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WIND ENERGY: AN ALTERNATE ENERGY SOURCE IN FUTURE

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***Abstract*- A wind energy system transforms the kinetic energy of the wind into mechanical or electrical energy that can be harnessed for practical use. Wind energy can diversify the economies of rural communities, adding to the tax base and providing new types of income. Wind turbines can add a new source of property value in rural areas that have a hard time attracting new industry**. **Estimation of the wind power potential for a site is the most important requirement for selecting a site for the installation of a wind electric generator and evaluating projects in economic terms**

I. INTRODUCTION

Around the world, wind turbines of all sizes have become a familiar sight. Their purpose is simple: harvesting the energy in wind. Wind turbines today are up to the task of producing serious amounts of electricity. Turbines vary in size from small 1 kW structures to large machines rated at 1.6 MW. A popular sized machine in the U.S. today is a state-of-the-art 750 kW turbine that stands as tall as a 20-story building. With a good wind resource, this size turbine can produce 2 million kWh of electricity each year. That's enough energy to run 200 average American households.Wind has been the fastest growing energy technology in the world for the past decade. In 1999, the world wind industry installed a record amount of new utility-scale wind generation equipment, more than 3,900 megawatts (MW), representing investments totaling nearly $4 billion. Total wind installations increased an average of 40 percent annually from 1995-1999 to nearly 14,000 MW worldwide. Much of that growth is due to cost reductions and progressive government policies. The pace of growth has been greatest in Europe, where 81 percent of the world's new wind equipment was installed 1999. Germany has the highest total wind capacity of any country, nearly 5,000 MW. Here in the United States, our total wind capacity has reached 2,500 MW, with large wind farms now online in farming and ranching states including Texas, Minnesota, Iowa, and Wyoming. The World Energy Council has estimated that wind energy capacity worldwide may total as much as 474,000 MW by the year 2020, and the federal Wind Powering America initiative aims to have more than 10,000 MW of wind capacity in the U.S. by 2010.Wind energy has only recently gained a foothold in the nation's heartland, which has far greater wind potential than in California where the U.S. wind industry got started in the 1980s. In Minnesota, a 1994 legislative mandate required Xcel Energy Company (formerly Northern States Power) to purchase 425 MW of wind generated electricity by 2002 in return for granting dry cask storage of its spent nuclear fuel. Because wind was demonstrated to be the least cost resource, Xcel is required to purchase an additional 400 MW of wind generation by 2012. The Texas state legislature has required that 2,000 MW of generating capacity from renewable sources (equivalent to about 3% of the state's electricity production) be built by 2009, with most expected to come from the state's abundant wind power. The Midwest has provided leadership in developing wind energy incentives to ensure that cleaner, renewable power is integrated into our energy mix. Our transmission system could utilize up to 20 percent of its electricity from wind. Most of that growth will come from wind power plants, which are large arrays of turbines run by wind companies, but significant contributions can be made by small clusters of turbines or even single turbines, operated by local landowners and small businesses. This paper is organized as follows. The working principle is discussed in Section II. In section III, selection of location for wind turbine, in SECTION IV advantage and disadvantages are discussed and conclusion is done in Section V.

II. WORKING PRINCIPLE

Wind is a source of energy that has been harnessed for different applications since a long time. The Chinese and the Babylonians have been famous for using wind power for the pumping of water for irrigation of crops some 4,000 years back. And in addition to this, sailing boats were harnessing wind power long before that.It has been recorded that wind power was used in Europe in the Middle Ages for other activities like grinding of corn. In fact, this is what has been attributed to the start of the term windmill. To understand the concept of wind power, it is better to first understand the science behind wind formation. With the sun heating the atmosphere unevenly, some patches of land become warmer than others; and this is where warm patches of air rise. With this, other air starts blowing to replace them and start a wind blowing. The energy produced from the wind is used by building a tall tower which has a large propeller on its top. The propeller starts turning round with wind energy, which in turn turns a generator to produce electricity. Many of these towers are built together to form a „wind farm‟ for the production of electricity. The production of electricity is increased by using more towers to turn more wind with larger propellers. It is basically better to build win farms having strong and steady winds like coastal areas, open plains, tops of rounded hills and gaps in mountains. It is required to have at least an average wind speed of about 25km/h to generate electricity with wind power. Small wind generators are used in boats and caravans to charge their batteries. Large propellers are used in windmills to extract maximum energy from wind power. Their blades are angled to fine or coarse pitch so that it copes with varying wind speeds. It is possible to turn the generator and propeller to face the wind, to harness maximum wind power. There are some windmills with vertical turbines which do not have to be turned to face the wind. Towers are usually tall as the higher the propellers reach the stronger is the wind there. with this feature, the land beneath the tower is not wasted, and can be used for farming. Wind energy is produced once the wind blows on blades to make them turn. These blades in turn turn a shaft in

the nacelle, which goes into a gearbox to increase the rotation speed of the generator. The rotational energy is converted into electrical energy with magnetic fields. This energy goes into a transformer to convert the 700V energy into the required voltage for distribution, 33,000V. This energy is transmitted around the country through the national grid. Wind power is not only used in large scale wind farms for national electrical grids but is also used in small individual turbines for providing electricity to rural residences and locations that are not reachable by grids. With wind power being renewable, widely distributed and clean, it reduces toxins and greenhouse gas emissions in the atmosphere.

The Sun heats our atmosphere unevenly, so some patches become warmer than others. These warm patches of air rise, other air blows in to replace them - and we feel a wind blowing. We can use the energy in the wind by building a tall tower, with a large propeller on the top. The wind blows the propeller round, which turns a generator to produce electricity. We tend to build many of these towers together, to make a "wind farm" and produce more electricity. The more towers, the more wind, and the larger the propellers, the more electricity we can make. It‟s only worth building wind farms in places that have strong, steady winds, although boats and caravans increasingly have small wind generators to help keep their batteries charged.

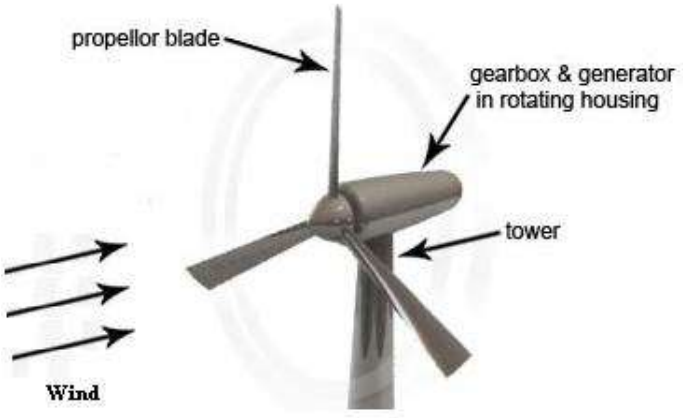

Fig.1: Wind turbine

The best places for wind farms are in coastal areas, at the tops of rounded hills, open plains and gaps in mountains - places where the wind is strong and reliable. Some are offshore. To be worthwhile, you need an average wind speed of around 25 km/h. Most wind farms in the UK are in Cornwall or Wales. Isolated places such as farms may have their own wind generators. In California, several "wind farms" supply electricity to homes around Los Angeles. The propellers are large, to extract energy from the largest possible volume of air. The blades can be angled to "fine" or "coarse" pitch, to cope with varying wind speeds, and the generator and propeller can turn to face the wind wherever it comes from. Some designs use vertical turbines, which don't need to be turned to face the wind. The towers are tall, to get the propellers as high as possible, up to where the wind is stronger. This means that the land beneath can still be used for farming.

III. COMPONENTS OF WIND TURBINE

The basic components of a typical wind energy system are shown on Figure 2.These basic components include:

- A rotor, consisting of blades with aerodynamic surfaces. When the wind blows over the blades, the rotor turns, causing the generator or alternator in the turbine to rotate and produce electricity.
- A gearbox, which matches the rotor speed to that of the generator/alternator. The smallest turbines (under 10 kW) usually do not require a gearbox
- An enclosure, or nacelle, which protects the gearbox, generator and other components of the turbine from the elements.
- A tail vane or yaw system, which aligns the turbine with the wind.

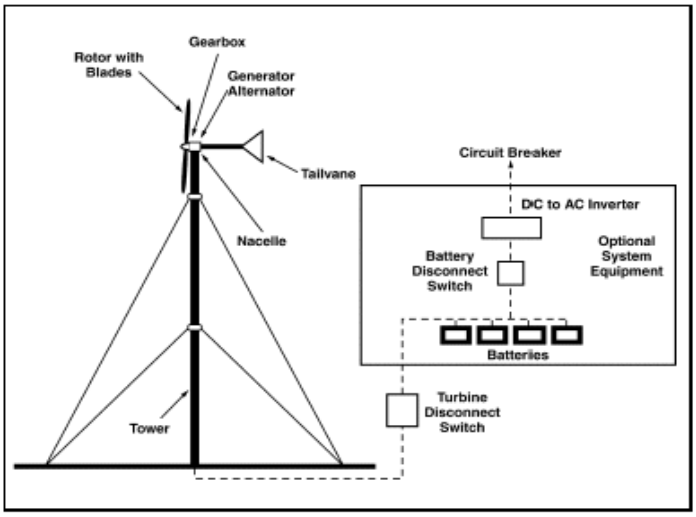

Fig. 2: Components of a wind energy system. (Source: Natural Resources Canada)

IV. SELECTION OF LOCATION FOR WIND TURBINE

Where you choose to build your wind turbine is important. Remember that if nearby houses, tree lines and silos obstruct the full force of the wind from your wind turbine; you will not be able to generate as much power. Also keep the following in mind:

- Wind speeds are always higher at the top of a hill, on a shoreline, and in places clear of tress and other structures.
- Remember that trees grow over the years.
- Inform neighbors of your plans to avoid conflict later on.
- Keep turbine as far away from neighbors as possible. 250-300m away is typical.
- Check with local government for any other by laws and regulations about zoing.

Wind speeds tend to be higher on the top of a ridge or hill, and for that reason it is a good idea to locate wind turbines at hilly locations. Just remember to keep your turbine away from high turbulence. Neighbors must also be taken into consideration when picking a spot to build your turbine. The farther your wind turbine site is from neighboring houses, the better. Do not expect your wind turbine to generate the same amount of power all the time. The wind speed at a single location may vary considerably, and this can have a significant impact on the power production from a wind turbine (Figure 3) Even if the wind speed varies by only 10%, the power production from a wind turbine can vary by up to 25%.

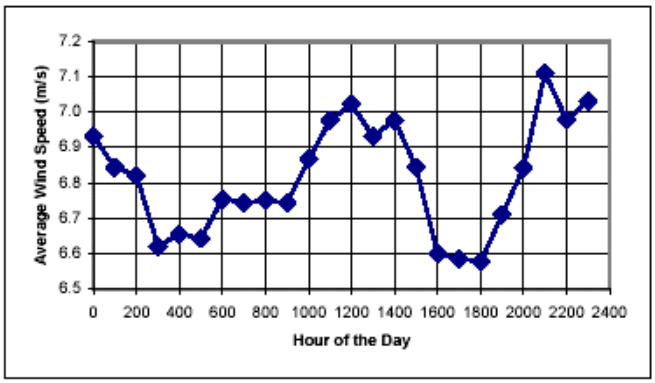

Fig.3. Example of wind speed distribution by hour of the day. Values shown are monthly averages of measurements made by anemometers. (Source: US Department of Energy)

V. ADVANTAGES & DISADVANTAGES

Most people are aware that burning coal releases harmful particulate emissions that cause breathing problems and asthma, and that it releases sulfur dioxide and nitrogen oxides, which cause acid rain. Coal is also one of the primary contributors of the carbon dioxide that causes global warming and mercury contamination of our lakes and fish. Natural gas is a better option than coal, but it still produces considerable air pollution and contributes to global warming. Nuclear energy produces no particulate emissions, but it creates dangerous radioactive wastes which will require thousands of years of careful storage. All three sources--coal, gas, and nuclear power--are limited fuels. Today, they compose the bulk of our electric generation sources. Wind, on the other hand, is a completely renewable fuel source. As long as the sun shines, the winds will blow. And wind power produces no health risks and no air pollution.

Wind energy is an intermittent resource: we get electricity only when the wind blows. Although modern wind turbines regulate power well and level off at their rated capacity, the amount of power they produce varies throughout the day. Hundreds of installations have demonstrated that 4 utility systems are capable of accommodating the changing wind power just as they modify their output to follow changing demand. Experts predict that wind power can compose up to 30% of our energy mix before reliability of the system would be an issue. In the US today, less than 1% of our electricity is produced by wind. Wind energy is also capital intensive. That's why local, state, and federal governments must support wind energy development through production incentives and public policy to encourage its growth and technological advancement. Such support does make a difference. Wind power now costs as little as 3¢ per kWh in the U.S., down from 50¢ per kWh in 1981.

VI. CONCLUSION

Modern wind turbines safely and efficiently turn wind into useable energy. Hundreds of rural landowners throughout the Midwest have learned how to harvest the wind. Many of these people have been operating small turbines on their farms for years. Others are just beginning to investigate the large wind turbines. As they would with any investment, these landowners must carefully weigh the benefits and risks and research just what a wind turbine on their property would involve. As a nation, we have decided that living more sustainably with less pollution is a priority. When we account for the social costs of energy production, wind energy is the clear winner. We cannot afford to wait to do the right thing anymore. Wind power is an energy technology for today and the 21st century that we can all feel good about.

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