ELECTRIST€RY.III OCEAN POWER, THE BIG UNKNOWN

In this course you will discover many sustainable terms, different technologies of marine potential and, probably the answer to this disturbing question:

Is going to be the ocean energy enough as to avoid our energy collapse?

1. PREVIOUS CONCEPTS

Probably at these days you have already hear about energy crisis and the break in the supply chain. That is because our economy is mainly based on fossil energy and it is run out (besides it is very pollutant). Our European Union, EU, is being from time ago investing in possible solutions like oceans and seas power.

"Our oceans and seas provide us with a vast and largely untapped source of renewable energy that can be used to put the EU on a path to climate neutrality by 2050. Research and innovation hold the keys to harvest this unique potential in a sustainable way, providing green power and blue growth in a circular economy".

Mariya Gabriel, EU Commissioner for Innovation, Research, Culture, Education and Youth

ec_rtd_offshore-renewable-energy.pdf (europa.eu)

File:Ocean landscape from shore.jpg - Wikimedia Commons

Activity 1. SUSTANAIBLE TERMS ACTIVITY (Interactive content-file:sustainable-terms-171.h5p)

Search the meaning of the following terms:

Green power

Circular economy

Climate neutrality

Blue growth

2. OCEAN ENERGY RESEARCH AND INNOVATION

Why the EU supports ocean energy research and innovation

Ocean energy is abundant and renewable. It can play an important role in the energy mix as it is very predictable, contributing substantial value to the energy system. The main forms of ocean energy are waves, tides, marine currents, salinity gradient and temperature gradient.

Under the right conditions, ocean energy could contribute around 10% of EU power demand by 2050.

The technologies to capture ocean energy are at different stages of development in Europe.

Challenges

Over the past ten years, tidal stream and wave devices - on different scales - have been tested in European waters. However, only a few examples can be found today of ocean energy systems in operation.

Considerable progress is needed - in research, development, demonstration and validation of the technology - for this sector to realize its potential contribution to energy supply, industrial leadership, economic growth and mitigation of climate change.

In particular, progress is needed in design and validation of ocean energy devices, balance of plant (supporting components and auxiliary systems), logistics and marine operations, integration in the energy system, and modeling tools.

Knowledge about the potential impacts of devices on the environment also needs to improve.

What the EU is doing

The EU has supported ocean energy research and development for many years through funding projects. Their focus has been on demonstrating the reliability of ocean technologies and their capacity to survive in aggressive sea conditions, thereby reducing the risk for project developers and investors.

EU support also aims to make ocean energy cost competitive with other technologies and demonstrate its market potential.

Ocean energy | European Commission (europa.eu)

Activity 2. Answer the following questions (more than one answer allowed)

1. Which are the main possible forms of ocean energy?

- [ ] Whales pushing boats
- [ ] Waves, tides, marine currents
- [ ] Availability of nuclear energy
- [ ] Salinity gradient and temperature gradient

2. Do you think that technologies are already ready to take profit from ocean energy?

- ( ) Yes
- ( ) Some
- ( ) None

3. Which are the main challenges that EU has to overcome?

- [ ] None
- [ ] Progress is needed in design and validation of ocean energy devices.
- [ ] Find oceans fish free

- ☐ knowledge about the potential impacts of devices on the marine environment .

4. What is EU doing in order to support ocean energy?

- ☐ Nothing at all
- ☐ Many things but slowly
- ☐ Funding different projects

3. MARINE ENERGY

The oceans have a tremendous amount of energy and are close to many if not most concentrated populations. Ocean energy has the potential of providing a substantial amount of new renewable energy around the world.

Marine energy or marine power (also sometimes referred to as ocean energy, ocean power, or marine and hydrokinetic energy) refers to the movement of water in the world's oceans which creates a vast store of kinetic energy, or energy in motion. Some of this energy can be harnessed to generate electricity to power homes, transport and industries.

This energy is carried by ocean waves, tides, salinity, and ocean temperature differences.

Offshore wind power is not a form of marine energy, as wind power is derived from the wind, even if the wind turbines are placed over water.

Marine energy - Wikipedia

Now we are going to discover these five different ways of marine energy:

Waves

Tides

Salinity gradient

Temperature gradient

Offshore wind

3.1 WAVE ENERGY (Interactive content-file: wave-energy-172.h5p)

Solar energy from the Sun creates temperature differentials that result in wind. The interaction between wind and the surface of water creates WAVES. A machine that exploits wave power is a **wave energy converter** (WEC). It is important to distinguish among the four most common WEC: point absorber buoys, surface attenuators, oscillating water columns, and overtopping devices.[8]

At a simplified level, wave energy technology can be located near-shore and offshore. Wave energy converters can also be designed for operation in specific water depth conditions: deep water, intermediate water or shallow water. The fundamental device design will be dependent on the location of the device and the intended resource characteristics.

Source: Marine energy - Wikipedia

3.2 TIDAL ENERGY (Interactive content-File: tidal-energy-173.h5p)

TIDES are the rise and fall of see levels caused by the combined effects of the gravitational forces exerted by the Moon and the Sun, and the rotation of the Earth.

Tidal power generation comprises three main forms, namely: tidal stream power, tidal barrage power, and dynamic tidal power.

Source: Marine energy - Wikipedia

3.3 SALINITY GRADIENT ENERGY (Interactive content-File: salinity-gradient-energy-174.h5p)

At the mouth of rivers where fresh water mixes with salt water, energy associated with the salinity gradient can be harnessed using pressure-retarded reverse osmosis process and associated conversion technologies.
It is important to note that small-scale investigations into salinity power production take place in other countries like Japan, Israel, and the United States. In Europe the research is concentrated in Norway and the Netherlands, in both places small pilots are tested. Salinity gradient energy is the energy available from the difference in salt concentration between freshwater with saltwater. This energy source is not easy to understand, as it is not directly occurring in nature in the form of heat, waterfalls, wind, waves, or radiation.

3.4 TEMPERATURE GRADIENT (Interactive content-File: temperature-gradient-175.h5p)

Water typically varies in temperature from the surface warmed by direct sunlight to greater depths where sunlight cannot penetrate. This differential is greatest in tropical waters, making this technology most applicable in water locations. A fluid

is often vaporized to drive a turbine that may generate electricity or produce desalinized water. Systems may be either open-cycle, closed-cycle, or hybrid.

Ocean Thermal Energy Conversion (**OTEC**) uses the ocean thermal gradient between cooler deep and warmer shallow or surface seawaters to run a heat engine and produce useful work, usually in the form of electricity. OTEC could be land, shelf and floating sites.

https://en.wikipedia.org/wiki/Marine_energy#Ocean_thermal_energy

3.4 OFFSHORE WIND ENERGY (Interactive content-File: offshore-wind-energy-176.h5p)

Offshore wind power or **offshore wind energy** is the deployment of wind farms sited in bodies of water. Higher wind speeds are available offshore compared to on land, so offshore farms' electricity generation is higher per amount of capacity installed, and NIMBY opposition is typically weaker.

Unlike the typical use of the term "offshore" in the marine industry, offshore wind power includes inshore water areas such as lakes, fjords and sheltered coastal areas as well as deeper-water areas. Most offshore wind farms employ fixed-foundation wind turbines in relatively shallow water. As of 2020, floating wind turbines for deeper waters were in the early phase of development and deployment.

https://en.wikipedia.org/wiki/Offshore_wind_power

4. HOW STRONG ARE YOU IN MARINE ENERGY???

Let's check how much you know about marine energies. I recommend you to make a drawing or scheme for each of the five previous energies before starting the game.

Keep calm!!!

TIDAL/WAVE/WIND/SALINITY/THERMAL ENERGY

(Interactive content-File: tidal-wave-wind-salinity-thermal-energy-177.h5p)

Now you will need to tape the kind of energy in each card.

Use the following words:

WAVES

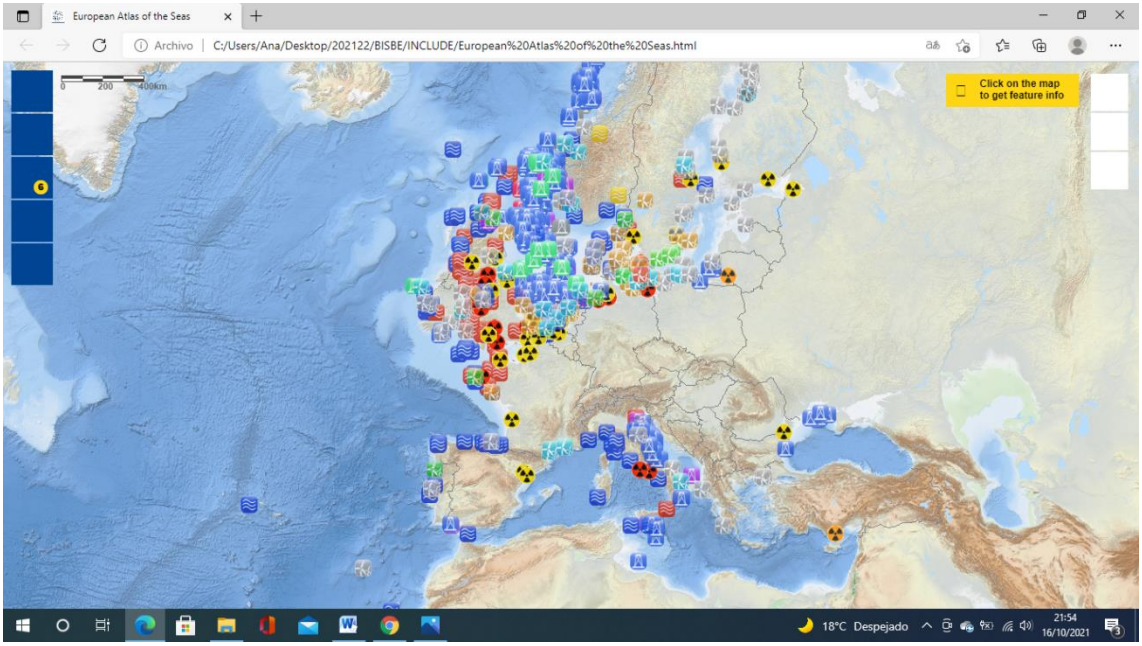
TIDAL

SALINITY

THERMAL

WIND

5. EUROPEAN ATLAS OF THE SEAS



Will be glad to know how developed Marine Energies in our seas are.
At this last point, you will be glad to know how developed Marine Energies in our seas are.
Click in this link and you will discover:
- How many marine power stations there are in your country?
- At which state are them (functional or in project).

https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas

OCEAN PROJECTS AND OFFSHORE WIND ENERGY

Click at this interactive map.

Then, click the button "Layer list and Legend" on the left side and search the answers to the following questions by selecting the appropriated layer.

(Interactive content-File: offshore-wind-energy-2-178.h5p)

Which Mediterranean countries have wind farms?

- Greece, France, Italy.
- Greece, France, Italy and Spain
- Cyprus, France, Italy and Spain
- Cyprus, France, Italy