

The importance of wind energy by Engineer Ernesto del Puerto, e360

In recent years, greater importance has been given to the differentiation between non-renewable resources that have a limited amount available on the planet or a very slow recovery (which would require several hundred years) and those that have a relatively Fast, Renewable Resources, which are available to all and simply require an effective use.

Among these resources, one of the most used daily and necessary for our daily lives is the Electric Energy, which for many years has been obtained by different means, but mainly by the Thermoelectric Plants that work by burning a large amount of Hydrocarbon Fossils. This is a Non-Renewable Resource and whose quantity is limited in the deposits of our planet.

Due to this future shortage, and in addition to the fact that in this process of obtaining a large quantity of Contaminant Gases that cause important damages to the Earth Atmosphere affecting the quality of life, that is why it is beginning to be used in greater and greater Quantity the use of alternative energy sources that have this renewal capacity and also do not pollute, called Clean Energies.

Among these technologies applied one of the most widespread is that of Wind Turbines, which consist of the use of Wind Energy to be able to mobilize propellers that put into operation a mechanism that converts Kinetic Energy (energy of movement) that Mobilizes the blades to create an Electric Power, by operating an electric generator, which can be used both by households and even supply entire cities.

The use of the wind has been used since very distant times, when the movement of the blades of the Windmill became later transformed into the Mechanical Energy that was used for the mobilization of some machinery that helped in the harvest or to process different materials (By grinding cereals, for example).

At the moment we can find what is denominated Wind Park that can be found both in the terrestrial surface as well as in Aeolian Wind Parks located in floating structures that take advantage of the winds that blow in High Sea and allow a very high yield, combining a great amount of Wind Turbines To be able to supply cities or even entire regions.

A little history about wind power

"First, there is the power of wind, constantly exerted over the globe ... Here is an almost incalculable power at our disposal, yet how do we try to use it?" Henry David Thorau. 1834.

The concept expressed by H. D. Thorau shows that, two centuries ago, we were thinking about the importance of wind energy and how we should take advantage of it.

I am going to make a translation into Spanish about the idea: First, we have the power of the wind, constant on Earth ... It is an incalculable power within our reach, let us see how we know how to take advantage of it.

Wind energy has been exploited for 200 years.

The older applications of energy contained in the wind, as we have said, were the use of mills to extract water, or to obtain flour from different grains - such as wheat - and other agricultural applications.

The wind energy industry flourished in the world in the 1970s, following the global oil crisis.

This was achieved with a large investment for research on the subject in countries such as the USA, Denmark and Germany.

In the 1980s, the flow of money for research projects in the field of sustainable energies declined considerably in the US, causing the wind energy industry to stagnate in that country.

But it was not so in Europe.

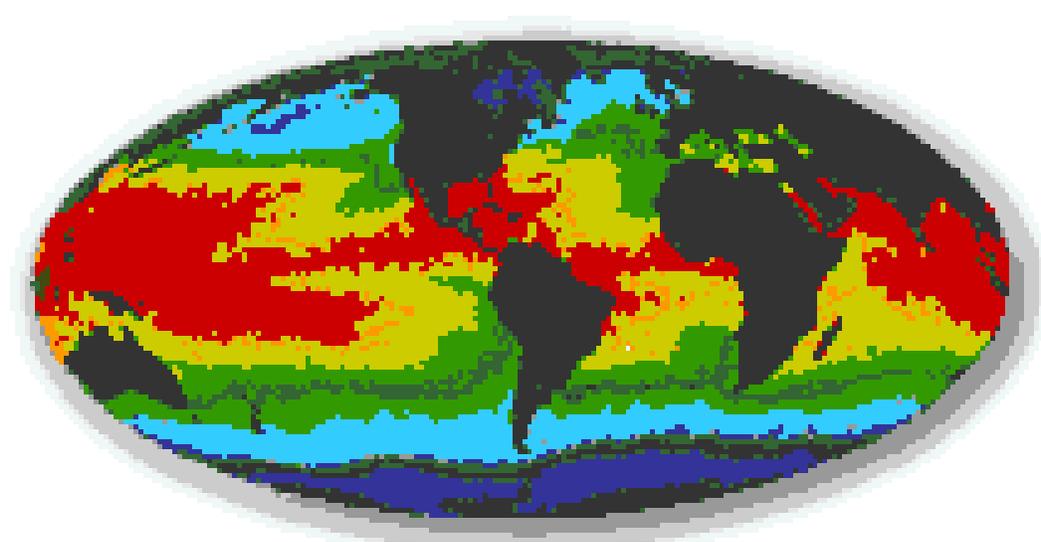
Europe leads in terms of technology and installed capacity.

In the early 2000s, US, Chinese and Indian wind facilities had significant growth.

The differences of temperatures that are generated in the Earth, are those that generate the air circulation.

Regions around the equator, at 0 ° latitude, are warmed by the sun more than the rest of the globe.

These hot areas, as shown in the following figure, are indicated in warm, red, orange and yellow colors in this infrared image of the sea surface (taken from a NASA satellite, NOAA-7, in July 1984).



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Hot air is lighter than cold air, so it will rise to a height of about 10 km and extend north and south.

If the Earth did not rotate, the air would simply reach the North Pole and the South Pole, then descend and return to the equator

On average, the net primary production of plants is around 4.95×10^6 calories per square meter per year.

This is the overall net primary production, ie the amount of energy available in all subsequent links in the food / energy chain.

Thus, the amount of net power stored by plants is 1.91×10^{13} W, which is equivalent to 0.011% of the power emitted to the Earth.

The wind rises from the equator and moves north and south in the highest layers of the atmosphere.

Around 30° latitude is an area of high pressures, so the air begins to descend again.

When the wind rises from the equator there will be an area of low pressures near ground level attracting the north and south winds.

At the poles, there will be high pressures due to the cold air.

Keeping in mind the force generated by the rotation of the earth, we obtain the following general results of the directions of the dominant wind:

Latitud	90 - 60 N	60 - 30 N	30 - 0 N	0 - 30 S	30 - 60 S	60 - 90 S
Dirección	NE	SO	NE	SE	NO	SE

Latitude 90 - 60 N 60 - 30 N 30 - 0 N 0 - 30 S 30 - 60 S 60 - 90 S

Address NE SO NE SE NO SE

However, local geography may influence the results of the table above.

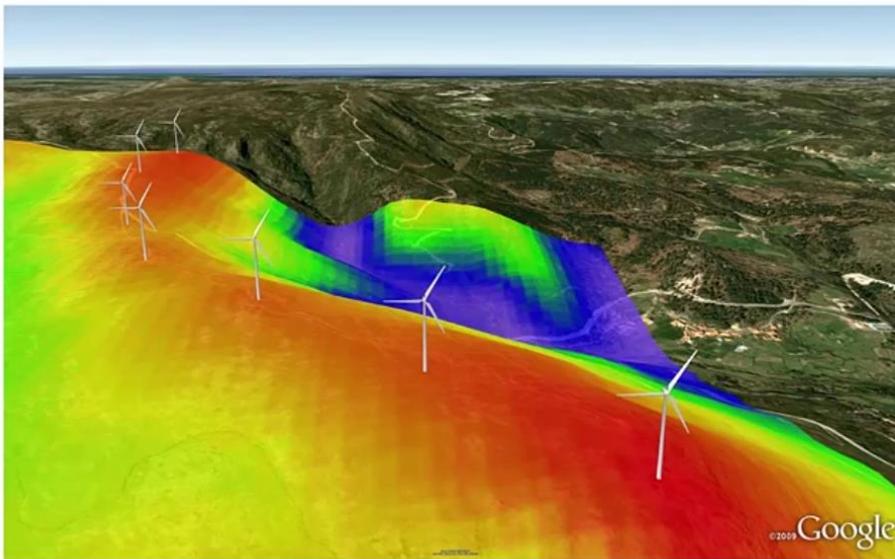
Actually the atmosphere has a thickness of only 10 km, which represents $1/1200$ (a 0.8%) of the diameter of the globe.

This part of the atmosphere, known as the troposphere, is where all the meteorological phenomena occur (and also the greenhouse effect).

The dominant wind directions are important for the location of wind turbines, as we will obviously want to locate them in places where there are as few obstacles as possible to the dominant wind directions.

We must take into account the AEP (Annual Energy Production - average annual production of energy generated by the winds) for a given area, where we are going to carry out the project - locating the wind farm - as shown in the following figure.

Wind farm Annual Energy Production (AEP)



The different colors indicate the intensity of the winds: the greater the red, followed by the yellow and the blue (the lower intensity).

At the top of the hill the intensity of the winds is greater decreasing as we descend from it, as observed.

We go from red to yellow and at the foot of the hill we reach the blue.

Why use wind power?

A country or region where energy production is based on imported coal or oil will become more self-sufficient using alternatives such as wind power.

The electricity produced by the wind does not produce CO₂ emissions and therefore does not contribute to the greenhouse effect.

Wind power is relatively labor intensive and therefore creates many jobs.

In remote areas or areas with a weak grid, wind energy can be used to charge batteries or can be combined with a diesel engine to save fuel whenever wind is available.

On the other hand, wind turbines can be used for desalination of water in coastal areas with little fresh water, such as in the Middle East.

In windy places the price of electricity, measured in \$ / kWh, is competitive with the production price of more conventional methods, for example, coal plants.

To further reduce the price and make wind power more competitive with other production methods, wind turbine manufacturers are focusing on reducing the price of the turbines themselves.

Other factors, such as interest rates, the cost of land and, not least, the amount of wind available in a given site, also influence the production price of the electric energy generated.

The production price is calculated as the investment plus the discounted maintenance cost divided by the discounted production measured in kWh over a period of 20 years.

When the characteristics of a given turbine (the power is known for a given wind speed, as well as the annual wind distribution), the annual production of energy can be estimated at a specific site.

In modern wind turbines, manufacturers have managed to reduce almost all mechanical noise and are now working hard to reduce the aerodynamic noise of rotating blades.

Noise is an important competitive factor, especially in densely populated areas.

Some people think that wind turbines are unsightly in the landscape, but as larger and larger machines gradually replace smaller machines, the actual number of wind turbines will be reduced while increasing capacity.

If many turbines are to be built in a region, it is important to have public acceptance.

This can be achieved by allowing people living near the turbines to own a part of the project and thus share the income.

In addition, noise and visual impact will be less important in the future, as more wind turbines will be placed on the high seas.

It is an advantage to know in advance what resources will be available in the near future so that conventional power plants can adapt their production.

Reliable weather forecasts are desirable as it takes some time for a coal plant to change its production.

The combination of wind energy with hydropower would be perfect as it takes almost no time to open or close a valve at the entrance to a water turbine and water can be stored in the tanks when the wind is strong enough .