment and the directive's goals.

It's important to be aware that Greece's legal environment for offshore wind farms is still developing, with new laws and regulations being established or changed on a frequent basis.

Chapter 4: The Study Area

4.1 The purpose of study

The proposed project entails the establishment of an offshore floating wind farm along the route between Mykonos and Ikaria. In order to avoid affecting the environment and generally the anthropogenic activities of the larger area, the location of the wind farm was chosen while taking into account the depths, the specifics of the marine area, as well as the constraints of the legislation in effect.

Figure 4.1: Map of the area

Source: Google Maps

The project's goal is to produce enough electricity to meet the demands of the islands of Mykonos and Ikaria by taking advantage of the wind potential that exists in the wind farm's offshore area.

The key feature of the suggested energy generation method is that there are no additional primary or intermediate techniques, which could potentially be sources of pollution, and that all mechanical labor is completely performed by the wind. The facility was designed with legal compliance, little disruption of daily operations, and regional and national sustainable development in mind.

4.2 The area

The area shown in Figure 4.2, which is the largest area of the offshore wind farm installation, has a total area of 88.37 km2. In this area, winds of 6 - 8 m/s develop at a height of 10 m above sea level, while the water depth ranges from 60 m to 200 m (Vasileiou, 2017). The selection of the wider marine area for the siting of the proposed project was based on the combined use of the Multi-Criteria Decision-Making Method and Geographic Information Systems (GIS). The criteria applied are in accordance with the Special Framework for Spatial Planning and Sustainable Development of Renewable Energy Sources and are divided into environmental, economic, technical and social criteria.

Figure 4.2: Map of the proposed area

Source: Google Maps

The proposed marine area is located 14 kilometers from the Mykonos shore, 42 kilometers from the city's current port, 14 kilometers from the Ikarias coast and 42 kilometers from the city's current port. The shipping channel crosses the southern boundary of this area, consequently the wind farm's precise position is determined to be in the northern portion of the proposed broader area.

Table 4.1 shows the coordinates (EEZ 87΄) of the marine area borders for the proposed offshore wind project.

Point	East	North
A	641680	414974
B	645040	414974
C	645040	413406
D	641680	413406

Table 4.1: Offshore wind farm coordinates (EEZ 87΄).

Source: Google Maps

4.2.1 The assets of the area

This specific maritime area is appropriate for the installation of the wind farm because it possesses the following qualities:

- It is not located within an area used for military drills, an area designated for hydrocarbon extraction and exploitation, or an area where the construction of another renewable energy facility is planned.

- There is no visual or audible disruption to residential areas due to the site's isolated location. It is not included in any regions that have been classified as environmental protection zones or archaeological sites (Natura or Nature 2000).

- This project is financially feasible because of the area's high wind potential, which is expected to result in a high yearly energy production.

- The area's depth permits the use of offshore wind farm technology that has previously been researched and used (Hywind, Scotland).

In particular, the Special Spatial Planning Framework's standards are entirely met by the planned offshore wind farm site. The offshore wind farm's chosen location does not fall within a unique institutional regime that expressly forbids installation, is not an exclusion zone, and does not cross a passenger shipping line in close vicinity to the wind farm, all of which are determined by the requirements outlined in Article 10.

Additionally, no wind turbine has been placed in a closed bay with an opening width of less than 1,500 meters, and the wind farm is situated more than 1,500 meters from the closest coastline.

Because the floating support structures on which the wind turbines will be erected have a foundation depth of less than 200 meters, they can be supported using methods that have been employed for many years.

Furthermore, there are no declared nature monuments, National Park cores, absolute nature protection areas, or attractive forests that are not part of nature conservation areas in the vicinity of the offshore wind farm. Additionally, there is a distance of more than 1,500 meters between the offshore wind farm installation area and the closest swimming beach.

Simultaneously, there are no declared cultural monuments and historic sites within a 500-meter radius, nor are there any monuments, archeological sites, or historic sites included on the World Heritage List within a 3,000-meter radius. Furthermore, no monument of inappropriate usage can be seen from the tower of any wind turbine inside the proposed wind farm.

The offshore wind farm's axis contains a limited region where sound levels higher than 45 dB are restricted. This band averages 400 meters between the closest wind farm turbine and a single residential property.

Lastly, all the requirements for minimal separations from areas or facilities for productive activities are satisfied for the planned offshore wind farm location.

Chapter 5: Proposal 1: EEZ declaration

5.1 The international law of the sea

The law of the sea represents one of the most complex and critical areas of international law, as the marine environment covers more than 70% of the Earth's surface. It encompasses a wide range of principles, rules and procedures governing maritime spaces, resources, navigation, environmental protection and geopolitical interests. As nations seek to balance their respective interests in the world's oceans, understanding the complexities of the Law of the Sea is becoming increasingly vital (Nordquist, 2011).

The 1982 United Nations Convention on the Law of the Sea[2] (UNCLOS) established a comprehensive legal framework for the world's oceans and seas. UNCLOS governs all uses of marine resources and environments, codifying traditional practices while introducing innovative legal concepts to address contemporary concerns (Cottier, 2015).

Pursuant to Resolution 72/249[3] adopted by the United Nations General Assembly on 24 December 2017, an Intergovernmental Conference was convened under the auspices of the UN. This conference was intended to consider the recommendations of a preparatory committee established earlier by resolution 69/292. The objective was to develop the text of a new international legally binding instrument focusing on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction, all within the framework of the United Nations Convention on the Law of the Sea (GEF, 2022).

Territorial and maritime boundaries

Under international law, as codified in the 1982 LOS Convention, there are five maritime zones in Montego Bay, Jamaica:

[2] https://www.imo.org/en/ourwork/legal/pages/unitednationsconventiononthelawofthesea.aspx United Nations Convention on the Law of the Sea. (Retrieved 18.2.2024)

[3] https://www.un.org/bbnj/ Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction. (Retrieved 18.2.2024).

- the inland sea - (inland waters, 3 nautical miles),
- the territorial sea - (territorial waters - coastal zone 12 nautical miles),
- contiguous zone - (contiguous - adjacent zone, (12 + 12 nautical miles)
- the continental shelf, or exclusive economic zone (EEZ) - (200 nautical miles - 370 kilometres),
- the open sea.

The Convention not only defines the coastal areas, but has specific guidelines and directives on the rights and responsibilities of states in the five concentric zones.

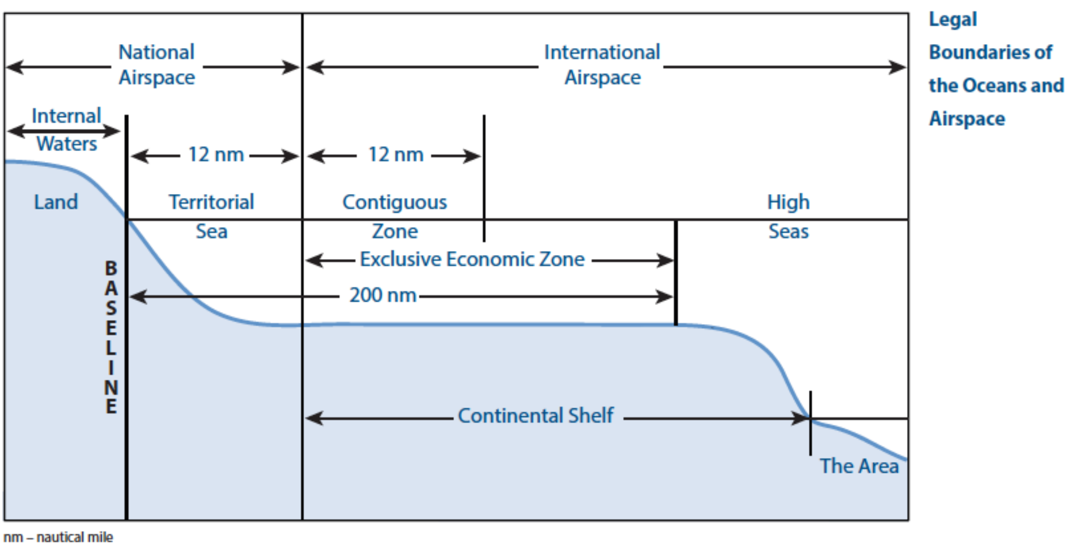

Diagram 5.1. Delimitation of land, maritime zones and airspace

Source: sites.tufts.edu

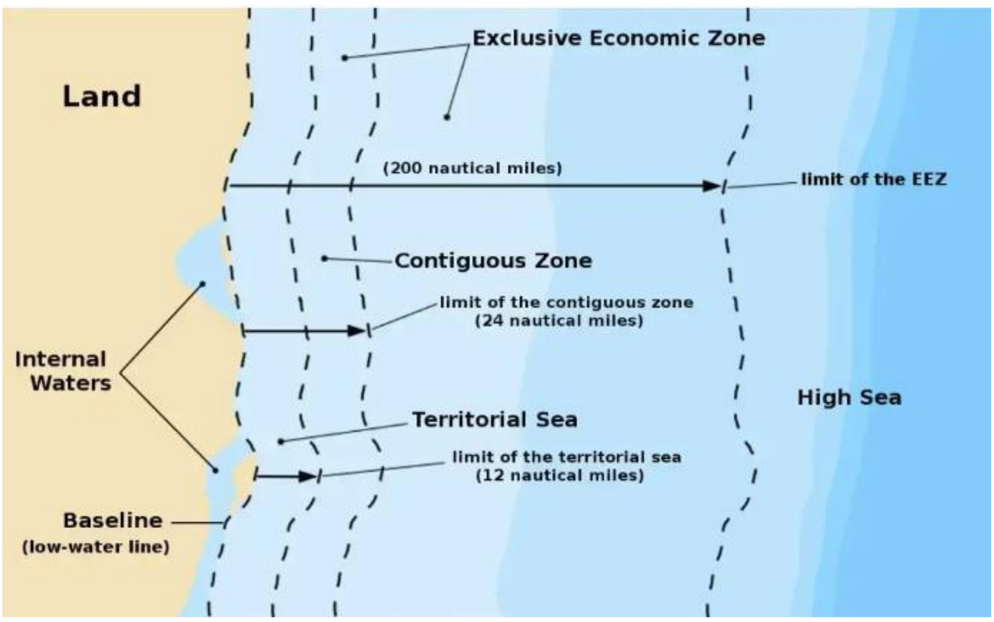

Figure 5.2: The five main maritime zones under UNCLOS
Source: sailorinsight.com

The main features of the UNCLOS Convention are:

- Coastal countries control a zone of sea around their coasts (territorial waters) of up to 12 nautical miles. Ships from other countries can sail freely through this zone, but not for harmful purposes.
- Important waterways (straits) used by many countries for travel are open to all ships and planes. Countries bordering these straits can set rules for traffic and other activities.
- States that include islands with connecting waters (archipelago) are treated as a single country with control over the surrounding waters. States under this regime designate designated routes for ships and planes that all countries can use. Island regions, including archipelagos, present unique challenges. While they share characteristics with continental areas, their island nature requires specialised approaches to environmental protection and resource management.

The Seychelles Archipelago is an example as it comprises 115 islands and covers 455,000 square kilometres with a population of 100,000. For comparative purposes, the Aegean Sea covers an area of 240,000 square kilometres (Klaoudatos & Konidis, 2023).

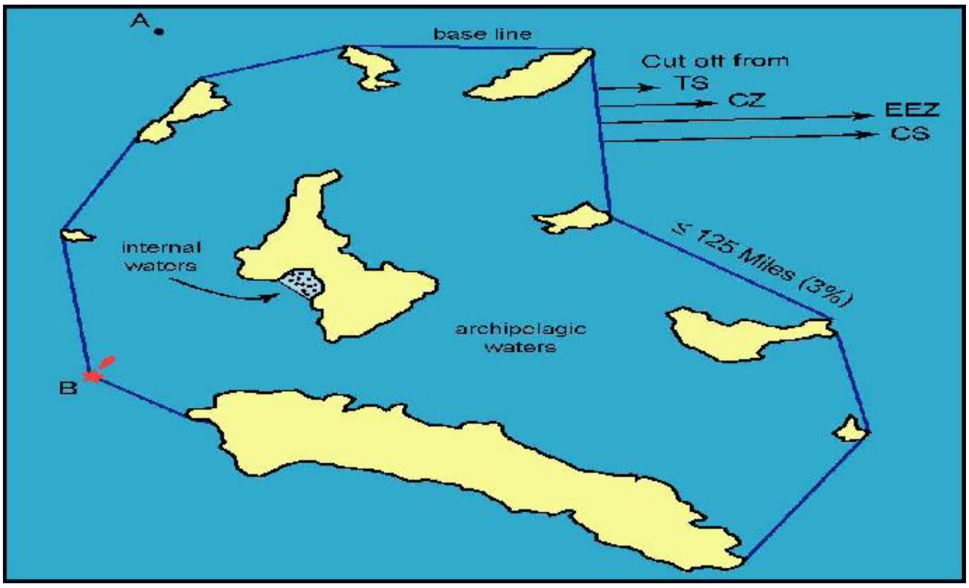

Figure 5.3 Archipelago waters
Source: iilss.net

- Countries have exclusive and sovereign rights to explore and use resources within 200 miles of their coasts (exclusive economic zone). They can also control exploration and environmental protection in this zone.
- All countries have the right of free navigation and overflight through this zone and to lay submarine cables and pipelines on the seabed.
- Countries with limited access to the ocean (landlocked and geographically disadvantaged) can share the resources of the EEZs of neighbouring coastal countries.
- Coastal countries have rights to explore and use resources in the submarine continent off their coasts (continental shelf). This area can extend beyond 200 miles under certain conditions.
- If the continental shelf extends beyond 200 miles, the coastal country shares part of the revenues from resource extraction with the international community.
- A special commission helps countries to determine the exact outer limits of their continental shelf if it extends beyond 200 miles (Cottier, 2015).

5.2.1 Inland waters - Internal Waters

The Convention clarifies the concept of internal waters (UNCLOS, Article 17), which include all enclosed bodies of water lying landward of the baseline used to measure the territorial sea of a coastal nation. Unlike territorial seas where there is a concept of innocent or innocuous[4] passage, a state exercises full sovereignty over its internal waters, similar to its control over its land territory. Accordingly, foreign vessels are generally prohibited from sailing freely in internal waters. However, special circumstances may allow access to foreign vessels entering designated areas, such as ports. These agreements often require advanced communication, usually requiring notification of the intended course to the port authority at least 24 hours in advance (Del Vecchio & Virzo, 2019).

[4] Safe Passage: a coastal state may not stop a foreign ship passing through its EEZ for inspection. In addition, warships and other government vessels that are not on a commercial mission are exempt from even suspicion of a crime. However, Article 30 of the UN Convention on the Law of the Sea gives the coastal state the right to require a warship to leave the Coastal Zone immediately if it fails to comply with the laws and regulations of the coastal state with respect to passage through the Coastal Zone

5.2.2 Territorial waters - coastal zone 12 nautical miles

Under international law, a state's territorial waters cover all maritime areas extending outwards from its baseline to a maximum distance of twelve nautical miles (UNCLOS, Article 2). Territorial seas represent the most basic maritime zone, giving the coastal State full sovereignty and jurisdiction. This principle includes not only surface waters, but also the seabed and subsoil, which extend perpendicularly to the airspace above. While the vast majority of states have established territorial seas at the twelve nautical mile limit, some states have established shorter limits due to disagreements and friction on the issue, with Greece and Turkey being prime examples (Nordquist, 2011; Suarez, 2008).

According to the international Law of the Sea, the Sovereignty of every State, including Greece, is complete especially in its Territory, including, of course, the territory of islands, islets and rocky islets, without any form of distinction; in its Coastal Zone and in the Airspace to which it is entitled.

Under Article 17 of the United Nations Convention on the Law of the Sea (UNCLOS), a coastal nation has full sovereignty over its territorial waters, usually extending twelve nautical miles from the national coastline. However, this sovereignty is not absolute. Foreign vessels have the right of innocent passage, allowing them to sail freely through these waters for non-harmful purposes. This right is not unconditional. Vessels must comply with certain regulations, including identification with the coastal state. In addition, certain restrictions may be imposed, such as requiring submarines of any nation to transit the surface while within territorial waters. The exact definition of the boundaries of the territorial sea may present some variations due to factors such as tidal fluctuations and the presence of islands or archipelagos under the control of the coastal state (Rowbotham, 2014).

With the precedent set by the July 12, 2016 ruling of the International Court of Arbitration in the case of Philippines v. China, it creates in Greece's favour a recognition that all islands in the Aegean and Eastern Mediterranean, regardless of size, create exclusive economic zones (EEZs) and continental shelves. This legal framework would support Greece's control over resource exploration and economic activity within these maritime zones (Pavlopoulos, 2021).

5.2.3 Contiguous Zone - Contiguous Zone 12 + 12 nautical miles

Under international law, coastal states have the possibility to create a contiguous zone. This zone extends out to sea from the outer limit of their territorial sea (usually 12 nautical miles) to a maximum of 24 nautical miles from the baseline. The primary function of the contiguous zone is to enhance a state's enforcement capabilities and to prevent violations of its national laws. Within this zone, a coastal state can take action to prevent and punish violations of its customs, fiscal, immigration and sanitary rules, even if they occur outside its territorial sea. It is vital to distinguish the Contiguous Zone from territorial waters. Unlike territorial waters, which include both the water column and the airspace above, the Contiguous Zone grants jurisdiction solely over the surface of the water and the seabed (Rowbotham, 2014).

UNCLOS Article 33 Continuous zone

1. In a zone adjacent to its territorial sea, described as a contiguous zone, the coastal State may exercise the necessary control to:

    A. prevent the violation of its customs, fiscal, immigration or sanitary laws and regulations in its territory or territorial waters;

    B. punish violations of the above laws and regulations committed within its territory or territorial waters.

2. The contiguous zone cannot extend beyond 24 nautical miles from the baselines from which you measure the width of the territorial sea (Nordquist, 2011).

Figure 5.4. Contiguous Zone 12 + 12 nautical miles

Source: www.marineinsight.com

5.2.4 Exclusive Economic Zone (EEZ) - 200 nautical miles

The concept of the Exclusive Economic Zone (EEZ) marks a significant departure from the traditional legal framework governing the world's oceans. Established by the United Nations Convention on the Law of the Sea, the EEZ represents a new concept distinct from previously recognised maritime zones. Unlike territorial seas, for example, which have existed for centuries under customary international law, the EEZ is a creation of the 1982 Convention (Del Vecchio & Virzo, 2019).

Coastal states can claim an EEZ extending 200 nautical miles outwards from their base lines. This zone gives them a huge range of exclusive rights and powers. First, coastal states enjoy the exclusive right to explore, exploit and manage all resources within the EEZ. This includes both living resources, such as fish stocks with significant economic value, and non-living resources, including oil, gas and seabed minerals. The economic potential of the EEZ extends beyond resource extraction. Coastal states also hold exclusive rights to generate energy from renewable resources such as wind, waves and currents within this zone (Cottier, 2015; Baztan, et al., 2015).

The Convention further empowers coastal states with additional authorities within the EEZ. Article 56 grants them the right to construct and use artificial islands, installations and structures. These structures can serve a variety of purposes, such as scientific research stations, platforms for resource extraction or even habitation. In particular, the right to conduct marine scientific research also falls within the competence of coastal States within the EEZ. However, the Convention requires coastal states to cooperate with other nations in research efforts intended for peaceful purposes.

Finally, the EEZ carries a responsibility for coastal states to act as stewards of the marine environment. The Convention obliges them to take measures to protect and preserve the marine environment within the EEZ. One approach to achieve this goal involves the creation of marine protected areas, where stricter regulations are applied to protect vulnerable ecosystems and endangered species (Nordquist, 2011).

5.2.5 Continental shelf

Prior to the United Nations Convention on the Law of the Sea (UNCLOS), the definition of the continental shelf depended on the depth of the water and the exploitability of the resources, usually extending to a maximum of 200 metres. UNCLOS replaced this definition, establishing a framework based on the natural extension of land (continental margin) or a minimum distance of 200 nautical miles from the baseline of the territorial sea (usually 12 nautical miles), with an outer limit of 350 nautical miles from the baselines (Article 76).

The continental shelf includes the relatively shallow area of the seabed adjacent to the coast of a coastal state. While traditionally referred to by the 200 nautical mile limit, the continental shelf can vary in extent based on specific geological features. Within this zone, a coastal state enjoys sovereign rights to explore and exploit the natural resources of the seabed and subsoil, including mineral and other non-living resources (UNCLOS, Article 77). These sovereign rights are exercised and enforced through specialized vessels, often belonging to the national navy or fisheries protection agencies (Nordquist, 2011).

In the mid-20th century, the concept of the continental shelf emerged in the field of public international law. Although it was not the only contentious issue in the law of the sea from 1945 to the 1960s, it represented the most recent development compared to established maritime zones (with the exception of the Exclusive Economic Zone, a later introduction during UNCLOS III). This new concept attracted considerable attention not only for its innovative nature but also for its potential to radically change the established maritime zone framework. Moreover, by extending sovereign rights to the seabed below the high seas, the continental shelf directly challenged a cornerstone principle of the law of the sea - freedom of the seas (Suarez, 2008).

5.2.6 High Seas

The United Nations Convention on the Law of the Sea[5] (UNCLOS) divides the ocean beyond the Exclusive Economic Zone (EEZ) into two distinct areas. Surface waters are designated as "high seas" where all nations enjoy guaranteed freedoms of navigation, overflight and scientific research (Article 87).

The seabed and subsoil beyond the combined limits of the EEZ and the continental shelf constitute the "Area" (Article 1). UNCLOS enshrines this area as the "common heritage of mankind" (Article 7), suggesting that it does not belong to any nation. While any state can engage in peaceful activities such as scientific research or exploration within the area, resource extraction is subject to a defined framework (Cottier, 2015).

Living resources, such as fish populations on the high seas, are open to exploitation by any nation. However, UNCLOS encourages collective efforts to ensure sustainable fishing practices through the provisions outlined in Part XVII. Non-living resources in the region, such as minerals, present a separate challenge. Given the significant capital investment required for large-scale mining, UNCLOS established the International Seabed Authority (the "Authority") to regulate the exploration and exploitation of resources for the collective benefit of all nations (Part XI) (Nordquist, 2011).

A particular State or entity does not have exclusive jurisdiction over all activities taking place in a particular location outside its territorial sea. Despite the enormous appropriation by coastal States, the oceans and enclosed seas outside territorial waters

5 https://www.imo.org/en/ourwork/legal/pages/unitednationsconventiononthelawofthesea.aspx United Nations Convention on the Law of the Sea. (Retrieved 18.2.2024).

remain essentially common space, with all the inherent problems of coordination, coexistence and cooperation that accompany common areas. Activities such as fishing, mining or drilling may conflict with commercial or military activities and vice versa. Legally, there are no easy answers as to which group of activities deserves priority over the other (Cottier, 2015).

5.2 The differences between Greece and Turkey

It is accepted that the Aegean Sea is a complex area due to the existence of many Greek islands near the Turkish border. Although Turkey has not signed UNCLOS, it uses the right of 12 nautical miles in the Black Sea, but denies it to Greece. According to many Greek researchers, politicians and lawyers, Turkey uses various excuses not to go to an international court, and when it does discuss doing so, it puts forward unprovoked positions and opinions on many issues, effectively cutting off any discussion and common solution, especially in the Aegean, in order to move forward with some exploitation projects, either in renewable energy or fishing. (Stratis, 2012; Pavlopoulos, 2021).

The Aegean Sea, a vital maritime corridor and resource-rich basin, has been a stage for a protracted legal conflict between Greece and Turkey for almost five decades. At the heart of this dispute lies the delimitation of maritime zones, particularly the continental shelf and Exclusive Economic Zones (EEZ) within the Aegean Sea (Gavouneli, 2020)

A central point of contention revolves around the treatment of the Aegean islands. Greece asserts that all islands create maritime zones, respecting the established legal framework. In contrast, Turkey disputes the full right of some islands, potentially influencing the final demarcation line (Gavouneli, 2020)

Further complicating the issue is Greece's desire to extend its territorial waters from 6 to 12 nautical miles, a move strongly opposed by Turkey. The dispute extends beyond maritime zones, with Turkey raising questions about Greek sovereignty over certain Aegean islands and arguing for the demilitarization of others (Pavlopoulos, 2021).

One option for Greece is the construction of a wind farm in the 6 nautical mile exclusive zone which is believed to address some of the problems the country has with Turkey, although as mentioned the problem is purely geopolitical - political, with the neighbouring country constantly objecting to any action in the Aegean Sea. This is believed to have something to do with the complex issue of air operations of the armed forces in the area and the fears that Turkey has expressed about the blockade and control of the Aegean by the Greek armed forces (Pavlopoulos, 2021). Turkey does not hesitate to send its research vessels to undertake exploratory work in maritime zones claimed or according to international law belonging to Greece or Cyprus. As Turkish exploration ships are accompanied by warships, accidents or even the use of force can no longer be ruled out (Heinz-Jurgen., 2021).

Regarding the resolution of these issues, Turkey argues that they should be discussed through political negotiations and not through legal means. They are taking a strong, demanding stance and are trying to create an impasse while strengthening their own position. Turkey's goal is to force Greece into broad negotiations where it can make greater gains through concessions rather than limited victories through legal rulings (Oikonomou, 2022).

Although there is an option for Greece to build wind farms within its own zone, the Turkish side is still raising objections and threats even in this case, considering that the construction of wind farms will create a frozen situation against it. It should be noted that Turkey recently created an issue[6] after the Greek government announced the creation of a marine park in the Aegean and Ionian Sea in view of the 9th International Ocean Conference [7] (Our Ocean Conference) to be held in Greece on 15-17 April. The first will include eleven clusters of uninhabited islands and islets - dubbed "the Greek Galapagos", as biodiversity treasures - from west of Milos to Nisyros. And the second will include an extensive marine area starting north of Kefalonia and ending in Kythera and Antikythera.

[6] https://www.huffingtonpost.gr/entry/omer-tselik-thalassio-parko-e-toerkia-den-tha-apodechthei-aete-ten-proseyyise-stis-thalasses_gr_662008f7e4b07db21fd5dd18 We consider the unilateral declaration of a marine park...a unilateral violation, (Retrieved 27.4.2024).

[7] https://www.kathimerini.gr/society/562965610/nea-thalassia-parka-se-aigaio-kai-ionio/ New marine parks in the Aegean and Ionian Seas, (Retrieved 27.4.2024).

Chapter 6: Proposal 2: Energy Zones

6.1 Introduction

In its latest decisions, the European Union has set a target to produce at least 32% of its energy from renewable sources by 2030 in order to participate in the global effort to limit global warming by 1.5°C. EU countries are working on and developing national plans for the management of their ocean areas and implementing spatial plans for marine parks.

6.2 Energy zones within 6 nautical miles

Many experts in the field of energy and renewable energy and many international environmental organisations believe that islands should be self-sufficient in energy or use electricity instead of fossil fuels. In order to reduce carbon emissions, coal-fired power stations on the islands should be closed in the coming years. Renewable energy is an excellent solution for islands, but they face particular challenges and multi-faceted problems compared to mainland regions:

- Limited space: islands have less land overall, so all facilities and infrastructure must fit there.
- Uneven ground: The spaciousness of the terrain can make it difficult to construct solar panels and wind turbines in certain places.
- Changing energy requirements: Tourist destinations experience an increase in energy use during peak periods.
- Precise connections: While some islands have submarine power cables connecting them to the mainland, building these cables is often costly and impractical for all islands.

Due to these challenges, there is a growing need for land-to-sea renewable energy transfer, especially on islands. The ocean offers much more space for wind turbines and other renewable energy installations, and offshore wind has much greater potential than onshore wind.

Due to the great interest of investors and developers in offshore wind farms in the Renewable Energy Sources (RES) sector, the technology in wind turbine construction is constantly evolving in order to address the challenges of water-related issues (erosion, high waves) and the construction of the foundations of the installations. Nevertheless, site selection for offshore wind farms, regardless of fixed or floating [8] foundation type, is a complex task with many different parameters and constraints that need to be taken into account when determining the optimal location for offshore wind turbine installations.

The location of the installation plays an important role, as there are significant differences between offshore and onshore wind conditions. Offshore winds are stronger and more stable (spatially and temporally) than onshore winds. Moreover, one of the fundamental problems in the design and construction of an offshore wind farm is the preliminary identification of suitable sites that meet specific criteria for its implementation (Vagiona & Kamilakis, 2018).

Among their advantages is that offshore environments provide a vast marine area for the construction of large wind farm projects, overcoming the constraints associated with limited onshore locations. Also, offshore development mitigates noise pollution and aesthetic - visual impacts compared to onshore projects and lack the legal land use conflicts (Soukissian & Papadopoulos, 2015).

Marine wind farms also come to address issues (Gkeka-Serpetsidaki & Tsoutsos, 2022), such as:

- the need for island energy coverage which eliminates the problem of long distances from the mainland and thus increased energy transport costs
- the liberation of the land and
- the high untapped offshore wind potential.

Their disadvantages include the fact that offshore wind farms generally involve significantly higher costs compared to onshore projects, the use of more specialised and evolving technology and greater risks and uncertainties about their long-term

[8] https://www.capital.gr/oikonomia/3801393/m-xatzigakis-hexicon-i-texnologia-ton-ploton-aiolikon-to-kleidi-stin-prasini-metabasi/ M. Hatzigiakis (Hexicon): floating wind technology is the key to the green transition, (25.4.2024).

socio-economic and environmental impacts in potential locations (Perveen, et al., 2014).

The advantages of marine parks, which have as an advantage the distance from populated areas, are reduced for Greece due to the problems with Turkey in the Aegean. The construction of a wind farm for example within the 6 nautical miles, which Greece has defined as territorial waters, in order to overcome the problems and geopolitical confrontations with Turkey in case of the definition of 12 nautical miles, which is derived from the international law of the sea and which Turkey, as mentioned, considers this decision as a cause for war, eliminates the advantage of the marine park, due to its proximity to the islands at 6 nautical miles (Pavlopoulos, 2021).

6.3 Wind farm proposal within 6 nautical miles

The proposed project entails the creation of an offshore floating wind farm along the route between Mykonos and Ikaria. In order to avoid the impact on the environment and generally the anthropogenic activities of the wider area, the location of the wind farm was chosen taking into account the depths, the particularities of the marine area, as well as the restrictions of the current legislation.

The aim of the project is to produce enough electricity to meet the requirements of the islands of Mykonos and Ikaria by utilizing the wind potential that exists in the offshore area of the wind farm.

The key feature of the proposed power generation method is that there are no additional primary or intermediate techniques, which could potentially be sources of pollution, and that all the mechanical work is performed entirely by the wind. The installation has been designed with legal compliance, minimal disruption to daily operations and regional and national sustainable development in mind.

The area shown in Map 1. is the largest area of offshore wind farm installation, with a total area of 88.37 km^2. In this area, winds of 6 - 8 m/s develop at a height of 10 m above sea level, while the water depth ranges from 60 m to 200 m. The selection of the wider marine area for the siting of the proposed project was based on the combined use of the multi-criteria decision-making method and geographic information systems (GIS). The criteria applied are in accordance with the Special

Framework for Spatial Planning and Sustainable Development of Renewable Energy Sources and are divided into environmental, economic, technical and social criteria.

The proposed marine area is located 14 km from the coast of Mykonos, 42 km from the current port of the town, 14 km from the coast of Ikaria and 42 km from the current port of the town. The transmission channel crosses the southern boundary of this area, therefore the exact location of the wind farm is identified in the northern part of the proposed wider area.

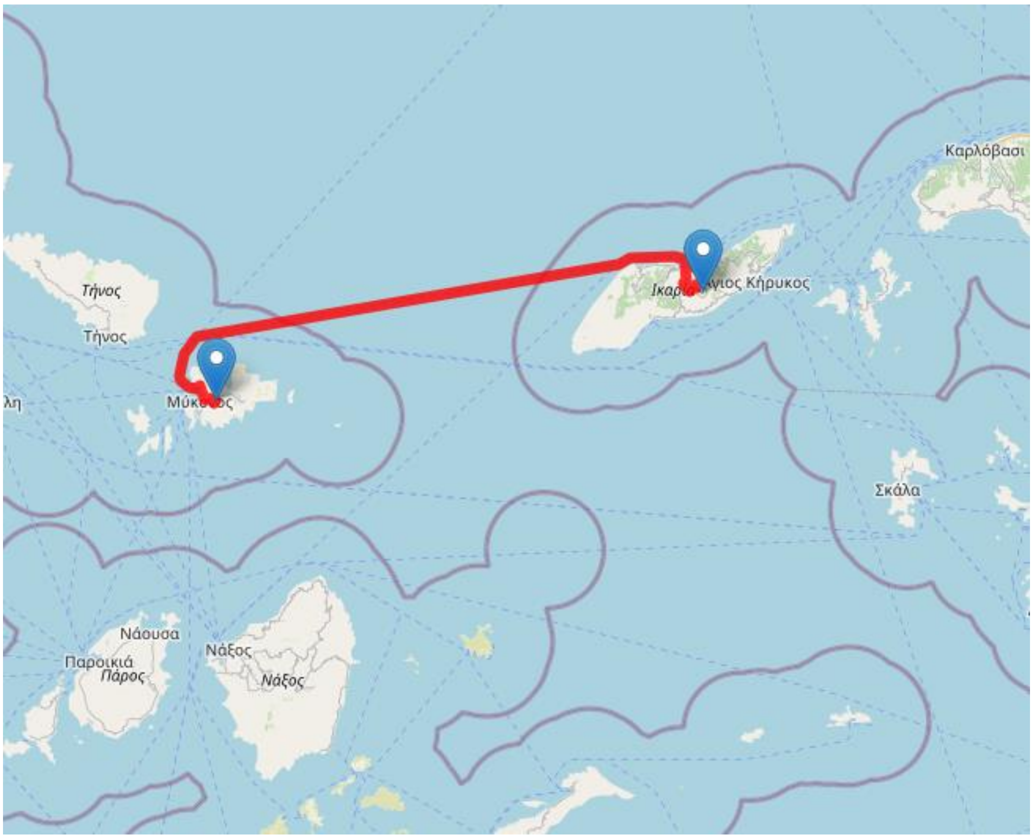

Figure 6.1 : Area of Mykonos Ikaria

Source: Google maps

This particular marine area is suitable for the installation of the wind farm because it has the following characteristics:

- It is not located in an area used for military exercises, in an area intended for the extraction and exploitation of hydrocarbons or in an area where the construction of another renewable energy facility is planned.

- There is no visual or auditory disturbance in residential areas due to the isolated location of the site. It is not included in areas designated as environmental protection zones or archaeological sites (Natura or Nature 2000).

- This project is economically feasible due to the high wind potential of the region, which is expected to result in high annual energy production.

- The depth of the site allows the use of offshore wind farm technology that has been previously researched and used (Hywind, Scotland).

In particular, the standards of the Special Spatial Framework are fully met by the planned offshore wind farm site. The selected location of the offshore wind farm does not fall within a single institutional regime that explicitly prohibits the installation, is not an exclusion zone and does not cross a passenger shipping line in close proximity to the wind farm, which are determined by the requirements described in Article 10.

In addition, no wind turbines have been installed in a closed bay with an opening width of less than 1,500 metres and the wind farm is located more than 1,500 metres from the nearest coastline.

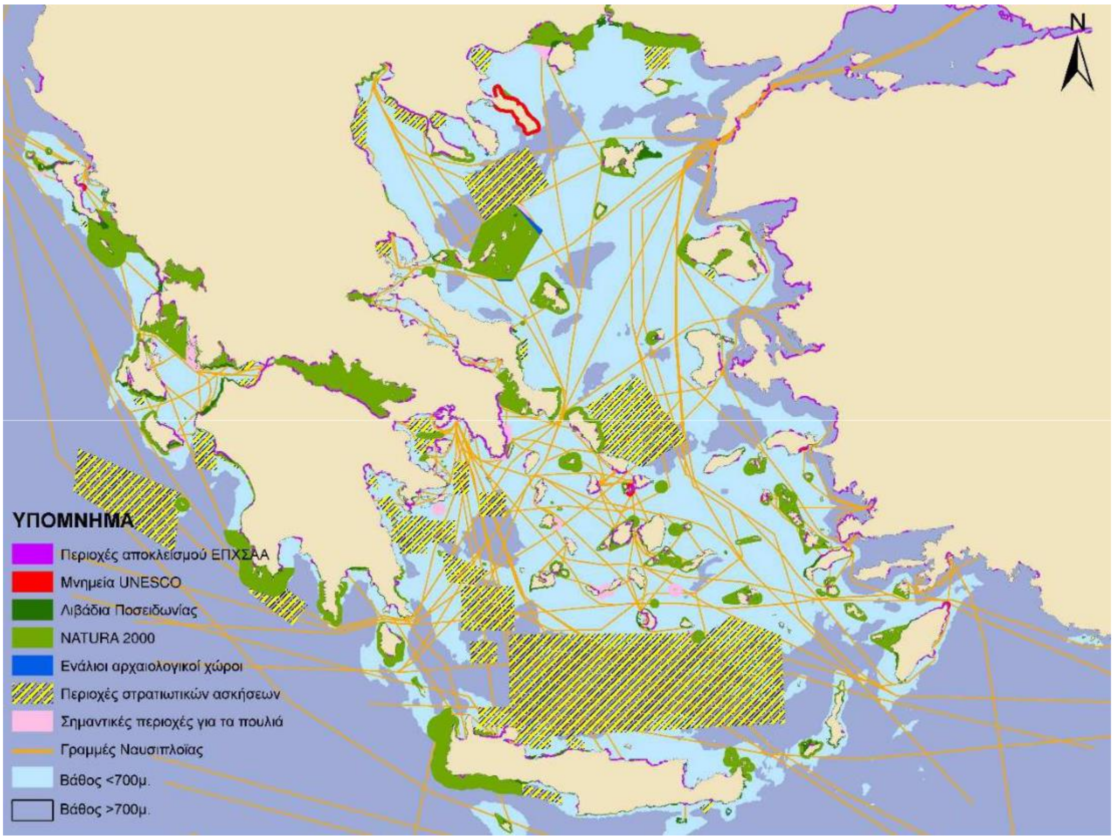

Figure 6.2 : Blocked areas in the Aegean depending on the situation

Source : energypress.gr

The area is located in the wider Aegean region where, according to a thesis research entitled "Applied Geography and Space Management", the area under study includes the Greek territorial waters and the international waters in the Aegean and Ionian Seas up to the isobath of 700m. which is the maximum depth for the installation of floating wind turbines according to the latest technical specifications.

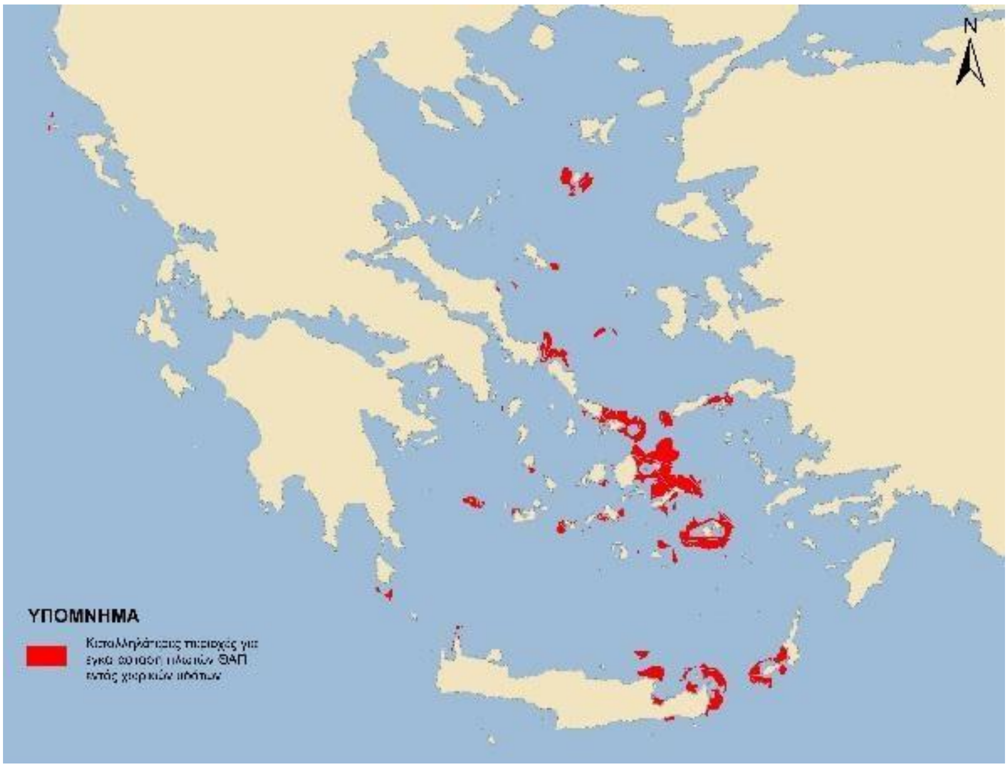

Figure 6.3 : . Areas best suited for the installation of offshore wind farms

Source: energypress.gr

(source: Katseli, Ch. (2019). Siting of marine wind farms in Greece: A GIS-based approach https://energypress.gr/news/horothetisi-thalassion-aiolikon-parkon-ston-elliniko-horo-mia-proseggisi-me-vasi-tin-tehnologia)

Public participation is critical for the successful siting and development of wind energy projects. The location of wind turbines is a key element and such projects can generate debate about their impact on local communities (Lombard & Ferreira, 2014). To ensure social acceptance of projects, it is important to incorporate the perspectives of local residents in the planning phase. Although public engagement does not guarantee universal support, it plays a vital role in addressing potential opposition and enhancing confidence in renewable energy initiatives (Loukogeorgaki, et al, 2022)

Chapter 7: Proposal 3: Co-exploitation of Energy Resources

7.1 Indroduction

Co-exploitation means that we entrust a company (joint, 3rd company, any company) that has the consent of both countries to start the construction of offshore wind farms in the region. This will be done through a contract, where it will return the profits to each country, with percentages on a pro-rata basis. This contract will initially be for a short period of time to make it easier to convince the countries to do it, say 10 years. but after 10 years both countries will have benefited so much from the power supply etc. so surely the contracts will be renewed and maybe applied to other areas.

One solution for the exploitation of energy resources and the construction of wind farms in the broad Aegean region would be the joint exploitation of the resources through an independent company, which could build a project, with the shares of each country (in this case Greece and Turkey) having been established and agreed in advance. Although this is estimated to be equally difficult to implement, due to Turkey's challenges and disputes[9] in the Aegean maritime space.

Theoretically, it is the only solution for the two countries to benefit from such an agreement, which would pave the way for other similar coexistence agreements, if Turkey gives up its territorial claims to the Greek islands, which is extremely difficult, as it is part of its political pressure against either Greece or the European Union. It should be noted that similar attempts of agreements, such as Turkey's agreement with Libya, have caused geopolitical reactions with Egypt, Italy and France as well as officially with the European Union[10] (Stanicek, 2020).

[9] Turkey's policy in the Eastern Mediterranean, and in particular its pursuit of the "Mavi Vatan" naval doctrine, is perceived in Athens as an existential threat. Turkey's repeated challenges to Greek sovereignty in the Aegean, both in terms of the long-standing casus belli over the extension of Greek territorial waters and the frequent questioning of Greek sovereignty over the Dodecanese islands, combined with Turkey's bellicose rhetoric, have reduced the chances of cooperation. (retrieved 2.5.2024 from https://www.eliamep.gr/en/publication/εντατική-διπλωματία-ελληνική-εξωτερ/).

[10] Since the early 2000s, the discovery of offshore gas reserves in the eastern Mediterranean has led to tensions between Turkey and its neighbours. Turkey has challenged international law and the delimitation of exclusive economic zones (EEZs) through illegal drilling and military actions, violating the territorial waters and airspace of neighbouring nations. These actions have caused tension in relations in the Aegean and Eastern Mediterranean, prompting strong condemnation from the

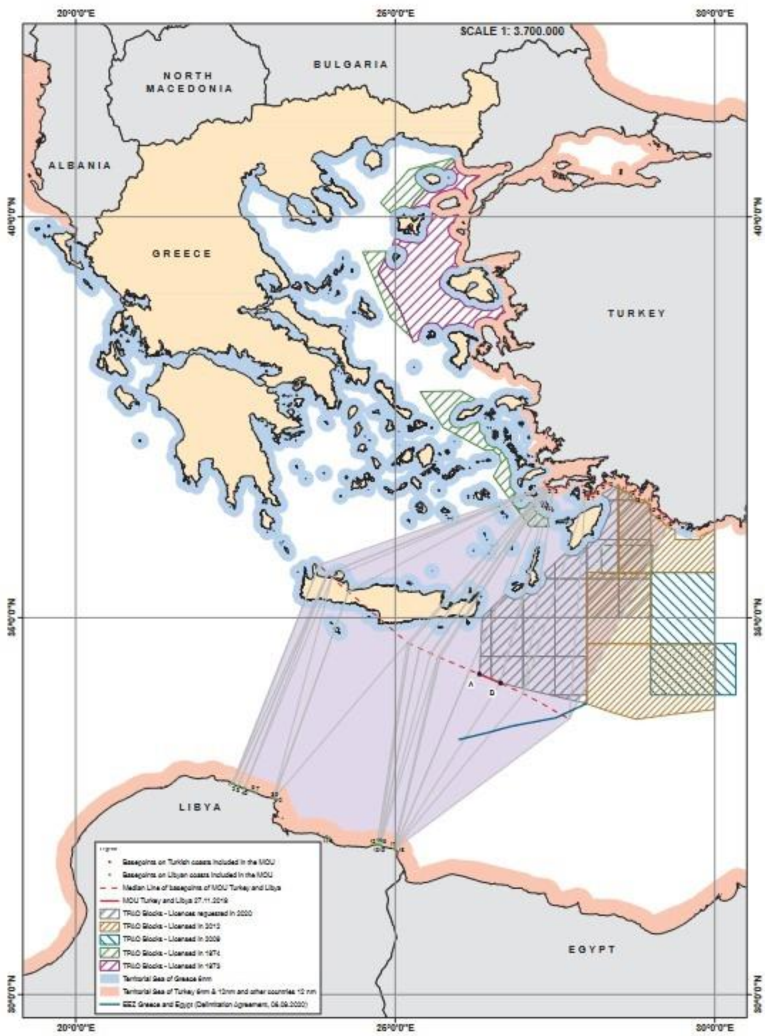

Figure 7.1 : Map of the Greek Ministry of Foreign Affairs showing the EEZ resulting from the 2019 Turkey-Libya Memorandum of Understanding and how it ignores the intervening Greek islands and their territorial waters and therefore violates Greek sovereign rights

Source: www.eliamep.gr

In the summer of 2023, the Greek Prime Minister ruled out any co-development of energy resources in the Aegean [11], stressing that our one and only dispute with Turkey can be resolved on the basis of international law and made it clear that if Mr Erdogan insists on rhetoric that infringes on our sovereignty and sovereign rights, "we have little to discuss, sovereignty and demilitarisation issues are off the agenda".

international community. The European Union has suspended accession negotiations and funding due to Turkey's poor human rights record and contempt for the rule of law. (Stanicek, 2020).

[11] https://businessvoice.gr/oikonomia/oikonomia-ellada/698630/k-mitsotakis-kamia-synekmetallefsi-energeiakon-poron-sto-aigaio/ Mr Mitsotakis: No coexploitation of energy resources in the Aegean, (Retrieved 2.5.2024).

Although geopolitical problems and conflict of interests appear intractable, a major development has taken place in the region with the agreement between Israel and Lebanon on the delimitation of the maritime border[12].

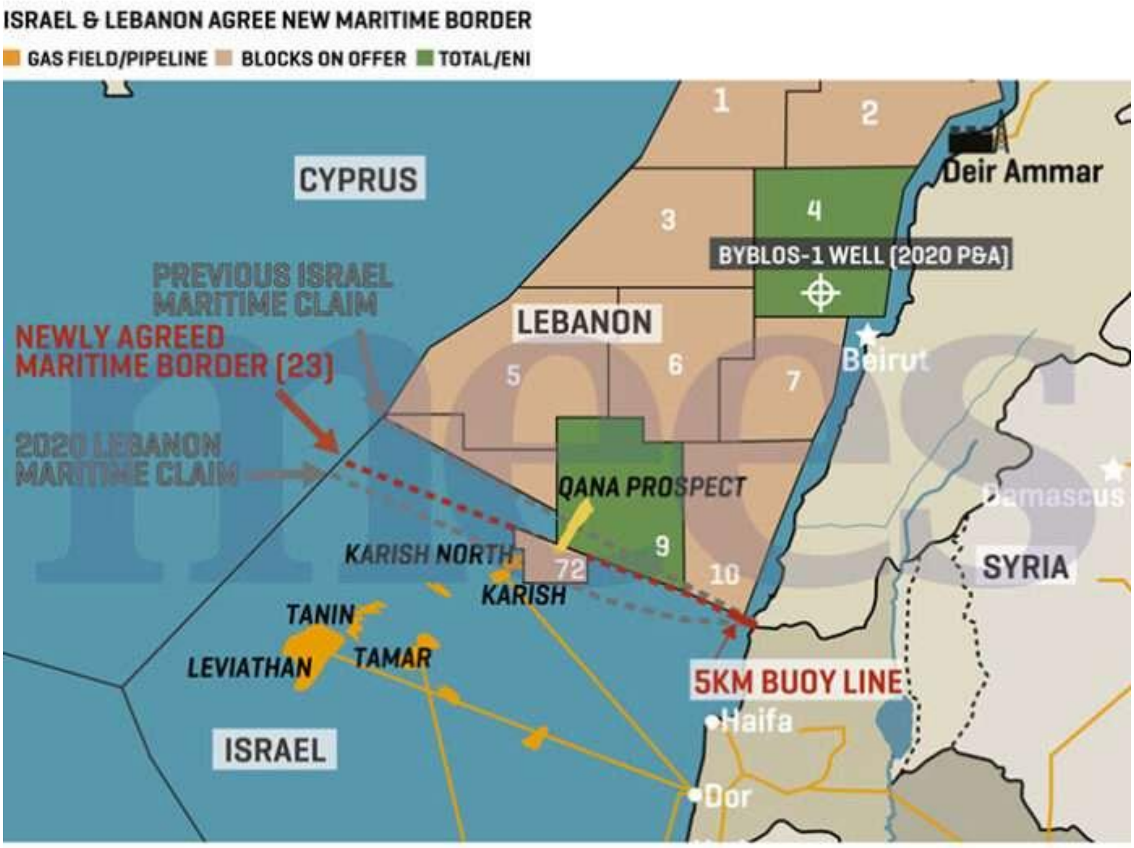

Figure 7.2 : Lebanon-Israel agreed maritime boundary

Source: www.anixneuseis.gr

The central axis of the agreement is the delimitation of sovereign rights in a sea area of 860 square kilometres, which both sides claimed as part of their Exclusive Economic Zone (EEZ). In this area, northeast of Haifa, the 'Karis' field had been identified, with the Israelis preparing to drill and Lebanon's pro-Iranian, Shiite 'Hezbollah' organisation threatening attacks if Israelis appeared in the 'Lebanese EEZ'. Details of the agreement have not been made public, but it is speculated that one country is promising to allow the other access either directly to the disputed deposits or to the revenues generated by their exploitation.

The agreement has four parts:

[12] https://www.reporter.gr/Diethnh/Diethneis-Eidhseis/540585-Ti-problepei-h-istorikh-symfwnia-Israhl-Libanoy-gia-AOZ%20(TO%20EXPLORE%20EXACTLY) What the historic Israel-Lebanon EEZ agreement provides for, (Retrieved 2.5.2024).

- Section 1 defines the exact location of the "permanent and equitable" maritime border line.
- Section 2 sets out the terms for the exploration and development of a specific cross-border hydrocarbon prospect (referred to as the "Prospect" in the Agreement).
- Section 3 deals with all other cross-border deposits that may be discovered in the future. and
- Section 4 relates to dispute settlement, ratification and entry into force.

7.2 Significant agreements

The agreement[13] on the Lebanon-Israel maritime border, although not perfect, may well be a win-win proposal if implemented in good faith, not only for Israel and Lebanon, but also for Cyprus. It can bring security, stability and mutual economic benefits. It also promotes the rule of international law, peaceful dispute resolution and regional cooperation.

Attempts at coexploitation and cooperation between states have been made in various regions of the world where there are common borders or disputed maritime areas. One such region is the North Sea, with many states that share a common maritime border having developed broad partnerships for the construction and exploitation of offshore wind farms. Gusatu, et al, (2020), in their study investigate the efficient development of energy resources to meet the 2050 targets. Previous research has highlighted the lack of suitable space (water depth above -55 m) in the North Sea, with only 3% remaining unclaimed. This limited space could accommodate 47-84 GW (3.6-6.4 MW/density), significantly less than the 180 GW required to decarbonise the power sector in the North Sea countries by 2045. Beyond technological readiness, coordination is needed across social, institutional and spatial aspects.

According to Wind Europe's central scenario, up to 48 GW of installed capacity will come online in the North Sea basin by 2030, representing more than five times the capacity of 2016. To address this growth, the assessment of multi-purpose potential

[13] https://www.ejiltalk.org/some-observations-on-the-agreement-between-lebanon-and-israel-on-the-delimitation-of-the-exclusive-economic-zone/ Some Observations on the Agreement between Lebanon and Israel on the Delimitation of the Exclusive Economic Zone, (Retrieved 4.5.2024).

and effective planning of the marine space included in the EEZs of many countries becomes crucial (SEANSEE Project, 2019).

The results of the North Sea survey showed that large-scale offshore wind infrastructure development in the North Sea faces significant constraints due to conflicts with other offshore activities. However, multiple use with fisheries and nature protected areas could increase the available space to the maximum in installed GW for the whole North Sea region. However, to support this potential, numerous studies emphasize the need for a collaborative approach, strong economic incentives and technical adaptation to be realized through an integrated planning approach (Gusatu, et al., 2020).

As can be seen from the above survey, there are no problems of national claims and disputes over EEZs and national territorial waters, even though there are many states in the North Sea with common maritime borders. However, it demonstrates that cooperation can address the multitude of other technical and environmental issues that arise when attempting to build large-scale offshore wind farm projects.

A similar co-exploitation treaty[14] was signed between Australia and Timor-Leste. The Timor Sea Treaty entered into force on 2 April 2003. The treaty set out the framework for the joint exploitation of the oil fields in the Timor Sea. However, exploitation did not take place due to a dispute between the 2 states over the percentage of revenues to which they were entitled.

The original 2002 contract is summarized below:

1. The Government of the Democratic Republic of Timor-Leste and the Government of Australia, reinforcing their desire to work together to develop the oil resources of the Timor Sea in accordance with the Timor Sea Treaty (the Treaty), will work expeditiously and in good faith to conclude an international unification agreement for certain oil fields in the Timor Sea known as Greater Sunrise by 31 December 2002.

2. The conclusion of the Agreement is without prejudice to the early entry into force of the Treaty and is without prejudice to the agreement recorded in paragraph 9 of the

[14] https://www.austlii.edu.au/au/other/dfat/special/etimor/MOU-EastTimor_17_May_02.html Memorandum of Understanding between the Government of Australia and the Government of the Democratic Republic of East Timor concerning an International Unitisation Agreement for the Greater Sunrise field. (Retrieved 7.5.2024).

exchange of notes of 20 May 2002 between the Government of the Democratic Republic of Timor-Leste and the Government of Australia, which states that the Treaty is suitable for immediate submission to the respective Treaty approval procedures and that the Parties will work expeditiously and in good faith to meet their respective requirements for entry into force of the Treaty.

7.1 The history of the new agreement in 2018

The new agreement[15] ends a decade-long dispute between the neighbours over rights to the rich oil and gas reserves of the sea. East Timor, one of the world's poorest nations, will now gain the bulk of future revenues. The countries signed the agreement at the UN headquarters in New York after negotiations at the international arbitration tribunal.

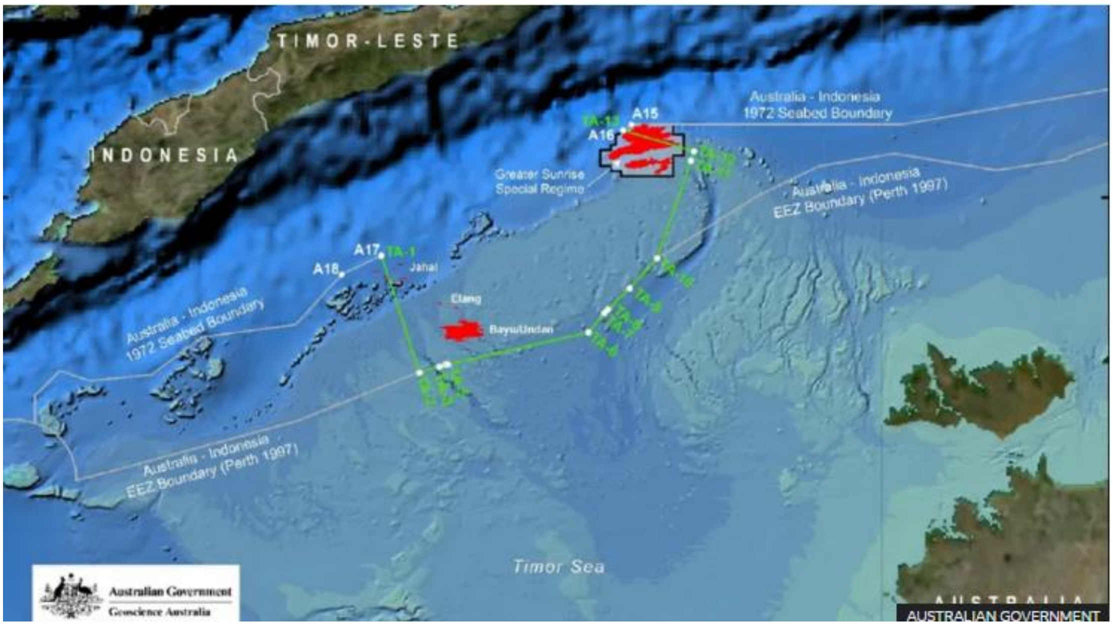

Figure 7.3: The area of oil deposits between East Timor and Australia.

Source: www.koha.net

Following the independence of East Timor, also known as Timor-Leste, from Indonesia in 2002, no permanent maritime boundary was established between Australia and the new nation. Instead, the two sides agreed to a temporary boundary, but East Timor later argued that the agreement was unfairly imposed on them. It refers to the first agreement of 2002, as shown above. East Timor believed that its more

[15] https://www.bbc.com/news/world-australia-43296488 Australia and East Timor sign historic maritime border deal. (Retrieved 7.5.2024).

powerful neighbor had an unfairly large share of access to oil and gas deposits estimated to be worth tens of billions of dollars. In 2016, Timor-Leste challenged the arrangements at the Permanent Court of Arbitration in The Hague.

The new deal means that Timor-Leste will receive at least 70% of the largest oil field, Greater Sunrise, worth around $40 billion. Previously, the revenue was to be divided evenly between the countries, according to the original treaty[16]. Australia would lose its jurisdiction over the oil fields currently shared by both nations. The new agreement is a major victory for Timor-Leste, which relies heavily on oil and gas for its economy but had been running out of resources. The Greater Sunrise oil field has yet to be mined, with a consortium of miners blaming delays in the long-running border dispute.

In conclusion, co-exploitation of natural resources is possible as long as there are no conflicts between the states involved. Various agreements that have been concluded or are planned to be concluded usually face problems due to the large economic interests involved.

In the case of Greece and the Aegean, the co-exploitation of natural resources is not a political option due to the problems created by Turkey, although the co-exploitation of wind energy produced by wind farms could be carried out in order for the two countries to benefit from the ideal wind conditions prevailing in the Aegean. A further inhibiting factor in the construction of wind farms is the increased tourism on the Aegean islands and the concerns and negative positions of environmental groups and organizations, due to the large fauna that live in the area.

Chapter 8: Conclusions

The growth of offshore wind farms in the Aegean area is heavily impacted by geopolitical conflicts, namely those that exist between Greece and Turkey. The creation and management of wind energy projects are complicated by the ongoing disputes over maritime boundaries. To settle these disputes, the thesis emphasizes the significance of international agreements and legal frameworks like the United Nations Convention on the Law of the Sea (UNCLOS). As successful precedents like the Timor Sea Treaty and the Israel-Lebanon maritime border accord show, these frameworks offer a foundation for fair resource sharing and conflict resolution.

The thesis emphasizes how important it is for international organizations, governments, and industry players to work together. These kinds of collaborations are essential to overcoming technological obstacles and realizing offshore wind resources' full potential. The thesis makes the case that the most promising course of action is collaboration, especially when it comes to joint ventures. In addition to reducing geopolitical tensions, this strategy serves the interests of nearby nations like Turkey, whose economies stand to gain from shared resource use. Significant financial incentives for regional collaboration include decreased CO2 emissions and dependence on imported fuels.

The Aegean region presents both challenges and opportunities for offshore wind energy development due to geopolitical tensions and disputes over maritime boundaries. Joint ventures and international agreements offer potential solutions but require political will and cooperation between neighboring countries.

Successful examples of international agreements, such as the Israel-Lebanon maritime border agreement and the Timor Sea Treaty, demonstrate the importance of delineating maritime boundaries and facilitating resource sharing through diplomatic means.

Aegean offshore wind energy projects need careful planning, which includes choosing locations that are appropriate and take into account factors like water depth, wind potential, and accessibility to existing infrastructure. Because of the region's distinct natural features—such as its deeper oceans than other parts of Europe—specialized technology like floating wind turbines are required. Public involvement and environmental impact assessments (EIAs) are essential elements in guaranteeing the sustainable development of these initiatives. The long-term viability of renewable energy projects depends on these procedures, which also serve to reduce possible negative effects on the environment and strengthen community support.

Adherence to international law, including the United Nations Convention on the Law of the Sea (UNCLOS), is crucial for resolving disputes and promoting cooperation in offshore wind energy development. Legal frameworks provide a basis for equitable resource management and dispute resolution.

Collaboration between governments, industry stakeholders, and international organizations is essential for overcoming challenges and maximizing the potential of offshore wind energy resources. Knowledge sharing, capacity building, and technology transfer can facilitate sustainable development.

The main goal of the first proposal is to create an Exclusive Economic Zone (EEZ) for Greece that can span up to 200 nautical miles by utilizing the United Nations Convention on the Law of the Sea (UNCLOS). The ability for Greece to exercise its rights over the abundant energy resources of the Aegean, guaranteeing sole control over the exploration and use of these resources, is one of the approach's main benefits.

However, because to the long-standing maritime conflicts with Turkey, the project faces substantial obstacles. The situation is complicated by Turkey's unwillingness to acknowledge the entirety of Greece's EEZ rights, particularly regarding island rights. The plan emphasizes how Greece's position needs to be strengthened by international assistance and legal clarity. Therefore, even though the EEZ declaration provides a solid legal framework for resource management, diplomatic discussions and international acceptance are crucial to the declaration's success.

The idea put up in the second proposal is to create energy zones in Greece's territorial waters, more precisely, within six nautical miles of the coast. By avoiding areas of difficulty with Turkey, which contests Greek rights beyond six nautical miles, the goal is to reduce geopolitical tensions. This strategy is more practical and easier to implement since it uses already-existing legal structures and carries less political risk.

The proposal emphasizes the environmental and technical factors that are essential to these projects' success. These include the choice of appropriate locations, the wind farms' financial sustainability, and the incorporation of offshore wind energy into the country's overall energy plan. Greece's renewable energy aspirations can still be greatly aided by the energy zones, even though their scope is smaller than that of the EEZ strategy. The primary disadvantage is the restricted area, which may not allow for the full exploitation of the wind potential in the area.

In the third plan, a cooperative strategy with Turkey is proposed, entailing joint resource utilization in marine areas that are under dispute. This approach places a focus on the reciprocal advantages of shared energy development, such as financial gains from revenue sharing and the fortification of regional stability via collaboration.

The Timor Sea Treaty between Australia and Timor-Leste, which enabled cooperative resource development despite early disagreements, is one example of a successful international precedent that the co-exploitation model relies from. According to the idea, a joint corporation would be established to oversee the projects, and the earnings would be allocated based on a predetermined formula. This strategy is regarded as the most practical since it aims to transform possible confrontations into cooperative possibilities. However, because of the long-standing mistrust and political difficulties between Greece and Turkey, its execution is difficult. This approach would need to be implemented with strong diplomatic involvement and confidence-building measures.

The thesis comes to the conclusion that each option has its own advantages and difficulties, and that the decision of which course of action to take will mostly depend on the geopolitical environment and Greece and Turkey's will to have a productive discourse. The EEZ statement offers a robust legal position, but there's a chance it will exacerbate tensions. Although it needs overcoming considerable political obstacles, the co-exploitation model presents a possible channel for cooperation, while the energy zones plan offers a less ambitious but safer option.

Out of the three, the third idea has been the most successful. This is due to the fact that it is the only plan that won't agitate the neighboring nation—in this case, Turkey. It will probably be on our side as well, and it will gain financially from the proceeds of the wind potential's utilization.

In conclusion, while offshore wind energy development in the Aegean region faces geopolitical, technical, and environmental challenges, international cooperation, adherence to legal frameworks, and a collaborative approach offer pathways to realizing the economic, environmental, and social benefits of renewable energy transition.

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