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UTILIZATION OF WIND POWER

(A SZÉLENERGIA HASZNOSÍTÁSA)

Let's take a look at our world! The water, soil, air is polluted by wastes and the reasons of this phenomena are us, human beings. We destroy the nature every day in several ways and not just with littering on the streets, but also with giving birth to harmful airborne pollutants caused by the activity of combusting fossil fuels in order to produce energy. All of the people should know the fact that there is another alternative to solve the energy supply of our world. This solution can be the use of renewable energy sources such as sunlight, wind or biomass.In this article I would like to present the characteristics of windpower and some technologies that use this method for producing energy.

Keywords: *windpower, wind turbines, operation,components, transmission of wind energy*

Vessünk egy pillantást a világunkra! Földünk vizei, a levegő,talaj szennyezett, és ennek az oka nem más, mint mi, emberek. Minden nap számos módon hozzájárulunk környezetünk pusztításához, kezdve az utcán történő szemeteléstől egészen a fosszilis tüzelőanyagok elégetéséig, mely tevékenység az energia előállításához szükséges, viszont környezetszennyező hatása óriási. Minden embernek tisztában kell lennie a ténnyel, hogy más lehetőségünk is van, mint ilyen módon és mértékben pusztítani világunkat. A megoldás a tradicionális energiaforrások megújuló energiaforrásokra történő kiváltása lehet. Ez véleményem szerint sosem fog megvalósulni, de legalább törekedhetünk arra, hogy arányaiban megváltoztassuk az energia előállítására használt energiaforrásokat. Publikációmban a szélenergia jellegzetességeit és a szélerőművek működésének elveit ismertetem pár érdekességgel kiegészítve.

Kulcsszavak: *szélenergia, szélerőművek, működési alapelvek, alkatrészek, szélenergia átvitele*

INTRODUCTION

Before we start to talk about windpower, let me tell you some words about our determining phenomenom, the wind. What is wind exactly? What happens with it in the atmosphere? How does it move? We have several questions.

Illustration 1. Wind turbines [1]

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Wind is the movement of air from an area of high pressure to an area of low pressure. In fact, wind exists because the sun unevenly heats the surface of the Earth. As hot air rises, cooler air moves in to fill the void. As long as the sun shines, the wind will blow. And as long as the wind blows, people will harness it to power their lives. Ancient mariners used sails to capture the wind and explore the world. Farmers once used windmills to grind their grains and pump water. Today, more and more people are using wind turbines to wring electricity from the breeze. Over the past decade, wind turbine use has increased at more than 25 percent a year, but still, it only provides just a small fraction of the world's energy, and it is a very big mistake.

THE TRANSFORMATION OF WIND INTO ENERGY

Most of the people do not know how useful the wind is. As I mentioned, we can use air flow through wind turbines to mechanically power generators for electricity. However not this one is the only one advantage of using wind.

Wind power is an alternative to burning fossil fuels, is plentiful, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. Wind is a clean source of renewable energy that produces no air or water pollution. And since the wind is free, operational costs are nearly zero once a turbine is erected. Mass production and technology advances are making turbines cheaper, and many governments offer tax incentives to spur wind-energy development.

As I mentioned earlier the wind belongs to the group of renewable energy sources, which means that the amount of this is unlimited, so that we can use it whenever we want, but, how can we get energy from the wind?

The windpower is the conversion of the air's kinetic energy into the kinetic energy of a machine called turbine, which then creates electrical energy. The idea of harnessing the energy in moving air is over 2,000 years old.

Illustration 2. Wind turbines are generating electricity to supply homes [2]

Wind power is becoming a significant source of electrical energy in places like Spain, Portugal, Denmark and Germany, where it contributes almost one-fifth of the energy total. A wind can be as tall as a 20-story building and have three 60-meter-long blades.

These contraptions look like giant airplane propellers on a stick. The wind spins the blades, which turn a shaft connected to a generator that produces electricity. Other turbines work almost the same way.

The biggest wind turbines generate enough electricity to supply several homes. Wind farms have tens and sometimes hundreds of these turbines lined up together in particularly windy spots, like along a ridge. Smaller turbines erected in a backyard can produce enough electricity for a single home or small business.

Some people think that wind turbines are ugly and complain about the noise the machines make. The slowly rotating blades can also kill birds and bats, but not nearly as many as cars, power lines, and high-rise buildings do. The wind is also variable: If it’s not blowing, there's no electricity generated. We always have to sacrifice something so as to get something advantageous.

The structure of wind turbines and their operation

First of all I would like to present the parts of a wind turbine and then you will see how do these gadgets work.

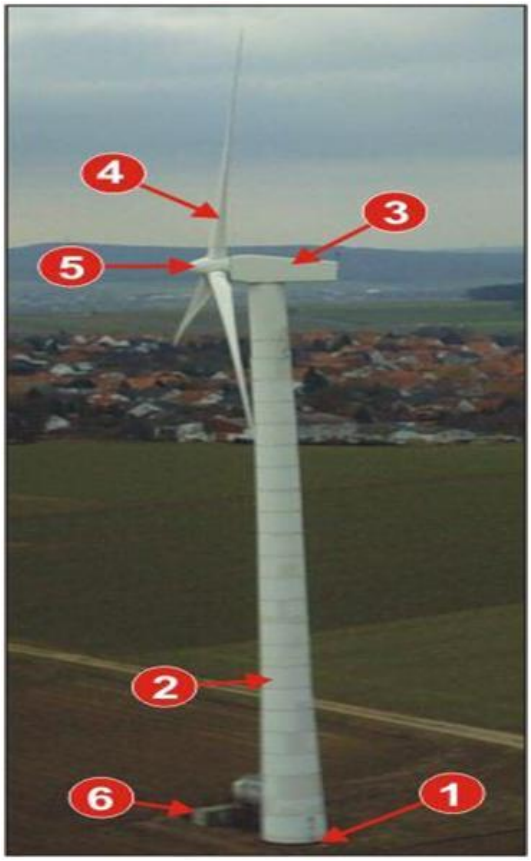

Illustration 3. Parts of a wind turbine [3]

There are 6 basic parts of a wind turbine that are the following:

1. Tower and foundation

In order to guarantee the stability of a wind turbine a pile or flat foundation is used, depending on the consistency of the underlying ground.The tower construction doesn't just carry the weight of the nacelle and the rotor blades, but must also absorb the huge static loads caused by the varying power of the wind. Generally, a tubular construction of concrete or steel is used. An alternative to this is the lattice tower form.

2. Rotor and rotor blades

The rotor is the component which, with the help of the rotor blades, converts the energy in the wind into rotary mechanical movement. Currently, the tree-blade, horizontal axis rotor dominates. The rotor blades are mainly made of glass-fibre or carbon-fibre reinforced plactics. The blade profile is similar to that of an aeroplane wing. They use the same principle of lift: on the lower side of the wind the passing air generates higher pressure, while the upper side generates a pull. These forces cause the rotor to move forwards and rotate.

3. Nacelle with drive train

The nacelle holds all the turbine machinery. Because it must be able to rotate to follow the wind direction, it is connected to the tower via bearings. The build-up of the nacelle shows how the manufacturer has decided to position the drive train components (rotor shaft with bearings. transmission, generator, coupling and brake) above this machine bearing.

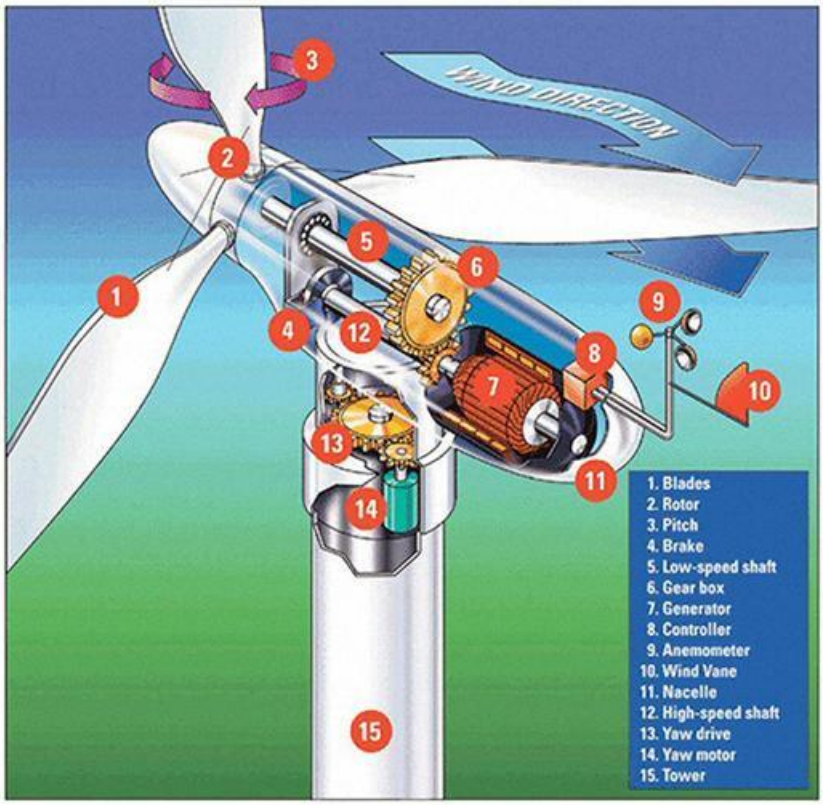

Illustration 4. Smaller components of a wind turbine [4]

It consists of more components such as the gearbox, generator, coupling and brake.

Gearbox: The gearbox converts the rotor motion of 18–50 rpm into 1,500 rpm that the generator requires. The gearbox thus takes on the task of matching the rotation speeds of the slow-moving rotor and the fast-moving generator, and generally has several steps to cover for various wind conditions. If a specially developed multi-pole ring generator is used, the gearbox is no longer required.

Generator: For high power wind turbines, doubly-fed asynchronous generators are most frequently used. Here, the operating rotation speed can be varied somewhat, unlike when using conventional asynchronous generators. Another concept uses synchronous generators. A grid connection of synchronous generators is only possible via transformers, due to the fixed rotation behaviour. The disadvantage of requiring complicated control systems is countered by the overall efficiency and better grid compatibility.

Coupling and brake: Because of the enormous torque, the coupling between the main shaft and the transmission is a rigid one. The type of brake depends on the control mechanism for the blades.

4. Electronic equipment

The electronic equipment of a wind turbine is composed of the generator, the system for the grid infeed of the electricity, and various sensors.The sensors for measuring temperature, wind direction, wind speed and many other things can be found in and around the nacelle, and assist in turbine control and monitoring.

5. Other components

Finally, the wind turbine contains components for following the wind direction, for cooling, heating and lightning protection, as well as lifting gear (e.g. winches for spare parts) and fire extinguishing equipment.

6. Transformer

It is not exactly the part of a wind turbine, it just contributes to the operation of the turbine.

Illustration 5. Wind turbine transformer [5]

The transmission of windpower

The transmission of energy „created" by wind turbines can be seen on the picture above. As I wrote it earlier, there is a transformer connected to the wind turbines. Transformers boosts the generating output of the turbine generator. These transformers are typically located at the base of the wind turbine. Grounding transformers are located at critical points in order to provide a neutral point for grounding purposes. From there, all the power is then interconnected to a collector step-up transformer located in a substation where it is transported to the electricity grid. That is how the system works.

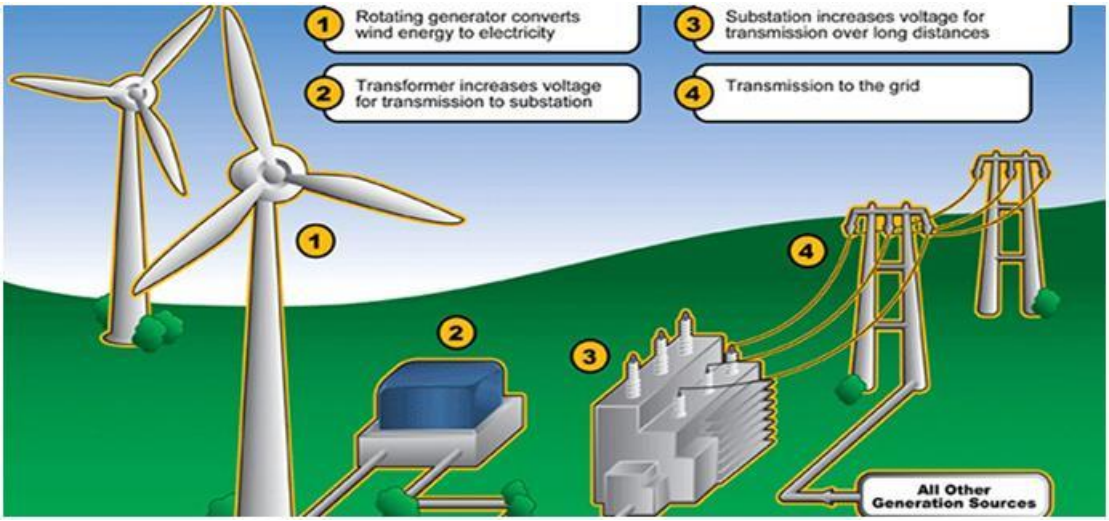

Illustration 6. The transmission of windpower [6]

WORLD'S LARGEST WIND TURBINE

I would like to share an interesting curiosity with you. The biggest wind turbine in the world will hover above Alaska. Manufacturers try to build higher and bigger turbines in order to capture more energy from the passing air. This would be a good solution for collecting energy owing to the higher altitude, because the strength of the wind in higher altitude is better.

Now, it seems that a turbine in Alaska, will spin high above the rest. A firm - called Altaeros Energies – will launch its high – altitude floating wind turbine to bring more affordable power to a remote community. This wind turbine is expected to provide power about half the price of off-grid electricity in Alaska. Instead, its sweet spot is serving far-flung villages, military bases, mines or disaster zones. Various researchers have been developing floating wind turbines for years, but the 18- month project in Alaska will be the first longer-term, commercial project to test this technology.

The name of this turbine would be BAT. This is the abbreviation of Buoyant Airborne Turbine. It would be an inflatable, helium-filled ring with a wind turbine suspended inside. It will float at a height of 300 meters, where winds tend to be far stronger than they are on the ground. The altitude of the BAT is about double the hub height of the world's largest wind turbine.

The BAT has a power capacity of 30 kilowatts and will create enough energy to power about 12 homes, the company says. But that's just the beginning. It can also lift communications equipment such as cellular transceivers or meteorological devices and other sensing equipment.

The technology does not require cranes or underground foundations. Instead it uses high-strength tethers, which hold the BAT steady and allow the electricity to be sent back to the ground. A power station on the ground controls the winches that hold the tethers and pulls in the power from the turbine before sending it on to a grid connection. The BAT prototype was tested in 70 kilometer-per-hour winds, but because it uses the same technology as other industrial blimps that are rated to withstand hurricane-level winds, it might be able to withstand stronger gusts.

The firm - Altaeros - says there is a US $17-billion remote power and microgrid market that could benefit from the technology. Many off-grid sites, including small islands, mining sites or military bases, rely on expensive diesel generators to provide some or all of their power needs. There are many projects that are trying to develop integrated solutions to tackle this market, particularly microgrids that integrate some type renewable energy.

Illustration 7. BAT – Buoyant Airborne Turbine [7]

Wind energy benefits

Now I try to explain why it is worth to use wind turbines and how we can benefit from the technology. So, let me see!

- Wind energy is cost competitive with other fuel sources.

The average levelized price of windpower purchase agreements signed in 2013 was approximately 2,5 cents per kilowatt-hour, a price that is not only cost competitive with new gas-fired power plants but also compares favorably to a range of fuel cost projections of gas-fired generation extending out through 2040.

- Wind energy creates jobs.

Wind energy development creates thousands of long-term, high-paying jobs in fields such as wind turbine component manufacturing, construction and installation, maintenance and operations, legal and marketing services, transportation and logistical services, and more.

- Wind energy is an indigenous, homegrown energy source that helps to diversify the national energy portfolio.

Adding wind power to the nation's energy mix diversifies our clean energy portfolio and helps reduce the reliance on imported fossil fuels. Additionally, wind energy can help stabilize the cost of electricity and reduce our vulnerability to price spikes and supply disruptions.

- Wind energy can provide income for farmers and ranchers, as well as economic benefits to communities.

Wind projects provide revenue to the communities in which they are located via lease payments to landowners, state and local tax revenues, and employment.Even a utility-scale wind turbine has a small footprint, enabling farmers and ranchers who lease their land to developers to continue growing crops and grazing livestock.

- Wind energy is an inexhaustible renewable energy source.

It is a plentiful and readily available, and capturing its power does not deplete our natural resources.

- Wind turbines do not consume water.

Most electric power plants require water to operate, but producing electricity from the wind does not require water.

- Wind energy is clean.

Electricity generated by wind turbines does not pollute the water we drink or the air we breathe, so wind energy means less smog, less acid rain, and fewer greenhouse gas emissions.

- Wind energy systems have low operating costs.

Wind energy systems have low operating expenses because there are no associated fuel costs.

- Wind energy is deployed in several regions and is widely supported.
- Wind energy can be used in a variety of applications.

Utility-scale wind farms can provide electricity to an entire community while smaller turbines often described as being used in „distributed applications", can be installed a tor near a site where the electricity will be used. Community wind projects include turbines for schools, tribes, municipal utilities, and rural electric cooperatives.

Despite wind energy's numerous benefits, wind development is not appropriate everywhere. Individuals and communities should make informed decisions on local wind development.

CONCLUSION

The wind energy industry is booming. Scientists predict that the number of wind turbines will increase in the coming years as more and more countries will allocate part of their budget in increasing their reliance on these renewable energy sources thereby reducing pollution levels and global warming. This is all part of the fight to reduce global warming induced climate change and reduce our dependence on fossil fuels. Germany has the most installed wind energy capacity, followed by Spain, the United States, India, and Denmark. Development is also fast growing in France and China.Industry experts predict that if this pace of growth continues, by 2050 the answer to one third of the world's electricity needs will be found blowing in the wind. I would be really happy about it. With wind turbines, solar cells and other renewable energy sources and technologies humans have a chance to change their lives, make a healthier environment and better energy supply method.

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