Advancements & recent trends in wind energy

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ABSTRACT-Wind energy conversion systems have become a focal point in the research of non conventional energy sources ources. From the beginning of the 21st century, interest has risen in new & non conventional energy sources(RE) sources especially wind energy for electricity generation. The scientists & researchers attempted to accelerate solutions for wind energy generation design parameters. Our life is directly related to energy & its consumption, & the issues of energy research are extremely important & highly sensitive. In a short time, wind energy is welcomed by society, industry & politics as a clean, practical, economical & environmentally friendly alternative.. Wind energy is one of the fastest-growing electrical energy sources in the United States. The United States installed over 5,200 MW in 2007 & experts are forecasting for as much to be installed in 2008. The United States cumulative installed capacity as of Dec. 31, 2007, was 16, 596 MW. Wind turbines have evolved rapidly over the past 20 years & the turbines have grown in size from 100 kW in the early 1980s to over 2.5 MW today. The evolution of wind technology is expected to continue over the next two decades resulting in a continued improvement in reliability & energy capture with a modest decrease in cost. The development of new & innovative rotors, drive systems, towers, & controls is expected to enable this continued improvement in the cost effectiveness of wind technology. Wind energy can supply 20% of the United States' electricity needs by 2030 & will be a significant contributor to the world's electricity supply.

Keywords-wind power, greenhouse ,turbine

1) INTRODUCTION

Towards the end of 20th & beginning of the 21st centuries, interest has risen in new & non conventional energy sources especially wind energy for electricity generation. The scientists & researchers attempted to accelerate solutions for wind energy generation design parameters. Our life is directly related to energy & its consumption, & the issues of energy research are extremely important & highly sensitive. In a short time, wind energy is welcomed by society, industry & politics as a clean, practical, economical & environment friendly alternative. After the 1973 oil crisis, the RE sources started to appear in the agenda & hence the wind energy gained significant interest. As a result of extensive studies on this topic, wind energy has recently been applied in various industries, & it started to compete with other energy resources. In this paper, wind energy is reviewed & opened for further discussion. Wind energy history, wind-power meteorology, the energy–climate relations, wind-turbine technology, wind economy, wind–hybrid applications & the current status of installed wind energy capacity all over the world reviewed critically with further enhancements & new research trend direction suggestions. After the first industrial revolution, the deem& for energy has been growing rapidly for production & normal life. According to the statistics by IEA, International Energy Agency, the total final consumption was more than doubled since 1971 to 2014, from 4244 Mote to 9426 Mote (International Energy Agency 2016). At the same time, the traditional energy coursing environmental pollution & the emergence of multiple global or regional energy crisis prompted humans to begin research on sustainable energy development. Sustainable energy is the energy which is derived from natural resources that are capable of being replenished, & hence can be sustained in the long term (Oxford Dictionary of English 2010). The most important feature of it is being environmental friendly. With the development & popularization of sustainable energy, energy tensions & environmental pollution problems will be alleviated to a certain extent. Wind power, as one of the sustainable energy, is showing its development & commercial potential.

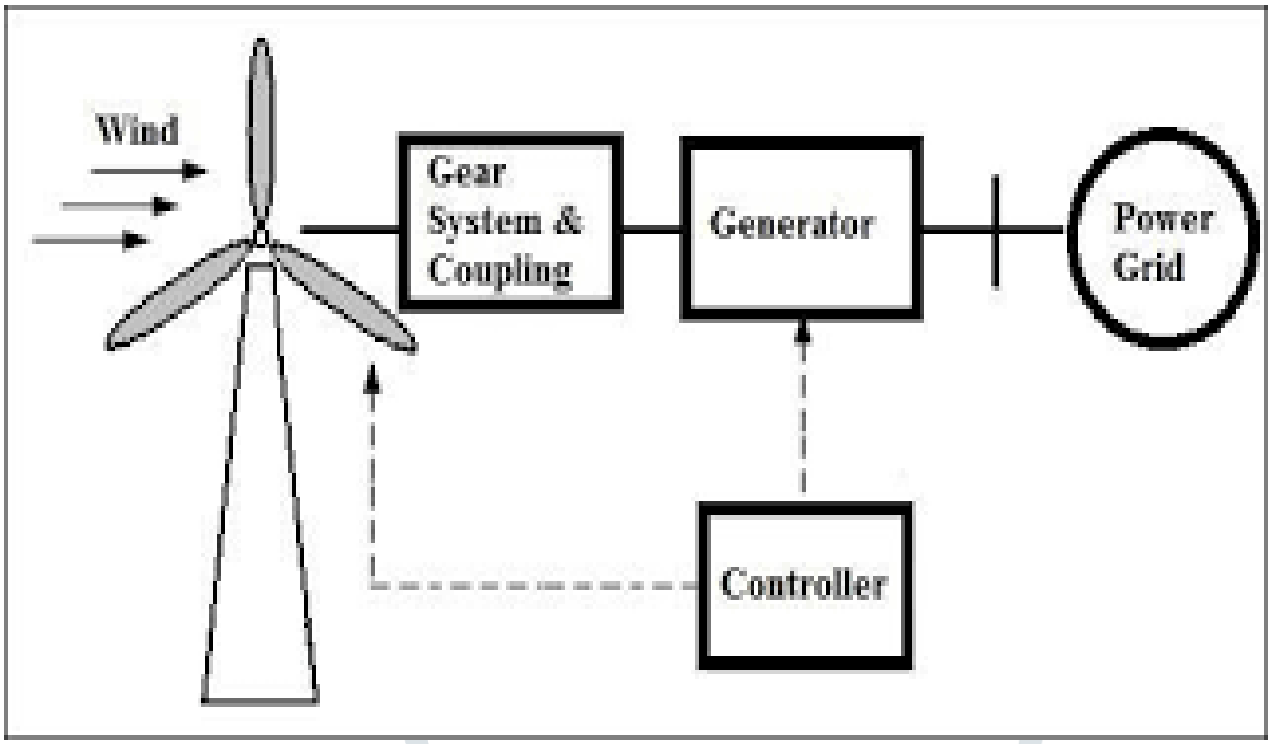

Fig.1. Flow Diagram of A Wind Turbine System

1.1) Non conventional energy sources Supply Technologies

The non conventional energy sources supply is continuously increasing. A large amount of investment has been made during recent years & the advancement of technology has enabled countries to produce non conventional energy sources more cost effectively. It is forecasted that the number of countries producing above 100 megawatts (MW) of non conventional energy sources will increase significantly by 4 2017 (IEA, 2012d). Due to some negative & irreversible externalities coming with conventional energy production, it is necessary to promote & develop non conventional energy sources supply technologies. These technologies may not be comparable with conventional fuels in terms of production cost, but they could be comparable if we consider their associated externalities, such as their environmental & social effects. Also, it should be noted that economies of scale could play a key role in reducing the unit production cost. Transmission & distribution costs, as well as technologies, do not differ much among the conventional & renewable energies. Below we present facts about the development of the main non conventional energy sources supply technologies.

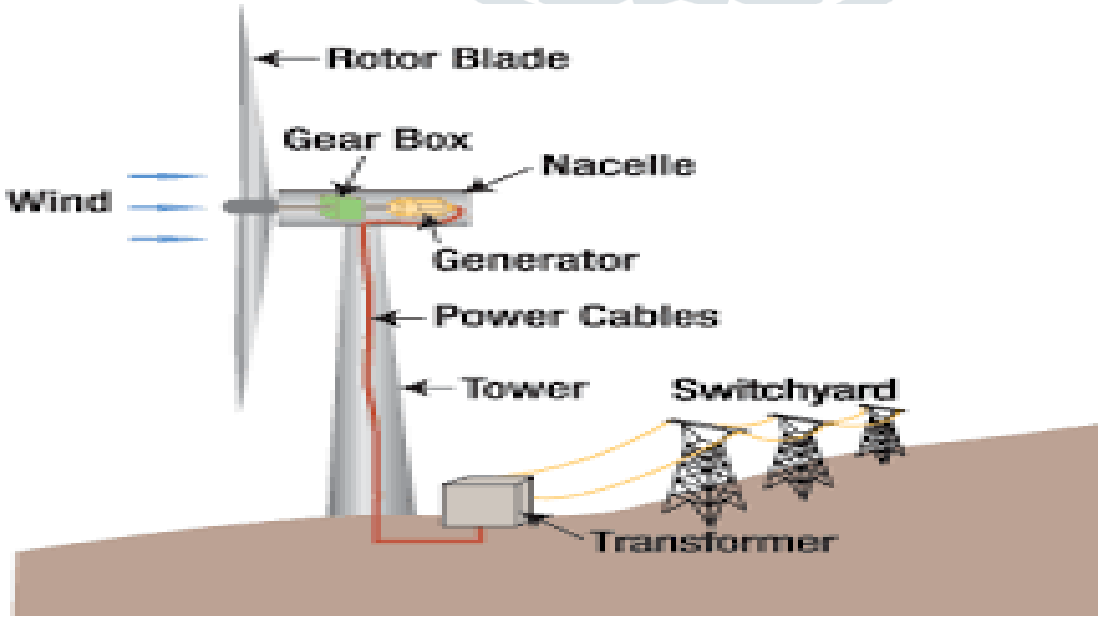

fig.2. wind energy diagram

Wind power The installed capacity of wind power has increased from 4.8 MW in 1995 to more than 239 GW in 2011. Today, each wind turbine could generate as much electricity as a conventional power plant. Wind energy has made its most significant contributions in China, the US & Germany, where the cumulative installed capacities are 62, 47 & 29 GW, respectively. Figure (3) shows the worldwide wind installation capacity trend based on the BP (2012) report. Figure (3): Cumulative installed wind turbine capacity, 1995-2011 (in GW) The trend shows that wind capacity installation has increased continuously throughout the last two decades. IEA estimates that the global capacity will increase from 238 GW in 2011 to almost 1,100 GW by 2035, of which 80% will be derived from onshore wind turbines (IEA, 2012e). According to this report, offshore wind capacity is expected to grow fairly quickly from 4 GW in 2011 to 175 GW by 2035 as a result of public support. This target will be achieved if the required investment is made based on the design plan. Estimates indicate that around 980 billion USD is required in investments between 2010-2020, with increases to 0 100 200 300 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 9 1,634 & 3,307 billion USD for 2020-2030 & 2030-2050, respectively (IEA, 2012e).

Wind Power Wind possesses energy by virtue of its motion .Any device capable of slowing down the mass of moving air can extract part of the energy & convert into useful work. Following factors control the output of wind energy converter: - * The wind speed * Cross-section of the wind swept by rotor * Conversion efficiently of rotor * Generator * Transmission system Theoretically it is possible to get 100% efficiency by halting & preventing the passage of air through the rotor. However, a rotor is able to decelerate the air column only to one third of its free velocity. A 100% efficient wind generator is able to convert maximum up to 60% of the available energy in wind into mechanical energy. In addition to this, losses incurred in the generator or pump decrease the overall efficiency of power generation to 35%.

2)OBJECTIVE-

1)This study will also help to understand& to store maximum thermal energy that reduce the requirement of conventional fuels like coal, oil etc
2)it will help in reducing greenhouse gasses & climatic changes
3) Improve the utilization of wind energy in commercial purpose
4)Get awareness about wind energy to societies.

3) THE NATIONAL POTENTIAL FOR WIND ENERGY

The vision of the wind industry in the United States & Europe is to increase wind's fraction of the electrical energy mix to more than 20% within the next two decades. Recently, the Department of Energy in conjunction with the American Wind Energy Association (AWEA), the National Non conventional energy sources Laboratory (NREL), & Black & Veatch undertook a study to explore the possibility of producing 20% of the nation's electricity using wind energy. This investigation attempts to estimate important aspects of this scenario, including the wind resource assessment, materials & manufacturing resources, environmental & sitting issues, transmission & system integration. It should be noted that several states have put in place Renewable Portfolio Starts that mate comparable levels of non conventional energy sources be deployed within the next 20 years.

3.1) The history of wind technology development

Until the early 1970s, wind energy filled a small niche market providing mechanical power for grinding grain & pumping water. With the exception of a small number of battery chargers & the rare experiments with larger electricityproducing machines, the windmill of 1850, or even 1950, differed little from the primitive devices from which they were derived. But the latter half of the 20th century saw spectacular changes in the technology. Blades that had once been made of sail or sheet metal progressed through wood to advanced fiberglass composites. The DC 6 alternator gave way to the induction generator that was grid synchronized. From mechanical cams & linkages that feathered or furled a machine, designs moved to high-speed digital controls. Airfoils are now tested in wind tunnels & are designed for insensitivity to surface roughness & dirt. Current knowledge of aeroelastic loads & the ability to incorporate this knowledge into detailed numerical models & structural dynamics codes make the machine of today more robust, but much less expensive than those of a decade ago.

4) SITE SELECTION

Site Selection Following factors are to be considered for selection of good site for wind power generation:-

- High annual wind speed.

- No tall obstructions for a radius of 3 Km.

- Open plain or open shore
- Top of a smooth, well rounded hill with gentle slopes
- Mountain gap which produces wind funneling.
- High annual average wind speed
- Availability of wind curve at the proposed site.
- Availability of anemometry data.

5) ENERGY STORAGE

Energy Storage Wind power turbines have operational limitations over very high & very low speeds. When the power generated exceeds the deem&, excess energy can be stored to be used at other times. Excess energy can be conveniently stored in storage batteries in the form of chemical energy. Excess energy can also be stored in water power storage in the form of mechanical energy. Wind power plant (WPP) along with Hydroelectric power plant (HPP), when generated power (Pg) exceeds the power deem& (Pd), helps to partly divert hydro power plant output to Pumping motor (PM) to pump water from an auxiliary reservoir at the bottom of the dam to main reservoir.

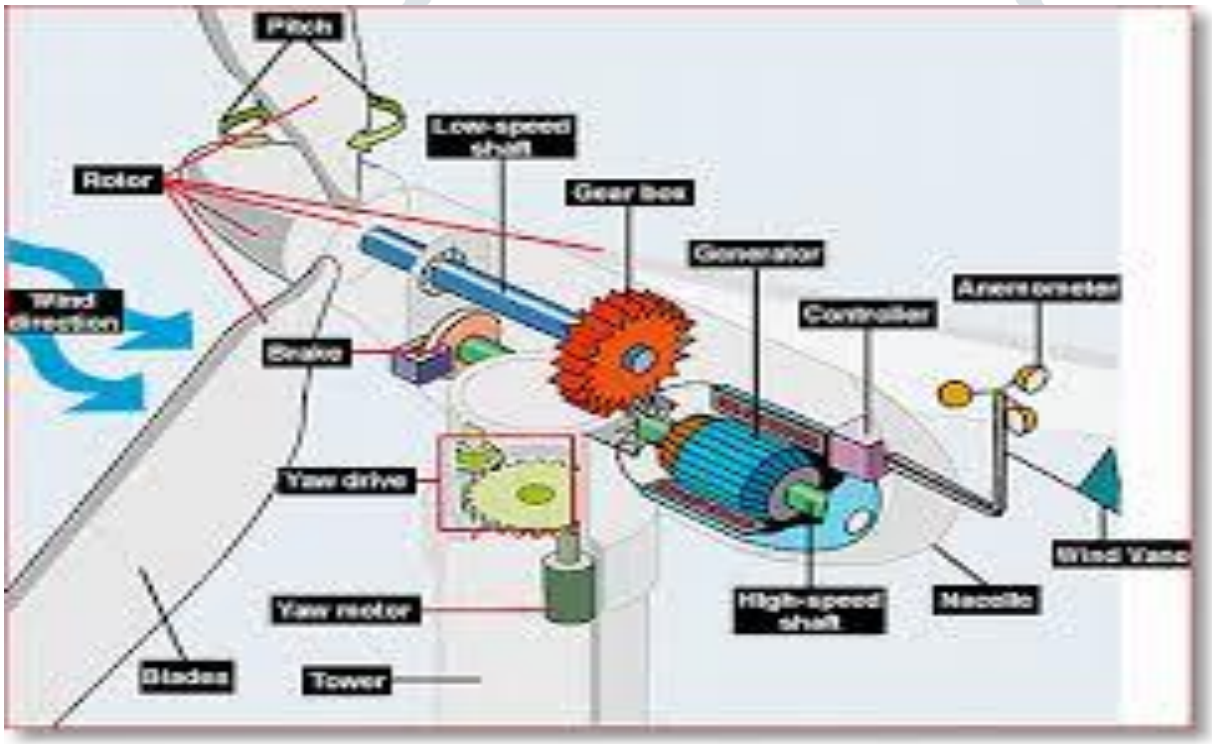

fig.3.wind turbine diagram

6) MAINTENANCE & AFTER-USING

The rapid development of wind power for the wind power equipment manufacturing industry has brought great market opportunities. Denmark, Germany, Spain, India & the United States are the world's largest concentrated areas for the wind power manufacturing industry. In particular, the Europe's production capacity of wind power equipment manufacturing has exceeded 50 % of the world, making Europe become to the major wind power equipment export area in the world. However, it has also brought great challenges. The increase of the capacity of the wind turbine increases the size & the scale of the wind turbine. It also puts forward the higher requirements for the safety & reliability of it. The excellent quality & high reliability of wind turbine units are the fundamental requirements of wind power generation. Besides production quality, maintenance is another important part for supporting high reliability. In order to achieve true sustainability, wind turbine material recycling is also very important. The design life of the wind turbine is about 20 years. After 20 years, the end of the wind turbine will be a huge challenge.

7) SWOT

SWOT of wind power SWOT is a tool to analyze strengths, weaknesses, opportunities & threats. With this tool, countries & organizations can make a correct decision to find a right place & policy to develop wind power. The main points of SWOT are in Table 4 & their details are described below. Strengths When the wind turbines are working, it does not have any fuel cost & emissions because the power is from the wind. Comparing with other renewable energies, wind power is the lowest cost renewable resource. Furthermore, the location of wind farms is not only on l& but also offshore with suitable environmental location. Weaknesses It is difficult to predicting the wind & it will cost lots of time to collect several years' data to determine where the location of a wind farm is. The generated electrical energy per year cannot still promise a fixed value. The maximum efficiency of wind turbine is less than 60 %, which less than other non conventional energy sources efficiency. For example, hydropower's efficiency is about 90 %. As easily accessible energy source, fossil fuels still have advantage in price. Opportunities With the developing of technology, single wind power capacity will be improved. This means larger & more efficient wind turbines will be installed & larger amounts of electricity with lower cost will be generated. Offshore wind turbines are another opportunity. Higher wind speed, not taking up l& resources & not affected by terrain are offshore wind farm's advantages. Threats Offshore wind turbine has its benefits, however, its costs still have to be considered. Nowadays, the cost of one offshore wind turbine is twice, even three times more than one onshore wind turbine.

8) CONCLUSION

Wind power, as one of the sustainable energy forms, is a future of electricity generation. However, the cost of early research & development is a serious problem for the enterprises. Fortunately, with the support from government such as Denmark, wind power industry has a health growth & becomes more & more important in the world economy. Another important issue that has to be focused is recycling. Nowadays some of waste can be re-used or recycled but lots of them cannot be treated as resources. The trend of wind power industry is that more & more wind turbines will be installed. However, the problem how to deal with more & more waste from wind farms needs to be solved. This is the aim why governments, enterprises & scientists have to cooperate to figure out feasible methods in materials choosing & waste treating. This way the wind power can be the truly sustainable energy

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