Renewable energies

LEONARDO da VINCI Partnership
"DISCOVER A NEW WORKING FIELD"

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Part 1

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1. Definitions

The renewable energy[1], is also called alternative energy, usable energy provided by sources that are capable of renewing, such as the Sun (solar energy), the wind (wind energy), the rivers (hidro energy), termal springs (geo-thermal energy), tides (tides energy) and biomass (bio-fuels).

The renewable energy[2] is the energy that comes from natural resources, such as the sun's light, wind, rain, tides and geothermal heat, that are renewable (completed by natural causes).

A non-renewable resource[3] is a natural resource that can not be reproduced, cultivated, generated or used on a scale that sustains the use rate. Once it is consumed, it isn't available anymore for the future needs. Also, the non-renewable resources are the ones that are comsumed a a speed much higher than the nature can create, like fosil fuels (coal, oil, natural gas), nuclear energy (uranium) and some aquifers examples. Metal ores are other examples of non-renewable resources.

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1 http://www.britannica.com/EBchecked/topic/17668/renewable-energy
2 http://en.wikipedia.org/wiki/Renewable_energy
3 http://en.wikipedia.org/wiki/Non-renewable_resources

2. Renewable energy characteristics

Renewable energy

- Are not linked to a certain geographical region
- Are not finite in quantity

Non-renewable energy

- Have a defined geographical region
- Are finite quantity

The Sun – the closest star

The Sun is the closest and biggest star in the solar system. The Sun, with a radius of 696 000 km, mass of 1,99 x 10^{30} kg, temperature of 5700^{0} K, age of 5,5 x 10^{9} years and a distance of 1 496 108 km from the Earth, is the center of our planetary system.

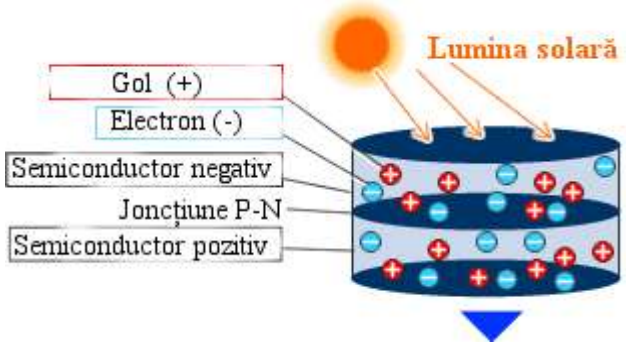
Almost all energy on Earth comes from this source. The sun unevenly heats the Earth's atmosphere, creating a difference of kinetic energy, wind source. Heat causes evaporation and condensation of water vapor in the upper crust and the result hydropower potential of the river.

Photosynthesis promotes plant growth and creating long-term fossil fuel.

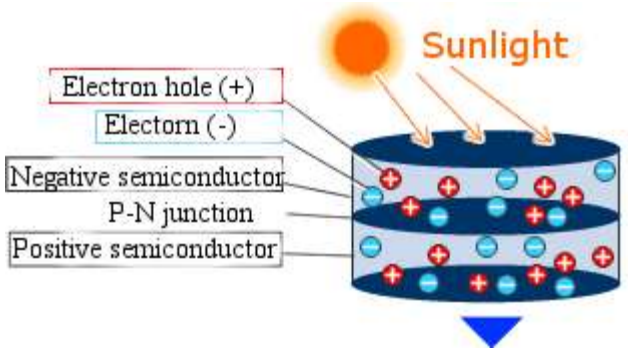
Sun is therefore a huge source of energy, either in the form of direct or indirect (wind, water and fossil fuels energy). We can imagine the sun like a giant nuclear reactor, in which thermonuclear reactions occur, reactions based on the conversion of hydrogen into helium. The "reactor" has energy to operate another 15 billion years. It is estimated that the Sun (and the Earth) exist since 5 billion years, so solar energy is practically inexhaustible.

THE PHOTOVOLTAIV PRINCIPLE

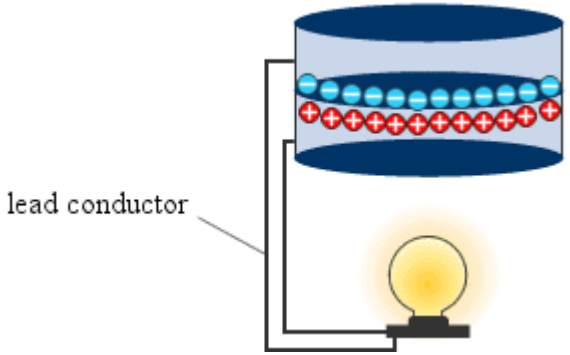
A photovoltaic system is a higher semiconductor diode, which produces voltages. If there is the appropriate resistance it can provide a load current.
The core of the transformation of sunlight into electricity is internal photoelectric effect. Light falling on the internal semiconductor increases concentration of charge carrier when there is light. The incident photons are absorbed by the semiconductor material transferring power generated by electrons and holes. Electrons and holes are separated by PN junction then collected in an external circuit where their presence is noticed as dc electric voltage or current.



Incident solar radiation causes the release of electrons that orbit around the atomic nucleus.



The holes (particles with positive charge) and the electrons (particle with negative charge) are moving toward the PN junction.



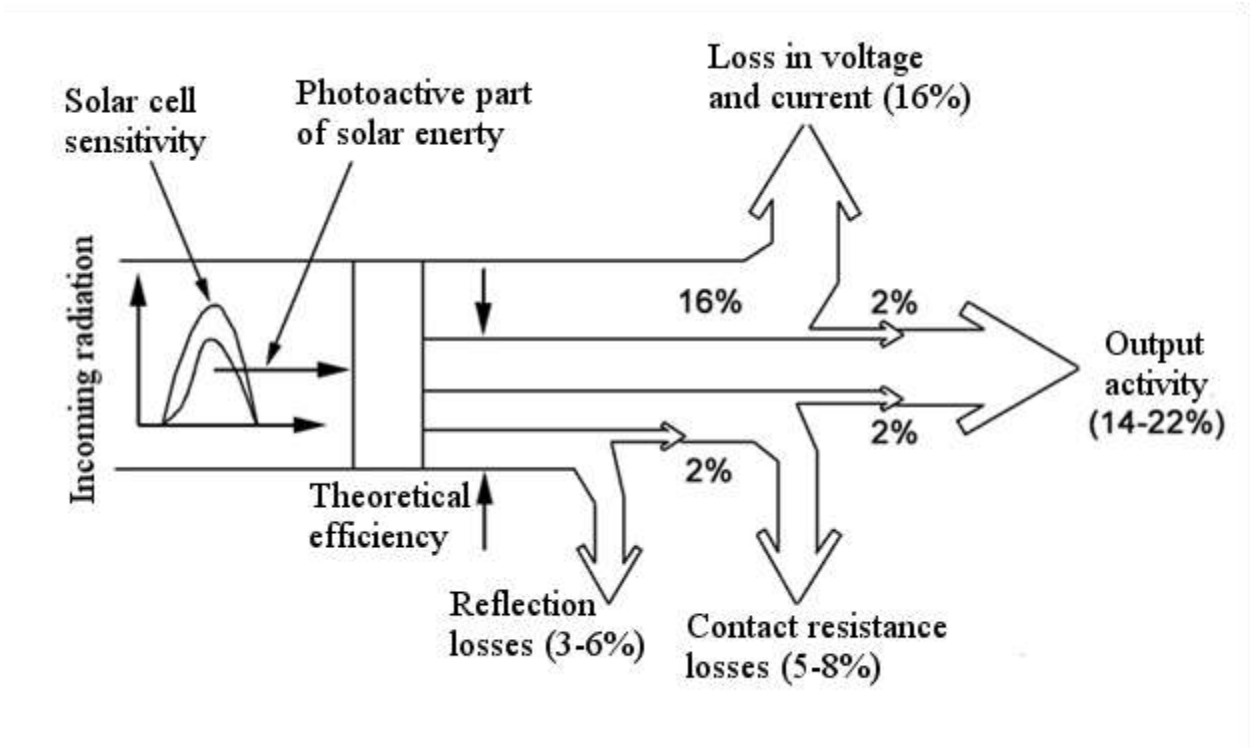
The settlement of electrons and holes in PN junction it is produced voltage, which causes (if appropriate resistance is connected) electric current.

Photovoltaic cells efficiency

Photovoltaic cell efficiency varies between 14% and 22%. Today is investigated methods to increase the efficiency of conversion of radiation. This low percentage is mainly due to:

· Reflective material;

· PN transition phenomena and loss of voltage and current.



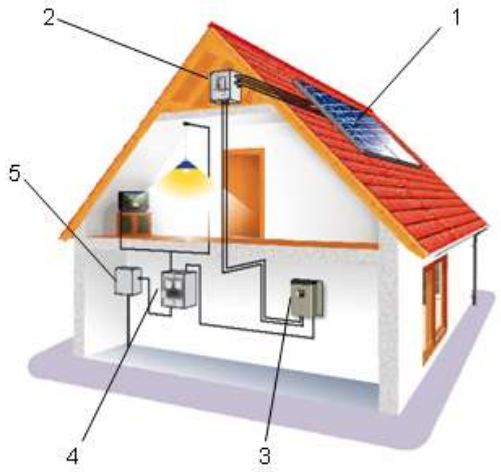
Some possibilities of increasing the solar radiation conversion are:

· **Restriction reflection and increase absorption** - light reflecting surface is directed to a semiconductor, so there is the opportunity to penetrate the rest of the unit. Among the results include:
· Creating textured surface;
· Incorporation of a N coating between N + P +.
· Linking photovoltaic cells with bifotovoltaice panels. Switch series-parallel PV module can produce photovoltaic modules of different power (between 10 and 64 W) and resulting different voltages.

Passive use of solar energy

The passive use of solar radiation means using an architecture and an appropriate locations for a building to significantly reduce consumption. A good place for such a building could be one protected from the sun and wind. Trees and natural depressions can protect your home from cold winds. Deciduous trees (leaved) placed in a convenient construction protects from overheating in summer and allow sunlight in winter.

Building integration of photovoltaic systems

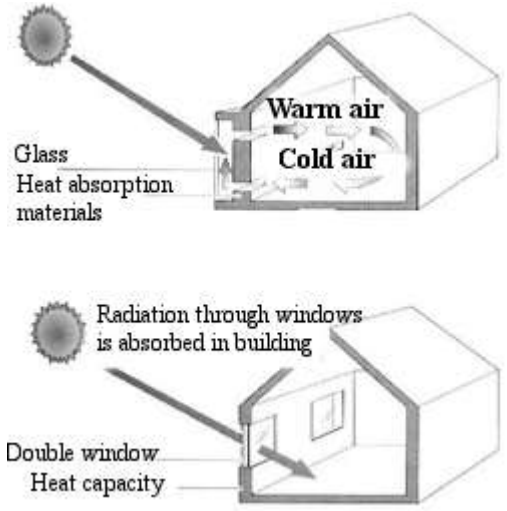


General description:

1. Photovoltaic pannles
2 Connecting box of the photovoltaic pannels
3 Direct/alternativ current inverter
4 Counter
5 General connection

Buildings with large windows facing south and small windows facing north are good thermal insulators, can absorb a significant amount of incident radiation. This free heat source can maintain a sufficient temperature for both indoor and outdoor, daylight and reduce the demand for artificial light and air conditioning.

Solar radiation hitting the walls, windows and other components of the building structure is absorbed and stored by the thermal capacity of the material. The stored energy is then emitted into the interior of the building.



Active use of solar energy

The active use of solar energy could be divided in four groups:

- For heating

- For warm water
- For cooking
- For the electric devices consume

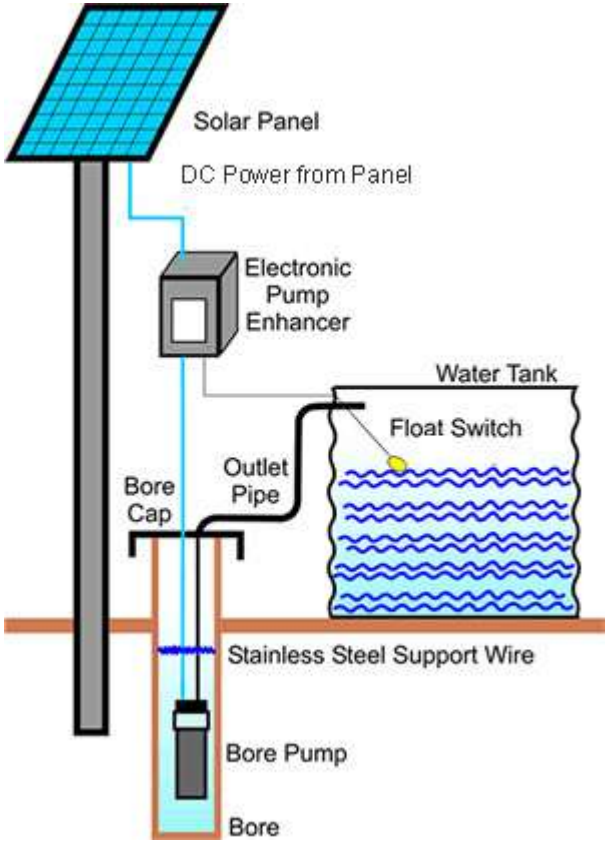
- Devices that convert solar energy into electricity are photovoltaic cells. A second type of equipment is used for solar thermal solar collector that converts solar radiation into thermal energy flowing heat transfer agents and is used most commonly for:
- · Hot water production
- · Inclazirea buildings
- · Heat water in pools
- · Industrial heating and cooling

Independent solar systems

Solar systems employed are small devices (about 70 kg) and simple that can be used to pump water, for power condition equipment, for fans or for research or weather station.

Water pomping with solar systems

The biggest advantage of pumping water using a solar system is its high utility when the water is needed in large amounts and is present in full sunlight.



Solar pump used for pumping water (www.global-greenhouse-warming.com)

Installing the solar water pump www.muskingumswcd.org

Solar pumps are comprised of one or more solar panels connected directly to the pump that floats in water. The main difference compared to conventional pumps is that the pumps working by using the sun, use DC current. In addition, pumping depends on the intensity of solar radiation. Because it is cheaper to store the energy depleted water, solar pumps usually do not require batteries, but in the storage tank, the water may be detained 3-10 days.

Solar systems with batteries

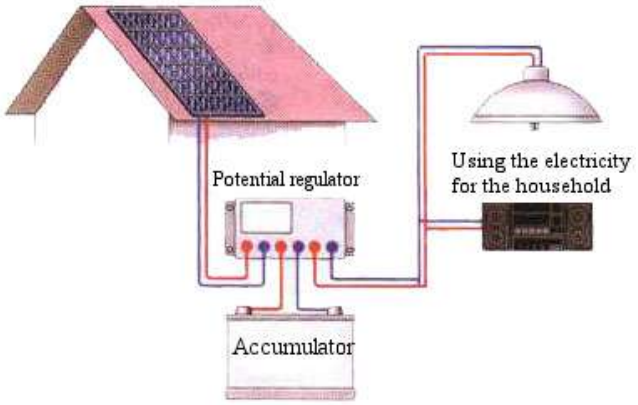
The disadvantage of independent solar systems is their operation only during the day because it requires solar lighting. In cases in which an amount of energy is stored, the systems are connected to the batteries, with the role of storage. During the day, the batteries are charged by solar energy, and during the night or whenever necessary they can provide electricity.

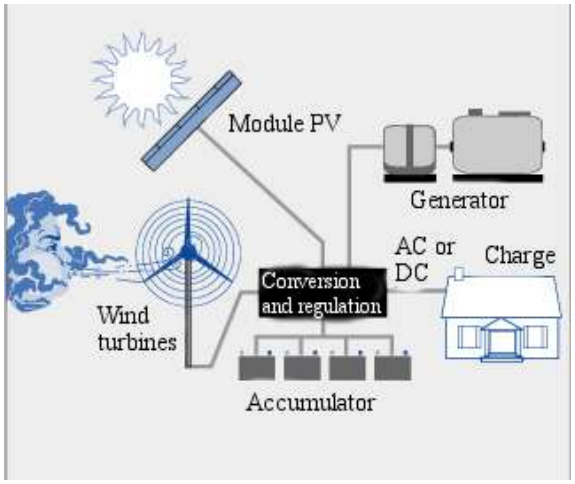
Solar system with batteries

The energy provided is used as street lighting, telecommunications equipment, and other appliances that require electricity for operation.

Hybrid solar systems

Solar cells with different types of sources may well cover the power consumption claims at lower costs than if it were based systems use a single source.





In cases where it is necessary to have continuous power sources with a high safety factor when it is needed a power higher than that which can transform solar systems other source of power, it must be used a more efficient solution . Solar cells during the day, are used to cover the energy consumption while the battery is charging. When the batteries are low, the system produces energy from sources until the battery is recharged. The system controls the connection of the amplitude and change in accordance with the instantaneous power consumption. In addition to traditional generators can be connected to a small hydraulic generator system or one based on energy production from wind or heat pump system and will do so even more hybrid than it already is.

Hybrid solar systems usually have a higher return than systems based on its own supply operation because their sizes are sufficient to cover the energy consumption during summer, and to store reserves to be used in winter. Annual earnings solar energy

equipment depend on the losses caused by the speed regulator and battery recharging, there are around 500 - 1250 kWh / KWP.

Wind energy

Worldwide status of wind energy sector

The capacity of wind energy worldwide increased by a quarter in 2010 compared to the previous year and reached 197 GW. According to information provided by the Global Wind Energy Council (CGEE), in 2010 China was the largest market, adding impressive capacity of 18.9 GW, surpassing the United States and became the country with the largest capacity wind energy market. Globally, leaders are China (44.7 GW), the U.S. (40.2 GW), Germany (27.2 GW) and Spain (20.7 GW)

Wind energy distribution

Wind turbines are classified according to several criteria:

· The principle of aerodynamics:

- Resistance

-winged

· Depending on the position of the axis of rotation:

-axis wind turbine with horizontal rotation

-turbine wind vertical axis rotation

· Depending on the speed produced λ:

Speed λ can be defined as the ratio of the circumferential velocity at the end of the wing and propeller wind speed before.

· Depending on the mode:

Water intake by wind;

Electrical installations for electricity production (wind farms).

Speed also affects the number of blades of the turbine rotor, profiles, width and angle of attack.

· Low speed (λ <1.5);

· Average speed (λ <1.5 to 3.5);

· High speed (λ> 3.5).

Depending on the source of electric power, energy can be:

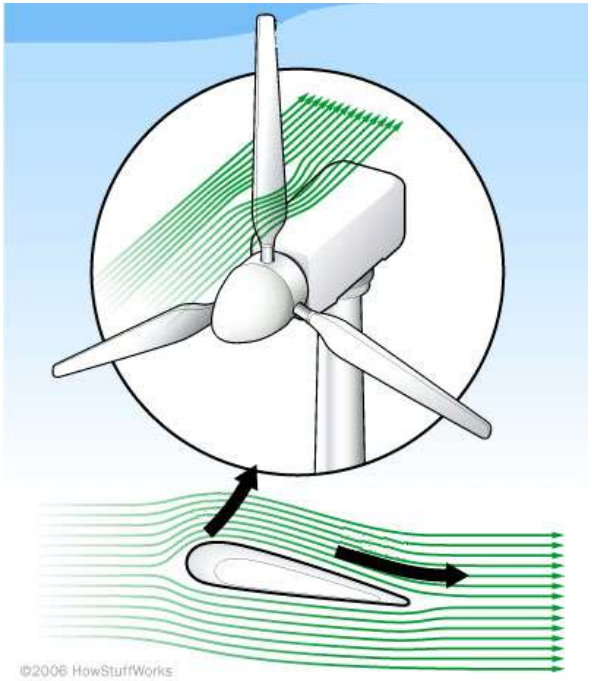
· Independent Network (used only for local electricity reserves);

· Integrated power supply from the mains supply.

Depending on the control mode:

· Passive Control;

· Active Control.



The principle of operation of wind turbines with horizontal axis of rotation

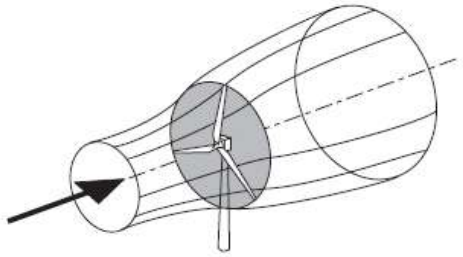
Horizontal axis wind turbine rotation

Horizontal axis windmills are those motors whose rotation axis is parallel to the wind direction. The first such engines were windmills, which appeared first in Holland and then gradually expanded throughout Europe.

The rotor of a windmill consists of four blades and bearing area is stretched on a wooden frame. The second device to the horizontal axis of rotation was particularly strong in North

America, was the windmill used for pumping water. The rotor consists of several individual blades. He has a diameter of up to 8 meters and a number of blades between 12 and 24. The advantage of this device is that it can operate at low speeds and disadvantage, it has a very large weight. Modern horizontal axis wind turbines are designed for high power and rotors have 2 or 3 blades. The blades are aerodynamically designed so that they get a larger efficiency. The advantage of this type of rotor is that it shows strength and light weight. A big disadvantage is that it works well at low wind speeds. To eliminate the disadvantages of incetinerea high speed turbine rotors are divided into three groups

Wind turbines are devices that captures the kinetic energy of the wind. To extract a portion of the wind kinetic energy must be slowed, but only passing through the rotor is affected. Assuming slow air mass is separated from the air which passes through the rotor and does not slow down the surface of separation between the two air masses then this limit is extended outward separation eleciei axis. The air does not pass the limit of separation and thus the two air streams flowing in parallel, with the same air mass flow. The air inside the internal flow does not compress, and to compensate for this difference in speed internal flow tube diameter increases.



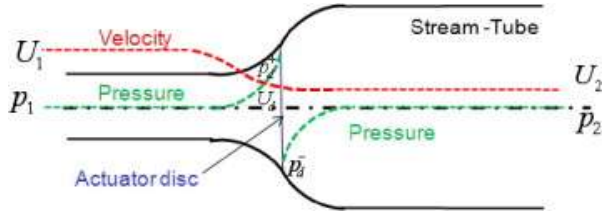
Although kinetic energy is extracted from the air flow, an abrupt change in velocity is

neither possible nor desirable because it required enormous accelerations and forces. Air static pressure energy can be extracted in a manner similar to the sudden change and all wind turbines, any design would have used it. This makes the air turbine to slow gradually approaching until it reaches the rotor and wind speed is already lower than the wind flowing along the rotor. Internal diameter flow tube expands to compensate for this difference in speed and because there has been no mechanical work of the air produces a pressure increase in front rotor and it absorbs the kinetic energy difference.
As the air passes through the rotor due to its design, it produces a decrease in static pressure, so that when it passes the rotor pressure is lower than that of air. The air passes away and pressure rotor speed lower, the air flow is called air gap. As the air moves away from the rotor pressure reaches normal. To achieve this increase in kinetic energy is needed and this is achieved by a decrease in wind speed yet. So between the wind turbine front and one behind it there is no pressure difference but a difference in speed.

Actuator concept

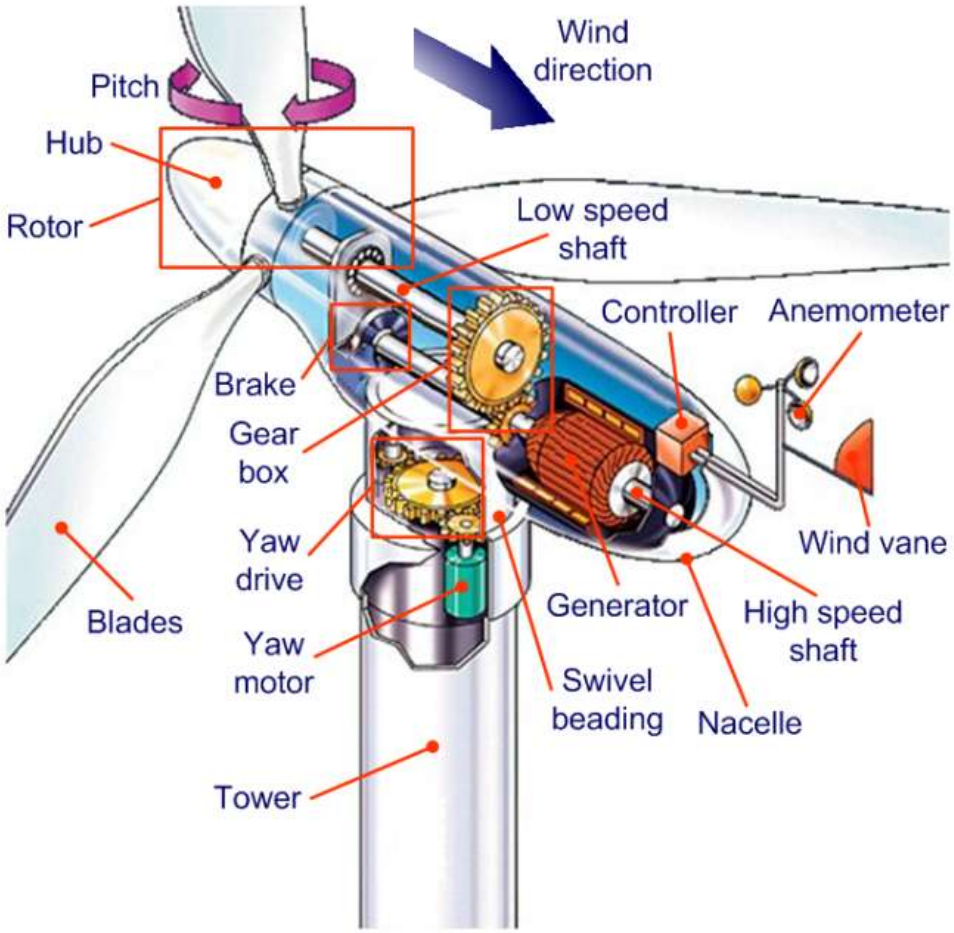
The mechanism described above explains extracting kinetic energy but does not explain what happens to that energy, it can be used once but still can lose the turbulent wind back and eventually dissipated into heat. Undoubtedly, we can start analyzing the aerodynamic behavior of wind turbines without taking into account any particular design, but the energy

extracted in this process. The device that does this is called disc / actuator. Prior disc flux tube has a smaller diameter than and after it higher. Flux tube expansion is because the mass flow must remain constant everywhere.



Torque reaction

Exercise of torque on the rotor of the wind to generate the appearance of equal and opposite torque on the air. The consequence of this coupled reaction is that air will rotate in the opposite direction to the rotor. Air and thus gains angular momentum in the low pressure produced by the air particle velocity vector has a tangential direction of rotation and an axial component. Receiving this component tangetiale speed translates into an increase in kinetic energy, which is compensated by the decrease of static pressure of the air in additional air gap as described in the previous paragraph. Flux entering the disk drive has no rotation. Exiting flow and the rotation is rotation lasts as long as the low pressure fluid traverses. Transfer rotational movement by air takes place only along the thickness of the disc.



The Theory Rotor Disc

The way energy is converted into usable energy obtained depends on the turbine design. Most converters use a rotor with a number of blades that rotate with an angular velocity of an axis normal to the rotor plane and parallel to the wind direction. Describe a disc blades and by virtue of their aerodynamic design creates a pressure difference on the disc, which,

as we discussed in the previous section, is responsible for the loss of momentum behind it. Associated with loss of axial momentum is a waste of energy that can be collected by an electric generator attached to the rotor shaft when the torque exerted on the rotor in the direction of rotation and a thrust. Generator torque exert equal and opposite to the direction of air flow that keeps constant rotation speed. The work performed by the aerodynamic torque on the generator is converted into electricity.

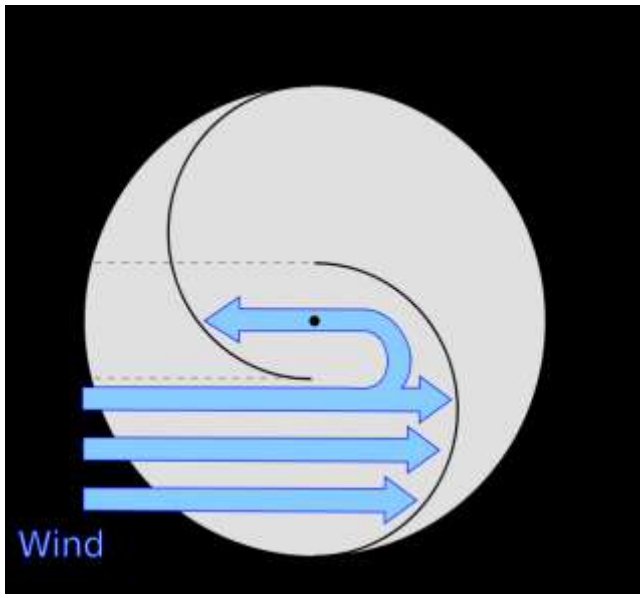
Currently, wind farms are almost entirely horizontal axis, vertical axis models except for the Savonius and Darrieus rotor, which are still used, but are endangered.

Wind turbine with vertical axis of rotation

They are the oldest wind installations in the Middle East and were used as a precursor windmills. Cars that use this design have a higher air pressure on the surface of the wings. Wind stations with vertical rotation axis of the rotor have several advantages. Among their advantages is the number and position of the motor generator and the bottom of the building. By far the most important avatanj is that the power produced is independent of wind direction. However, the wind is low intensity at ground level, which causes low efficiency wind turbine, which is subject to wind and turbulence. In addition, the turbine must be trained to start, Pillar is subjected to significant mechanical stress.

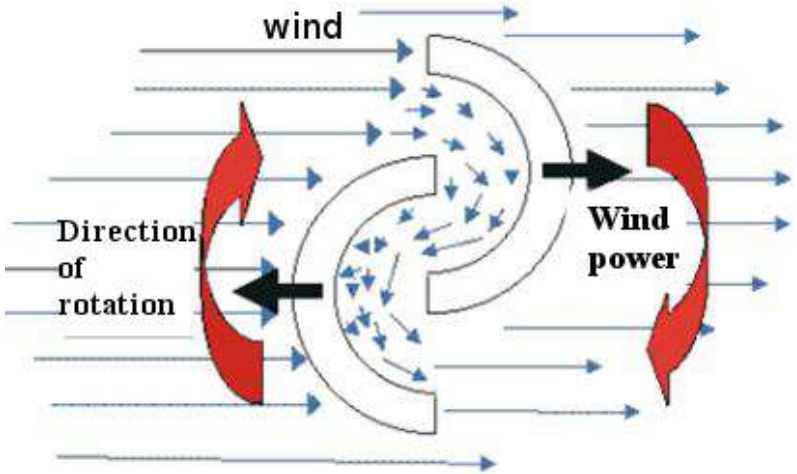
Savonius Rotor

It is one of the most popular and easiest to use wind rotors. Its operation is based on the principle of traction differentials. Efforts exerted by the wind on each of the sides of a curved body have different intensities. It follows a couple who determine rotation assembly (with semi-circular blades). Return of the rotor, despite the simplicity of the structure, in comparison with power piston is better. Unlike other wind energy capture systems, Savonius rotor is effective in the low power. This means that at low wind speeds can already deliver mechanical energy. These advantages provide the necessary conditions for the use of wind power machines such as pumps volume.



Darrieus Rotor

Darrieus rotor is based on the principle of periodic variation in incidence. A profile placed



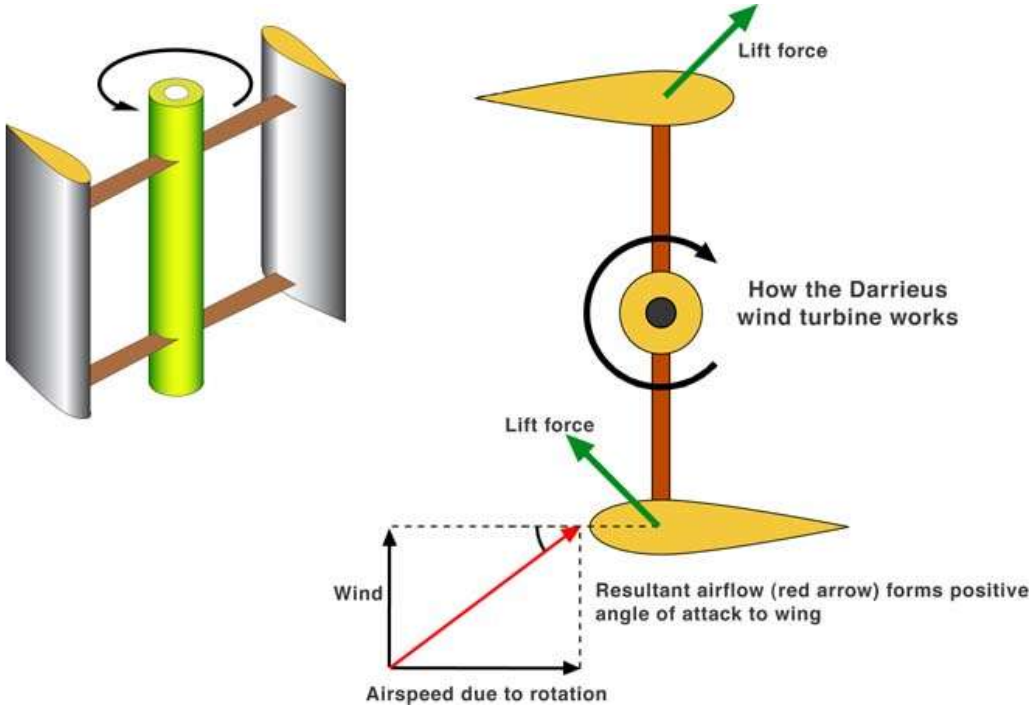
in a stream of air, depending on the different angles subjected to forces whose intensity and direction are different. The resultant of these forces cause a torque that rotates the device. The rotor consists of two or three aerodynamic wings that rotate around a vertical axis. Propeller aerodynamic principle functions as the power transmitted by the propeller. One of the advantages of this type of rotor is that it moves with a speed that has nothing to do with wind speed, which is usually higher. Another feature of these turbines is that they should be trained to start.

Darrieus rotor is composed of:

· A curved area of the rotor (Φ - rotor)

· Horizontal arm of the rotor and wing vertical (H - rotor)

· Wing rotor attached to the upper and lower pivot attached to the axis of rotation (Δ - rotor).



Darrieus rotor

Low power wind turbines

These turbines can be used only in areas where the average wind speed is higher than 4 m / s

Most of these turbines are designed to be able to upload directly to a battery. These include

a power generator that operates at low wind power. Batteries contain a controller to prevent overcharging.

These turbines consist of rotor blades, alternator and regulator and a battery to be charged. An important part is the turbine nacelle Fork guidance on wind direction and orientation of the blades, depending on its intensity. It may also include a controller device orientation, which is responsible for directional control at high speeds, the sudden changes of wind direction or wind when complete stop. Stopping rotor do the ASEM and with a catch. Propeller blades are mostly made of laminate. The generator uses a permanent magnet, so it does not require any maintenance. Controller and the control electronics ensure maximum efficiency, keep the rotor speed to a desired level and controls the battery charging.

Topics considered in the Environmental Statement includes, normally these issues (BWEA, 1994):

Political context. This topic is related to national and regional political contexts.

Site selection. Specific choice of site selected should be carefully justified.

Areas of interest. The potential impact of a wind farm in any of the areas designated to be evaluated carefully.

Visual and Landscape Assessment - This is generally the most important to take into consideration is, certainly, the subject exposed to subjective judgments. Therefore, in practice usually hiring a professional consultancy to prepare the assessment. The main techniques to be used include: areas of visual influence (ZIV) that indicate where wind farms will be visible, technical analysis, showing the location of turbines from different angles, and photomontage production, which are computer generated images superimposed on a photo the site.

Assessment of noise - After visual impact, perhaps the most important issue is the noise. Predictions therefore require sound is generated by the proposed development, special attention being paid to the nearest inhabited areas in each direction. Setting the background noise in the home may be necessary, by a series of measurements so realistic assessment can be made after the wind farm will be operational.

Ecological analysis - is necessary to consider the impact on local flora and fauna. This may require site assessments in certain seasons of the year.

Archaeological and historical analysis - This is an extension of investigations made during site selection.

Hydrological assessment - up to site and may require an assessment of project impacts on river and water.

Interference with telecommunications systems - Although wind turbines cause some interference with TV broadcasts, it is normally only a local effect and, in general, can be easily remedied at a modest price. Any interference with the main features of point-to-point communication (eg microwave systems) or radar (aviation) could be a more important issue.

Aviation security - Proximity to airports or military training areas should be considered carefully.

Safety - required a site safety assessment, including structural integrity of the turbines. Particular issues may include local highway safety and shadow flickering.

Traffic management and construction - Environmental Statement addresses all phases of the project and thus tracks both access and vehicle traffic on public roads must be taken into account.

Electrical connections - electrical connection can have a significant impact on the environment (eg construction of a substation and a new circuit). Although this can be solved formally, based on a special analysis, separate, one must consider that any requirement to place long underground circuits with high blood pressure would be very expensive.

Economic effects on the local economy, global environmental benefits business is another important aspect. Normally, highlight the benefits of the wind farm will bring, both to support the local economy and reducing emissions.

Decommissioning - Evaluation should include proposals for decommissioning of wind farms and turbines disposal at the end of the project. Decommissioning measures could include eliminating all equipment located above ground level and restoring agricultural area affected.

Mitigation measures - is obvious that wind farms will have an impact on the environment, locally and so this section details the steps proposed to mitigate the negative effects.

Impact Analysis

Much of the Environmental Statement refers to the visual impact assessment.
Mainly used two techniques:
· Analysis visibility using visual impact zones (ZIV)
· Analysis using diagrams and photomontages (viewpoint analysis).

Visual impact zones of the country highlights the areas surrounding the site, generally within a radius of 10-20km, of which a wind turbine or any part of a wind turbine, a wind farm is visible. ZIV is generated using methods based on a digital terrain model and show how local topology will affect the visibility of the wind farm. In general, techniques ZIV ignore local landscape features such as shielding the trees and buildings. Also, weather conditions are not taken into account and requires clear vision.

The analysis in terms of visual impact is based on selecting a number of important

locations of the wind farm is visible and the application of professional judgment, using quantitative criteria to assess the visual impact. Visibility points are selected in consultation with civil authorities and planning for a large wind farm may be chosen up to 20 locations. Although the approach varies, the assessment may take into account three aspects:

· Aspects of landscape sensitivity,
· Aspects of sensitivity on the points of view,
· Major influence (magnitude) in changing the landscape.

Thus, for example, the landscape of a National Park will present a level of damage "high", while a discordant existing landscape features such as old quarries, could this just a level of damage "low". Similarly, the visual impact in an area where land is used for residential purposes, or has a high recreational value, present a high impact, but in an area used by companies in which the activities take place mostly inside (eg an industrial estate), it can be considered that the impact is "low". Major influences - magnitude of the impact can be described similarly, depending, for example, the number of turbines visible distance from the wind farm, etc..

Overall significance of the impact is then evaluated again using quantitative terminology (such as substantial, moderate, low, negligible, etc.), the combination of these factors. If you identify a substantial impact, acceptability will depend on how it is considered that the wind farm will have a negative effect on the quality of the landscape.

Flickering Shadow

Flickering shadow of is the term used to describe the stroboscopic effect of shadows created by the rotating blades of wind turbines when the sun is behind them. Shadow can disrupt people in buildings exposed to such light passing through a narrow window.

Frequencies that may cause disorders are in the range from 2.5 to 20 Hz. The effect on humans is similar to that caused by changes in light intensity electric network voltage variations due powered by a wind turbine.

If a flickering shadows, the most important problem is the variation of light at frequencies 2.5-3 Hz, which has been shown to cause abnormal EEG (electroencephalogram) reactions in certain people suffering from epilepsy. Higher frequencies (15-20 Hz) may even lead to epileptic seizures. All the population, about 10% of all adults and 15-30% of children are deranjasi to some extent by variations of light at these frequencies.

Modern turbines, large, three blades will rotate at less than 35 revolutions per minute, creating frequent rotation of blades of less than 1.75 Hz, 2.5 Hz below the critical frequency. A minimum spacing between the nearest turbine a house of 10 diameters rotors is recommended to minimize any inconveniences due to the effect of flickering shadows. However, a spacing of this magnitude is likely to be required to comply with constraints related to noise and to avoid visual dominance.

Sociological Aspects

In quantifying visual effects using several computer-based tools and landscapers and architects have developed techniques plainficatorii quantitative measures to assess visual impact, foslosind professional criteria. With all these public attitudes, which are the ones that have the final say in prinvinta building a wind farm are influenced by many factors more complex.

In general, most people give their consent for wind farms after they are built, although a minority continues to oppose significant precious. In particular, there is a very important issue, namely that some residents consider paying a higher price than the benefit, whether financial or environmental, which is higher in others.

Financial benefits can be shared with the rest of the community in several ways, including the development of cooperative or community-owned wind mills, while environmental problems require a professional analysis. It is also suggested stationary turn, prevents wind turbines are less acceptable than those that rotate and thus maintaining high availability with low wind speed has a good chance to improve public perception.

Noise

Noise from wind turbines is often perceived as having one of the biggest negative impacts on the environment. At first, when barely dezovolta wind energy in the 1980s, some

turbines were quite noisy and this attracted justified complaints of those who lived nearby. However, since then, both in the development of technologies to reduce noise from wind turbines and in the forecasting of disturbances due to noise generated by a wind farm, there was a considerable development.

British document 'Planning Policy Guidance Note "(Department of Environment, 1993) states that:

· Planning an application for any development of a wind farm could usefully accompanied by the following information on the details of the proposed turbines and predicted noise levels:

· Noise levels predicted wind properties nearest station, where the widest beaches wind speed;

· Background noise levels and wind speeds measured in terms outlined above;

· Scale map showing the proposed location for the turbine, wind conditions prevailing urban development in close proximity;

· Results of independent measurements of noise emissions from the proposed wind turbines, including power noise and frequency spectrum band, where a prototype turbine where no measurements, predictions should be made by comparison with similar machines. "

Perspectives

Wind energy is considered one of the most sustainable options of future alternatives, wind resources are immense. It is estimated that global recoverable wind energy stands at about 53 000 TWh (TerraWatt hour), which is 4 times more than the current world electricity

consumption.

In Europe, the potential is sufficient to ensure at least 20% of electricity by 2020, especially if we take into account the new offshore potential.