ELBE

EUROPEAN LEADERS OF BLUE ENERGY

ELECTRIC SUPPLY TO O&G PLATFORMS

ANALYSIS OF POTENTIAL NICHE MARKETS TO OVERCOME VALLEY OF DEATH IN WAVE ENERGY DEVELOPMENT

Co-funded by the COSME programme of the European Union

ESCPoi ELBE Partnership

ELBE - European Strategic Cluster Partnership in Blue Energy

Cluster Energía BASQUE ENERGY CLUSTER

areG Aberdeen Renewable Energy Group

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GCE NODE GLOBAL CENTER OF EXPERTISE

OFFSHORE VÄST

PÔLE MER MÉDITERRANÉE

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Purpose of the project

- The world is living a transition to a cleaner and more eco-friendly energy. Different renewable energies like wind or solar, are already competing with the rest of conventional energies in the electric market. Their technology maturity allow them to have competitive prices and so, supply electricity into the main grid. However, this is not the case for other renewables energies, such as wave energy, with a lower level of maturity.

- This project aims to support wave energy development by contributing to identify potential market niches which may be a suitable target for early commercial development of wave energy converters. All these potential niches have in common that they are applications not served by the main electrical grid, and therefore prices for electricity are significantly higher, making wave energy converters to potentially become a competitive contester.

- This project has been developed as the Final Thesis of Master REM (https://www.master-rem.eu/) of Nerea Guinea in collaboration with the Basque Energy Cluster and the ELBE alliance (http://www.elbeproject.eu/), which gathers seven European clusters joining efforts for development of Blue Energy.

Two phases to identify the niches with a higher potential

The analysis carried out in the project is structured in two phases:

- **Phase 1** consisted on a first study of all possible niches with potential interest.
  - 14 niches were identified. Each niche was analysed in order to give information regarding two independent prioritization criteria:
    - Market potential, which tries to quantify the size of the potential market
    - Competitiveness, which analyses main advantages and disadvantages that wave energy presents versus other potential alternatives
  - A survey was sent to key stakeholders so that they prioritized which niches they deemed more relevant based on the information provided

- **Phase 2 (this report)** is a more in-depth analysis of the three niches that were considered more interesting based on the feedback gathered from the survey. The selected three market niches are:
  1. Isolated Power Systems
  2. Electric Supply of O&G Platforms
  3. Offshore Marine Aquaculture

  These niches has been analysed following the most suitable structure for each case depending on the available information.

1. Introduction

2. Overview of the niche market

3. Analysis of the electric supply to O&G platforms

   I. Main geographical markets

   II. Power requirements

   III. Opportunities for wave energy

4. Main conclusions

The **Electric Supply of O&G Platforms** accounts around 5-15% of the total generated energy by the stations

Main characteristics

In the offshore extraction of O&G**, platforms consume energy for different exploitation activities**, e.g. drilling or accommodation. The required energy is normally obtained through pipelines or by transporting it to the site with vessels. As the platforms are usually at remote or isolated places, the energy supply is a challenge. In the case of umbilical power cables from the shore, they are very expensive and in some cases the station is really far. On the other hand, the diesel refuelling is not reliable [1].

Due to stricter emission policies, many companies in the industry are choosing to exchange diesel engines or gas turbines by cleaner supply sources, such as wind farms or wave energy converters (WECs).

Power Requirements

In an O&G platform there are several energy consuming facilities with different power requirements like the accommodation, with less consumption, or the drilling and processing activities, which need more power.

The usual amount of energy used by these platforms for the production of O&G is about 5 – 15% of the total generated energy [2]. Gas turbines are the most commonly used method to supply such energy but to meet availability requirements, more turbines are started than it is really necessary. This means that more diesel or gas than required is used and, that more CO_2 is emitted.

With the aim of decarbonising the O&G applications, the integration of renewable alternatives that supply energy is being sought by many companies. These alternatives should be able to produce the following energy percentage [2]:

- In the oil exploitations, the 11% of the energy extracted
- In the gas exploitations, the 4% of the energy extracted

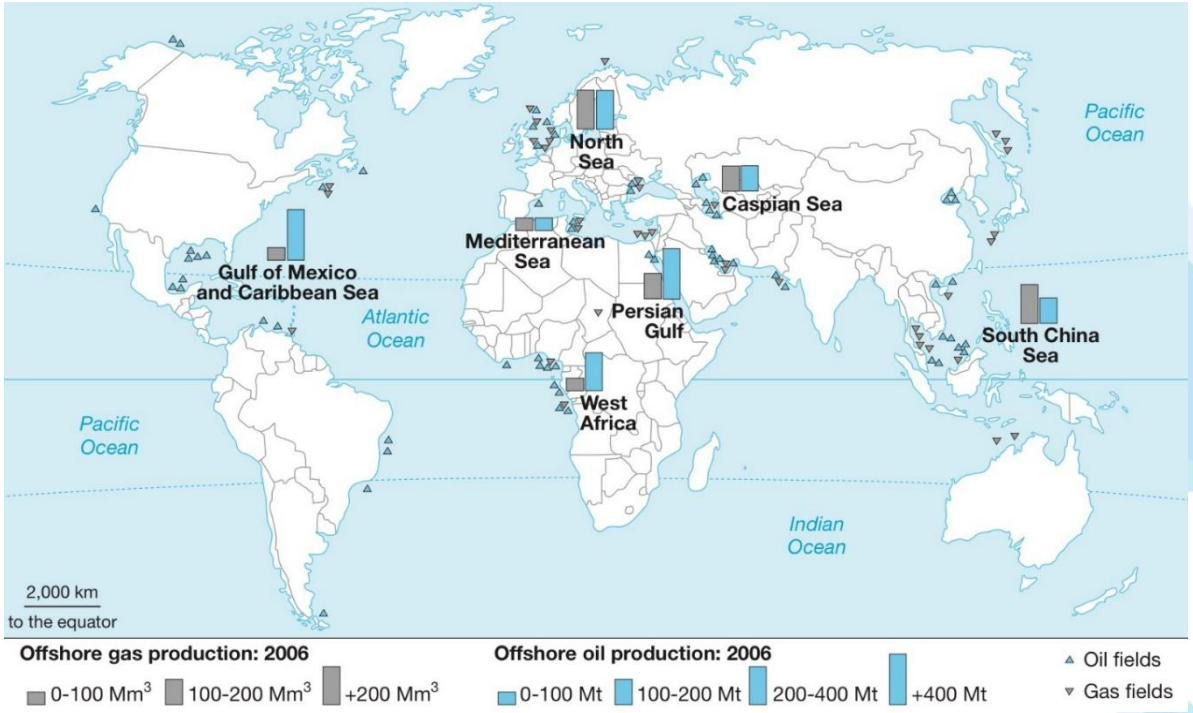
The power demand of these platforms averages between **5 – 30MW**, depending on the type [3].

[1] https://www.aquanetpower.com/offshore-platforms-1
[2] https://www.dtoceanplus.eu/content/download/4463/file/DTOceanPlus_D8.1%20Potential%20Markets_UEDIN_20200128_v1.0.pdf
[3] https://www.sciencedirect.com/science/article/pii/S036054421630305X

There are offshore O&G rigs all around the world although they are concentrated in certain areas

Location

As of today, there are hundreds of offshore O&G platforms worldwide, most of them no so far from the coast due to the lack of development in the area of floating platforms. The locations with higher concentration of offshore rigs are North Sea, Gulf of Mexico, Persian Gulf, South China Sea, West Africa, Caspian Sea and Mediterranean Sea. These areas are the ones with greater number of offshore platforms, but they can be found all around the world, e.g. Brazil or Alaska. Some of those main regions, such as Caspian Sea and Persian Gulf, do not have enough wave energy resource due to their geographic characteristics and so, they are going to be dismissed in this study.



Global offshore O&G market location

Figure: http://regardssurlaterre.com/en/toward-international-regulation-offshore-oil-drilling

Investments in the O&G market have been affected by COVD-19 by almost 30%

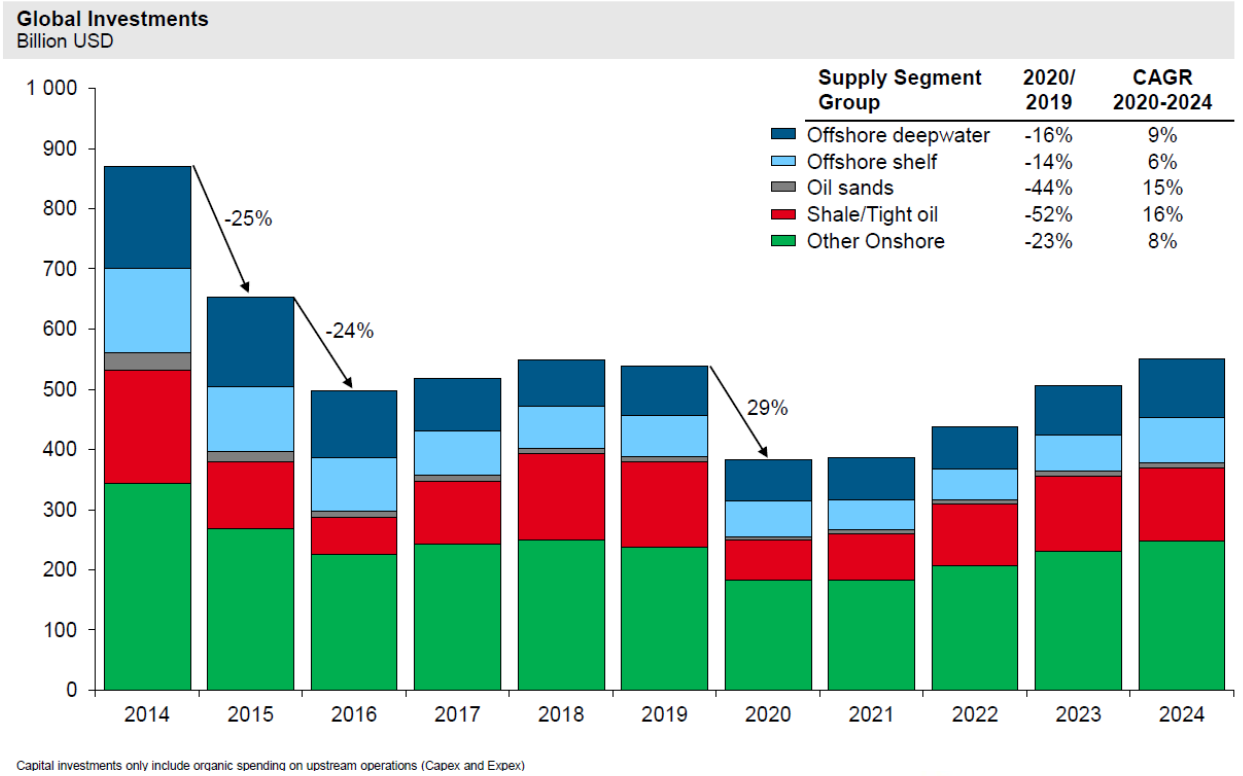
Investments

In the recent years, the O&G market has grown after the drop of 2014-2015. However, after the recent world pandemic of the COVID-19, the market has experiment another fall of almost 30%. It must be remarked that the offshore sector is the one that has suffered in less measurement the negative impacts of the COVID-19.

For the next years, it is expected a gradual increase in the investments.

Reduced investments activity

Global E&P investments expected to fall by nearly 30% this year



Capital investments only include organic spending on upstream operations (Capex and Expex)

Figure: Rystad Energy UCube

O&G companies are investing in renewable energies, mainly Equinor

Investments

The O&G companies have started to invest in renewable energies, specially in wind and solar energy. The main investor is Equinor, with already offshore wind projects. However, with the COVID-19, the investments in the green energy could be reduced by 20%.

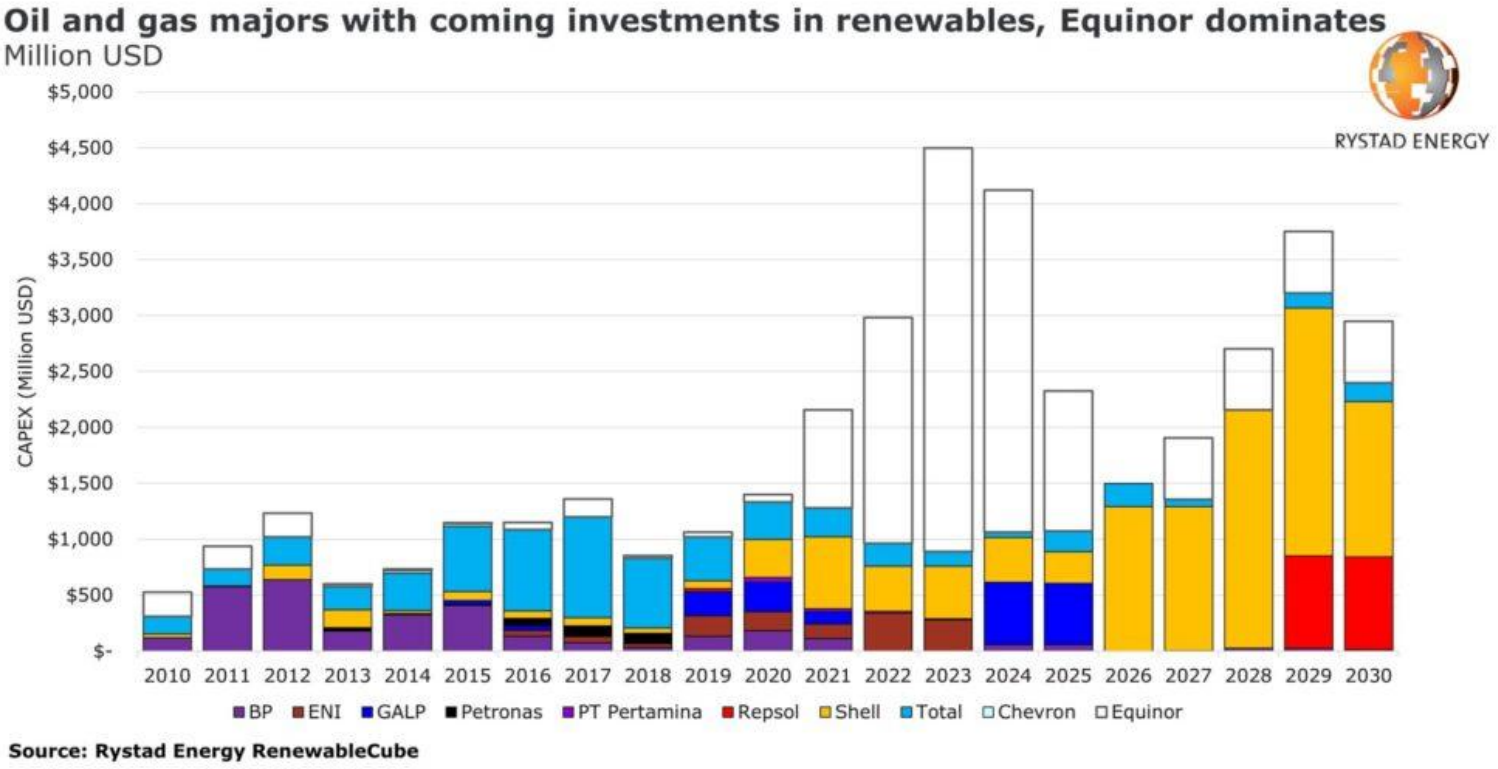


Figure: Rystad Energy RenewableCube

The biggest offshore O&G platforms companies are spread worldwide

Main competitors

Apart from considering the main locations of the offshore O&G platforms, it is also interesting to know which the main competitors/owners of those platforms are. The world's biggest offshore O&G enterprises are the following ones:

- Sinopec. It is located in Shanghai. Its specialization is offshore oil and gas exploration and development. The offshore exploration that they do takes place in the East China Sea, the South China Sea and the Yellow Sea.
- Royal Dutch Shell. It is a global group that manages the exploration and extraction of crude oil, natural gas and natural gas liquids.
- Saudi Aramco. With a presence in Asia, Europe and the Americas, this O&G company is investing in new technological solutions to achieve a more efficient production and consumption of oil by improving the efficiency and sustainability of transportation.
- British Petroleum. It does exploration activities as well as production ones thanks to wells all around the world. They are working with biofuels, wind energy and biopower so that they can modernize their business.
- ExxonMobil. With a global presence, it is focus on the extraction of oil and natural gas.
- Total. They work in all the continents for the exploration and production of O&G. They also have the ambition of achieving 25GW of solar and onshore and offshore wind energy by 2025.
- Chevron. It is present in 28 countries from all the continents, working in different activities from exploration and production of O&G to its transportation and supply.
- Gazprom. The company holds the largest natural gas reserves, sharing the 16% of the world's reserves and producing the 12% of the world's natural gas.
- Petrobas. Its main activities are O&G exploration and production being specialist in offshore fields.

https://www.moneycontrol.com/news/business/biggest-oil-and-gas-companies-in-the-world-shell-saudi-aramco-beaten-by-chinese-conglomerate-4634311-11.html

In the map below it can be seen where the largest offshore O&G companies have mainly their platforms

Main competitors

The analysis is structured in **3 independent sections**, which depth also depends on the **available information**

Structure

The study of the niche market niche has 3 sections and each one analyses different prioritization criteria. The first section analyses the criteria considering the 5 optimum locations where O&G drillings are done, which are:

- Gulf of Mexico
- North Sea
- South China Sea
- West Africa
- Mediterranean Sea

The study is conditioned by the available information. The sections and each analysis points are:

- **Main geographical markets.** It is studied in 3 different areas.
  - Location of rigs/platforms. An approximate value of the existing offshore structures and if it is possible, their location.
  - Wave energy resource. Description of the wave energy density of the site. Areas with less than 5kW/m have been dismissed.
  - Bathymetry. Analysis of the depth of the water where the platforms are located.
- **Power requirements.** An average value of the power demand per platform regarding its drilling capacity.
- **Opportunities for wave energy.** It is analysed describing 2 different points.
  - Competitiveness. Main advantages and disadvantages that other energy sources present.
  - Examples. Real cases where diesel engines have been replaced by other source.

1. Introduction
2. Overview of the niche market
3. **Analysis of the electric supply to O&G platforms**
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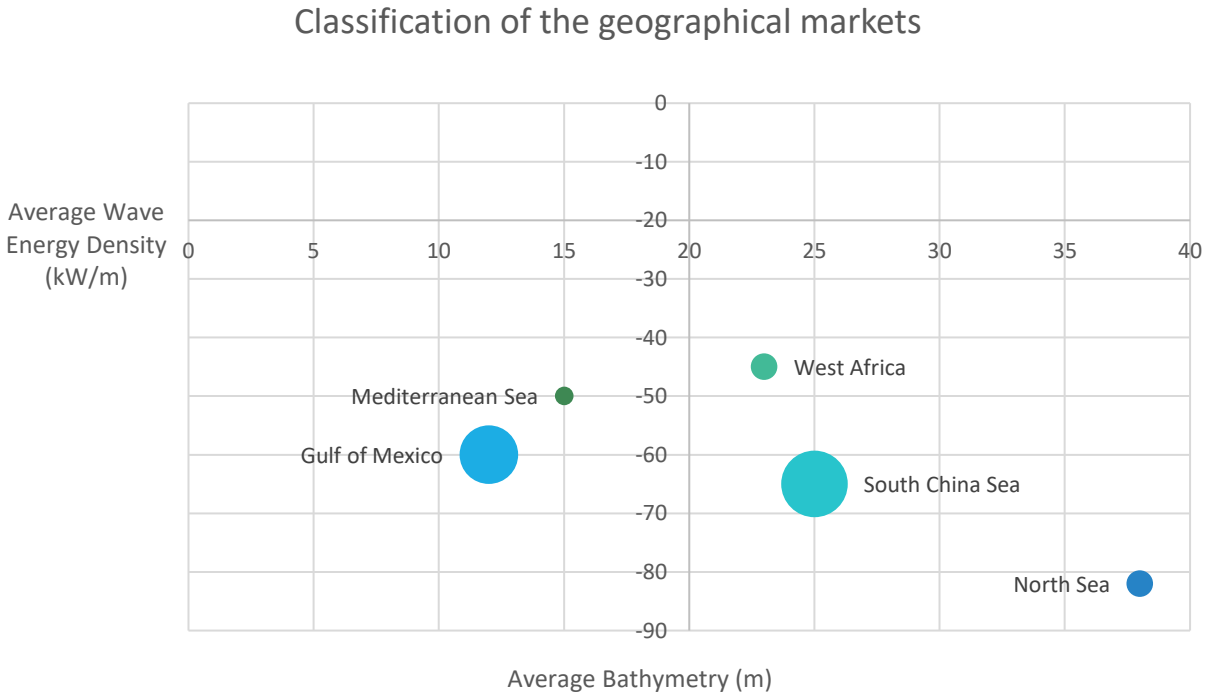
4. Main conclusions

- Gulf of Mexico
- North Sea
- South China Sea
- West Africa
- Mediterranean Sea

Overview of wave energy resource and bathymetry of each region, as well as their market size

Classification

The matrix comprises all the regions, considering the wave energy resource (horizontal axis) and bathymetry (vertical axis) of the areas where offshore platforms are located. Although in the following analyses some platforms have greater bathymetry, the value shown in the matrix is the average of the region. The size of the ball of each region represents the size of the market, this is the number of offshore O&G rigs.

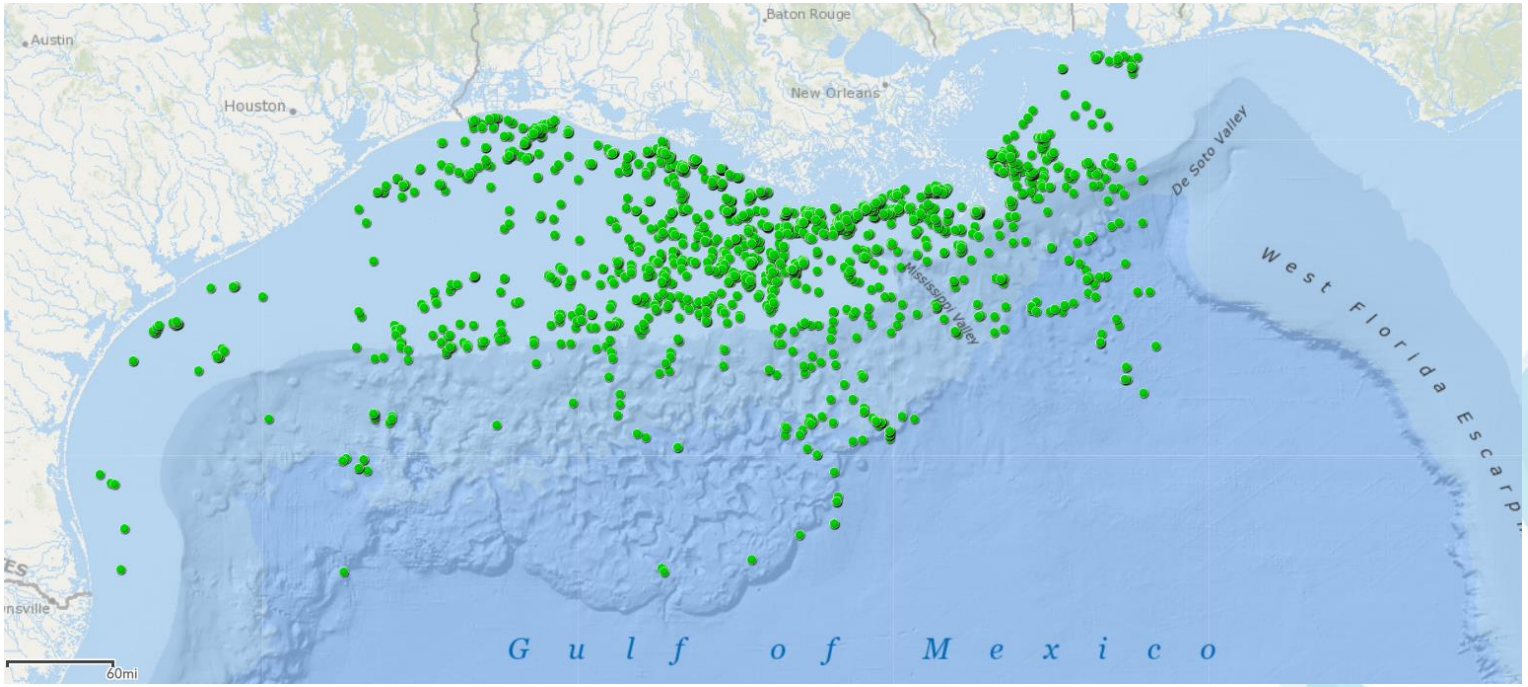


In the Gulf of Mexico there are around 1,500 – 2,000 offshore O&G platforms

Location of O&G platforms

When consulting different data sources, the **total number of offshore O&G structures** varies between **1,500 – 2,000**, being 35 floating platforms. One third of these platforms correspond to Mexico while the other two thirds to the United States. It should be noted that in 2003, the number of O&G platforms was almost double.

The location of these rigs is shown in the following map.



Map of location of offshore O&G platforms in the Gulf of Mexico

PlatformLogix by Westwood Global Energy Group
https://bobson.maps.arcgis.com/apps/webappviewer/index.html?id=9c82bd4a9ef541f0bf32dfa107173c21
https://www.un.org/Depts/los/global_reporting/WOA_RPROC/Chapter_21.pdf

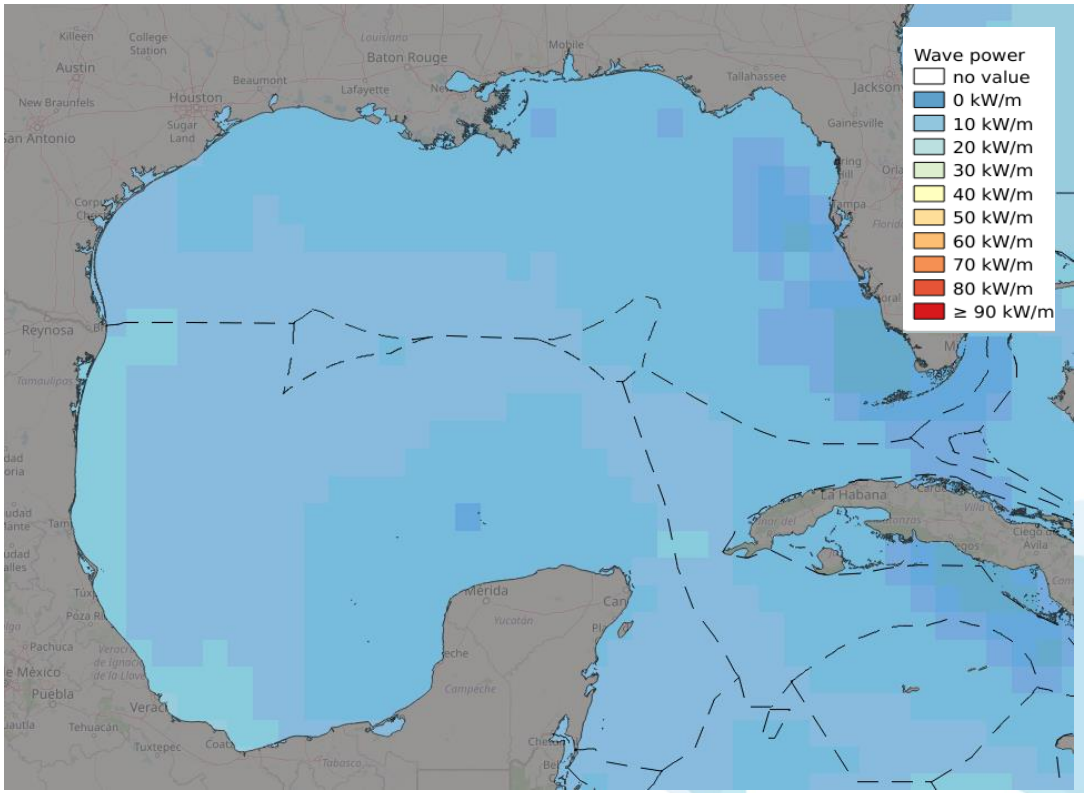
The Gulf of Mexico does not have a high wave energy potential

Wave Energy Resource

The offshore O&G rigs are spread along the Gulf of Mexico, especially in the north side. The wave energy density (WED) of all the locations is quite similar although it can be classified as:

- Low, 10kW/m. Platforms located in the north side of the gulf.
- Medium, 10 – 20kW/m. Platforms placed close to the west coast of the gulf.

Generally, the wave resource that the Gulf of Mexico has is quite low and it might not be enough to power those O&G platforms.



Map of the WED in the Gulf of Mexico

https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/

Most of the rigs are placed in waters up to 300m depth

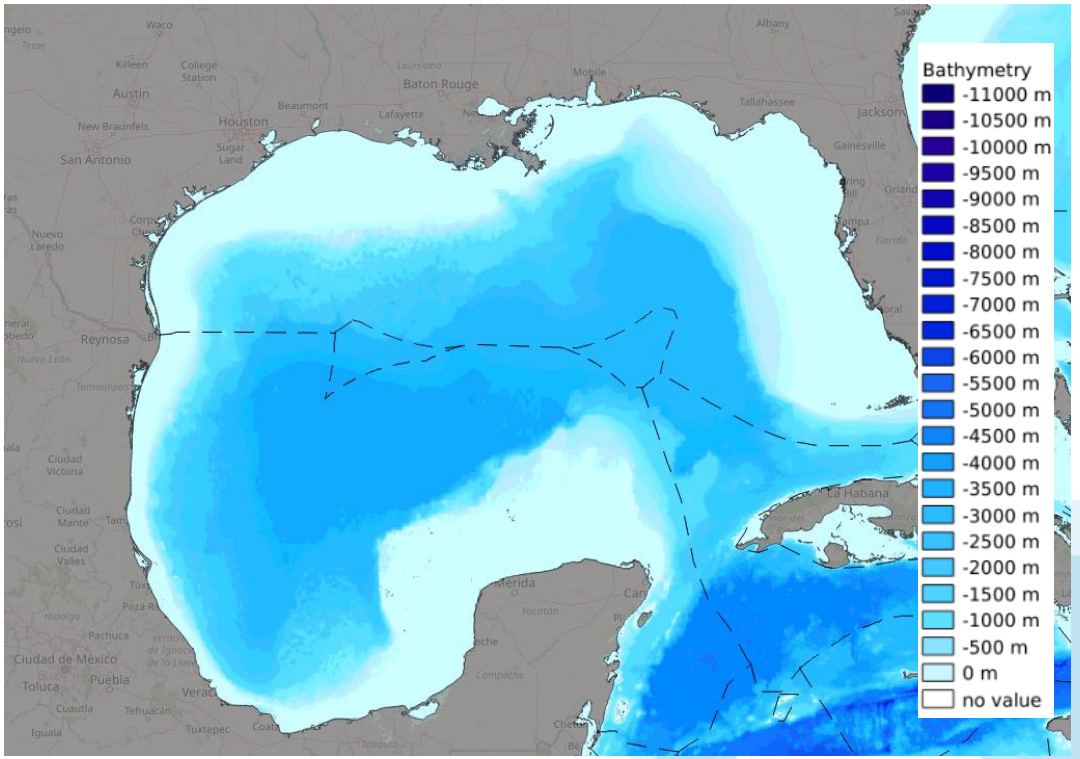
Bathymetry

Until now, the offshore O&G platforms have been placed in the shallowest waters of the Gulf of Mexico due to the lack of development of floating platforms.

Most of the 1,500 – 2,000 platforms that are in the Gulf of Mexico are in depths up to 300m. They can be classified as:

- Very shallow water, < 50m depth. More than 600 O&G rigs are in depths lower than 50m.
- Shallow water, up to 100m depth. Between 50 and 100m depth there are around 300 O&G platforms.
- Intermedium water, up to 300m depth. There are more than 100 platforms that are placed in water of 100 – 300m depth.

There is a small percentage located far away from the coast where the depth is quite larger, up to 3,000m.



Bathymetry map of the Gulf of Mexico

https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/
https://www.data.bsee.gov/Other/DataTables/PermDeepStruc.aspx

There are around 600 offshore O&G structures in the North Sea

Location of O&G platforms

The number of offshore O&G structures by countries that are in service in the North Sea are:

- United Kingdom: 270 – 290 platforms
- Norway: 90 – 110 platforms
- Netherlands: 170 platforms
- Denmark: 60 platforms
- Germany: 1 platform

The total **number of offshore O&G platforms** varies between **590 – 630**.

The location of these structures can be observed in the map on the right, with the exception of the structures of the Netherlands due to lack of information about their coordinates.

Map of location of offshore O&G platforms in the North Sea

https://odims.ospar.org/documents/1623
PlatformLogix by Westwood Global Energy Group

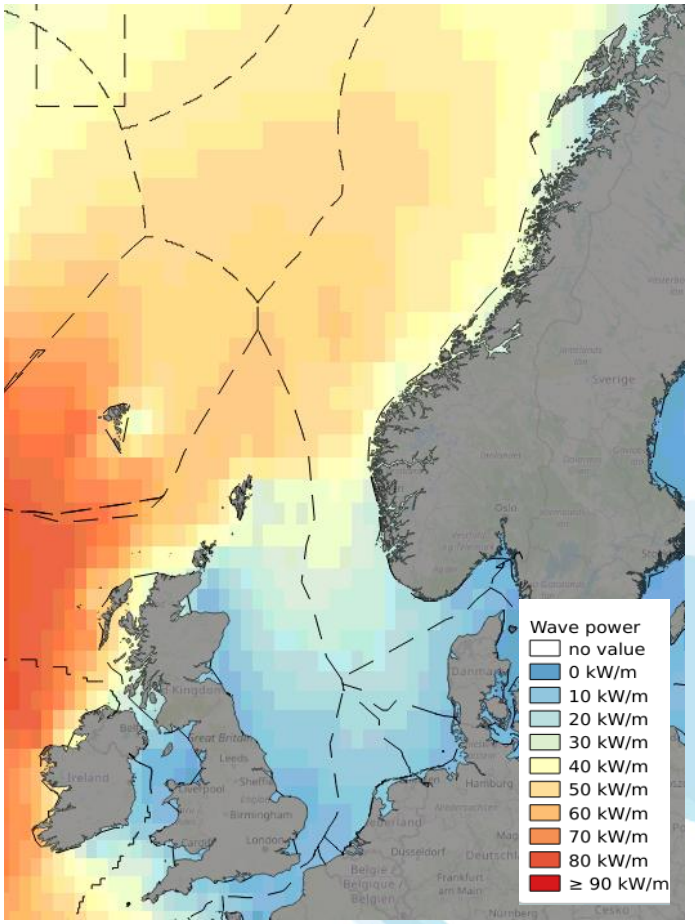
The North Sea has a high wave energy resource

Wave Energy Resource

The offshore structures are spread along the North Sea and so, the WED that will have each of them change regarding their location. In the region, the WED can be classified as:

- Low, 10 – 20kW/m. UK's platforms located in the south and Netherlands' platforms.
- Medium, 20 – 40kW/m. Platforms from Germany, Denmark and the middle ones of Norway and UK.
- High, 40 – 50kW/m. North UK and Norway platforms.

Generally, the wave resource that the North Sea has is quite high.



Map of the WED in the North Sea

https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/

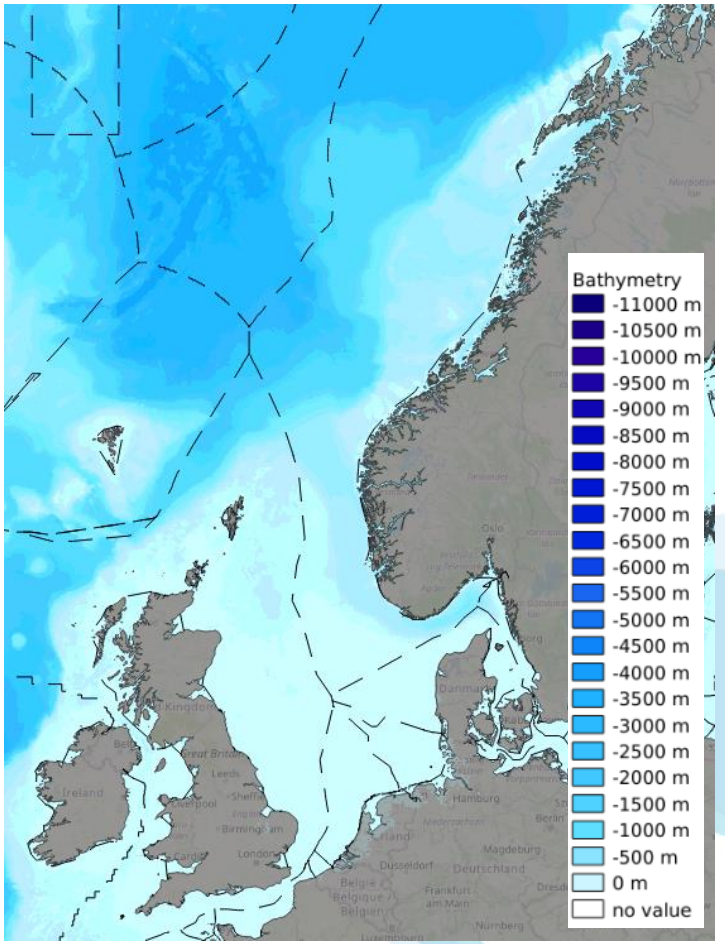
North Sea has shallow waters

Bathymetry

The North Sea is a shallow sea with depths up to 500m, as shown in the map.

The operating water depth of the platforms increases with the latitude. For this reason, location of the platforms can be classified in the next way:

- Very shallow water. Platforms from Denmark, Netherlands, Germany and south of UK have depths up to 50m.
- Shallow water. The ones located in the middle, Norwegian's and UK's, have a depth up to 100m.
- Intermedium water. Those Norwegian platforms located in the north have up to 300m depth.



Bathymetry map of the North Sea

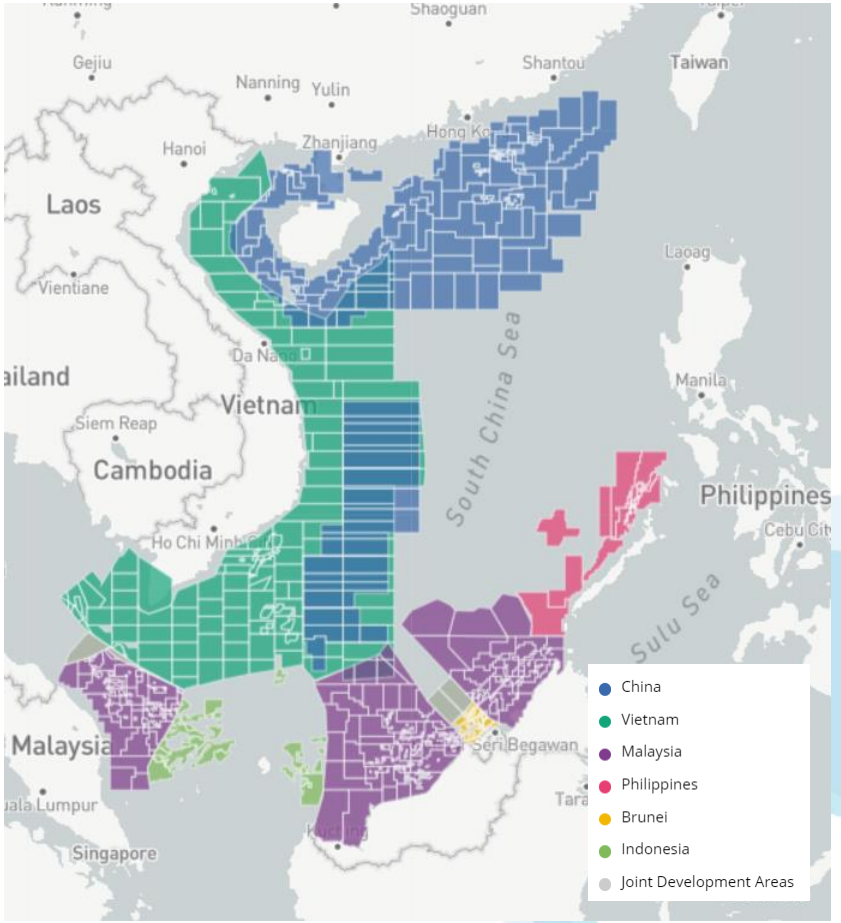
The are almost 2,000 offshore O&G platforms in the South China Sea

Location of O&G platforms

South China Sea contains around 1,900 offshore O&G rigs, which correspond to the 7 countries that border the sea. The number of platforms that each one owns is listed below:

- China: 270 offshore platforms
- Vietnam: 110 offshore platforms
- Malaysia: 450 offshore platforms
- Philippines: 2 offshore platforms
- Brunei: 180 offshore platforms
- Indonesia: 500 offshore platforms. However, not all of them are in the South China Sea.
- Thailand: 380 offshore platforms

The map on the right shows the O&G fields classify by country. The platforms of each country can change their exactly position inside those fields. Thailand's platforms are considered in the group named "Joint Development Areas".



Map of the location of offshore O&G fields in the South China Sea

PlatformLogix by Westwood Global Energy Group
https://amti.csis.org/south-china-sea-energy-exploration-and-development/

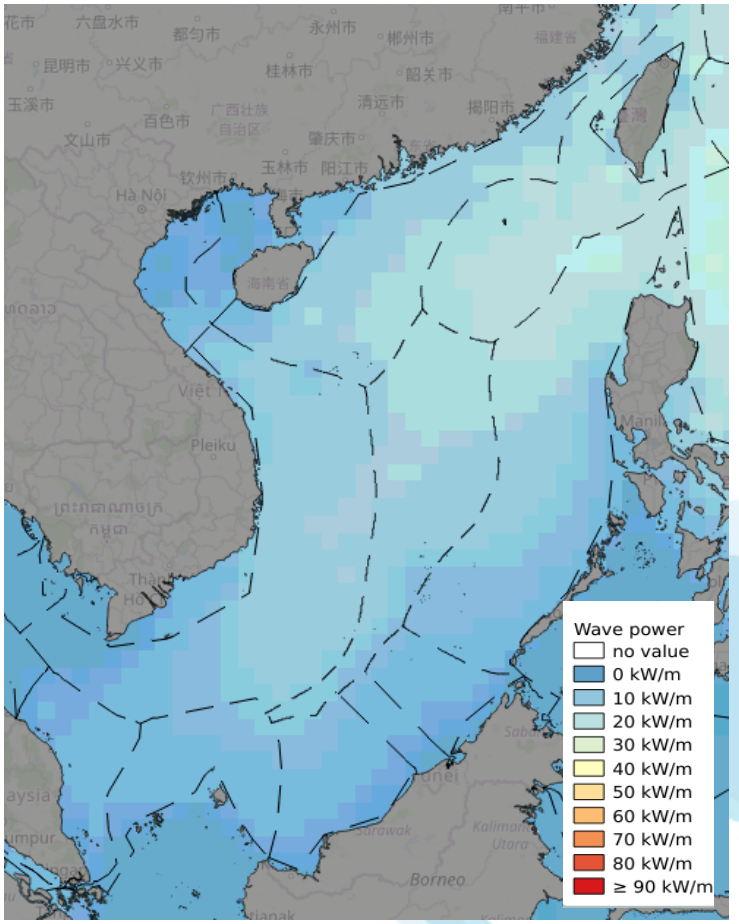
Generally, the fields located in the South China Sea have WED values between 10 – 30kW/m

Wave Energy Resource

The South China Sea contains offshore structures that are spread through all the sea and so, the WED changes from one field to other. In the region, the WED can be classified as:

- Low, 10 – 20kW/m. Rigs located in the fields of Malaysia, Indonesia, Thailand and South Vietnam do not have a great wave potential.
- Medium, 20 – 30kW/m. Fields corresponding to South China, Philippines and North Vietnam have larger wave energy resource.
- High, > 30kW/m. Some of Chinese fields can reach to the greatest WED values.

In general, the South China Sea has a medium wave energy potential.



Map of the WED in the South China Sea

The coastline of the South China Sea has very shallow waters

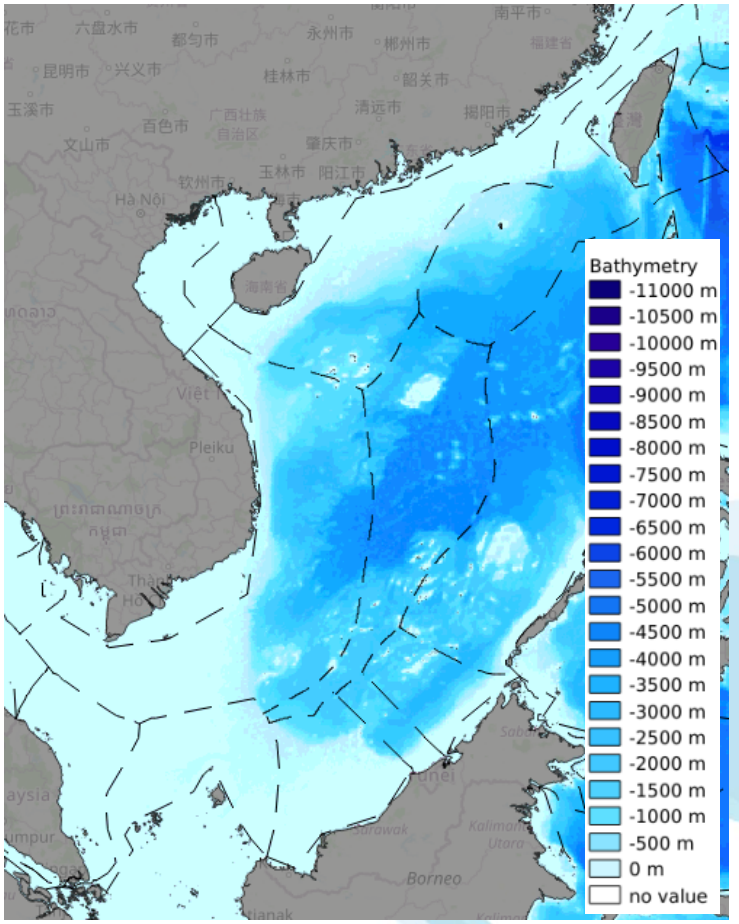
Bathymetry

The coastline of the South China Sea has very shallow water. It takes many kilometres to reach depths greater than 500m.

The fields with greater depth are those of South China and Central Vietnam, where the depth increase more rapidly a few kilometres from the coast.

Regarding the depth of each platform, it can be done the next classification:

- Very shallow water, < 50m depth: Half of the platforms, around 950, are located in waters up to 50m, being most of them fixed platforms.
- Shallow water, up to 100m depth: More than 800 platforms are placed in water with a depth between 50 – 100m and, once again, almost all of them are fixed.
- Intermedium water, up to 300m depth: only 120 platforms have an operating water depth greater than 100m and out of those, approximately 60 exceed the 200m depth.



Bathymetry map of the South China Sea

West Africa has only around 600 platforms but a huge O&G potential

Location of O&G platforms

The West of Africa has huge potential in the O&G industry and so, in the recent years it is growing considerably with Nigeria and Angola as the most remarkable countries. The number of rigs per country are listed below:

- Nigeria, 130 offshore rigs
- Angola, 130 offshore rigs
- Gabon, 80 offshore rigs
- Democratic Republic of the Congo (DRC), 70 offshore rigs
- Cameroon, 60 offshore rigs
- Republic of the Congo, 40 offshore rigs
- Equatorial Guinea, 15 offshore rigs
- Ivory Coast, 10 offshore rigs

There are more than **600 offshore O&G platforms** in the West Africa.

PlatformLogix by Westwood Global Energy Group
https://yannhazoume.com/wp-content/uploads/2019/07/za_africa_oil_gas_state_of_play_Nov2018.pdf

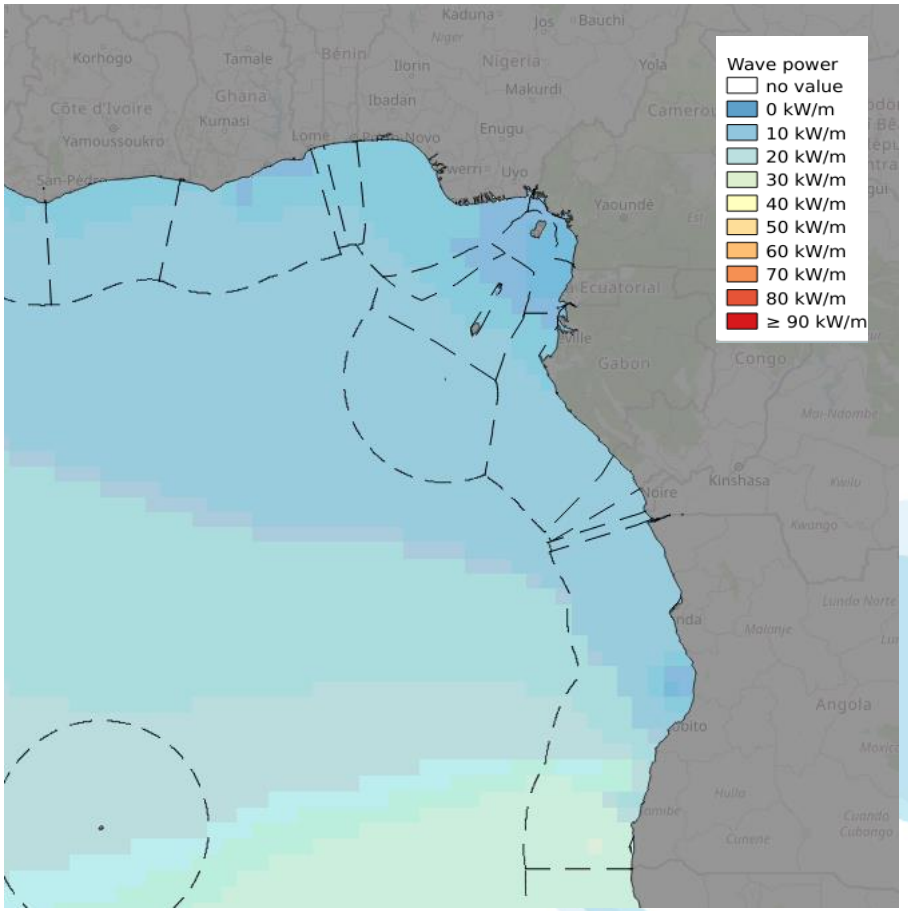
Excluding the south coast of Angola, the wave potential of the West Africa is low

Wave Energy Resource

The offshore platforms are placed mostly near the coastal of the African countries. In this region, the WED can be classified as:

- Null, < 10kW/m. The coasts of Cameroon and Equatorial Guinea have not enough resource for powering O&G platforms.
- Low, 10 – 20kW/m. Most of the countries, such as Ivory Coast, Nigeria, Gabon, Republic of the Congo, DRC and the north coast of Angola have low wave resource.
- Medium, 20 – 30kW/m. The south coast of Angola is the region with greatest wave potential.

Generally, the wave resource that the West Africa has is low.



Map of the WED in the West Africa

https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/

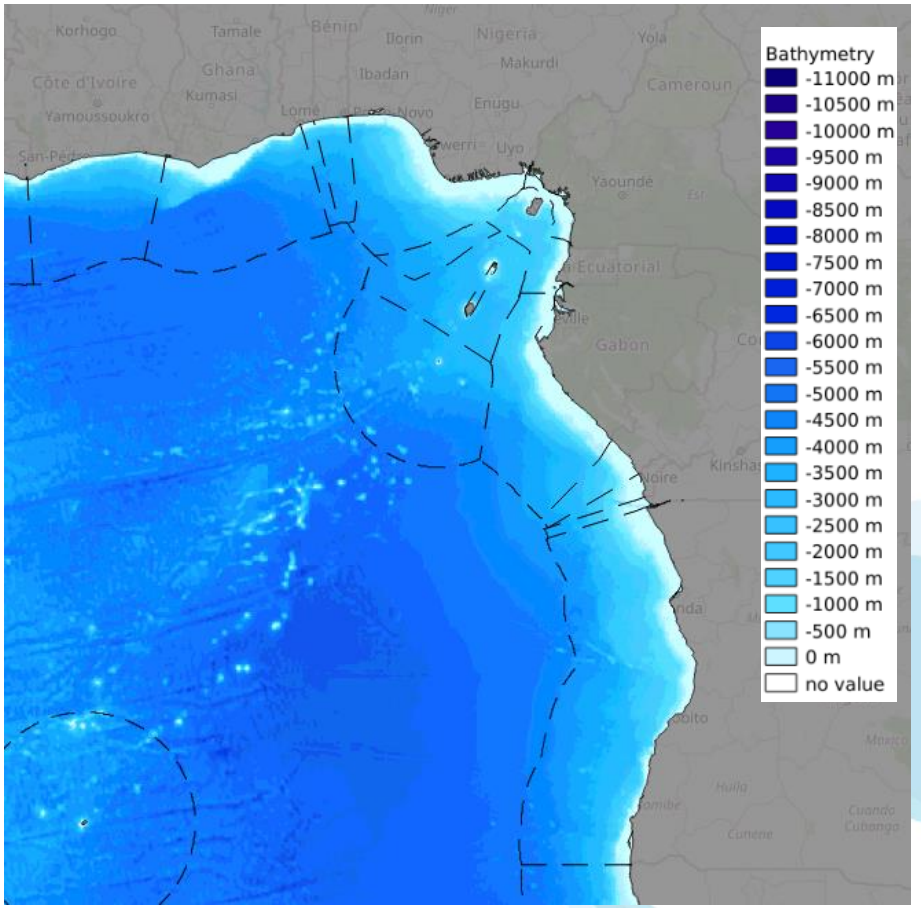
Most of the offshore O&G platforms are located close to the West Africa coastline where the water is still shallow

Bathymetry

The West African coast has shallow water in the areas close to the coastline but then, the depth increases rapidly. All the countries located in this region have the same characteristics regarding the coastline depth.

If considering the depth of each platform, it can be done the next classification:

- Very shallow water, < 50m depth: two thirds of the offshore rigs, more than 400, are fixed platforms placed in a depth lower than 50m.
- Shallow water, up to 100m depth: More than 170 fixed platforms are located in water with a depth between 50 – 100m.
- Intermedium water, up to 300m depth: only 35 platforms have an operating water depth between 100 – 300m. In this region it appears the first floating platform.
- Deep water, > 300m depth: there are only 6 platforms in this range, being 4 of them floating rigs reaching 1,000m depth.



Bathymetry map of the West Africa

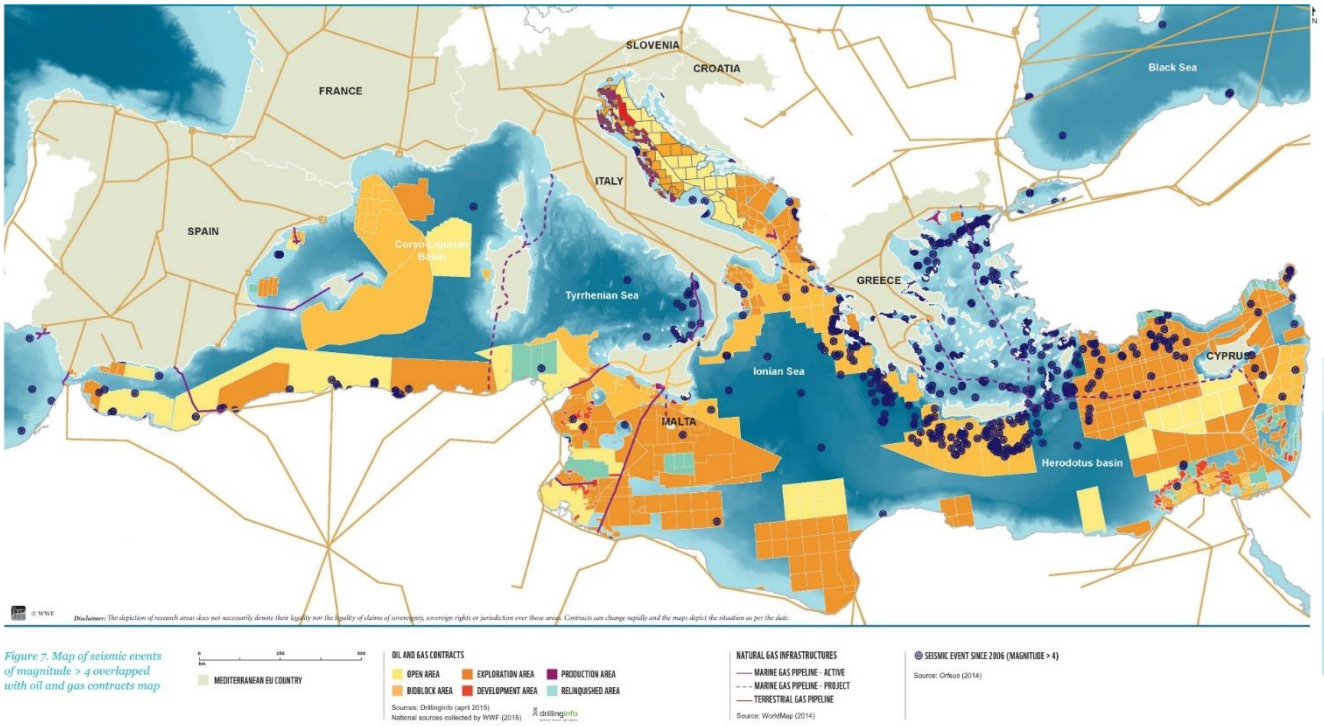
The Mediterranean Sea has become a hot spot for offshore O&G exploration with 300 platforms

Location of O&G platforms

The O&G exploitations in the Mediterranean Sea have increase substantially in the recent years. This region is bordered by countries not only in the EU but in the Northern Africa too. Some of these countries like Italy and Croatia are quite novel in this industry while Libya and Egypt, for example, are already known producers. The O&G platforms classified by countries are listed below:

- Egypt: 141 offshore rigs
- Italy: 104 offshore rigs
- Croatia: 18 offshore rigs
- Tunisia: 13 offshore rigs
- Libya: 7 offshore rigs
- Greece: 7 offshore rigs
- Israel: 3 offshore rigs
- Spain: 1 offshore rig

Despite the fact that these values change constantly, there are approximately **300 offshore O&G platforms** in the Mediterranean Sea.



Map of the location of offshore O&G fields in the Mediterranean Sea

PlatformLogix by Westwood Global Energy Group
https://www.rigzone.com/news/oil_gas/a/80517/analysis_drilling_picks_up_in_the_mediterranean_and_black_seas/
http://medtrends.org/sectors.php?sector=oil-extraction

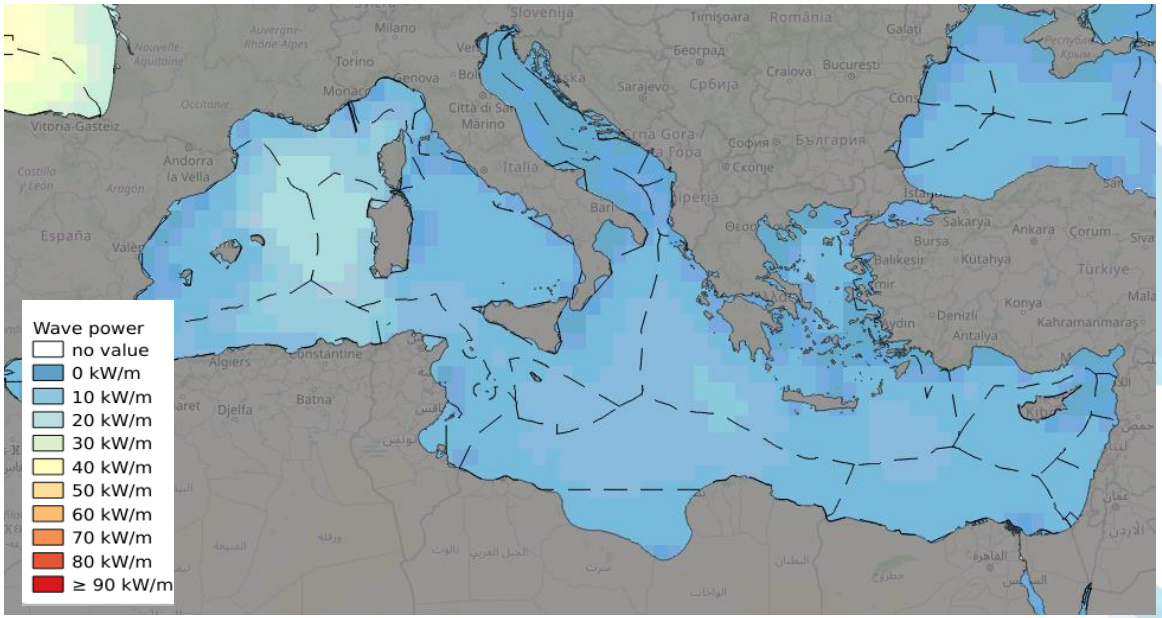
The Mediterranean Sea, as it is an almost closed sea, has a very low wave energy resource

Wave Energy Resource

The Mediterranean Sea is an almost closed sea and therefore, the wave energy potential is mostly low. In this area, the WED can be classified as:

- Null, < 10kW/m. The coasts of Italy and Croatia, due to their location, have little resource.
- Low, 10 – 20kW/m. Platforms located in the Northern Africa, e.g. in Libyan's, Egypt's and Israel's coasts, have greater resource that could be enough

Generally, the wave resource that the Mediterranean Sea has is quite low.



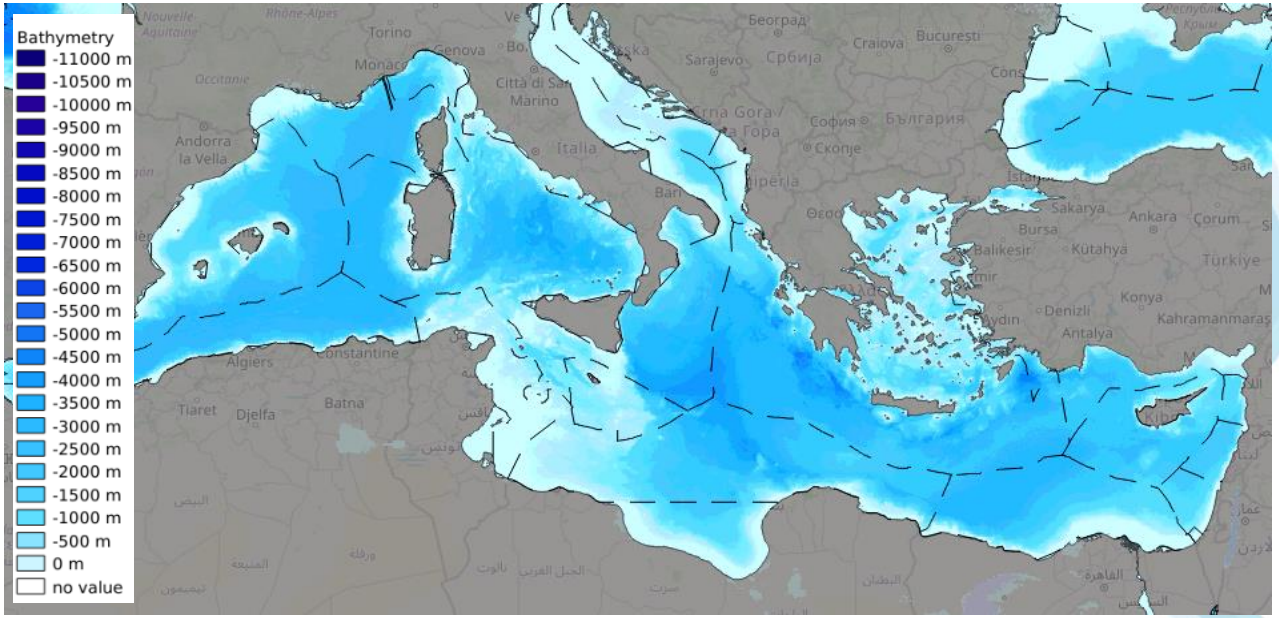
Map of the WED in the Mediterranean Sea

The Mediterranean Sea has mostly shallow waters, up to 300m depth

Bathymetry

The coastline of the Mediterranean Sea is characterized for having shallow waters. Regarding the depth of each platform, it can be done the next classification:

- Very shallow water, < 50m depth: almost two thirds of the offshore rigs, around 180, are fixed platforms placed in a depth lower than 50m.
- Shallow water, up to 100m depth: approximately 100 fixed platforms are located in water with a depth between 50 – 100m.
- Intermedium water, up to 300m depth: only 15 platforms have an operating water depth between 100 – 250m.



Bathymetry map of the Mediterranean Sea

The 34 analysed offshore O&G rigs have diesel engines and are located in waters up to 120m depth

Characteristics

For the analysis of the power demand it has been studied the data of 34 offshore O&G platforms. 19 of them are in Liberian coast, 11 in Vanuatu and 4 in Panama. The values given in the following slides correspond to those platforms and may not be a rule for the rest of the platforms worldwide.

General information about the rigs:

- Mean operating water depth: 100 – 125m
- Mean accommodation capacity: 120 – 150 people
- Power source: diesel engines
- Storage capacity: each platform needs storage for different propose such as for drilling water, fuel oil for power supply, potable water for the workers, etc. The liquid mud storage is the one more related with the power demand. Despite most of the platforms have a storage capacity for around 4,000 – 5,000bbl, the rigs with greatest demand (> 17MW) have a storage of 5,000 – 6,000bbl and the ones with lowest demand (< 5MW) of 1,500 – 2,000bbl.

http://borrdrilling.com/our-fleet/

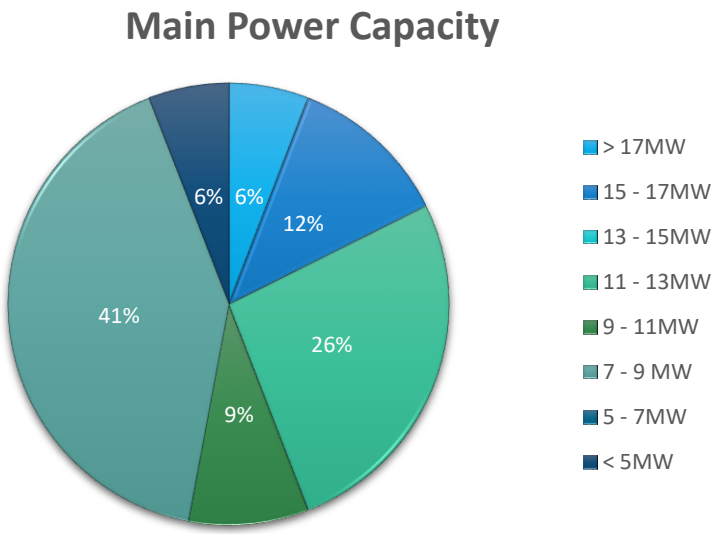
The power demand of a rig varies between 5 – 20MW and each rig has its own emergency engines

Power Demand

The rigs have their own engines for supplying the different activities that take place there. The **power demand** of each platform varies in a range of **5 – 20MW**. Most of the platforms (76%) have a main power capacity between 7 – 13MW. 18% have a greater capacity, more than 15MW and the last 6% corresponds to rigs with less than 5MW of capacity.

It should be noted that the newest platforms tend to have a higher power demand.

Apart from the main power source, the platforms have an **emergency power**. These generators have lower power capacity than the main ones, around **0.5 – 4MW**, representing between the 10 – 30% of the main power supply.



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Overview of the main competitors in the O&G supplying field

Competitiveness

The current power systems of the O&G platforms are **diesel engines**. However, new environmental targets are forcing O&G companies to change them by a more cleaner power resource. Diesel also presents the disadvantage of the need of transporting it to the site, what can be expensive.

On the one hand, **wind energy** generators' platforms are been developing following the O&G industry steps, from fixed platforms to floating ones. This can be key when considering wind energy as the power supply because the generators can be placed where the rigs are. However, the investment of a wind farm is huge and therefore, it should be able to supply more than one O&G platform to be economically profitable. Wind energy resource usually is more constant and greater in the open sea, where the structures are located. On the other hand, **solar energy** can be used by placing the panels in the roof of the O&G platforms. However, the solar resource is lower in high latitudes while great in the equator. For both wind and solar energy, batteries will be required to ensure a reliable supply.

Finally, **wave energy** is presented as an option to fulfil the power demand. It has a more constant resource than the other renewable energies although batteries are still necessary. The is wave energy resource in open sea, which could be useful in those new O&G platforms that tend to be installed in deeper waters.

Wind energy is supplying electric demand of 5 O&G platforms of Equinor

Examples

Wind energy

- Hywind Tampen in the name of the project developed by Equinor in the Norwegian North Sea.
- An 88MW floating offshore wind farm is been developing and it will supply the energy demand of the platforms located in two O&G fields: Snorre and Gullfaks.
- Siemens Gamesa provides 11 SG 8.0 – 167 DD wind turbines of 8MW each. The rotor of the generator has a diameter of 167m.
- The site is located 140km away from the coast and the depths at which the structures are ranging from 260 – 300m.
- These turbines are expected to provide the 35% of the total energy demand of 5 O&G platforms: Snorre A and B and Gullfaks A, B and C. This percentage is expected to increase considerably in periods of higher wind speed.
- On the one hand, this project is a test to further developments of these kind of synergies as well as floating wind technology. On the other hand, it helps the company to reduce the greenhouse gas emissions.

Deployment of offshore wind turbines that are going to supply the O&G platforms

https://www.equinor.com/en/what-we-do/hywind-tampen.html

Eni is working in WECs to increase the energy self-sufficient of its O&G platforms

Examples

Wave energy

- Eni developed the Inertial Sea Wave Energy Converter (ISWEC) in collaboration with Wave for Energy company.
- The system is composed by a sealed floating hull and a pair of gyroscopic systems located inside, which are connected to two generators.
- Eni deployed the first pilot in Ravenna, which is connected to its PC80 platform that also has a photovoltaic system. The aim of the company is to increase the energy self-sufficiency of their offshore structures that are placed far away from the coastline. This first version of the converter succeeded producing 105% of its nominal power, 50kW. Eni is already working on an industrial model of 100MW of peak power that could be used for medium to large O&G platforms. It is expected to be installed in the second semester of 2020 connected to Prezioso platform, in Gela.

ISWEC pilot version linked to Ravenna's O&G platform

https://www.eni.com/en-IT/operations/iswec-eni.html

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Conclusions of the Electric Supply to O&G Platforms

- Although there are O&G platforms worldwide, there are 5 regions that are more suitable for wave energy regarding the number of platforms and the WED of the area. These are the Gulf of Mexico, the North Sea, the South China Sea, West Africa and the Mediterranean Sea.
- In the face of new and more restrictive environmental policies, O&G companies are prone to reduce their greenhouse gas emissions. To meet this target, they are opting for a change of diesel engines, which have to be refilled periodically due to being most of them away from the coast, by renewable sources that generate on-site. O&G companies are already investing on them. However, the general investments in the O&G markets have been affected by the COVID-19 by almost 30%.
- Based on the analysis of the number of offshore O&G platforms and the wave energy potential, the most interesting market could be the South China Sea followed by the North Sea and West Africa. Although the Gulf of Mexico has a large number of platforms it is not profitable for the installations of WECs. Regarding the North Sea, it does not have the greatest market size, but it has a great WED and there are already O&G companies changing the current diesel engines, being a region to be considered.
- With respect the bathymetry analysis, until now, the structures have been located in shallow waters due to the current high costs of the floating technology. For this reason, the mean depth value of the rigs of the different sites are quite similar, between 50 – 80m, and so, it is not a relevant factor.
- The power requirements of the platforms vary depending on the size of each platform. After analysing some platforms' power demand, it can be concluded that the demand ranges between 5 – 20MW, being the average value between 7 – 13MW.
- There are already projects involving renewable energies such as wind and wave energy in the power supply systems of some O&G platforms, e.g. Hywind Tampen and ISWEC. These projects have been developed in the North Sea and in the Mediterranean Sea respectively. The floating offshore wind farms are attractive to the niche due to their similarities in terms of structure and power generation capability, although floating structures are not a mature technology yet. Wave energy has a great potential and some advantages compared with wind energy such as its lower infrastructure and installation operating costs.

All the bibliography used is in an addition file.

Cluster Energía
BASQUE ENERGY CLUSTER

C/ San Vicente 8, Edificio Albia II.
4ª plta Dpto. B. Dcha. 48001 Bilbao
Tel. 944 24 02 11
mail@clusterenergia.com

www.clusterenergia.com