Department of International and European Studies
MSc in Energy: Strategy, Law & Economics

Thesis

"Latest developments regarding the offshore wind farms"

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Affirmation

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Table of Figures and Diagrams

Table of Contents

Thanks

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Abstract

In this master's thesis, latest developments regarding offshore coastal wind farms are studied. Their utilization wind power has been inextricably linked to development as it has led to vertical increasing of the potential of man in the various fields of his activity where it was used.

Wind energy is a renewable source of energy, clean and gentle on the environment, which use does not burden the ecosystems of the installation areas and replaces polluting energy sources.

In this context, this work thoroughly examines the prospects of its utilization wind energy for the production of electricity in onshore or coastal areas and specifically their interconnection in the network through an extensive reference to the special legislative framework in force in Greece, Europe and internationally.

The purpose is to highlight the course of the energy generation by exploiting the wind potential and its conversion into electricity as well as the advantages and disadvantages of the said source of energy compared to conventional methods of electricity generation. This analysis assumes familiarity with the infrastructure and the operation of offshore wind farms under the legal framework as well as practical application of energy operational projects.

Words - Keys: *wind farm, offshore, energy, law, project*

Introduction

Wind energy, along with other Renewable Energy Sources (RES) (solar, hydro, biomass, fuel cells) can contribute to the effort to deal with climate change and energy crisis since it does not release to atmosphere of pollutants that aggravate the greenhouse effect. The wind energy systems, unlike conventional ones, do not burden the environment with the dangerous pollutants of carbon monoxide (CO), the sulfur dioxide (SO2) and carcinogenic microparticles. It is estimated that in 2100 RES will cover over 70% of global energy consumption.

Under the latest legal commitments that derive from the Paris Agreement signed in 2016 to confront climate change all countries (contracting parties) are obliged to limit Greenhouse Gas Emissions in accordance with the provisions of the previously signed agreement of the Kyoto Protocol. To achieve the temperature goal of reaching net zero by the middle of the 21st century, emissions need to be cut by roughly 50% by 2030.

Sequentially the EU issued a set of policy initiatives, which aims to accelerate the goal of the energy transition, security of supply and the tackling of climate change until 2050, such as the European Green Deal, Target Model, Fit For 55, Next Generation EU, RePower EU, etc. Necessary step on the way to achieving these targets is to increase the use of renewable energy sources by sustainable way. Offshore renewable energy production is expected to contribute significantly to the achievement the objectives of the EU.

In this context, Greece is called upon to increase the penetration of RES in final energy consumption to 18% by 2020 (Petrochilou, 2011). After the issuance of Act. 4964/2022 our country achieves the establishment of a legal framework for the development of offshore wind farms by regulating special issues such as the implementation of environmental licensing. More recently in 2023, The National Energy and Climate Plan (NECP) is the country's map for the energy transition along with climate neutrality until 2025.

The contribution of wind power in Greece’s energy mix by achieving the above goals is expected to be decisive, since according to recent studies there is a wind abundance in our country which can provide the energy market with eco-friendly solutions, investment incentives, as well as perspectives of economic growth.

Theoretical Part

Unit A: ENERGY SOURCES

1. History of Energy

The universe, as we know it today, came from a grand transformation of energy into mass about 14 billion years ago. Since then our world is constantly changing. The windmill is turned by the wind that blows, the plant grows by taking food from the ground, the relief of the Earth changes with earthquakes and volcanic eruptions...

Every change requires action. To breathe, to speak, to move, you need energy. Cars, trains, all machines need energy to run. Energy does not appear out of nowhere or disappear, but is constantly changing "form" and constantly moving.

Energy is stored in some form, is converted from one form to another and is constantly moving.

As humans, we are trying to manage the Earth's energy wealth. Total energy is conserved. We don't lose energy, but we can't create energy either. But we can, with various machines, convert the energy stored on Earth into the form that is useful to us each time and benefit from this conversion.

2. Types of energy sources

2.1. Conventional Energy Sources - Fossil Fuels

Conventional energies are those derived from energy resources provided by nature. In this group we can include oil, coal, wood or natural gas, sources of energy that are limited and increasingly difficult to obtain given their high level of exploitation in the world. This type of conventional energy also pollutes a lot, emitting gases that are harmful to the ozone layer which, in turn, affect the ecosystem and living things that inhabit the planet. More and more, people are trying to use renewable energy sources that are more environmentally friendly (Koutsoubas, 2006).

Coal is produced by decaying plants and is in the form of black or brown rock. The collection of coal takes place in coal mines which are responsible for serious environmental impacts as toxic chemicals are released into the surrounding environment and seep into nearby sources. 65% of sulfur dioxide emissions, 33% of carbon dioxide emissions, and 25% of nitrogen oxide emissions in the United States come from burning coal. These quantities contribute significantly to the increase in the earth's temperature, to acid rain, as well as to the creation of many diseases. Burning oil causes less pollution than burning coal, but still quite significant. The so-called "Black gold" is widely used worldwide mainly for the movement of vehicles but also for heating. The coming depletion of its reserves makes the exploitation of renewable energy sources increasingly important to solve the energy problem worldwide. Nuclear energy is produced by the fission of uranium and plutonium atoms. Although in this case there are no emissions of harmful gases, there are serious risks for health and the environment. A possible accident at nuclear facilities would release radioactive material into the atmosphere with catastrophic results, similar to those of Chernobyl. Another serious problem is the safe storage of nuclear waste. Nuclear fission creates products that remain dangerously radioactive for thousands of years and it becomes impossible to guarantee the safe storage of this waste for such a long period of time. This is a cheap and environmentally friendly solution, but not a renewable energy source. Although natural gas reserves have been around for decades, they are still finite, so their price is going to go up, given their scarcity. Its use certainly produces harmful gases, but much less than other conventional fuels (Vagiona, 2016).

2.2. Nuclear Or Atomic Energy

Nuclear power is a low-carbon alternative and accounts for 26% of the electricity produced in the EU. However, after the Chernobyl disasters in 1986 and Fukushima in 2011, the nuclear power is strongly contested. Although Member States choose whether nuclear power will be included in their energy mix, the legislation of the EU aims to improve nuclear safety standards power plants and ensuring that the treatment and disposal of nuclear of waste is carried out in a safe manner.

The energy released during nuclear reactions. In practice the term nuclear energy is used to denote the energy released in huge quantities during nuclear fission, the splitting of atomic nuclei into lighter ones, and during nuclear fusion, the joining of nuclei to form heavier ones. Uncontrolled nuclear reactions take place during the detonation of the atomic bomb or the hydrogen bomb. Controlled nuclear reactions are used as a primary energy source for the production of electricity, as well as for the production of mechanical energy through special engines. Until 1995, the applications of engines using nuclear fuel were limited to shipping (warships, submarines, icebreakers, merchant ships - but on a small scale), while efforts were also being made to build nuclear rocket engines. However, much more important for the world economy is the use of nuclear energy as a primary energy source with the help of special devices called nuclear reactors (Mamasis, 2011).

2.3. Renewable Energy Sources

Renewable energy sources (RES) are defined as energy sources that exist in abundance in the natural environment. It is the first form of energy used by man and almost the exclusive source of energy until his beginnings previous century, before it turned strongly to the use of coal and hydrocarbons.

The interest in modern times for the development of these technologies and the wider utilization of RES was initially presented after the first oil crisis of 1973 and consolidated after the awareness of global environmental problems on last 20 years. For many countries RES are a domestic form of energy with favorable conditions prospects of contributing to the energy balance by helping to reduce dependence on the expensive imported oil and in strengthening their energy security supply. At the same time, they contribute to improving the quality of the environment in largely as it has now been established that the energy sector is a sector to blame by main hill for the pollution of the environment, since almost 95% of the atmospheric and thermal pollution is due to the production, transformation and use of conventional coal and oil fuels (Tzanakaki & Mavrioiorgou, 2005).

It seems thus, that the only possible way for the European Union to be able to respond to the ambitious goal he set in 1992 at the UN conferences in Rio on the environment and development, is to limit its carbon dioxide coal emissions until 2005.

Those systems are characterized by the term Renewable Energy Sources systems which utilize renewable energy resources to convert the energy that offered by nature in a form immediately useful for human activities (electricity, pumping, heating, etc.). Their main characteristic is that the "fuels" that they use are inexhaustible, i.e. they are renewed naturally (wind, solar radiation, etc.), which is why they are also called renewable energy systems (Greek Association of Power Producers from RES, 2015).

RES can be used either directly (mainly for heating), or converted into other forms of energy (mainly electricity or mechanical energy). It is estimated that the technically exploitable energy potential from RES is times the world's total energy consumption. But the high up to recently, price of new energy applications, technical application problems, as well as the political and economic expediencies associated with its preservation current level of development in the energy sector, prevented exploitation even and part of this potential.

The interest in the wider utilization of RES, as well as in development reliable and cost-effective technologies that engage their potential, first presented after the first oil use of 1979 as a result mainly of the repeated oil crises of the time, and consolidated in the last decade, after realizing the global environmental problems from the use classical energy sources. Particularly expensive at first, they started out as experimental applications.

Today, however, they are taken into account in their official designs developed countries for energy, due to the development of their technologies and of expanding the productive base of technology in developing countries, with a corresponding reduction of investment and production costs. They are also for the states strategic choice, since they have matured and are safe, competitive and attractive to individuals and investors. While their application contributes to the improvement of environmental indicators and in particular in the reduction of emissions and in independence from imported oil. That is, they can answer effectively in the triad of problems that concern the energy sector (Siouta, 2011):

A) inventory adequacy

B) security of supply

C) environmental protection.

Besides, in the promotion of RES contributed to the global energy market the fact that they can contribute to the energy self-sufficiency of small and developing countries, being the alternative proposal in relation to oil economy. It is obvious that countries with large reserves in primary forms of energy usually tend to use this advantage as a means of political and economic control of the rest. Example of such consequence is the political and economic situation which has established itself in Middle East.

The RES however, they are flexible applications that can produce energy commensurate with the needs of the local population, while abolishing it need for huge energy production units, but also for its transportation energy over long distances. At the same time, decentralization is supported and development of the local economy in each area where such establishments are established units. The most important benefit they can provide to an economy is related to the improvement of employment. Renewable energy sources they show amazing potential in terms of creating and maintaining positions work. Research of WWF for Biomass identifies a potential employment of the order of 170,000-290,000 full-time jobs in OECD countries from this particular renewable source alone energy. The jobs in question are estimated to be created mainly in rural, infrastructurally weak, areas and will therefore be extremely important (Papaioannou, 2017).

An additional advantage is that it is simple to build and maintain their equipment. Besides, the zero cost of raw material, combined with the small to the minimum maintenance requirements they show, it implies limited costs operation. Thus, its disadvantage to date is compensated to a large extent increased costs required for the installation of the exploitation units their. In addition, to the technical advantages of renewable energy sources included: The possibility of diversifying energy carriers, technologies and heat, fuel and electricity production infrastructure and its increase flexibility of power generation systems, so that they respond to changing electricity demand.

For each country the choice between the various available energy resources strongly depends on the physical constraints placed on each type of resource (water potential, wind potential per area, maximum average solar exposure per area unit etc). So for each resource there is a threshold of optimality performance. The financial and social criteria are summarized below which are necessary for the technical implementation of renewable resources in a country (Vagiona, 2016):

A) economic competition (KWh cost)

B) effects on employment

D) sensitivity to the prices of raw materials (oil, and other minerals)

E) environmental effects

G) social acceptance.

At this point it should be mentioned that the main types of RES are the following:

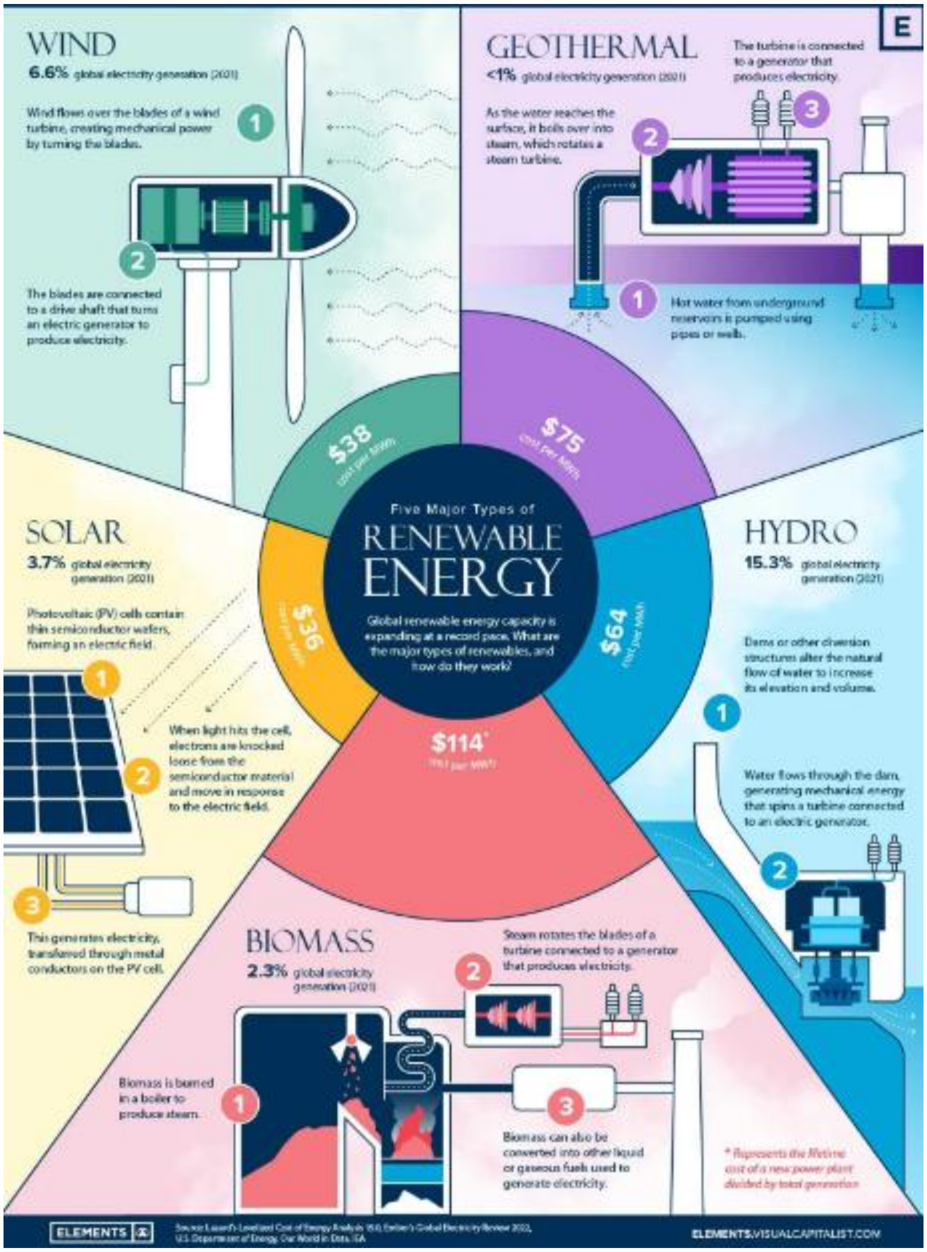
A) Wind energy

B) Solar energy

C) Hydroelectricity

D) Biomass

E) Geothermal energy.



The above infographic uses data from various sources to outline everything one needs to know about the five main types of renewable energy.

Although often not in the limelight, hydropower is the largest renewable source of electricity, followed by wind and solar. Together, the five main sources combine for about 28% of global electricity generation in 2021, with wind and solar combined breaking the 10% barrier for the first time.

Levelized Cost of Energy (LCOE) measures the lifetime cost of a new power plant divided by the total electricity output from that plant. The LCOE for solar and wind is almost one-fifth that of lignite plants ($167/MWh), which means that new solar and wind plants are now much cheaper to build and operate than new lignite units in the long term.

With that in mind, here's a closer look at the five main types of renewable energy and how they work (Kritikos, 2010):

1. Wind turbines

Wind turbines use large blades that turn a rotor, placed at high altitudes both on land and at sea, to collect the kinetic energy created by the wind. When wind flows across the blade, the air pressure on one side of the blade is reduced, pulling the blade down. The difference in air pressure on the two sides of the blade causes the blades to rotate, turning the rotor. The rotor is connected to a turbine, which in turn rotates, to convert the kinetic energy of the wind into electrical energy.

2. Solar panels (Photovoltaics)

Solar energy technologies harness light or electromagnetic radiation from the sun and convert it into electricity. Photovoltaic (PV) solar panels contain semiconductor plates, positively charged on one side and negatively charged on the other, thus forming an electric field. When light hits the cell, the semiconductor absorbs the sunlight and transfers the energy in the form of electrons. These electrons are captured by the electric field and create an electric current. The ability of a photovoltaic system to generate electricity depends on the semiconductor material, along with environmental conditions such as heat, pollutants on the panel and sunlight.

3. Geothermal energy

Geothermal energy comes directly from the Earth's core. The heat from the core boils underground reservoirs of water, known as geothermal springs. Geothermal plants typically use wells to draw hot water from geothermal resources, which is then turned into steam to drive a turbine. The extracted water and steam can then be re-injected, making geothermal a renewable energy source.

4. Hydroelectric energy

Similar to wind turbines, hydroelectric plants convert the kinetic energy from the flow of water into electricity using a turbine. Hydroelectric facilities are usually located near bodies of water and use diversion structures such as dams to change the flow of water. The production of electricity depends on the volume and change in the lift or head of the flowing water. Larger volumes of water and higher heads produce more kinetic energy and thus electricity, and vice versa.

5. Biomass

Humans have probably used biomass energy or bioenergy for heat since our ancestors learned how to make fires. Biomass essentially, organic materials such as wood, dry leaves, and agricultural waste is typically burned but is considered renewable because it can be regrown or renewed. Burning biomass in a boiler produces high-pressure steam, which spins a turbine to generate electricity. Biomass is also converted into liquid or gaseous fuels for use in transport. However, emissions from biomass vary depending on the material burned and are often higher than other clean sources.

UNIT B. WIND ENERGY

Wind energy is created indirectly by solar radiation, because the uneven heating of the earth's surface causes large masses of air to move from one area to another, thus creating the winds. It is a mild form of energy, friendly to the environment, practically inexhaustible. If it were possible, with today's technology, to make the earth's total wind potential exploitable, it is estimated that the electricity produced in one year would be more than twice the needs of humanity in the same period. It is estimated that on 25% of the earth's surface average annual wind speed above 5.1 m/sec prevails, at a height of 10 m above the ground.

When the winds blow at a speed greater than this value, then the wind potential of the site is considered exploitable and the required facilities can be made economically viable, according to today's data. After all, the cost of building wind turbines has decreased significantly and it can be considered that wind energy is going through the "first" period of maturity, as it is now competitive with conventional forms of energy. Our country has extremely rich wind potential and wind energy can become an important driver of its development. Since 1982, when PPC installed the first wind farm in Kythnos, until today wind power generation facilities with a total capacity of over 30 have been built in Andros, Evia, Limnos, Lesvos, Chios, Samos and Crete Megawatt. The private sector is also showing great interest in the exploitation of wind energy, especially in Crete, where the Ministry of Development has issued installation permits for new wind farms of total capacity (Katsaprakakis, 2008).

1. Advantages-Disadvantages Of Wind Energy

Wind energy offers many advantages, which explains why it is the fastest growing energy source in the world. Research efforts are aimed at meeting the needs for wider use of wind energy.

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Advantages

Derived from the wind, wind power is a clean energy source. Wind energy does not pollute the atmosphere like power plants that rely on burning fossil fuels, such as coal or natural gas. Wind turbines do not release chemicals into the environment that cause acid rain or greenhouse gases.

In the United States wind power is a household energy source, as the available source, wind, is abundant. The technology that is being developed around wind energy is one of the most economical that exists today in the field of renewable energy sources. It costs between 4 and 6 cents per kilowatt-hour; the price depends on the availability/provision of wind and whether or not the wind power project is funded (Kanellopoulos, 2010).

Wind turbines can be set up on farms or ranches, thus benefiting the economy of rural areas, where most of the best wind sites are located. Farmers can continue to work the land as the wind turbines only use a small part of the land. The owners of the wind energy production facilities pay rent to the farmers for the use of the land.

Disadvantages

Wind energy must compete with conventional energy sources in terms of cost. Depending on how wind active a site is, the wind farm may or may not be cost competitive. Although the cost of wind power has fallen dramatically over the past 10 years, the technology requires a higher initial investment than fossil-fired generators.

The strongest challenge in using wind as an energy source is that wind is intermittent and does not always blow when the electricity is needed. Wind energy cannot be stored (unless batteries are used). Furthermore, not all wind can be harnessed to meet electricity needs as they arise.

Suitable sites for wind farms are often located in remote areas, far from cities where electricity is needed.

The development of the exploitation of wind as a natural resource may compete with other uses of the land and these alternative uses may be more valued than the production of electricity.

Although wind farms have a relatively small impact on the environment compared to other conventional energy production facilities, there is a concern for the noise produced by the electric motor (rotor) blades, for the aesthetic (visual) impact and for the birds that sometimes they have been killed flying towards the electric motors. Most of these problems have been solved or significantly reduced through technological development or through the selection of suitable areas for the establishment of wind farms (Katsaprakakis, 2008).

Offshore Wind Farms

Offshore Wind Farms are a technology tested in the North Sea, which can give very interesting ramifications to national interests. Before analyzing their importance for the national strategy, reference should be made to their two categories: floating and fixed-bottom.

Fixed foundation wind turbines, by definition, are founded on the seabed unlike floating wind turbines which are designed to be held in place by fixed mooring points (anchors). It is therefore clear that the wind turbines with a fixed foundation are anchored on the continental shelf, while the floating ones are located on the water column above it.

This difference is extremely important: As Greece has not demarcated its continental shelf with Turkey, the installation of Fixed Foundation Wind Turbines becomes problematic. However, Article 87 of the Convention on the Law of the Sea defines the freedoms of coastal states in international waters: the right of navigation, overflight, laying of submarine cables and pipes), the construction of artificial islands and other installations, fishing and scientific research. Given the non-declaration of an EEZ by Greece to date, the sea zones located beyond 6 n.m. from its coastline are considered international waters (high seas) (Koutsoubas, 2006).

Greece may therefore consider the possibility of installing floating Wind Turbines (falling under the category of "other installations") and connecting them to the insular or continental grid, without first declaring an Exclusive Integrated Zone. Of course, any other coastal state has the same right, but in the case of Greece, the energy isolation of its islands and the need to meet the RES penetration targets that have been set make such a move justified.

On the other hand, the existence of many Greek islands opposite the Asia Minor coast cuts off the continuity of Turkish waters - international waters in many places, making a corresponding Turkish attempt more difficult and financially problematic. What is sought for Greece in this case is the registration of a future mortgage for the declaration of the Exclusive Integrated Zone and the creation of a deed which will provide leverage at the negotiating table or in the courtroom, if ever needed.

It is, of course, naïve to think that these moves on the part of Greece will go unnoticed by the opposite side. Turkey's reaction is expected, just as it was expected in the effort of the Republic of Cyprus to explore the underwater wealth of its own Exclusive Integrated Zone. However, this does not mean that it is not manageable. Greece can act in ways that will balance possible reactions:

Careful selection of the islands to qualify for economic exploitation. Turkey has spread the sheet of its disputes in areas that are far from its shores and reach as far as Gavdos. The installation of Wind Turbines on rocky islands whose sovereignty status it does not accept, but which are located far away from it, does not significantly increase the tension and constitutes a practical challenge to its claims.

Development of offshore Wind Farms in sea blocks east of the 25th Meridian, in areas with a density of Greek islands (e.g. Cyclades), located in international waters between 6 and 12 nm from the coastline. In this way, multiple objectives are achieved: a) de facto undermining of the Turkish claim for influence in the Aegean east of the 25th Meridian b) registration of a future mortgage for the extension of territorial waters to 12 nm and the rendering of the largest possible Exclusive Integrated Zone) ensuring energy absorption of a large amount of energy through the existing and future electrical interconnections and the significant Wind Power (Kritikos, 2010).

2. Wind Energy In Europe And Greece

The data comes from the European Wind Energy Association (WindEurope) and is reflected in the publication entitled "Wind energy in Europe – 2020 Statistics and the outlook for 2021-2025", published in 2/2021.

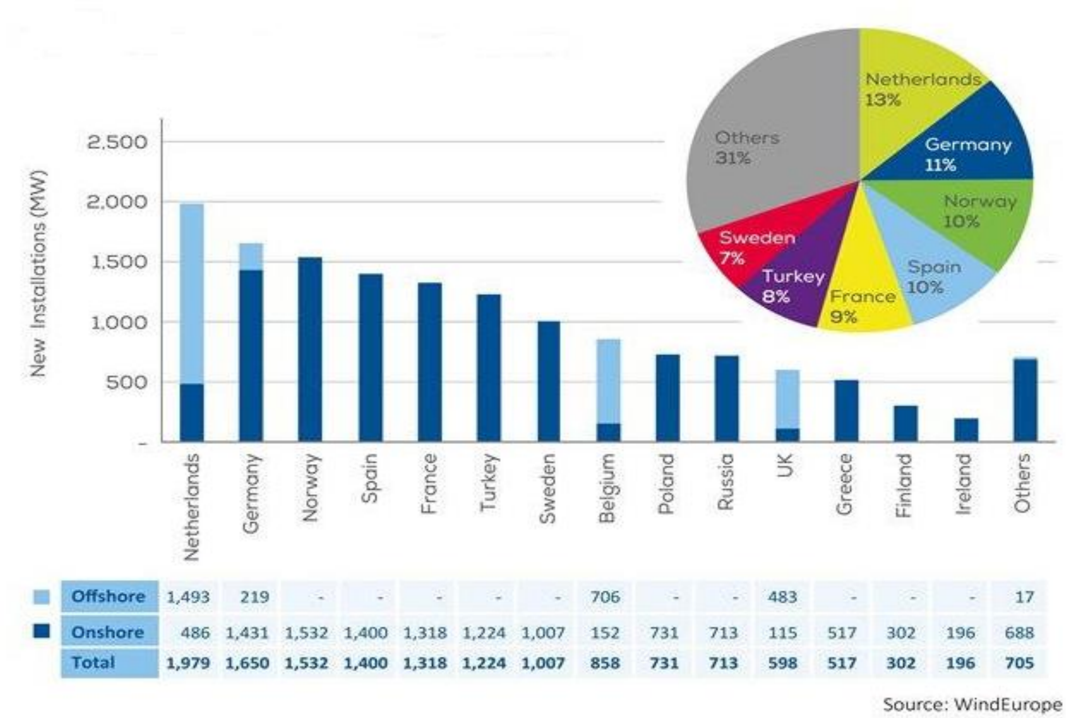
In Europe, a total of 14.7 GW (14,700 MW) of new wind farms were installed in 2020. In the European Union, 10.5 GW (10,500 MW) were installed and covered 16% of the electricity consumed (EU 27 and UK) (Katsaprakakis, 2008).

In Europe today the total installed capacity is 220 GW (220,000 MW)

The figure below shows the new installed capacity in Europe for 2020.

A new 517 MW were installed in Greece, with the first countries: Holland, Germany, Norway, Spain, France and Turkey.

The figures below show the picture of wind farm installations in Europe for 2020.



	Netherlands	Germany	Norway	Spain	France	Turkey	Sweden	Belgium	Poland	Russia	UK	Greece	Finland	Ireland	Others
Offshore	1,493	219	-	-	-	-	-	706	-	-	483	-	-	-	17
Onshore	486	1,431	1,532	1,400	1,318	1,224	1,007	152	731	713	115	517	302	196	688
Total	1,979	1,650	1,532	1,400	1,318	1,224	1,007	858	731	713	598	517	302	196	705

Figure 1: New onshore and offshore wind installations in Europe in 2020

The five countries with the most installed wind capacity are:

- Germany – 62,627 MW – covered 27% of the annual total electricity consumption.
- Spain – 27,264 MW – covered 22% of the annual total electricity consumed.
- France – 17,949 MW – covered 9% of the annual total electricity consumption.
- Italy – 10,852 MW – covered 7% of the annual total electricity consumption.
- Sweden – 9,992 MW – covered 20% of the annual total electricity consumption.

Indicative for Greece and Cyprus we have:

In 2020, Greece had an installed wind power equal to 4,113MW – it covered 27% of the annual total electricity consumed.

Cyprus had in 2020 an installed wind power equal to 158MW – it covered 6% of the annual total electricity consumed.

The table below shows by country, the new installed capacity for 2020, the total installed capacity and the share of wind energy coverage of the electricity consumed for 2020.

Table 1: New installations and cumulative capacity in 2020

EU-27 (MW)	NEW INSTALLATIONS 2020			CUMULATIVE CAPACITY			SHARE OF WIND IN 2020		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Austria	25	-	25	3,120	-	3,120	12%	N/A	12%
Belgium	152	706	858	2,459	2,261	4,719	5%	9%	14%
Bulgaria	-	-	-	691	-	691	4%	0%	4%
Croatia	152	-	152	803	-	803	10%	0%	10%
Cyprus	-	-	-	158	-	158	6%	0%	6%
Czechia	-	-	-	337	-	337	1%	N/A	1%
Denmark	136	-	136	4,478	1,703	6,180	30%	19%	48%
Estonia	-	-	-	320	-	320	11%	0%	11%
Finland	302	-	302	2,515	71	2,586	9%	0%	9%
France	1,318	-	1,318	17,947	2	17,949	9%	0%	9%
Germany	1,431	219	1,650	54,938	7,689	62,627	22%	6%	27%
Greece	517	-	517	4,113	-	4,113	15%	0%	15%
Hungary	-	-	-	329	-	329	2%	N/A	2%
Ireland[7]	196	-	196	4,326	25	4,351	38%	0%	38%
Italy[8]	137	-	137	10,852	-	10,852	7%	0%	7%
Latvia	-	-	-	66	-	66	2%	0%	2%
Lithuania	-	-	-	548	-	548	13%	0%	13%
Luxembourg	30	-	30	166	-	166	N/A	N/A	N/A
Malta	-	-	-	-	-	-	0%	0%	0%
Netherlands	486	1,493	1,979	4,174	2,611	6,784	9%	3%	12%
Poland	731	-	731	6,614	-	6,614	9%	0%	9%
Portugal	4	17	21	5,461	25	5,486	25%	0%	25%
Romania	-	-	-	3,029	-	3,029	12%	0%	12%
Slovakia	-	-	-	3	-	3	0%	N/A	0%
Slovenia	-	-	-	3	-	3	0%	0%	0%
Spain[9]	1,400	-	1,400	27,259	5	27,264	22%	0%	22%
Sweden	1,007	-	1,007	9,801	192	9,992	20%	0%	20%
Total EU-27	8,024	2,435	10,459	164,510	14,583	179,093	13%	2%	15%

OTHERS (MW)	NEW INSTALLATIONS 2020			CUMULATIVE CAPACITY			SHARE OF WIND IN 2020		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Bosnia & Herzegovina	48	-	48	135	-	135	N/A	N/A	N/A
Kosovo	-	-	-	32	-	32	N/A	N/A	N/A
Montenegro	-	-	-	118	-	118	N/A	N/A	N/A
North Macedonia	-	-	-	37	-	37	N/A	N/A	N/A
Norway	1,532	-	1,532	3,977	2	3,980	7%	0%	7%
Russia	713	-	713	905	-	905	N/A	N/A	N/A
Serbia	-	-	-	374	-	374	N/A	N/A	N/A
Switzerland	12	-	12	87	-	87	N/A	N/A	0.2%
Turkey	1,224	-	1,224	9,305	-	9,305	8%	0%	8%
Ukraine	144	-	144	1,314	-	1,314	N/A	N/A	N/A
UK	115	483	598	13,740	10,428	24,167	N/A	N/A	27%
Total others	3,788	483	4,271	30,023	10,430	40,453	N/A	N/A	N/A
Total Europe	11,813	2,918	14,731	194,533	25,013	219,546	13%	3%	16%

6. All numbers are rounded and therefore may not add up.
7. Irish figures are an estimate.
8. Italian figures are up to 31 October 2020.
9. Spanish figures are an estimate from Red Eléctrica de España.

Wind energy in Europe - 2020 Statistics and the outlook for 2021-2025
WindEurope

As previously mentioned wind energy covered 16% of the annual total electricity consumption in the European Union and the United Kingdom.

In the five highest positions in terms of covering the annual electricity consumption (as can be seen from the figure below) from wind farms are:

- Denmark with 48%
- Ireland with 38%
- Germany with 27%
- United Kingdom with 27%
- Portugal with 25%
- Greece is at 15%.

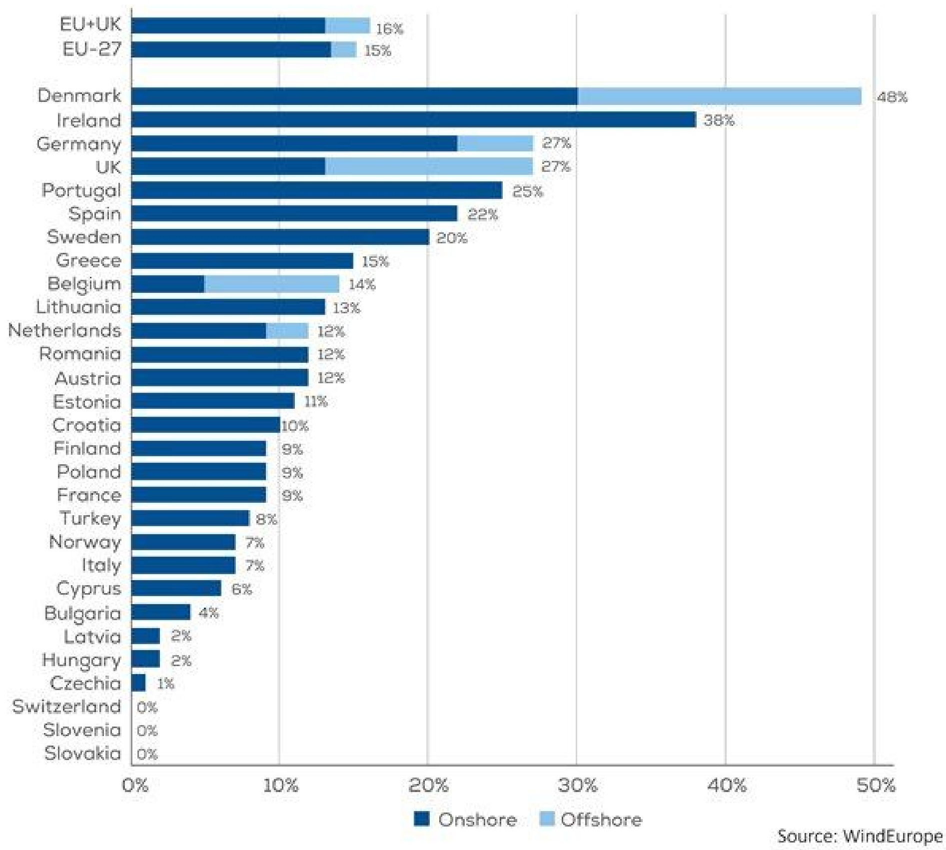


Figure 2: Percentage of the average annual electricity demand covered by wind

3. Current State Of Wind Energy Production

105GW (105,000 MW) of new wind farms are expected to be installed in Europe in 2021-2025 under existing National Government target commitments, of which 70% will be onshore.

The figure below shows the estimates of the annual new installed wind capacity for the period 2021-2025.

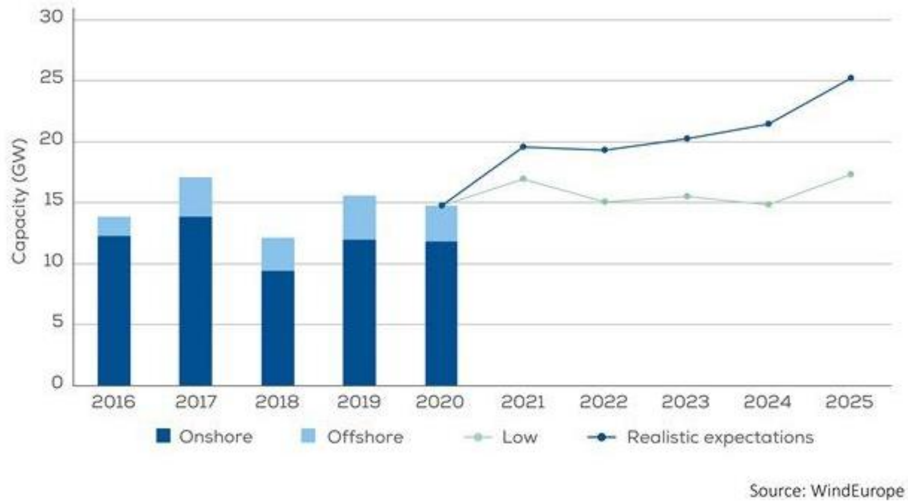


Figure 3: 2021-2025 new onshore and offshore wind installations in Europe – WindEurope's scenarios

The European Union of 27 is estimated to install 75 GW (75,000 MW) by 2025 at a rate of 15 GW (15,000 MW) per year.

72% of the new installations will be onshore and 28% offshore wind farms.

Germany is estimated to install 16,000MW of new wind capacity, France 12,000MW, Sweden 7,000MW and the Netherlands 6,000MW.

RES and especially wind farms have a bright future and strong prospects to continue their successful course in Europe.

In conclusion, after quoting all these statistics from reliable sources it is easy to conclude that wind energy is competitive, rapidly growing and is the solution for a safe, reliable and economical energy source for the European continent.

4. Latest Wind Energy statistics and developments

In 2022, renewable energy covers 23 % of overall energy consumed in the EU. The share of renewable energy in electricity consumption was even higher, at 41.2 %, while wind power covers 37.5 % of the total electricity generated from renewable sources (a significant increase from 4.9 % of all renewables in 2000). The share of wind in electricity production was 16 % (14% onshore and 2% offshore). According to a 2023 Wind Europe report, in 2022, the total installed wind power capacity in the EU reached 204 GW, with 188 GW onshore (92 %) and 16 GW offshore (8 %). The capacity of wind power varies across EU Member States. The countries with the largest offshore wind capacity are Germany, the Netherlands, Denmark and Belgium. Wind is considered to holds the highest share of electricity mix in Denmark (55 %), Ireland (34 %), Germany (26 %), Portugal (26 %), Spain and Sweden (both 25 %).

Furthermore, European countries like Denmark and Belgium are intented to build Artificial islands in the North Sea in order to install offshore wind farms and therefore to produce clean energy. The company Copenhagen Energy Islands with the support of the Copenhagen Infrastructure Partners group wants to invest 150 billion euros over the next decades so as to develop a series of such islands, which will have very large wind turbines installed for electricity as well as contribute to the production of green hydrogen[1].

5. Map of the biggest offshore wind farms globally

The new project of The Hornsea 3 development of Orsted's largest offshore wind farm site is a big innovation. The project, which will be built off the British coast and will have a capacity of 2.9 GW, is due to be completed by the end of 2027. The project is seen as important to Britain's energy security and rapidly increase renewable energy production in order to achieve its climate goals .

[1] https://www.tanea.gr/2024/01/26/economy/etoimazoun-texnita-nisia-crgia-yperaktia-aiolika-parka-online/

The wind farm, which will be located 160 km off the coast of Yorkshire, is expected to supply electricity to more than 3.3 million households. (Article “Real Estate and Development”)[2].

Europe is a at the helm of developments in the exploitation of offshore wind energy with the northern countries leading the race. Following the outburst of the energy crisis and the geopolitical explosion with the war in Ukraine, combined with the necessary "green" turn due to the climate crisis, the " map" of energy has changes and renewables are gaining strategic priority. After Horsea 3, next is Moray East, again in the UK, which is 950MW, commissioned this year and includes 100 Vestas wind turbines.

In fourth place in terms of capacity is the 857 GW Triton Knoll in the UK, which came on stream in 2021 and includes 90 Vestas wind turbines.

It is followed by Borssale 1&2 in the Netherlands, with a capacity of 752 MW from 94 Siemens Gamesa wind turbines, commissioned in 2020, and then the "little brother" of Borssale 3&4, -also in the Netherlands-, with a capacity of 731.5 MW and with 77 Vestas wind turbines, which went into operation in 2021.
It follows East Anglia One, which, as its name suggests, is located in the United Kingdom and went online in 2020. It has a power of 714 MW and is equipped with 102 Siemens Gamesa wind turbines.

Finally in the list of the 10 largest offshore wind farms is the 605 MW Kriegers Flak in Denmark, which came on stream in 2021 and includes 72 wind turbines[3].

6. Legal Status

The legal situation regarding the granting of licenses is mainly determined by whether the relevant sea area is within the area of territorial waters, i.e. within of the 12-mile zone, or

[2] https://www.ered.gr/real-estate-news/to-megalytero-yperaktio-aioliko-parko-pagkosmiws
[3] https://www.newmoney.gr/roh/palmos-oikonomias/energeia/afta-ine-ta-10-megalitera-iperaktia-eolika-parka-ston-kosmo-pics/

beyond that limit. Of course the legislative regulations they differ from country to country. In particular, each plan must follow the others national regulations. In some countries, such as Germany, the same are required licensing criteria and legal authorities as on land. At the same time you must there is also the agreement and permission from the respective organizations concerning the flora and fauna as well as the protection of areas with endangered birds. The regional authorities are typically responsible for issuing building permits as well on land (Aligizaki, 2023).

For construction operations on the seabed (foundation, marine cables), there are also regulations to be followed. The legal situation in its exclusively economic zone is much less clear and leads to a debate about the principles of international law, regardless of the location of the wind turbines. All national and European laws apply strictly up to the limit of territorial waters. Some countries are inclined to make it possible to simplify the method of administration licenses in the exclusive economic zone.

7. Licensing Procedure

At the start of the debate on the siting of wind turbines at sea, the prevailing opinion was that for the open sea one could escape from the Licensing constraints on the use of wind energy that exist for land. When the first plans became known and the public debate began immediately it became clear that this it was a false hope. Thus there are geographical and environmental conditions which must be taken into account, while the legal situation also differs from country to country.

8. Licensing Criteria

The criteria based on which the permit application for the installation of wind turbines considered are the following (Kritikos, 2010):

- Traffic safety for water and air transport
- Ecological effects
- Violation of the financial interests of third parties.

The certificate application must be made with the usual documents to the relevant authorities, accordingly with whether the location is within territorial waters or outside the 12-mile zone.

The authorities will ask the competent offices and the associations involved a first observation. When considering the environmental conditions, the application must contains the necessary assessments and examinations by recognized persons or organizations. Based on this situation, the competent authority will decide on it completeness of the application and, if the decision is positive, will grant the necessary permission construction, in accordance with the current building construction legislation.

The necessary criteria for the license are as follows (Kritikos, 2010):

Traffic safety for water and air transport

Most of the time the areas near the coasts are shipping routes. Attention must be paid not only to civil water transport but also to its use areas from the military for exercises or facilities. Civil aviation is less of a problem, but possibly require wind turbine height restrictions as well as visual - electronic warning signals.

Ecological effects

The key words according to which the ecological effects are examined are:

Birds: bird migration, bird collisions, breeding areas, sources bird food, etc.

Marine mammals (small whales, seals): disturbance of animals by the submarine sound of the emissions and possibly from electric and magnetic fields coming from them from the wind turbines.

Fish: effect of their spawning and feeding grounds, changes in the oceans

currents and on the nature of the bottom due to foundations and possible influence on behavior of fish.

Small life forms on the bottom of the sea: negative effects on each habitat particularly during building operations.

Preservation of the landscape: the projection of wind turbines from the ground (visual nuisance).

Meanwhile, the visibility from land seems to have preoccupied the ecologists organizations and the tourism industry to a large extent. In Denmark, for example, due to the distance from the coast the visibility is minimal and in fact when the atmosphere is quite clean. The situation is similar in Germany. It must to emphasize that, due to the curvature of the earth, the wind turbines will disappear from the horizon at a distance of 20 to 30 kilometers, in any case.

Financial interest

When a new field appears, it must be delineated with existing economics interests. More special cases are the following:

- Obstruction of fishing
- Preventing any possible exploitation of the mineral wealth
- Observation of already existing infrastructure facilities (oil pipelines and natural gas, marine electric cables, etc.).

9. Technical Requirements of Offshore Wind Turbines

The first condition for the successful utilization of wind energy is the appropriate design and the technical equipment of the wind turbines. The existing ones wind turbines were designed for installation on land. The wind turbines that are at sea are subjected to different external conditions that must taken into account in the design (Kritikos, 2010):

Tower height

To make use of the high wind speed, the offshore towers wind turbines need not be as tall as those in inland areas. The wind speed profile has more than one swell, so that the lower tower height to be sufficient to achieve optimal economic value. The height of the tower is also determined by the oceanographic conditions in relation to the diameter of the rotor diameter. Factors to consider are the water depth, tidal range, maximum wave height expected and sufficient space for the impeller.

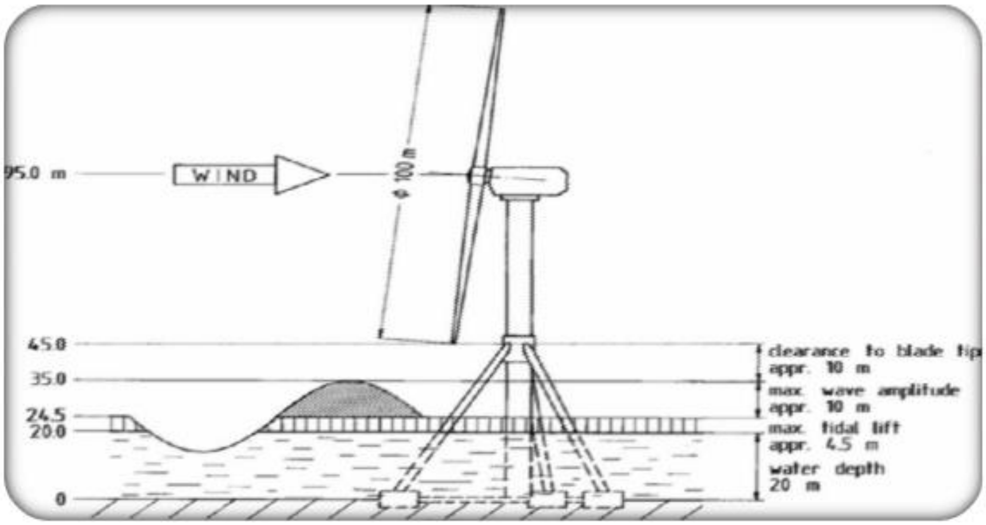


Figure 4: Water levels in the North Sea in relation to the tower height of a wind turbine.

<u>Load spectrum</u>

Loads to be considered when designing offshore construction differ significantly from those on land:

- The average wind speed is higher.
- Turbulence intensity over the open sea is less, but a higher induced turbulence is expected depending on the distance of wind turbines.
- Wave motion of water is a new important effect. That's true both for the extreme loads and the dynamic response of the journals of waves.
- Sea ice movement can lead to very high and extreme loads, especially in the Baltic. Additional ice training on wind turbine must be considered.
- The change in sea level height due to tides may have an effect on the load spectrum.
- In some sea regions, the currents can be so strong which play a role in the load spectrum.
- Sea currents can affect the foundation of the layout.
- Increased corrosion - if not prevented by appropriate protective measures meters - plays an important role and reduces the resistance of components of the arrangement.

An important aspect is the superposition of wind and wave loads on its spectrum load, since it affects the strength in the dynamic design of the structure. So his load wave mainly affects the tower and foundations, while the wind load affects the rotor and the mechanical drive system. It is noteworthy that the superposition of wind loads and wave affects the structure less than if the loads were independent. The reason lies in the aerodynamic damping of the moving rotor due to the movement of the waves something similar to the way a sailboat's sails are dampened by the movement of the ship when there are waves.

Turbine equipment

Compared to onshore, offshore wind turbines have more requirements in terms of their technical equipment. Their main differences concern the following characteristics:

- Much greater corrosion protection in almost all structural data.
- Spindles with better sealing.
- Closed cooling system for the generator.
- Monitoring and control systems that can
- rescheduled from land.
- Existence of a special crane on the fuselage to facilitate it maintenance and repair.
- Special lifting tools on fuselage and tower for heavy items and loads.
- Docking platforms for maintenance vessels with special reinforcements access in case of rough seas.
- Lighting, according to the rules at sea.

Foundation of Offshore Wind Turbines

The most difficult adjustment required for seating the arrangement concerns the design of the tower and its foundation on the seabed. The specific foundation is obviously more complex than the counterparts on land. In bigger ones water depths, the required design and construction work may lead to financial deviations of the total investment. Its basic static principle foundation of the wind turbines is based on whether the stability due to the size and depth of the foundations or whether it will need to additional reinforcements or supports should be placed on the bottom. The compaction of wind turbines at the bottom of the areas to be settle is a job that requires special study from many sides.

In Greece there are many peculiarities that we need to get a study like this kind of seriously. The main issue that applies to every such construction is the seismic prevention. Our country is characterized as a fairly seismic region and this brings a special attention to any static study. A reason that makes more such a specific study is also the changes of the bottom material of each area. Many times the materials that make up the relief of the underwater area change. This can be from a flat sandy area to a rocky one full of rocks and dry.

The foundation of a wind farm depends on the depth of the bottom, its type available subsoil but also the availability of special equipment for construction transportation as well as placement of the various types of foundations. The weight of each foundation depends mainly on the material that will be used for its construction (concrete or steel) but also the way it will rest on the bottom. The last the criterion for any solution is the cost. Among the criteria set for the preliminary zoning of offshore wind farms in Greece, is also the maximum permitted depth of 50 meters which excludes floating wind turbines and large ones sea depths.

However, the technology for greater depths exists from the pumping industry oil and bridge building but also in new forms which are evolving this year period. The types of foundations that have been used in respective applications in other countries such as Denmark and the United Kingdom are introduced and explained below.

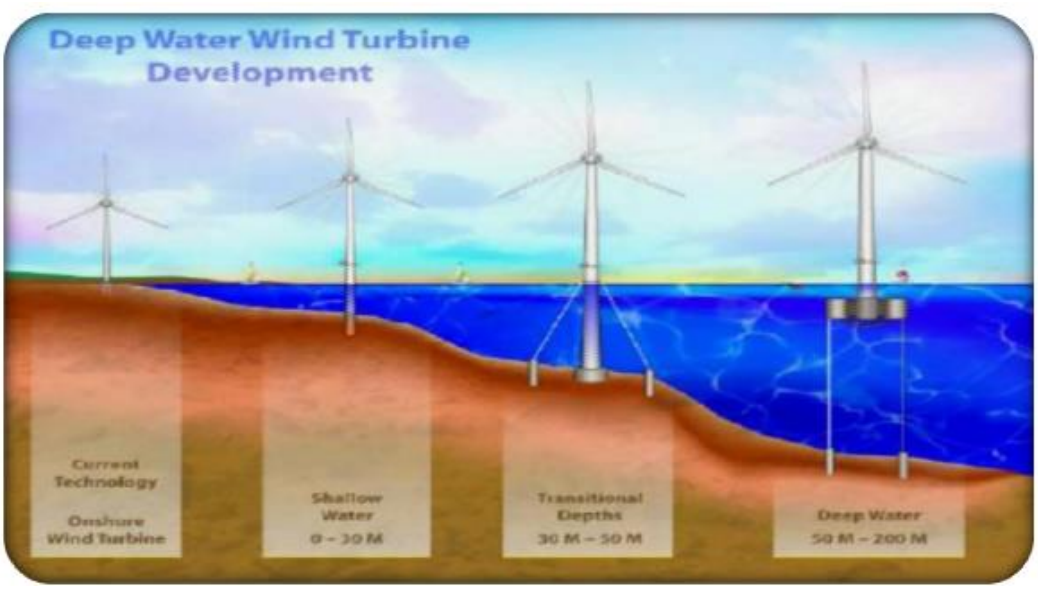


Figure 5: Different types of foundations.

Construction Materials for Offshore Wind Turbines

In investigations that have been done to compare steel and reinforced or prestressed of concrete from a group of energy companies and three construction companies in 1997 it was found that steel was much more economical than concrete for large wind farms. It also appeared that the newer foundation technologies that were more economical for at least 15 meters depth. In any case the use of steel and the piled foundations showed that their costs rose to much less ratio with respect to that of concrete gravity foundation which as mentioned above had a cost proportional to the square of the foundation depth. Indicative is that the calculated cost of interconnection to the network and its construction foundation for 1.5 MW wind turbines found only 10 to 20% greater than that of the 450 KW installed in the Vindeby and Tunoe areas.

On the contrary, in corresponding investigations carried out by the British concrete center the 2007 found that concrete gravity foundations for larger wind turbines of the order of 3.5 MW and for depths of 20 to 30 meters was competitive with the rest steel solutions.

However, it should be noted that the perception that steel has a short life span is due to corrosion, proves to be non-existent since the oil extraction industry with the use of steel cathodic protection, uses such constructions with predicted time life 50 years. However, concrete can, with appropriate processing, also maintenance to reach 100 years of life. This would mean a significant cost reduction since the foundation and pillar which is 40% of the construction cost will be needed one less replacement in this period. In addition, concrete due to weight of and of its nature generally gives larger eigenperiods and coefficients depreciation which is what is required for these constructions.

In conclusion, it is obvious that the choice of the type and the material of its construction foundation is a function of many factors and must be preceded by a special study for finding the best economic solution that will take into account the sizes of wind turbines, the economies of scale, the available means of construction, transportation and installation of the foundations but also the soil, the depth, the erosion and in general the conditions prevailing at sea.

Transportation & Installation of Offshore Wind Turbines

The transportation, installation and operation of wind turbines at sea has special requirements and above all they cost much more than wind installations energy on land. The first difficulties appear in the transfer of the tower and its rotors, exceeding 50 meters in length, for such long distances from land. The same is true in cases of transferring complex structures, such as for example the foundations of many pillars.

For economic reasons parts of the wind turbines should be prefabricated on land in order to avoid costly work at sea with the uncertainties in timing and weather conditions. In all these you must take into account the size of both the workshop and the machines that will be needed. A heavy-hydraulic hammer is required in a single-pillar foundation in order to lay the steel pipes with a diameter of 4 meters in the sea at a depth of about 20 meters. Assembling the tripod base requires less heavy equipment. However, it is more difficult to transport the prefabricated part of the foundation. Weather conditions are an important risk factor for assembly as this can only be done when the sea is calm. The more important criterion is the wave height during the connection. the projects they become extremely difficult to impossible when the wave height exceeds one measure, resulting in their temporary interruption. Something like this implies something more cost of operations.

Transportation to the site is usually done via a floating platform and with the assistance of a towing vessel. Platforms have support pillars which they rest on the bottom for greater stability during assembly work. During transport the support pillars are obviously packed. Another important one the problem is the accessibility of workers and managers in the field of wind power park. In case of heavy seas, the ship cannot reach pier. So lately attempts are being made to access underwater or by air, respectively with underwater vehicles or helicopters.

Development Of Offshore Wind Farms Parks

Advantages – Disadvantages of Coastal A/P Development

Offshore wind farms are not a panacea, they have advantages as well disadvantages. Advantage is that at sea there are stronger winds and also, since the energy produced varies with the cube of its speed of wind, it is estimated that each offshore wind turbine produces enough energy to one time, in order to cover the needs of approximately 1,500 households, while at the same time limiting by 35,000 tons of carbon dioxide production.

Another advantage is that on board the turbulence is lower than on land. This is due to the smaller temperature variations in the vertical plane than in terrain. Lower turbulence can result in longer lifespan of the wind turbine and therefore economically viable construction. The lowest turbulence also means that the blades are flapping at a speed higher than on the ground. Coastal air resources with their low turbulence increase the duration lifetime of the wind turbines on a possible scale of 25 to 30 years. If we assume a program life, for example, 25 years instead of 20, this makes the costs maintenance about 9% lower. Therefore, if its life time is also taken into account, which at sea is 25 years older, its great importance emerges exploitation of wind energy for the protection of the environment.

Another motivation for developing coastal parks is the difficulty of finding enough of them of suitable wind farm areas on the ground, especially in the densely populated and relatively flat province of a country. Also the presence of array of trees has as resulting in zero wind speed up to the height of the top of the trees.

Finally, the adjacent buildings are another type of obstacle, given that the their presence disrupts the wind flow field to a significant extent. So knowing that for the correct aerodynamic behavior of a wind machine the impeller is appropriate of the wind turbine to be outside the field of influence of any surface obstacles, we conclude that during the operation of marine WF we have a maximization of it of available kinetic energy of the wind, the flow field is free and its turbulence wind is the minimum possible. It is therefore appropriate to choose marine areas for the development of wind farms without the problem of the influence of surface obstacles. Coastal air quality can therefore ensure better standards operation in the WF which means fewer hours outside but also more economical maintenance costs of wind turbines. Can the cost of installing the WF to is burdened due to the sea of the area but the amortization of the cost of of work will theoretically be at the same, maybe even lower, level as the terrestrial one since the quality of operation of the coastal WF is clearly better than that of the land. The process of planning, creating and operating offshore wind farms and respectively of the management bodies, create the following activities which in turn they create new jobs.

Onshore wind power is a bit more expensive than conventional power. But if we consider the environmental costs of fossil fuels and internalize we will discover that such programs are very competitive.

Their disadvantages include the higher cost of their construction, maintenance and their operation. At sea, the construction of the project costs 50% more compared to an onshore wind farm of similar capacity, as large funds both for its installation (positioning on the seabed) and for its connection via submarine cable to the mainland electrical system. Wind turbines must be resistant to storms, high waves and salt water. Precisely because of the cost, a higher selling price has been predicted for it of generated electricity to DESMIE, which is 93 euros/MWh. In continental wind farms this price is 75.82 euros/MWh for those located in interconnected system and 87.42 euros/MWh for those located on islands.

In Greece, few sea areas meet the specifications, which is the shallow depth a few kilometers from the coast. In addition, a serious obstacle in our country is also the infrastructure of the electrical system, the lack of serious zoning framework and the licensing process.

Finally, another disadvantage is the environmental effects. The effects of offshore wind farms in the environment differ significantly, depending on the location, the number, the layout of the wind turbines, the type of foundation and the ones used construction materials. Short-term effects will occur during the stages construction and decommissioning of the wind farm, while smaller, but larger duration during its operating phase. However, studies are ongoing on monitoring and ascertaining the environmental effects on environment while at the same time there are indications of the environmental benefits that can arise from offshore electricity production.

Special Part

A. The Legal Approach Of Offshore Wind Farms

1. The Concept Of Integrated Coastal Management Zones In International And European Texts

The concept of integrated and sustainable coastal zone management was born in 1992 in the context of the Rio World Conference and specialized further in the context of Agenda 21, and specifically in chapter 17 thereof. Initially, the US, facing multiple challenges from the ever-increasing development of their coastal areas and recognizing that the safeguarding of access to clean water and the maintenance of healthy ecosystems, which they support and keep the coastal economy alive, is a combined effect of it of science, technology and public policy, established in 1972 the "Act Management of coastal zones" (The Coastal Zone Management Act - CZMA) sub under the auspices of the National Oceanic and Atmospheric Administration (NOAA), with the aim of preserving, protecting, strengthening and safeguarding, if possible, the valuable natural coastal environment of the country. First, adopting principles for the Integrated Coastal Area Management (Integrated Coastal Area Management-ICAM), particular emphasis was placed on the wider area of the archipelago of the Caribbean complex that constitutes, due to the incomparable quality and amount of its natural reserves, an area of high ecological importance, but at the same time extremely sensitive, as it shows from the highest percentages tourist traffic worldwide. Subsequently, the concerted effort, mainly scientific, but also political, bodies, led in the long term, not only in the theoretical conception, but also in the full implementation of one, long-term planned, Integrated Maritime Policy.

The beginning was made with planning of marine protected areas in the Atlantic Ocean (Marine Protected Areas- MPA's), which, in turn, evolved into processing and full implementation of Marine Spatial Planning (UNEP/CEP, 1996), with the aim of achieving a wider network of protection of the marine environment and promoting the maritime economy in the region (Ogden, 2010). The specific of fundamental importance, practices were a guide for the undertaking of counterparts initiatives in Europe as well. Specifically, the definition of Marine of Protected Areas (MPA's) as early as 2008, which covered, until 2012, 5.9% of the total surface of the European seas, while roughly, that is, the extent of the German state, against the extremely ambitious target of 10% coverage by 2020, according to the International Convention on Biodiversity (CBD), but also the promotion of Marine Spatial Planning, through the adoption of a directive of the same name, for the entire European maritime space, are decisive steps in the context of more special transnational efforts to achieve a broader, intercontinental cooperation in the future, in order to protect marine biodiversity and resources from the various anthropogenic activities, which are developed, however, mainly in coastal areas, however, affect, more broadly, the marine environment worldwide level. Today, the international community is laying the foundations for further development elaboration, through a wider framework of discussions, of a series of sustainable goals development, even for the oceans (UNESCO, PEGASO, 2014).

Finally, the environmental pillar of the EU maritime policy, in context and in accordance with the terms of which the "potential" nuisance must be exercised the marine environment tourism activity, is the directive 2008/56/EC for the maritime strategy and, pursuant to it, the recently adopted directive 2014/89/EU establishing a framework for marine spatial planning, at European marine waters. The latter allows, as a cross-sectoral policy instrument, to public authorities of member states or third countries to achieve coordinated, comprehensive and transboundary cooperation for coastal protection and marine ecosystems and the rational exercise of any human activity with impacts on the marine environment, such as tourism, by virtue of the division and classification of wider marine areas, highest importance for coastal economies, in Zones and Protection Areas, with the aim of highlighting their economic, ecological importance and usefulness for conservation and sustainable use of marine resources and services (Crowder et al. 2006). Of course, for the successful completion of the objectives set by the above instructions, there is still a long way to go, as from official registration data on the conservation status of its marine environment Mediterranean, which is estimated to host about 20% of the world's biodiversity, it appears that, until 2012, they were under legal status of protection, in total, 677 Protected Areas, i.e. a percentage of only 4.56%, which covers, almost exclusively, coastal areas of the northwest edge of the Mediterranean, while it is estimated that, under integration status, there are 55 more marine areas, in the immediate future (Gabrié C. et al., MedPAN& RAC/SPA, 2012).

10. Institutional framework of RES and Offshore Wind Farms

Legal Framework:

International:

1) Kyoto Protocol (1997): The Kyoto Protocol was adopted by the United Nations on 11 December 1997 and it was entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol. The Kyoto Protocol is governed by principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries, by placing a burden on them under the principle of "common but differentiated responsibility and respective capabilities", as it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere[4].

2) Paris Agreement (2016): The Paris Agreement is a **legally binding international treaty on climate change**. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015 and set into forth on 4 November 2016.Its target is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and to limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030and 50% by 2030.The Paris Agreement requires a **five-year cycle** of increasingly ambitious climate action carried out by countries. Since 2020, countries have been submitting their national climate action plans, the so called "N**ationally determined contributions (NDCs)**. Each successive NDC is meant to reflect an increasingly higher degree of ambition compared to the previous version[5].

EU legal instruments:

Directive 2014/89/EU: Establishment of a framework for maritime spatial planning for all Member States, which "*shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses" (Article 5 par. 1).*

[4] https://unfccc.int/kyoto_protocol

[5] https://unfccc.int/process-and-meetings/the-paris-agreement

European Green Deal (2020): The European Green Deal constitutes a political initiative of the European Commission, the main objective of which is to make Europe climate neutral by 2050.It provides the review of each existing law on its climate merits, as well as the issuance of new legislation on the circular economy, building renovation, biodiversity and innovation[6].

Target Model: Under its commitments as a Member state of the EU, Greece is thus complying with a fundamental obligation to contribute to the effort of the creation of a European electricity system that will remove trade restrictions, allow the connection between national markets and will be accessible to all on the terms so as to enhance competition and ultimately benefit the consumer.

Fit For 55

The energy efficiency directive is one of the proposals put forward by the Commission as part of the Fit for 55 package — the EU's plan to reduce emissions by at least 55% by 2030 compared to 1990 levels. Furthermore, the said package of measures upgrades the goals of the EU Emissions Trading System (EU ETS) based on caps and trading rights for energy-intensive industries and the electricity sector. It is the EU's main instrument aimed at reducing emissions. Since its introduction in 2005, EU emissions have fallen by 41%.The Fit for 55 package aimed to reform the EU ETS, making it more ambitious.

TEN-E Regulation:

TEN-E Regulation The TEN-E Regulation, revised in 2022, introduces the framework for cross border energy infrastructure projects. It sets the legal provisions for projects of common interest (PCIs), which are selected every two years (the latest list was published in November 2023). Pursuant to the target of decarbonisation, renewable energy projects (including wind) are appearing more frequently. The revised TEN-E Regulation also

[6]https://www.consilium.europa.eu/el/policies/green-deal/

provides regional cooperation structures that can support the creation of integrated and efficient offshore and onshore grids, including hybrid projects interconnecting Member States and offshore wind projects. The most recent TEN-E revision of 2022 included setting up a framework for long-term offshore grid planning by transmission system operators (TSOs), involving regulators and the Member States in each sea basin, including for hybrid projects. Furthermore, among other provisions Member States are committed to conclude a non-binding agreement to cooperate on goals for offshore renewables generation, to be deployed within each sea basin by 2050, with intermediate steps in 2030 and 2040.

Renewable Energy Directive

The Renewable Energy Directive revised in 2023 sets a target of 42.5 % renewables share in EU energy consumption, which means that EU promotes renewable energy projects. The directive also includes specific provisions to support the deployment of such projects. Member States are required to cooperate on joint projects to produce renewable energy including wind. They must also publish information on the offshore volumes they plan to achieve through tenders, based on indicative targets for offshore renewable energy generation within each sea basin identified in accordance with the TEN-E Regulation. Moreover, Member States are encouraged to allocate space for offshore renewable energy projects in their maritime spatial plans, taking into consideration the activities already taking place in the affected areas.

Offshore renewable energy strategy

In November 2020, the EU strategy on offshore renewable energy was pursuant to climate goals set out in the European Green Deal. The targets include an installed capacity of at least 60GW of offshore wind by 2030 and 300GW by 2050. In addition, it set goals for ocean energy of at least 1 GW by 2030 and 40 GW by 2050. The strategy also includes specific actions to enhance the offshore energy sector's sustainable development. It confronts issues such as access to sea-space and maritime spatial planning, regional and international cooperation, industrial and employment matters, environmental protection, and also the development of new technologies such as floating wind, which is not yet a commercially viable in comparison with offshore wind.

Wind power package

The European wind power package was adopted on 24October 2023,promoting the objective of enhancing the EU wind industry. The package consists of two elements: an action plan and a communication. The action plan proposes measures to assist maintain a competitive supply chain for wind energy, with a clear and secure pipeline of projects, able to attract funding and compete on a level playing field globally. The communication, 'Delivering on the EU offshore renewable energy ambition', proposes a new vision, following up on the EU offshore renewable energy strategy. Overall, the package aims to ensure that the EU clean energy transition goes hand in hand with industrial competitiveness[7].

Greek legal framework:

- KYA 49628/2008 :‘’Special Framework for RES Spatial Planning’’: Includes provision for offshore wind farms and sets initial siting criteria. In accordance with the said KYA in period of time between 2008-2010 production permits have been submitted for 18 offshore wind farms with a total capacity of 4500 MW approximately.
- Act 3851/2010 (Article 15, par. 17a): ‘Pending the approval of the National Program for the Development of Offshore Wind Parks, no new applications for production licenses are accepted’.
- Act 4414/2016: ‘New support regime for renewable energy power stations’. An increased reference price is allowed for offshore wind farms connected to a new subsea connection at the expense of their owners.
- Act. 4546/2018: Establishment of a framework for maritime spatial planning in application of the Directive2014/89/EU. The National Marine Spatial Planning

[7] https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/757628/EPRS_BRI(2024)757628_EN.pdf

includes the national spatial strategy for the marine space which sets directions, indicates and prioritizes the priorities for the development of marine spatial plans in individual spatial units.

- Act 4964/2022: ‘Provisions for the simplification of environmental licensing, establishing a framework for the development of Offshore Wind Farms dealing with the energy crisis, environmental protection and other provisions.
- The National Energy and Climate Plan (NECP) for Greece constitues a Strategic Plan for Climate and Energy issues and presents the guidlines for the fulfillment of Energy and Climate Goals by the year 2030. The NECP presents and analyzes Priorities and Policy Measures in a wide range of development and economic activities for the benefit of Greek society, making it a reference text for the next decade.

Finally, the Centre of Renewable Energy Sources (CRES), as the Implementation Body of the European Energy Programs, which are managed by the Ministry of Environment and Energy, has submitted a funding application for the maturation studies regarding the preparation for the integration of offshore wind farm infrastructure projects for the Programming Period 2021-2027.(N. Stefanatos, Head of Wind Energy Department)[8].

11. Europe 2020 Strategy

Renewable Energy Sources play an important role in the European Strategy for the protection of the environment. For this reason the European Union raised some targets that all member countries must achieve by 2020.

A basic principle of Energy 2020 is the achievement of a competitive strategy, sustainable and safe energy.

The main objective of the Strategy is the harmonization of environmental needs with availability of energy potential. As mentioned above, Renewable Sources Energy include

[8] https://ypen.gov.gr/energeia/esek/

wind energy (both onshore and offshore), the solar energy (photovoltaics), hydroelectric energy, geothermal energy and biomass/biofuels (Ristori et al., 2010).

According to the Directive approved in 2007, three main objectives were set which are also known as "Europe 20-20-20". These objectives are as follows:

1. Reduction of greenhouse gas emissions by 20%
2. Increase the use of Renewable Energy Sources by 20%
3. Energy efficiency improvement by 20%.

In addition, all countries must increase the use of renewable energy sources in transport by 10%.

By achieving the above objectives, the EU will contribute to the fight against it climate change and air pollution but also will be able to become energy independent, as it will use its own resources and not foreign ones. Also, the energy offered will be affordable for both consumers as well as for businesses (Ristori et al., 2010).

To achieve the goals mentioned, the Energy Strategy sets five priorities:

- To make Europe energy efficient by investing in efficient buildings, products but also in transport. This will be achieved using systems energy labeling, with the renovation of public buildings as well as with ecological design of energy-intensive products (Ristori et al., 2010).
- Building a pan-European energy market by building them necessary transmission lines, natural gas pipelines and infrastructure (Ristori et al., 2010).
- Protection of consumer rights, ensuring high standards security, which will allow consumers to switch easily energy suppliers, monitor energy use and resolve immediate potential problems (Ristori et al., 2010).
- Implementation of the Energy Technologies Strategic Plan, which includes the development and installation of low-emission technologies carbon, such as solar energy, smart grids and technologies carbon sequestration and storage (Ristori et al., 2010).

- Maintaining good relations with external suppliers of the countries and creating of an Energy Community with the aim of integrating the neighboring countries into internal energy market (Ristori et al., 2010).

12. Strategy Europe 2030

The countries of the European Union have agreed on a framework for the climate and the energy until 2030 which includes the goals and policy for the period 2020-2030. The goals are to keep it competitive, safe and sustainable energy system which will be achieved by 2020, but also in its continuation until 2050 (Ristori et al., 2010).

The strategy encourages private investment in new pipelines, electricity networks energy and in the development of low-carbon technologies. The goals based on long-term economic analysis that will measure the economic benefits of decarbonisation by 2050. Its main economic outcome decarbonisation will be to shift costs from fuel sources in low-carbon technologies (Ristori et al., 2010).

The main objectives of the Europe 2030 Strategy which have been set are the following:

- Reduction of greenhouse gas emissions by 40% compared to levels of 1990
- Use of Renewable Energy Sources at a rate of 27%
- Energy saving of at least 27%.

In order to achieve the above objectives, the European Commission proposes:

- A reform of the EU emissions trading system
- Creation of new energy competitiveness and security indicators systemic
- Creation of a governance system based on national plans for a more competitive, secure and sustainable energy.

13. Europe 2050 Strategy

The European Union aims to reduce its gas emissions by 2050 greenhouse by 80-95%. The Energy Roadmap for 2050 looks for ways that they will go hand in hand with the reduction of greenhouse gas emissions, maximizing it competitiveness and security (Ristori et al., 2010).

To achieve these goals, it is necessary to invest in technologies low carbon, renewable energy sources as well as energy performance.

The European Commission's Energy Roadmap sets out four paths for the achieving the goals for 2050:

- Energy efficiency
- Renewable energy sources
- Nuclear energy
- Carbon sequestration and storage.

More specifically, to achieve the goals it is necessary to:

- More efficient use of energy and increasing the share of renewable sources
- Investments in new infrastructures and replacement of existing ones with low carbon alternatives
- Creation of a common energy market, with the aim of producing it wherever it is cheaper and to share where necessary.

Economic development due to Offshore Wind Farms

Wind energy constitutes one of America's fastest-growing energy sources and it is of crucial importance as it creats high-quality jobs. Actually, employment in the United States wind energy industry reached a new record of over 125,000 workers in 2022.

Wind energy projects can create employment opportunities for the communities that host them, regardingtheir construction as well as their operation. These jobs may include:

- Turbine technicians and engineers
- Component manufacturers
- Project developers

- Financial analysts
- Supply chain managers.

Wind farm developers can also provide nearby communities with financial and/or nonfinancial investments and benefits for communities impacted by wind energy projects. For instance they may include support for local schools or job opportunities.

Individual and commercial landowners can receive compensation for use of their land through lease contracts.

Community wind energy projects are owned by local governmental organizations or a group of people. This differs from commercial wind farms, which are usually owned by companies with limited local ties. Community wind energy projects can be used by schools, hospitals, businesses, farms, ranches, or community facilities to supply local electricity. Rural electric cooperatives or municipal utilities can also own community wind projects and use them to diversify electricity supplies and to engage stakeholders in their local energy projects. Because they are locally owned and can therefore keep their profits local, community wind energy projects can create greater economic opportunities for area residents than conventional wind farms.

The Greek economy is strengthened through Wind Farms:

By increasing competitiveness: Wind farms produce 3-4 times cheaper electricity than fossil fuels. In addition to being low, the total cost of electricity from wind farms remains constant throughout their decades of life. This is because it depends only on the initial cost of their construction which has been paid upfront and is not affected by international fuel price fluctuations, since wind is free. Low and stable costs enhance the competitiveness of the economy.

By reducing electricity bills: Wind farms therefore reduce the total amount that consumers pay for electricity. For example, with data from 2017, if there were no wind farms, electricity consumers would have paid over 53 million euros more this year.

Now this benefit is much greater because the newer wind farms produce even cheaper electricity. This is particularly important as it comes as a relief to consumers who are hit with high electricity costs due to skyrocketing fossil fuel costs. The economic benefit from wind farms in Greece allows the State to transfer additional resources to the Energy Transition Fund through which it subsidizes consumer bills.

From the processing of the data of the latest APE Special Account Bulletin, it appears that the benefit that the wind farms offered to consumers in October 2021 (most recent month for which official data was published) was at least 114 million euros for this one month. This benefit results from the difference of the average price of the wholesale market (€204/MWh) from the average compensation of the wind farms. This benefit is actually even greater because it does not take into account the reduction in wholesale market price that occurs thanks to the penetration of wind power.

Thus, the large increase in electricity production from wind leads to a reduction in overall costs, to the benefit of the consumer.

Through investments: In the last five years, Wind Energy attracted investments that reached 2.5 billion. Euro. All these investments were made in the region. Their domestic added value can reach 35% of the construction costs of a wind farm and every year it reaches an average of 80% of its operating costs. In addition, it helps in the development of other sectors of the economy such as cement industry, transport, construction, cables, ports. For offshore wind farms, the percentage of domestic added value will reach 70%.

Through job creation: Wind Energy creates more permanent jobs per unit of installed capacity than any other new conventional power plant. Each MW of wind power creates and maintains 1.8 jobs. Overall, the A.P.E. maintain over 26,000 jobs across the spectrum of the Greek economy.

A. Social Acceptance of Offshore Wind Farms and Renewable Energy Sources

The NIMBY (not in my backyard) syndromeis a basic characteristic of social acceptance of wind power. The NIMBY-explanation is however a too simplistic way of explaining all parameters involved when determining the general and local public acceptance of a specific wind power development. This means that the question of social acceptance really has many options: e.g. the general attitude towards offshore wind power in the population as a whole, the acceptance in the population who will experience the local impacts, the conflict management strategies and economic factors.

In Denmark, most of the offshore projects will be owned by the utilities, though it is still in the political agenda to encourage the cooperation as regards the ownership status. It is highly possible that the next generation of offshore farms (Horns Rev, Rdsand, Ls, Om Stlgrunde and Gedser) will be partly publicly owned, giving the possibility to test different ownership models. The project will be managed by the Danish Association of Wind Turbine Owners, yet it has not been politically approved.

However, the aforementioned "Danish model" israther unique, and for most other countries the offshore wind farms are either owned by utilities or private companies, thus there exist indirect financial benefits for the local society.

Furthermore, the Swedish offshore project in Kalmarsund conducted by Vattenfall constitutes a rather interesting case. This is a form of conflict management, as there are many actors involved in the decision process, therefore it increases transparency and promotes negotiations. An important factor is thus, the people being involved in the decision process and in which form can different actors participate and promote their interests in the planning process. The result of this approach is so far that the project gives priority to management of different views instead of fictitious consent. The importance of this type of conflict management has to do with the amount of realised and planned projects in a defined geographical area suitable for offshore wind power[9].

For the greatest development of RES, it is necessary to create a suitable environment which until now did not exist in most countries. An integrated support framework includes

[9] https://offshorewindenergy.org/CA-OWEE/Envi_4.html

initiatives in five different axes: Political, institutional, financial, the axis of dissemination and intervention in society and the axis of research and technological support.

The introduction of the concept of RES at all educational levels as well as the information campaign at all levels: international, national, regional and local, are catalysts for society's familiarity with the technology, the possibility of use and the application of RES. After all, without the acceptance of the local bodies and the residents of an area, no renewable energy production unit can be licensed.

The main reason for the reactions to the development of RES units remains the lack of substantial information and real dialogue with local communities. The dialogue is required to be conducted in a timely manner and with the initiative and decisive participation of the state and its competent public energy bodies (Ministries, Regions, Municipalities, System Operator, Research Centers, Public Enterprises, Local Associations, etc.).

In the dialogue, the active presence of the local government, the social partners, who have strong ties with the local communities, as well as the scientific bodies, is considered important. In Greece, as a rule, any information efforts, even for important energy projects, were limited to piecemeal actions without substantial impact on local communities.

The experience to date shows that where there has been valid and timely information to the citizens at the local level, the degree of acceptance of new energy projects and sources has been satisfactory and increasing over time. The widest possible social acceptance of any new energy activity, after public consultation and broad consensus of those involved, is of primary importance.

A central pillar for a country's regional development with a contribution to regional GDP and employment are electricity generation and transmission projects. In areas where GDP and employment remain high due to energy projects there is a positive response of local communities to energy projects, while in other areas that have reached different development patterns the acceptance of energy projects is negative.

When energy projects are combined with coverage of broader social needs (water supply, irrigation, district heating), regional integration of areas (creation or maintenance of railway lines for the transport of energy products) and environmental protection, social consensus is easier.

A comprehensive plan is required for the development and well-being of society, combined with energy production. Favorable electricity pricing in the regions producing energy from RES will make these regions friendly to RES technologies, while the regions themselves will become a pole of attraction for new investments.

The essential information at the level of society can be carried out by the preparation and implementation of an integrated communication intervention.

A communication strategy action plan regarding publicity is a tool aimed at familiarizing the general public and target groups such as local government, and the competent services with the economic, environmental and social benefits that citizens will have from the penetration of RES in their daily life.

A special target group is young people, children and teenagers. Environmental and consumer consciousness in the field of energy is founded and essentially shaped in childhood and adolescence. It is necessary to specialize the actions that will approach young people through an appropriate educational or recreational orientation methodology, enhancing their knowledge of the relevant issues.

According to the above, the main general objective can be the provision of valid and complete information to the general public as well as special groups, regarding the benefits (economic, social and environmental) resulting from the development of RES and their penetration into the energy sector balance.

The promotion of good practices, their results and their usefulness to the citizen and the highlighting of projects financed by European or national programs as well as their contribution to the development perspective of the region can contribute to the formation of a positive climate for the development of RES applications, to raising awareness and changing public behavior on energy issues.

The open democratic consultation on development issues and especially on the issues of new Renewable Energy Sources projects on the one hand makes society actively involved and slows the pace of licensing and completion of projects, on the one hand it marginalizes those dogmatic groups, who ideologically and perhaps professionally, however certainly unscientifically, stand against any positive social and economic development.

Protecting the environment and tackling climate change are two very important issues to which wind farms contribute in various ways. But they are not the only ones. Cheap energy costs, economic growth, new jobs, supporting local communities are a few more.

Wind farms are a decentralized form of energy generation. They grow in the Greek countryside, in places of settlement that are scattered. It is not about huge nuclear power plants or fossil fuel plants and mines that can monopolize a local economy, as for example happened in previous decades in the main lignite regions of Europe. The characteristic of these wind farms, and of renewable energy sources in general, has the effect that they contribute significantly to the diffusion of development, i.e. regional development.

It is well known to the residents of energy Jerusalem that the achievement of the ambitious goals established by the EU and adopted by our country is the great challenge of the 2020-2030 decade. Indeed, the effort to achieve 32% of final energy consumption from Renewable Sources by 2030 is expected to provide incentives and impetus for the further development of related technologies, reducing their costs and expanding their penetration. Especially in the area of Wind Energy, according to the latest published data, Greece has experienced remarkable growth in the last decade without achieving the goal that had been set (Aligizaki, 2023).

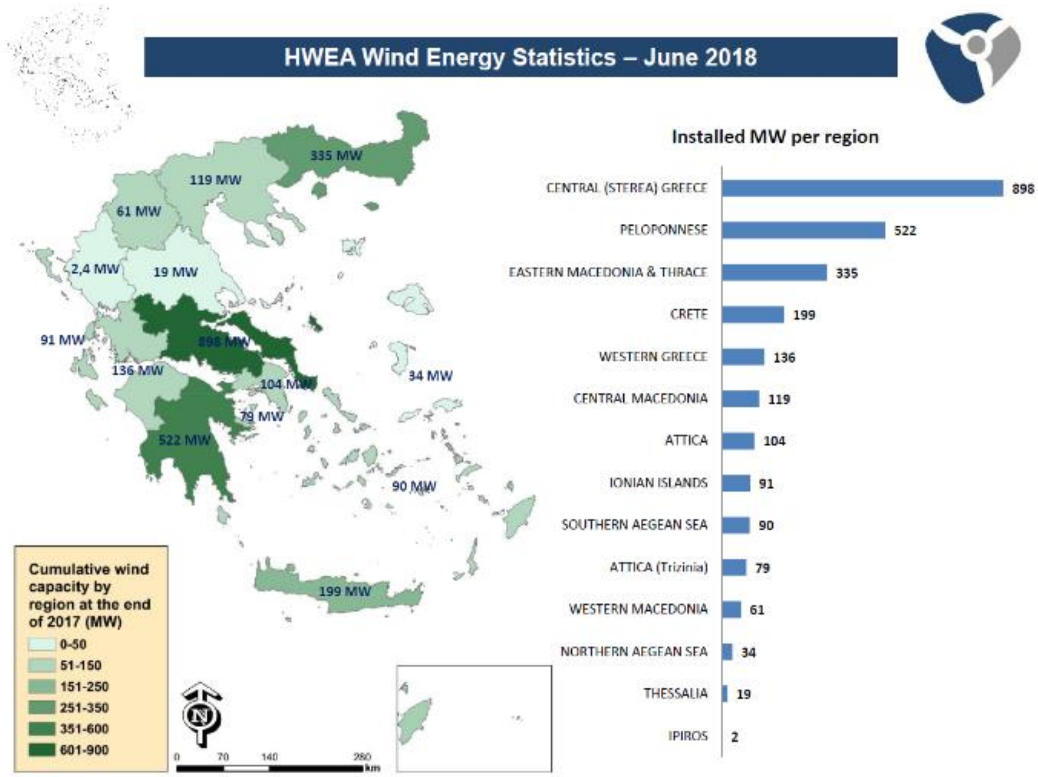


Figure 6: Installed Wind Power by Region

However, it is extremely interesting to note that one of the most offered areas for Wind power installations in terms of Wind Power in Greece, is located in a regime of peculiar isolation: the Aegean area. The main reason for this reality is none other than the lack of electrical interconnection of most of the Aegean islands with the Interconnected System. The recent processes for the electrical interconnection of Crete and the Cyclades are expected to give the impetus for the implementation of wind installations that had been frozen due to the lack of electricity space and the increased investment risk associated with the implementation of RES projects in the non-existent Interconnected System.

Finally it should be mentioned that the social acceptance of offshore wind farms, may expect to increase significantly, since people are aware of the their positive impacts. The fact that oil and gas reserves are very limited, that other sources of energy are not only much more polluting but also more expensive if externalities are accounted for,should be stressed in the public dialogue.

B. Geopolitical Dimension Of Coastal Marine Wind Farms

1. Exclusive Economic Zone and Sea Shelf

The Exclusive Economic Zone and the continental shelf are perhaps the most well-known but at the same time the most unclear terms for the average reader when referring to the Greek-Turkish disputes. Before proceeding to the analysis of the contribution of RES to the promotion of national interests, it is necessary to refer to the similarities, differences and particularities of these two terms.

Continental shelf is a geological term. It is the part of the sea bed and subsoil that extends beyond the territorial waters and which is a smooth extension of the coast below the surface of the sea, up to the point where it is abruptly interrupted by a steep slope. According to Article 76.1 of the Convention on the Law of the Sea (UNCLOS 1982), the continental shelf extends 200 nautical miles from the baselines from which territorial waters are measured. Within the continental shelf, the coastal state does not have full sovereignty but exercises sovereign rights, which exclusively concern a) the exploration of the continental shelf and b) the exploitation of its natural resources.

In the case of the Aegean where the distances between the Greek islands of the Eastern Aegean and the coasts of Asia Minor are very short, the delimitation of the continental shelf according to the Greek interpretation and international jurisprudence is carried out based on the principle of equal distance between of (median line/equidistance). The difference with Turkey lies in the fact that the latter does not recognize the islands of the Eastern Aegean as a continental shelf but claims that the seabed that surrounds them is the natural extension of Anatolia and therefore the continental shelves of the two states meet in the middle of the Aegean on the 25th Meridian. It should be noted that the demarcation of the continental shelf with Turkey is the only dispute in the Aegean which Greece accepts and which it is willing to submit to international arbitration (Karakonstanoglou, 2001).

In contrast to the continental shelf, the Exclusive Economic Zone is not a geological definition but a legal construct. The Exclusive Economic Zone of a coastal state extends up to 200 nautical miles from the coast but unlike the continental shelf includes not only the seabed and subsoil, but also the natural resources of the overlying seabed waters as well as economic exploration, exploitation and protection. As can be seen, the Exclusive Economic Zone includes the concept of the continental shelf, or in other words the continental shelf is largely a subset of the Exclusive Economic Zone.

It is extremely useful to note the essential differences between these two terms (Karakonstanoglou, 2001):

The Exclusive Economic Zone includes the seabed, the subsoil and the overlying waters (water column). The continental shelf includes only the seabed and the subsoil.

The rights and jurisdictions of a state over the Exclusive Economic Zone are acquired only when the state expressly seizes that particular maritime zone. On the contrary, the coastal state's rights to the continental shelf do not depend on actual or notional possession or on any express declaration and exist ab initio and ipso facto.

The Exclusive Economic Zone includes the exploitation of wealth-producing sources as well as the protection and environmental control of these sources, as well as scientific research. The continental shelf refers exclusively to the economic exploitation of the wealth-producing sources of the seabed and subsoil.

The concept of the Exclusive Economic Zone is exclusively a legal institution, with no relation to any natural event of the sea area in which its development takes place, in contrast to the continental shelf which, in addition to being a legal one, is also a geological definition.

The following map illustrates the maximum potential demarcation of the Greek Exclusive Economic Zone based on the UN Convention. on the Law of the Sea (UNCLOS).

Figure 7: Maximum potential demarcation of the Greek Exclusive Economic Zone

It is clear that the provision of the Exclusive Economic Zone does not allow Turkey to use the same argument it puts forward for the continental shelf, that the Greek islands lie on the natural extension of the Anatolian peninsula. For this reason, moreover, Turkey was one of the few states in the world that did not sign the Convention on the Law of the Sea, as the existence of islands of another state in front of their shores significantly limits the extent of the Exclusive Economic Zone to which they are entitled.

It is important to underline that based on Article 121 of the Convention on the Law of the Sea, islands have all maritime zones including Exclusive Economic Zones and continental shelves. Excluded are the rocky islands which do not have their own economic life. They are attributed only to the coastal zone (territorial waters). This marking is extremely important, as the development of economic activity on a rock island may bring about a return to the coastal state of the Exclusive Economic Zone with all the relevant rights over it.

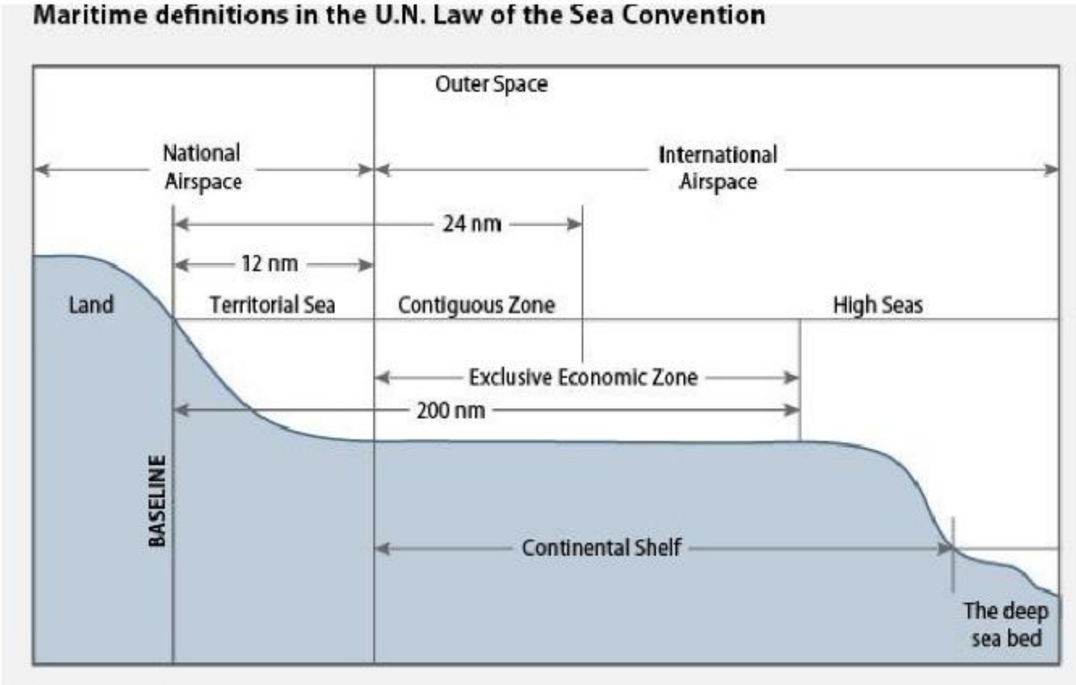


Figure 8: Definitions of Marine Zones

2. Territorial sea

Territorial waters are the extension of a state's national territory into the sea, within which the state exercises full sovereignty. At the moment, Greece has a territorial waters of 6 nautical miles from the natural coastline, except in cases where the distance between the Greek coast and the Turkish coast is less than 6 nautical miles. so territorial waters are determined by the median line.

According to the Treaty of Lausanne (1923), Turkey has irrevocably renounced the sovereignty of islands located beyond 3 nautical miles from the coasts of Asia Minor, the ownership of which passed to Greece. The agreement of 04/01/1932 and the protocol of 28/12/1932 between Turkey and Italy apply especially to the Dodecanese. Greece is considered a successor state of Italy in this agreement based on the Paris Peace Treaty of 10/02/1947 by which the Dodecanese were ceded to Greece.

Article 3 of the UN Convention on the Law of the Sea (UNCLOS) grants Greece the right to extend its territorial waters up to 12 nautical miles from its coastline. Such an expansion would significantly increase the percentage of the Aegean area under the full sovereignty of Greece, as shown in the map below.

As can be seen, such an extension puts the continental shelf/Exclusive Economic Zone debate on a different footing, as the Aegean essentially becomes a Greek lake. The area of the continental shelf that will remain to be claimed will be limited to 5% of the Aegean, with the difference becoming insignificant.

Until today, under the threat of war, Greece has not proceeded to exercise this right, reserving to do so at a time and in a way that it chooses.

3. Islets and uninhabited islands

Greece has a multitude of rocky islets and uninhabited islands in the Aegean which, under the Convention on the Law of the Sea, do not have the right to an Exclusive Economic Zone. The strategic development of economic activity through the placement of Renewable Energy Sources on them is a way of strengthening the Greek positions when the moment comes to declare the Exclusive Economic Zone, while at the same time the exercise of national sovereignty de facto cancels the Turkish claims of the existence of "grey zones" and of indefinite island sovereignty. At the same time, within the framework of Greece's commitment from the European Goals to increase the participation of RES in the energy mix, but also having the constant European support for ending the energy isolation of the islands and supplying them with RES (Clean Energy for EU islands Initiative), it becomes clear that this move can be supported by the EU simultaneously putting Turkey on a path of direct conflict with it in case of reactions (Kokkosis & Tsartas, 2001).

It is of course important to mention that the current environmental licensing regime for RES projects includes significant restrictions on the siting of Wind Farms in areas of the Natura network. As shown in the following map, the great majority of the islands, islets and islets of the Aegean fall within this network. Since Greece decides that its strategic interest dictates the economic exploitation of the rocky islands, the review of the prohibitions of the environmental licensing framework as the case may be for the various forms of RES is necessary to achieve its goals.

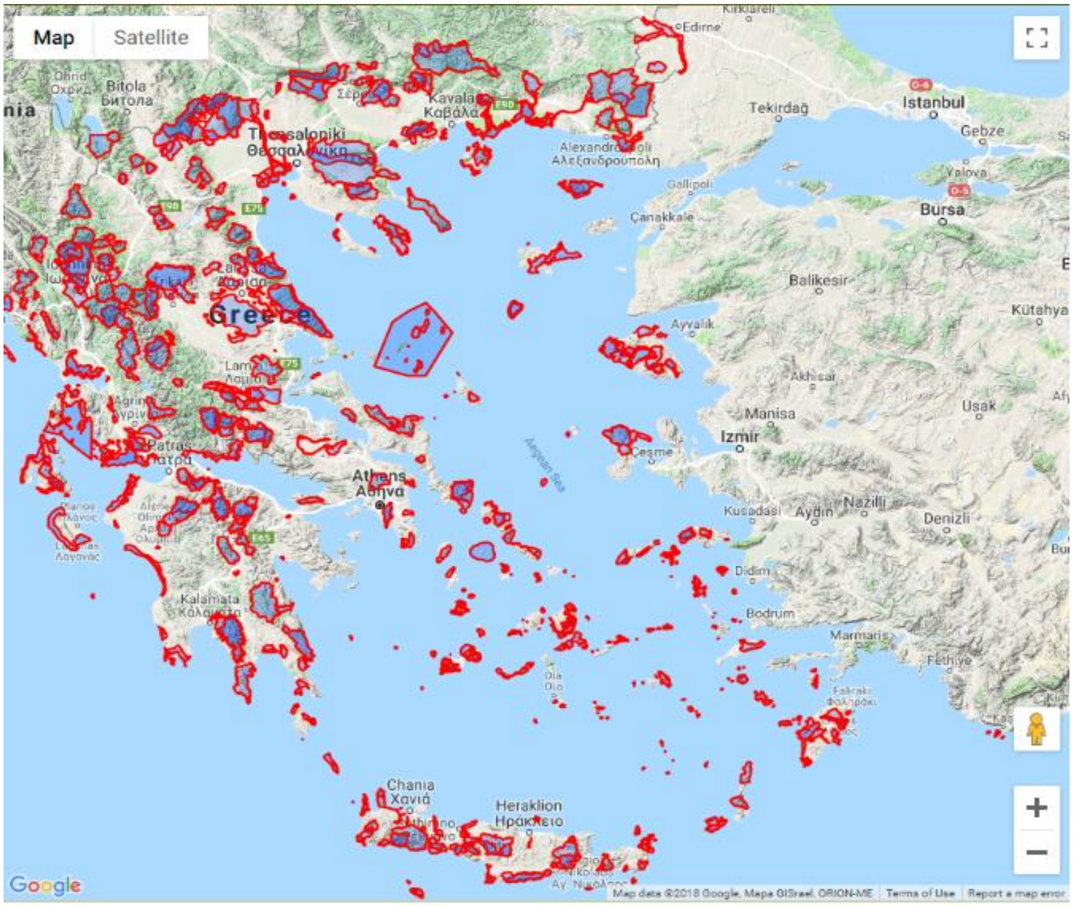


Figure 9: Network of Natura sites

At the same time, an equally important parameter for the utilization of the rocky islands is the implementation of electrical interconnections of the islands of the Eastern Aegean with the Interconnected System. The Energy Regulatory Authority has already studied the electrical interconnection of the islands of the Eastern Aegean and the Dodecanese with multiple benefits for the economy and consumers. The launch of these projects will create the necessary electrical space and at the same time will ensure the seamless injection of energy from the Wind Stations into the grid, an essential element for the bankability of investments.

Of course, this move should be accompanied by appropriate financial incentives for potential investors. Securing attractive energy injection prices as well as finding ways to finance such a demanding investment will require the support of European and other International Financial Institutions which will provide investors with the conditions to allow them to undertake an investment risk comparatively greater than a standard wind installation on the mainland Hellas.

However, as the number of rocky islets and/or uninhabited islands that are offered for RES development is specific, a sector that, although still in its embryonic stage in the Greek market, can provide geopolitical added value is marine (offshore) Wind Farms.

Wind Energy strengthens Greece's position on the European and world map:

Offering energy independence:

Wind energy, and renewable energy in general, apart from being a means of economic development and environmental protection, is a factor of geopolitical power, peace and security in the Aegean region. This national resource must be a pillar of foreign policy and strengthen the energy independence of Europe. The large investments for facilities and networks promote the development, security and geostrategic strengthening of the country and, by extension, of Europe. This is another reason why we need onshore and offshore wind farms.

Giving international recognition: The massive utilization of Wind Energy in combination with other RES makes our country an equal partner in the international battle against climate change, the greatest danger to Man, Nature and the Planet.

Geopolitics as much as price or quality will play a crucial role in how successfully China's turbine makers penetrate global wind markets, as big names such as Envision, Gold wind and Mingyangtry to accelerate their international expansion on- and offshore.

The ambition of Chinese OEMs was highlighted last week when China Three Gorges announced that it was commencing installation of a 16MW Gold wind offshore turbine off the southeastern province of Fujian, shortly after erecting a 13GW machine in the same waters.

The big four among Western turbine manufacturers – Siemens Gamesa, Vestas, GE and Nordex – are producing bigger machines too on land and sea, but none have yet deployed the size of machine seen off Fujian now.

Conclusions

The present writing endeavor is innovative as an extremely useful tool for familiarizing oneself with recent developments in offshore wind farms, which is an eminently interdisciplinary field of economics, geopolitics, law and international relations, but also a field of conflict and contestation at national and international level.

In addition, it sought to shed light on all institutional and geopolitical energy rearrangements, through the research and mapping of all recent developments in energy law in the light of the distribution of power between EU member states. In particular, the basic principles and recent EU institutional initiatives on the internal energy market, provisions on energy security, research and exploitation of energy resources, green transition and decarbonisation of the energy system. Through the study of institutions, the relationship between energy and geopolitics was investigated, with an emphasis on the Eastern Mediterranean, a region of "special energy weight" for the European Union. Energy-producing states, as the work shows, use the power derived from their energy resources to achieve geopolitical goals, triggering new geopolitical developments, which influence the formation of law.

Overall, we concluded that EU actions, including the financing it provides, contributed to development of offshore wind energy. However, the goals that have been set to grow the industry are ambitious and potentially difficult to achieve. Ensuring sustainability, from a social and environmental point of view, of the development of offshore renewable energy sources.

In its strategy, the Commission proposed objectives by distinguishing depending on wind farm technology. EU targets for offshore wind energy with a horizon of 2030 are in line with the national plans for the coastal renewable energy production and foresee its development in big scale. Taking into account the national plans and its maturity of relevant technology, the targets could be achieved if the annual growth rate increased significantly and addressed the identified challenges. In contrast, ocean energy targets are rarely reflected at Member State level and the contribution of this form of energy to the achievement of EU-level targets for 2030 is expected to be marginal. The efforts of both the Commission and the Member States at maritime level basin are focused on the development of offshore wind energy facilities, while far fewer actions concern ocean energy.

As Aligizaki (2023) mentions, starting from the institutionalization of the rules of law, the law can provide power to the states that spin the energy resources, but they too, with the "weapon" of the geopolitical power they accumulate, shape the Right and they affect geopolitical developments.

Bibliographical References

Aligizaki, A. (2023). *Law and Geopolitics of Energy*. Sakkoula Publications

COM (2010) 352, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Europe, the first tourist destination in world – a new policy framework for European tourism, Brussels, 30.6.2010.

Crowder, L.B., G. Osherenko, O.R. Young, S. Airame, E.A. Norse, N. Baron, J.C. Day, F. Douvere, C.N. Ehler, B.S. Halpern, S.J. Langdon, K.L. McLeod, J.C.Ogden, R.E. Peach, A.A. Rosenberg&J.A. Wilson. (2006). Resolving mismatches in U.S. ocean governance.*Science*, 313, 617-61.

Gabrié C., Lagabrielle E., Bissery C., Crochelet E., Meola B., Webster C., Claudet J., Chassanite A., Marinesque S., Robert P., Goutx M. &Quod C. (2012). *The Status of Marine Protected Areas in the Mediterranean Sea*. MedPAN& RAC/SPA, MedPAN Collection, 256.

Kalokardo - Kradonelli, R. (2011). *Characteristics of tourism activity in the European and Greek area, presentation at a conference "Economic situation and spatial planning of Tourism"*. National Technical University of Athens, 25-33. Prepompos Publications.

Kanellopoulos, B.D. (2010). *Wind power*. Athens: ION.

Karakonstanoglou, B. (2001). *The Exclusive Economic Zone in the new Law of the Sea*. Library of International Law and International Relations.

Katsaprakakis, A.D. (2008). *Wind Energy and Wind Farm Development Courses Parks*. INTERREG NORTH.

Kokkosis, C. &Tsartas, P. (2001). *Sustainable tourism development and environment*. Kritiki Publications, Athens.

Koutsoubas, X. I. (2006). *Soft forms of energy*. Athens: EllinikaGrammata.

Kritikos, A. (2010). *Wind turbines and Photovoltaics*. Athens: Neo Publications Technologies.

K.Y.A. 1726/2003 (Government Gazette 552B8-5-2003), Preliminary Environmental Procedure assessment and evaluation, approval of environmental conditions, as well as approval intervention or concession of forest or forest area in the context of the issuance of a permit installation of power plants, from Renewable Energy Sources.

Lykourgiotis, A., Kordoulis, X. &Lykourgiotis, S. (2017). *Beyond fossil fuels. The journey back to renewable energy*. University Publications of Crete.

Maleviti, E. (2013). *Energy Management and Renewable Energy Sources*. Athens. Publications: Field.

Mamasis, N. (2011). *Introduction to energy technology*. Athens: ION Publications.

Papadopoulos, M.P. (1997). *Electricity Production from Renewable Sources*. Athens.

Papaioannou, E. I. (2017). *The Acceleration of the Development of Renewable Sources of Energy to Address the Effect of Climate Change*. *Institutionally Issues*. Thessaloniki.

Petrochilou, V. (2011). *Placement of renewable energy sources. The Greek Reality*. Thessaloniki.

OECD (2015). *OECD Environmental Performance Reviews*. OECD Publishing.

Ogden, J.C. (2010). Marine spatial planning (MSP): A first step to ecosystem-based management (EBM) in the Wider Caribbean. *Revista de Biologia Tropical*, 58, (Suppl.3), 71-79.

Sardá, R., Mora, J. & Avila, C. (2005). Tourism development in the Costa Brava (Girona, Spain) - how integrated coastal zone management may rejuvenate its lifecycle. In: Vermaat, J.E. et al. (Ed.) *Managing European coasts: past, present and future*, 291-314.

Silva (2007). The Management of Beach Carrying Capacity: The case of northern Portugal. *Journal of Coastal Research*, Special Issue, 50, 312-317.

Siouta, H. (2011). *Renewable Energy Sources & Coastal Zone Management in Greece*. National Technical University. Athens.

Siouti, G. (2011). *Handbook of Environmental Law*. Publications Bag: 278.

Spiliotopoulos, E. (2010). *Handbook of Administrative Law*.PublicationsSakkoula, 286-289.

Tzanakaki, E. &Mavrioiorgou, D. (2005).*Renewable Energy Sources & Saving Energy: Public Acceptance.* Center for Renewable Energy Sources.

Tsakalakis, K. (2003). The greenhouse effect and the effect of burning them fossil fuels and anthropogenic activities in its evolution.*Mineralogical-Metallurgical Chronicles*, Volume 13, Issue 1/2, pp. 23-49.

UNEP/MAP, (2014). Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership), 2013 Annual Report, Athens.

UNWTO (2014). Tourism Highlights.

Vagianni, E. &Spilanis, G. (2002). *Sustainable tourism and carrying capacity in sensitive island ecosystems*. Conference "Carrying Capacity and Visitor Management in Protected Areas", WWF, Athens.

Vagiona, D. (2016). *Sustainable Development and Management of Natural Resources*. Thessaloniki.

Official Gazette 135/A/85, Accelerating the Development of Renewable Energy Sources for dealing with climate change and other provisions in matters of its competence Ministry of Environment, Energy and Climate Change.

Official Gazette A΄168/07-10-94, Regulation of Electricity Production from Renewable Sources Energy and from conventional fuels and other provisions.

Official Gazette A' 81/15-04-98, Support for private investments for the economic and regional development of the country and other provisions.

Official Gazette A' 286/22-12-99, Liberalization of the electricity market - Regulation of issues energy policy and other provisions.

Official Gazette 91A/25/4/2002, "Harmonization of Law 1650/1986 with EU Directives 97/11 and 96/61 EU, delimitation procedure and regulations on watercourses and other issues provisions".

Official Gazette A' 201/12-09-01, Simplification of company establishment and licensing procedures of Renewable Energy Sources, regulation of matters of A.E. "GREEK SHIPYARDS" and other provisions.

Official Gazette A' 153/28.06.2002, For the protection of antiquities and cultural heritage in general heritage.

Official Gazette 2464 B' 03.12.2008, Approval of a special spatial planning framework and sustainable development for renewable energy sources and the strategic study environmental effects thereof.

Official Gazette 129/A/04-07-2022: Modernization of the licensing process for Renewable Energy Sources - Phase B, Licensing of electricity production and storage, framework for the development of Pilot Marine Floating Photovoltaic Plants and more specific provisions for energy and environmental protection

Official Gazette 1671/B`/11.11.2004: Amendment and completion of joint ministerial decision 13727/724/2003 regarding the matching of electricity production activities with the degrees of nuisance referred to in urban planning legislation

Recommendation 2002/413 - Implementation of Integrated Coastal Zone Management in Europe.

Ristori, Šefčovič, Cañete, European Commission (2010). Energy 2020 A strategy for competitive, sustainable and secure energy. Retrieved from: https://energy.ec.europa.eu/index_en.