The Most Promising New Energy Source—Wind Power

Yu Wang*

Urals Institute, North China University of Water Resources and Electric Power, Zhengzhou, China

*Corresponding author: 201923308@stu.ncwu.edu.cn

Abstract: Energy is an important part of the development of human society, but due to the large consumption of oil, coal and other resources, it also brings environmental pollution. Therefore, people have higher and higher requirements for environmental protection and sustainable development. Renewable energy plays a key role in meeting climate change agreement targets, increasing energy security, improving access to electricity and reducing fossil energy consumption. Wind power is a sustainable energy source. Because it is environmentally friendly and rich in resources, scientists have spent thousands of years looking for an effective method. This paper mainly introduces the development of wind power utilization and generation, wind navigation aid, wind water diversion and wind heat. In addition, the present situation, advantages and disadvantages of these technologies are described in detail, and the future development of wind power generation is briefly described. Hopefully this article will give a general idea of what wind power can be used for.

Keywords: Environmentally Friendly, New Energy, Wind Power, Wind Energy.

1. Introduction

Wind energy is a type of energy produced by the action of air currents. It is a renewable resource (including water energy, bioenergy, etc.). The kinetic energy in the air is called wind power. As the speed of the air stream increases, its kinetic energy increases. Wind power is an energy source that can be converted into solar energy. Solar radiation causes uneven surface temperatures, resulting in uneven distribution of air pressure. Under horizontal pressure gradient, the air flows horizontally, generating wind force. Wind energy resources are abundant, inexhaustible and widely distributed; It can purify and reduce the greenhouse effect. The overall power generated by wind is huge. Although it merely 2% of solar energy is evaluated to enter the Earth, the total energy is considerable enough for human beings to utilize. Almost 130 megawatts of wind power reach the Earth, which is 50-100 times more than all the plants on the planet. They both absorb and convert chemical energy through photosynthesis. Wind power produces more than ten times more energy than the water on Earth today.

People have used wind power since as early as B.C. The first countries in the world to harness wind power were Egypt, China and Babylon. At that time, wind energy was applied to carry water, irrigate, mill rice, and propel boats. Modern ships have drawn attention for being fuel-starved. The use of windmills in China reached its peak during the Song Dynasty, and the vertical axis windmills that prevailed at that time are still in use today. As early as the second century BC, the Persians began to use vertical axis windmills to grind rice. In the tenth century AD, the Islamic people applied windmills to transport water. In the thirteenth century, the windmill was introduced to European countries and became an irreplaceable driving force. The windmill at that time could be adopted to pump water and then to make oil and saw wood. In Europe, the number of windmills did not decline dramatically until the advent of the steam engine. Over the past few thousand years, wind power technology has been slow to develop and not received enough attention. Nevertheless, since the 1973 oil crisis, due to energy shortage as well as worldwide environmental deterioration, wind power has become an attractive new energy.

Below are some existing wind energy technologies, their strengths and weaknesses, and an introduction to their development prospects.

2. Wind power generation

As early as the early days of human beings, people have started to use wind power to generate electricity. It was not until the early twentieth century, thanks to the pioneering work of Albert Bates and others in aerodynamics, that the science of wind energy was established and used to generate electricity. Using scientific design concepts, "wind turbines"(WTs) are manufactured and deployed around the world to provide electricity to people who are not yet connected to larger grids.

Wind power generation uses wind to drive the fan blade to rotate, and then increases the generator speed to generate electricity. With the help of wind turbine technology, the wind can turn on electricity at a speed of around three meters per second. Wind power converts wind energy into electricity. Many parts of the world have strong winds, but the best places for wind power are the remote oceans. In modern WTs, wind turns rotor blade converts kinetic energy into rotational energy. The rotating energy is generated by an axial generator. A wind farm consists of a number of wind turbines connected to a transmission system. Then electricity can be generated depending on WT sizes and blade length. The power is directly proportional to the rotor size and the square of the wind speed. In theory, a doubling of wind speed increases wind energy potentially eightfold [1]. Wind power is non-polluting and renewable, especially for coastal islands, remote mountain areas with poor access, remote villages as well as fences in remote areas, or where these resources cannot be available in the near future. Wind power generation is a reliable solution to solve the problems of energy production and living.

The advantage of wind energy lies in its large accumulation, wide distribution, renewable and pollution-free. Furthermore, the maintenance and operation costs of wind power generation equipment are also low, and the land occupation is also small. In addition, the cost of wind energy has been reduced by 1/3 from 2008 to 2015 [2]. However, wind energy has similar disadvantages to solar energy, that is, the energy supply is not uniform, and there are huge differences between different regions; it also produces noise pollution, which is dangerous to some wild birds and bats. Besides, how to store the wind power is always an urgent problem to be solved. In addition, different wind turbines face different problems. Large-scale WTs possess the advantages of high power supply reliability and low maintenance cost, but their operating costs are relatively high. Small wind energy systems have high power generation as well as low system, operation and maintenance cost. To improve the efficiency of wind energy use, some scientific efforts are needed. First, to provide a better understanding of the physics of air movement at critical points in wind farm operation. Secondly, the system dynamics and dynamics aspects of the stand-alone wind power generation system are introduced. Ultimately, a wind power plant is composed of hundreds of individual generators working together on a large power grid for optimal control. These major challenges are interconnected, so progress in any one needs to be consistent with progress in the other two [3-5].

Wind power is a new type of high-efficiency and clean new energy, which is increasingly attracting people's attention and widely used. Although the global onshore wind power market would stagnate by 2021, 72.5 GW of new installations will hit a record high. This year, my country's offshore wind power installed capacity has exceeded 2 trillion watts, an increase of more than three times that of last year, reaching the highest level in history. Europe has two-thirds of the world's wind resources, while North America has one-fifth. Texas and South Dakota have enough wind resources to meet the electricity needs of the entire country, according to statistics from the U.S. Department of Energy. Although Asia accounts for only one-eighth of the world's energy, it still has considerable generating capacity. Taking 2020 as an example, the national installed capacity of wind power would reach 328 million kW, including 302 million kW of land wind power and 26.39 million kW from ocean. China has 652.6 billion kilowatts of wind power generation, which has been used for 2246 hours. The utilization rate of wind energy in China can be as high as 96.9%, especially in remote areas where the rate is even higher. From a global perspective, land and sea wind power still have greater potential for development and improvement. According to the forecast of GWEC Market Intelligence, from 2022 to 2026, the annual growth rate of global land wind power will reach 466 GW, with an average annual growth rate of 93.3 GW. The global installed capacity will exceed 90 GW, growing 18.1 GW

per year and a compound annual growth rate of 8.3%. By 2022, the installed capacity of offshore wind power will return to the level of 2019 and 2020. However, after 2023, the development speed of the world's offshore wind power will accelerate again, and the installed capacity in 2023 may exceed 30 GW in 2026 [6,7].

3. Wind aid to navigation

Wind assist is a method of using wind as power to propel a ship forward. People first used wind power because canvas was a powered device thousands of years ago. In history, the ships of the Age of Discovery are the most glorious. Traditional sailboats use the force of the wind. Factors such as the size and direction of the wind force can affect performance of wind power generation, and its stability is also poor. With the advancement of science and technology, motorboats have gradually replaced sails. Only a few countries and regions have used sail boats for inland rivers and small-scale fisheries. Wind energy is back on the agenda due to the energy crisis, rising oil prices and emission reductions. Today, nearly every commercial vessel is powered by oil. Fossil fuels were introduced on ships in the early 20th century when they cost less than 10%. Now, fuel oil accounts for 40% to 60% of the operating costs of various models, and the oil fields are becoming less and less [8,9]. Even in the future, there will be a temporary improvement due to the development of large oil fields, and the production of crude oil will not increase much due to the growing global demand. Oil prices are likely to continue to rise. When the price of oil rises, the price of fuel also rises, and it will not be very cost-effective to use fuel as fuel. Oil prices can drive people to seek alternative ship power.

In February 2007, the world's first 10,000-ton sail cargo ship MS Beluga SkySails sailed from the port of Bremen, Germany to Venezuela. The new technology helps ships move forward by attaching sails to ships and using computers to measure wind direction. Sailing is also a combination of environmental protection and economic development. As a ship owner, Japan has used computer-controlled sailboards in its 10,000-ton cargo ships, which can save 15% of fuel.

However, there are still many shortcomings. First of all, the wind power in the ocean is unstable, and the energy it can provide is also unstable. Due to geographical location, the use of wind power generation is greatly restricted; the power conversion efficiency is low; the new wind power navigation device is not yet perfect. At the same time, other effective energy-saving measures are taken to improve the energy-saving effect of the overall platform. For example, Japanese lifeboats adopted a series of energy-saving measures, taking into account components such as sails, engines, and oars, and also used poor-quality fuel. The hull can also use asymmetrical lines. Energy-saving equipment such as front pipes and power rudders can be installed on board. Large-diameter propellers or low-speed propellers can be selected for use. Energy saving measures for power plants and power plants can also be adopted.

4. Other applications

Other uses of wind power include wind power and water supply. The method of converting wind energy into heat is called wind heating. An air heater is a type of wind heater. Wind turbines are usually composed of wind turbines, transmissions, and heating devices; they are composed of heat storage, heat exchangers and other components. There is a component in the heating device that directly interacts with this medium and transmits energy to it. Wind-to-heat conversion is realized through four methods: liquid agitation heat generation, solid friction heat generation, liquid extrusion heat generation, and swirling flow heat generation. The United States, the United Kingdom, and Japan have already applied wind power generation to practical applications, and its application range includes bathroom hot water, residential heating, and greenhouse heating; pond water insulation, field operations, and refrigeration [10]. In many cold places, converting wind power into heat energy for use in homes, livestock sheds, vegetable greenhouses, etc. is the best use of wind power and heating needs. Feng Shui has always been common in ancient times. Modern wind-powered water lifters can

be divided into two types according to the usage: one is a high-lift, low-flow wind-powered water lifter; the other is a low-head, high-flow wind power generation device. Compared with building large-scale wind farms, the requirements for annual average wind speed and hours of effective wind speed are not high. When there is wind, the water can be concentrated into the reservoir for emergency use. The machine stops working when there is no wind. Realized "divided storage, water intake, instant irrigation". Feng Shui can also be used to build water towers to improve drinking water for rural residents. In winter, the deep groundwater pumped out by wind energy is reused as a heat source for greenhouses, nurseries, greenhouses; vegetables and fish farms.

5. Conclusion

Generally speaking, due to the gradual depletion of non-renewable resources such as petroleum and the increasingly serious pollution to the environment, the development and utilization of renewable resources has become a top priority. Wind energy is large, widely distributed, and environmentally friendly, which is the key to future development. In addition, there are great differences in the development and utilization of wind power, such as instability, uncontrollability, and uneven distribution. This paper mainly expounds the application of wind power generation, wind aid navigation, wind lifting water, wind energy heating, etc.; its application, advantages and existing problems in wind power water pumping and other fields. Therefore, in the future development, how to make good use of wind power generation, improve it, and control it is a significant direction for future research of wind power. It is believed that wind power will be widely used in the future development, which is of great value to alleviate the energy and environmental problems.

References

[1] Home. IRENA. (n.d.). Retrieved November 10, 2022, from https://www.irena.org/Energy-Transition/Technology/Wind-energy

[2] Grand challenges in the science of Wind Energy | Science. (n.d.). Retrieved December 2, 2022, from https://www.science.org/doi/10.1126/science.aau2027

[3] Dolara, A., Gandelli, A., Grimaccia, F., et al. (1970, January 1). Weather-based machine learning technique for day-Ahead wind power forecasting: Semantic scholar. undefined. Retrieved December 2, 2022, from https://www.semanticscholar.org/paper/Weather-based-machine-learning-technique-for-wind-Dolara-Gandelli/825a3b38b35de21910de4ac0e1b8633398d34d92

[4] Hong, Y., Rioflorido, C.L.P. 2019. A Hybrid Deep Learning-based Neural Network for 24-h Ahead Wind Power Forecasting, Applied Energy, Volume. 250, p. 530-539.

[5] Ma, Y., Zhai, M. 2019. A Dual-Step Integrated Machine Learning Model for 24h-Ahead Wind Energy Generation Prediction Based on Actual Measurement Data and Environmental Factors, Applied Sciences, Volume. 9, p. 2125.

[6] H. Zhang, Y. Cao, Y. Zhang, et al. Quantitative synergy assessment of regional wind-solar energy resources based on MERRA reanalysis data Appl Energy, 216 (2018), pp. 172-182.

[7] X. Lu, M.B. McElroy Global Potential for Wind-Generated Electricity Proc. Natl. Acad. Sci. U. S. A. (2017), pp. 51-73.

[8] P. Barutha, A. Nahvi, B. Cai, et al. Evaluating commercial feasibility of a new tall wind tower design concept using a stochastic levelized cost of energy model J Clean Prod, 240 (2019).

[9] B. Sliz-Szkliniarz, J. Eberbach, B. Hoffmann, et al. Assessing the cost of onshore wind development scenarios: Modelling of spatial and temporal distribution of wind power for the case of Poland Renew Sustain Energy Rev (2019).

[10] M. Mahmoud, M. Ramadan, A.G. Olabi, et al. A review of mechanical energy storage systems combined with wind and solar applications Energy Convers Manag, 210 (2020).