Renewable energy resources (wind energy)

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Abstract- Energy crisis is one of the major problem in the present scenario. We are in a position to extract energy from every possible source. Non-conventional energy sources are pollution free and cost effective.This paper examines the use of windmill for electricity generation.Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage, or sails to propel ships. In a wind farm, individual turbines are interconnected with a medium voltage (often 34.5 kV). Energy is the Betz limit through a 100 m (328 ft) diameter circle facing directly into the wind. Total energy for the year through that circle was 15.4 GW-h. The capacity factor achieved by new wind turbines at 2009 and 2010 in India was reached 36%. In India 13,064 MW power is produced by wind mills at 2010. Totally 3% of all electricity produced by wind mills in India. Now a day some small scale industries and homes had small scale wind power sources. This type of small-scale wind power is the name given to wind generation systems with the capacity to produce up to 50 kW of electrical power. This type of small scale wind turbine charges a 12 V battery to run 12 V appliances.

The wind turbines are classified in to three primary types as bellow,

(1)VAWT (Vertical Axis Wind Turbine) Savonius,

(2) HAWT (Horizontal Axis Wind Turbine) towered,

(3) VAWT (Vertical Axis Wind Turbine) Darrieus.

The HWAT towered mill is mostly used in India.

It doesn't produce any greenhouse gas emissions during operation. Maintenance of this power source is easy. It is readily available energy in our earth.

I. INTRODUCTION:

Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage, or sails to propel ships. Large-scale wind farms are connected to the electric power transmission network; smaller facilities are used to provide electricity to isolated locations. Utility companies increasingly buy back surplus electricity produced by small domestic turbines. Wind energy, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, and produces no greenhouse gas emissions during operation. However, the construction of wind farms is not universally welcomed because of their visual impact but any effects on the environment are generally among the least problematic of any power source. Windmills are typically installed in favourable windy locations. Humans have been using wind power for at least 5,500 years to propel sailboats and sailing ships. Windmills have been used for irrigation pumping and for milling grain since the 7th century AD in what is now Afghanistan, Iran and Pakistan. In the United States, the development of the "water-pumping windmill" was the major factor in allowing the farming and ranching of vast areas otherwise devoid of readily accessible water. Windpumps contributed to the expansion of rail transport systems throughout the world, by

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pumping water from water wells for the steam locomotives. The multi-bladed wind turbine atop a lattice tower made of wood or steel was, for many years, a fixture of the landscape throughout rural America. When fitted with generators and battery banks, small wind machines provided electricity to isolated farms. Small wind turbines for lighting of isolated rural buildings were widespread in the first part of the 20th century. Larger units intended for connection to a distribution network were tried at several locations.

II. WIND ENERGY

The Earth is unevenly heated by the sun, such that the poles receive less energy from the sun than the equator; along with this, dry land heats up (and cools down) more quickly than the seas do. The differential heating drives a global atmospheric convection system reaching from the Earth's surface to the stratosphere which acts as a virtual ceiling. Most of the energy stored in these wind movements can be found at high altitudes where continuous wind speeds of over 160 km/h (99 mph) occur. Eventually, the wind energy is converted through friction into diffuse heat throughout the Earth's surface and the atmosphere.The total amount of economically extractable power available from the wind is considerably more than present human power use from all sources. An estimated 72 TW of wind power on the Earth potentially can be commercially viable, compared to about 15 TW average global power consumption from all sources in 2005. Not all the energy of the wind flowing past a given point can be recovered. Energy is the Betz limit through a 100 m (328 ft) diameter circle facing directly into the wind. Total energy for the year through that circle was 15.4 GW·h.

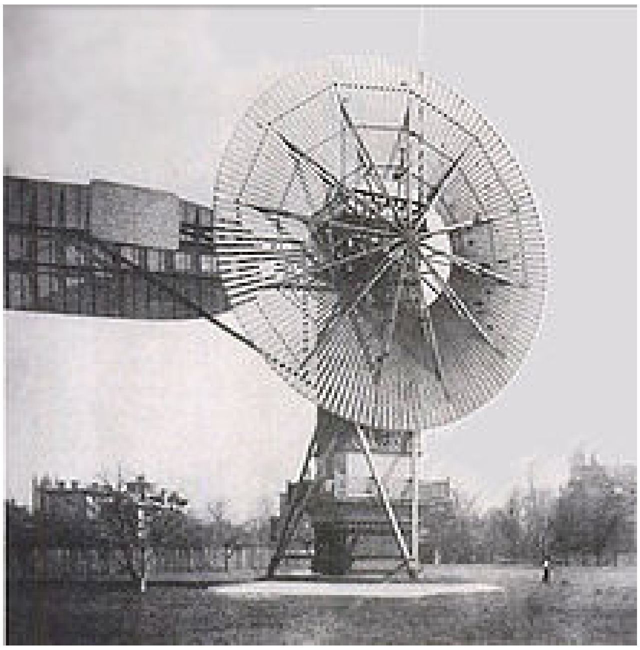
2.1 Distribution of wind speed:

The strength of wind varies, and an average value for a given location does not alone indicate the amount of energy a wind turbine could produce there. To assess the frequency of wind speeds at a particular location, a probability distribution function is often fit to the observed data. Different locations will have different wind speed distributions. The Weibull model closely mirrors the actual distribution of hourly wind speeds at many locations. Because so much power is generated by higher wind speed, much of the energy comes in short bursts. The 2002 Lee Ranch sample is telling; half of the energy available arrived in just 15% of the operating time. The consequence is that wind energy from a particular turbine or wind farm does not have as consistent an output as fuel-fired power plants; utilities that use wind power provide power from starting existing generation for times when the wind is weak thus wind power is primarily a fuel saver rather than a capacity saver. Making wind power more consistent requires that various existing technologies and methods be extended, in particular the use of stronger inter-regional transmission lines to link widely distributed wind farms.

III. WIND TURBINE

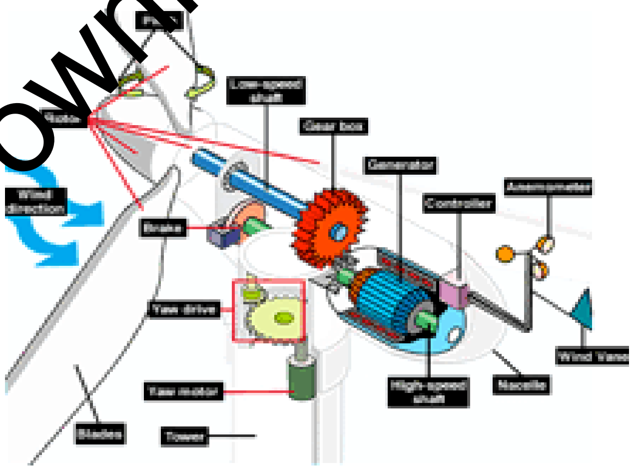
A wind turbine is a device that converts kinetic energy from the wind into mechanical energy. If the mechanical energy is used to produce electricity, the device may be called a wind generator or wind charger. If the mechanical energy is used to drive machinery, such as for grinding grain or pumping water, the device is called a windmill or wind pump.

The picture shown in above figure the first designed wind turbine. It was 60 feet (18 m) tall, weighed 4 tons (3.6 metric tonnes) and powered a 12kW generator. The first electricity generating wind turbine, was a battery charging machine installed in July 1887 by Scottish academic, James Blyth to light his holiday home in Marykirk, Scotland.[8] Some month later American inventor Charles F Brush built the first



automatically operated wind turbine for electricity production in Cleveland, Ohio.[8] Although Blyth's turbine was considered uneconomical in the United Kingdom electricity generation by wind turbines was more cost effective in countries with widely scattered populations.[6] In Denmark by 1900, there were about 2500 windmills for mechanical loads such as pumps and mills, producing an estimated combined peak power of about 30 MW. The largest machines were on 24-metre (79 ft) towers with four-bladed 23-metre (75 ft) diameter rotors. By 1908 there were 72 wind-driven electric generators operating in the US from 5 kW to 25 kW. Around the time of World War I, American windmill makers were producing 100,000 farm windmills each year, mostly for water-pumping.[9] By the 1930s, windmills for electricity were common on farms, mostly in the United States where distribution systems had not yet been installed. In this period, high-tensile steel was cheap, and windmills were placed atop prefabricated open steel lattice towers.

IV. CONSTRUCTION OF WIND MILL



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The construction of expand assembly view of wind mill is shown in above figure. Wind turbines are designed to exploit the wind energy that exists at a location. Aerodynamic modeling is used to determine the optimum tower height, control systems, number of blades and blade shape. Wind turbines convert wind energy to electricity for distribution. Conventional horizontal axis turbines can be divided into three components. The rotor component, which is approximately 20% of the wind turbine cost, includes the blades for converting wind energy to low speed rotational energy. The generator component, which is approximately 34% of the wind turbine cost, includes the electrical generator, the control electronics, and most likely a gearbox component for converting the low speed incoming rotation to high speed rotation suitable for generating electricity. The structural support component, which is approximately 15% of the wind turbine cost, includes the tower and rotor yaw mechanism.

4.1 Electricity generation

Typical components of a wind turbine (gearbox, rotor shaft and brake assembly) being lifted into position. In a wind farm, individual turbines are interconnected with a medium voltage (often 34.5 kV), power collection system and communications network. At a substation, this medium-voltage electric current is increased in voltage with a transformer for connection to the high voltage electric power transmission system. The surplus power produced by domestic microgenerators can, in some jurisdictions, be fed into the network and sold to the utility company, producing a retail credit for the microgenerators' owners to offset their energy costs.

Types:

The wind turbines are classified in to three primary types as bellow,

(1)VAWT (Vertical Axis Wind Turbine) Savonius,

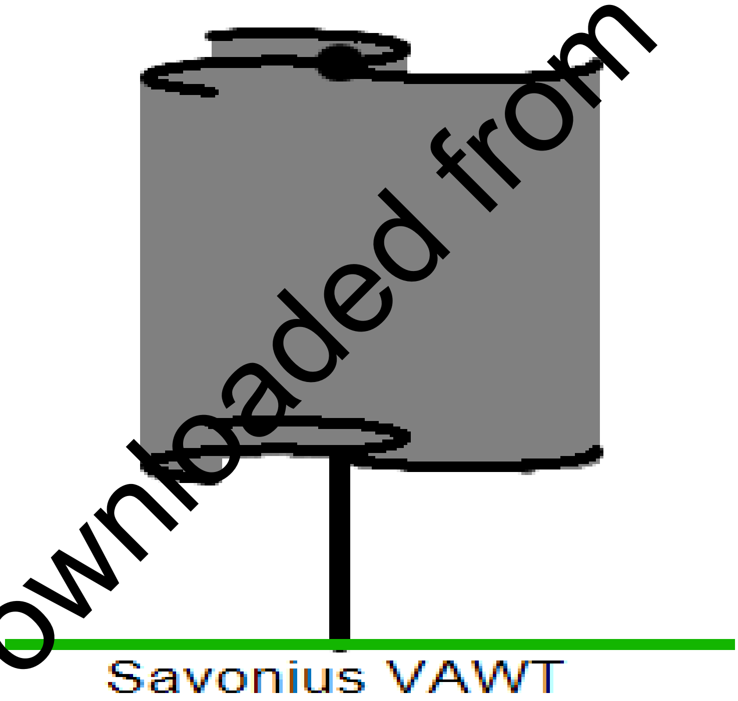
(2) HAWT (Horizontal Axis Wind Turbine) towered,

(3) VAWT (Vertical Axis Wind Turbine) Darrieus.

This classification was done depends upon the position and shape of the wings on the turbines.

VAWT (Vertical Axis Wind Turbine) Savonius:

Components of a horizontal axis wind turbine (gearbox, rotor shaft and brake assembly) being lifted into position. Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator. Since a tower produces turbulence behind it, the turbine is usually positioned upwind of its supporting tower. Turbine blades are made stiff to prevent the blades from being pushed into the tower by high winds. Additionally, the blades are placed a considerable distance in front of the tower and are sometimes tilted forward into the wind a small amount.



Downwind machines have been built, despite the problem of turbulence (mast wake), because they don't need an additional mechanism for keeping them in line with the wind, and because in high winds the blades can be allowed to bend which reduces their swept area and thus their wind resistance. Since cyclical (that is repetitive) turbulence may lead to fatigue failures, most HAWTs are of upwind design.

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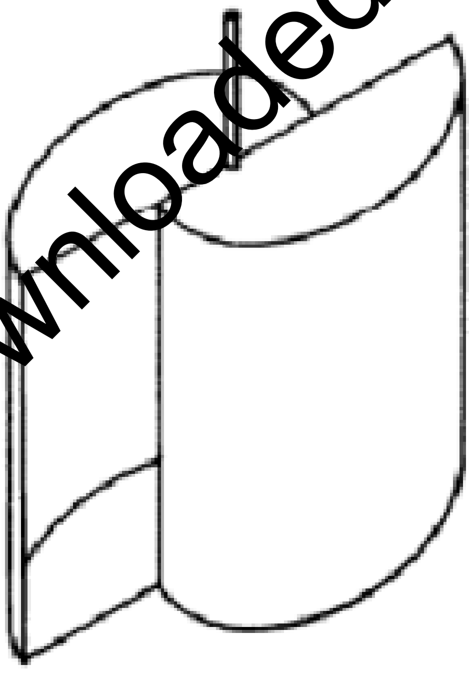
4.2 Savonius wind turbine

Savonius wind turbines are a type of vertical-axis wind turbine (VAWT), used for converting the force of the wind into torque on a rotating shaft. The turbine consists of a number of aero foils usually--but not always--vertically mounted on a rotating shaft or framework, either ground stationed or tethered in airborne systems. They were invented by the Finnish engineer Sigurd J. Savonius in 1922.

Johann Ernst Elias Bessler (born 1680) was the first to attempt to build a horizontal windmill of the Savonius type in the town of Furstenburg in Germany in 1745. He fell to his death whilst construction was under way. It was never completed but the building still exists.

Operation:

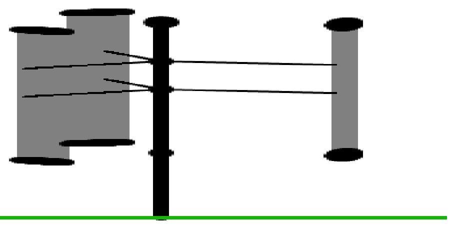


Savonius turbines are one of the simplest turbines. Aerodynamically, they are drag-type devices, consisting of two or three scoops. Looking down on the rotor from above, a two-scoop machine would look like an "S" shape in cross section. Because of the curvature, the scoops experience less drag when moving against the wind than when moving with the wind. The differential drag causes the Savonius turbine to spin. Because they are drag-type devices, Savonius turbines extract much less of the wind's power than other similarly-sized lift-type turbines. Much of the swept area of a Savonius rotor may be near the ground, if it has a small mount without an extended post, making the overall energy extraction less effective due to the lower wind speeds found at lower heights.

<u>Use:</u>

Savonius turbines are used wherever cost or reliability is much more important than efficiency. For example, most anemometers are Savonius turbines, because efficiency is completely irrelevant for that application. Much larger Savonius turbines have been used to generate electric power on deep-water buoys, which need small amounts of power and get very little maintenance. Design is simplified because, unlike with Horizontal Axis Wind Turbines (HAWTs), no pointing mechanism is required to allow for shifting wind direction and the turbine is self-starting. Savonius and other vertical-axis machines are not usually connected to electric power grids. They can sometimes have long helical scoops, to give smooth torque.

VAWT (Vertical Axis Wind Turbine) Darrieus:

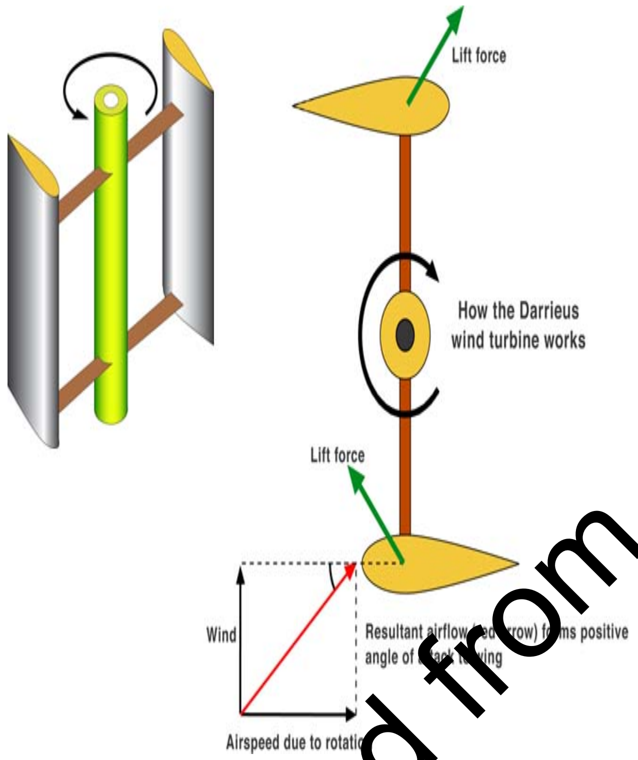


Giromill/Darrieus VAWT

The Darrieus wind turbine is a type of vertical axis wind turbine (VAWT) used to generate electricity from the energy carried in the wind. The turbine consists of a number of aero foils usually--but not always--vertically mounted on a rotating shaft or framework. This design of wind turbine was patented by Georges Jean Marie Darrieus, a French aeronautical engineer in 1931.

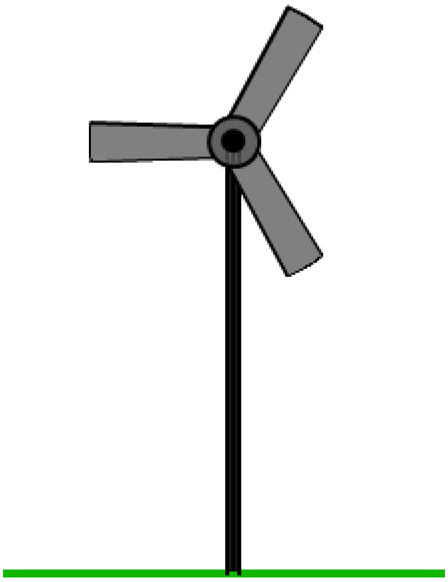
OPERATION:

The Darrieus rotor is spinning, the aero foils are moving forward through the air in a circular path. Relative to the blade, this oncoming airflow is added vectorially to the wind, so that the resultant airflow creates a varying



small positive angle of attack (AoA) to the blade. This generates a net force pointing obliquely forwards along a certain 'line-of-action'. This force can be projected inwards past the turbine axis at a certain distance, giving a positive torque to the shaft, thus helping it to rotate in the direction it is already traveling in. The aerodynamic principles which rotate the rotor are equivalent to that in autogiros, and normal helicopters in autorotation. As the aerofoil moves around the back of the apparatus, the angle of attack changes to the opposite sign, but the generated force is still obliquely in the direction of rotation, because the wings are symmetrical and the rigging angle is zero. The rotor spins at a rate unrelated to the wind speed, and usually many times faster. The energy arising from the torque and speed may be extracted and converted into useful power by using an electrical generator. The aeronautical terms lift and drag are, strictly speaking, forces across and along the approaching net relative airflow respectively, so they are not useful here. We really want to know the tangential force pulling the blade around, and the radial force acting against the bearings. When the rotor is stationary, no net rotational force arises, even if the wind speed rises quite high -- the rotor must already be spinning to generate torque. Thus the design is not normally self-starting. Under rare conditions, Darrieus rotors can self-start, so some form of brake is required to hold it when stopped.

HAWT (Horizontal Axis Wind Turbine) towered:



Modern HAWT

This turbine was mostly used in all over world. Wind turbines convert wind energy to electricity for distribution. Conventional horizontal axis turbines can be divided into three components. The rotor component, which is approximately 20% of the wind turbine cost, includes the blades for converting wind energy to low speed rotational energy. The generator component, which is approximately 34% of the wind turbine cost, includes the electrical generator, the control electronics, and most likely a gearbox component for converting the low speed incoming rotation to high speed rotation suitable for generating electricity. The structural support component, which is approximately 15% of the wind turbine cost, includes the tower and rotor yaw mechanism.

CONCLUSION

The renewable energy is the readily available in the earth. We have much renewable energy like bio-mass energy, solar energy, tidal energy, etc… When we compare all renewable energies wind energy is easily usable. This power plant does not produce any pollution. And it does not affect the environments. This type of power production is carried by some small scale industries & homes.

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