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APPLICATION OF WIND POWER GENERATION AND ITS EFFECT ON ENVIRONMENTAL PROTECTION

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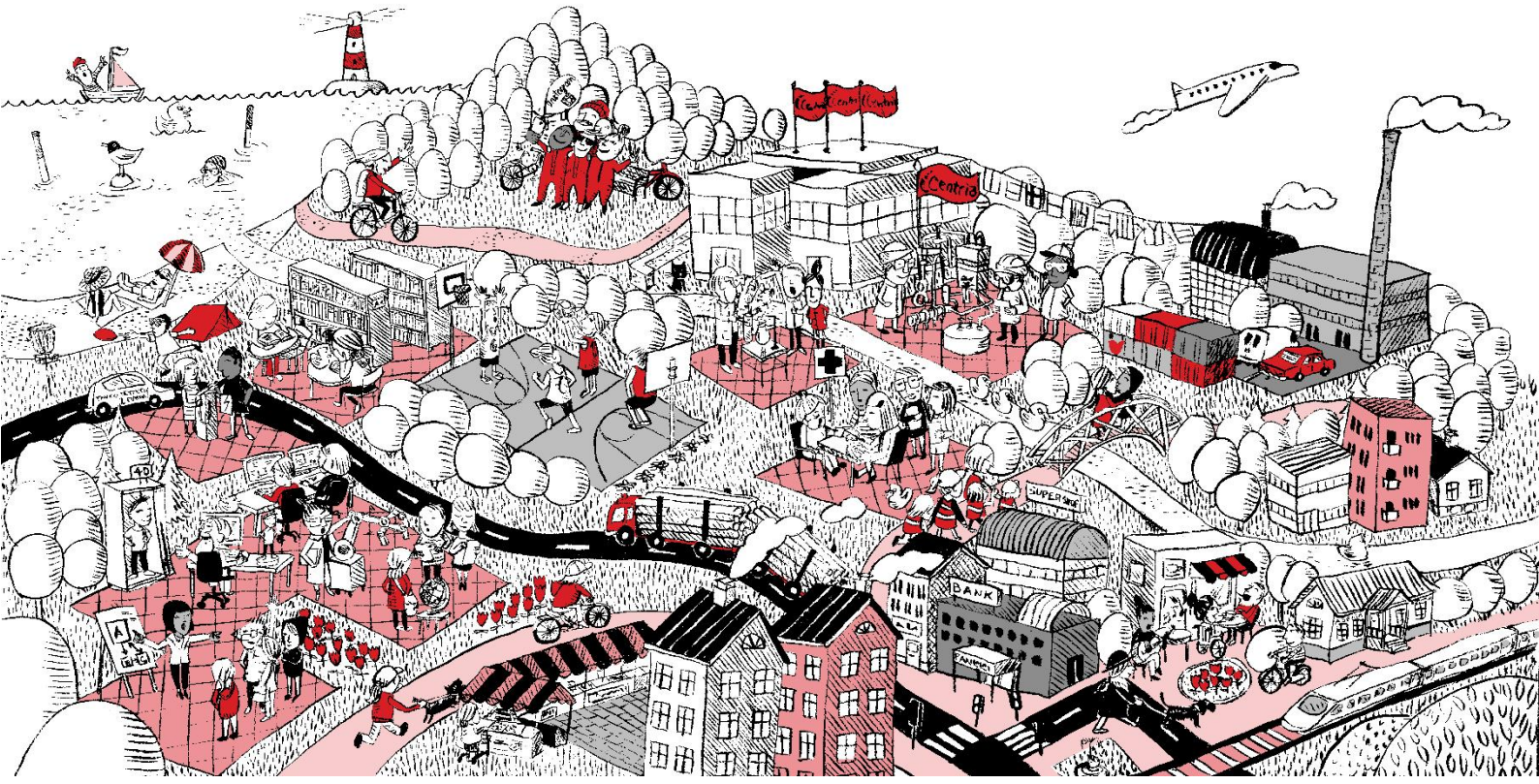

ABSTRACT

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With the development of science and technology, people's living standards are improving. The demand for energy is also increasing. With the increase of the use of traditional energy, the pollution in the process of using traditional energy has a more serious impact on the environment. The problem that the use of traditional energy will pollute the environment is a problem that any country needs to face. The main problem of energy nowadays is how to develop a kind of energy which can produce a large amount of energy without causing excessive pollution to the environment.

Wind energy plays an irreplaceable role in today's energy field. This kind of energy is one of the best representatives of clean energy. This paper introduces the working principle and application form of wind energy. The main applications of wind energy include wind water lifting, wind power generation, wind navigation assistance and wind heating. This paper will compare the use effect of wind energy and traditional energy, analyze the advantages and disadvantages of wind energy, including production cost, energy efficiency, impact on the environment and other factors, and finally summarize the impact of wind energy on environmental protection.

Key words
Coal, environmental protection, natural as, sustainable development, wind energy

CONCEPT DEFINITIONS

HAWT

Horizontal axis wind turbine, the wind turbine rotating plane is perpendicular to the wind direction, the rotation axis and the ground parallel to the wind turbine

VAWT

Vertical axis wind turbines, wind turbines whose rotational axis is perpendicular to the ground or the direction of airflow

CAES

Compressed air energy storage, which refers to the energy storage method of using electrical energy for compressed air during the grid load low period and releasing compressed air to drive the turbine to generate electricity during the grid load peak period

AWES

Airborne Wind Energy Systems

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1 INTRODUCTION

In recent ten years, with the development of economy, people's living standards have continuously improved. The ecosystem in nature is a dynamic system, so the natural environment has a certain resistance and self-recovery ability to the pollution caused by the combustion of traditional energy sources such as coal and oil. Therefore, people ignore the environmental pollution caused by the excessive use of local energy at that stage. However, due to the continuous growth of the population base, people's energy needs are also increasing, and the resulting pollution is also increasing. In the use of traditional energy, the pollution caused by combustion has now reached or even exceeded the amount that the environment can bear, so the environmental pollution is also increasing, seriously affecting people's quality of life. Using a new type of clean energy instead of traditional energy has become an urgent problem to be solved.

The emergence of wind energy has brought a new choice to people's use of energy. At this stage, due to the extensive use of traditional energy, competition for resources has also brought more contradictions. The emergence of wind energy can alleviate the shortage of energy and reduce the dependence on traditional energy in various fields. At the same time, the most important factor is that wind energy can slow down urban pollution. If can reduce carbon emissions in cities and natural pollution. For example, most of the electric energy in China's large cities is generated by burning coal. If wind power can be reasonably used, urban air pollution can be reduced. At present, the main application forms of wind energy include lifting water by wind, wind power generation, wind navigation assistance and wind heating. The theory behind wind power is basically to convert wind energy into required energy indirectly or directly through a certain transmission device. But wind energy also has shortcomings. The use of wind energy may interfere with some organisms in the environment. As an emerging energy, wind energy still has a lot of chance to be developed. Its biggest advantage is that it is pollution-free, has strong feasibility, plays an important role in promoting sustainable development, and plays an important enlightening role in solving the problem of providing energy without excessive environmental pollution, and even has the hope to become a solution to this problem.

The purpose of this thesis is to introduce the principle of wind energy, its application and its role in the protection of environment. The first part introduces the generation principle of wind energy and its four main applications. The second part mainly discusses the role of wind energy in environmental

protection by comparing wind energy with traditional energy in different fields. The last part is the summary of the current situation and the description of the future development of wind energy.

2 WIND ENERGY

Wind is simply the movement of air. It arises because the Earth's surface consists of different types of land and water, and it absorbs heat from the sun at different rates. During the day, the air over land heats up faster than the air over water. The warm air above the land expands and rises, and heavier, cooler air rushes in to replace it, creating winds. At night, the winds are reversed because the air over land cools faster than the air over water. Similarly, because the land near the Earth's equator is heated more by the sun than the land near the South and North Poles, large atmospheric winds are generated around the Earth. Wind energy is actually a by-product of the sun. The uneven heating of the atmosphere by the sun, the irregular surface of the Earth (mountains and valleys), and the Earth's revolution around the Sun are all factors that produce wind. Because wind is in abundant supply, it can be said to be a sustainable resource as long as sunlight heats the Earth, and it can be produced. Wind is a form of solar energy that consists of a combination of three simultaneous events, the first condition being the uneven heating of the atmosphere by the Sun, the second condition being the irregularity of the Earth's surface, and the third condition being the rotation of the Earth. (Wind Energy Technologies Office, 2018)

Wind energy is primarily used to generate electricity, and that mechanical power can be used for specific tasks (such as grinding grains or pumping water), or a generator can convert that mechanical power into electricity.For example, wind flow patterns and speeds vary widely across the United States and are influenced by differences in bodies of water, vegetation and topography. Humans use this airflow or motion for a variety of purposes: sailing, kite flying, and even electricity generation Wind power technology, once known as windmills, has made significant advances in the past decade. It collects and converts the kinetic energy generated by the wind into electricity to power the grid, which is the primary wind energy conversion device at this stage. In addition, because wind power is a growing industry, it is adding jobs for people across the country. The same kind of wind energy creates varying degrees of value around the world.(Eia 2020.)

2.1 History of wind energy

Wind energy is actually a very ancient source of energy as a resource for human applications and has been used since ancient times. Over 5,000 years ago, the ancient Egyptians used the wind to navigate

the Nile River. Later, windmills were built to grind wheat and other grains. The earliest known windmills were in Iran. (McIntosh 2019) These early windmills looked like large bright wheels. A few centuries later, the Dutch improved the basic design of the windmill. They gave it propeller-style blades, still made of sails. The Netherlands is famous for its windmills. American colonists used windmills to grind wheat and corn, pump water, and cut timber at sawmills. Until the 1920s, Americans used small windmills to generate electricity in rural areas where there was no electricity supply. In the 1930s, when power lines began delivering electricity to rural areas, local windmills were used less, although they could still be seen on some ranches in the West. The oil shortage of the 1970s changed the energy landscape of the United States and the world. It generated interest in alternative energy sources and paved the way for a return to the use of windmills for electricity generation. In the early 1980s, wind energy really took off in California, in part because of state policies encouraging the use of renewable energy. The first offshore wind park in the United States is planned for an area off the coast of Cape Cod, Massachusetts. This shows that even though wind energy is now often mentioned as a new energy source, it is in some ways one of the oldest. (Energy Kid's Page 2019.)

2.2 Wind turbine

Wind turbine is a device that converts wind energy into electrical energy. Wind turbines come in several sizes, with small models ranging from 20 to 100 kilowatts used to power rural homes or huts and community-scale models used to power a few homes in a community. At the industrial scale between 110 and 420 feet, many large turbines collect wind for farms located in rural areas or offshore. The term windmill, which usually refers to the conversion of wind energy into power for milling or pumping, is sometimes used to describe a wind turbine. However, the term wind turbine is widely used as a mainstream reference for renewable energy (see also wind energy). A wind turbine converts wind energy into electricity using aerodynamic forces generated by rotor blades, which work similarly to aircraft wings or helicopter rotor blades. When the wind flows through the blades, the air pressure on one side of the blades decreases. The difference in air pressure between the two sides of the blade produces lift and drag. The lift force is stronger than the drag force, which causes the rotor to rotate. (WINDExchange 2019.)

There are two main types of wind turbines used to implement wind energy systems: horizontal axis wind turbines (HAWTs) and vertical axis wind turbines (VAWTs). HAWTs are the most common

type, with two or three blades per turbine or a disc containing multiple blades (multi-blade type) attached to each turbine. VAWTs are capable of harnessing the wind blowing from any direction and are usually made of blades that rotate around a vertical rod. Mainstream wind turbine blade size can be 68m, 54m or 56m. (Cooper 2010.)

2.2.1 The basic concept of Horizontal Axis Wind Turbine

Horizontal axis wind turbines (HAWTs) can be divided into two categories: lift type and drag type. There are many types of horizontal wind turbines, some have wind turbines with reversing blades. Some install multiple wind turbines on a tower in order to reduce the cost of the tower under the condition of certain output power. some use conical cover to make the airflow concentrated or spread when passing through the horizontal axis wind turbine, thus accelerating or decelerating. There are also horizontal axis wind turbines that produce vortex around the wind turbine to concentrate the airflow. It increase the speed of airflow. The lift type rotates fast and the drag type rotates slowly. For wind power generation, most of the horizontal axis wind turbines of the lift type are used. Most horizontal axis wind turbines have a counter wind device that can rotate with the change of wind direction. HAWTs are also the most common wind turbine design used today. Machines with upwind rotors require a yaw or tail rotor to help position them into the wind, while upwind rotors have tapered blades that allow the turbine to position itself. (Carbó TimDe Troyerb Massaia Vergaerdeb Mark GianniBartolia, 2019).

HAWTs are characterized by high or low solids devices, where solids refers to the percentage of swept areas containing solid materials. High strength HAWTs include multi blade types, i.e. covering the total area swept by the blade with solid material to maximize the total air volume in contact with the blade. An example of high-intensity HAWTs is multi blade turbines for farm pumping, which are often seen in the landscape of the western United States. Low solids HAWTs usually use two to three long blades, which are similar to aircraft propellers. The material ratio of low solids HAWTs in the swept area is very low, which can be compensated by the faster speed of filling the swept area. Low solid strength HAWTs are the most commonly used commercial wind turbines and are the most commonly represented type through media sources. These HAWTs provide maximum power generation efficiency and are therefore one of the most cost-effective designs used. (Aviation bolg, 2020.)

2.2.2 The basic concept of Vertical Axis Wind Turbine

Vertical axis wind turbines (VAWTs) represent a unique technology for generating electricity. Vawt are typically small wind turbines characterized by a rotating axis perpendicular to the ground. As a result, the vawt can operate independently of the wind direction, which is a major advantage for urban applications where the wind direction can change rapidly. The two main VAWT designs come from the Darrieus (lift-driven) or Savonius (drag-driven) rotor. Historically, due to their yawless design, they only catered to a niche market of commercially available wind turbines. The current VAWT design lags behind its horizontal axis wind turbine (HAWT) counterpart in terms of efficiency, as measured by the power factor.(Hyams 2017.)

However, new research suggests that these types of wind turbines may be more suitable for wind farm installations than previously thought. Vertical axis wind turbines have been developed, with many large Darrieus-type turbines being built in the United States and the Musgrove turbine being tested in the United Kingdom. These two types of turbines vertical axis wind turbine and horizontal axis wind turbine are now well known in the field of wind energy research. At Napier College, work in wind energy has centered on student projects in the past. The work in wind energy complements the ongoing work in solar energy research. (Britannica, 2015.)

Development of a vertical axis turbine began in 1978. It was thought that there were other possible options than the basic Musgrove design. In 1979, at the first wind energy symposium organized by the British Wind Energy Association, another idea was presented, increased robustness to improve performance, which was subsequently developed to include the effect of low aspect ratios (1980). Small vertical axis wind turbines are not yet commercially available in significant numbers. Further work is needed to improve wind turbine performance, power conversion, reliability and overall economic viability (Britannica 2015.)

2.3 Main applications of wind energy

Wind energy is used in many applications today,there are four main applications. First, wind energy is used to propel sailboats in rivers and oceans to transport people and materials from one place to another. Second, wind energy is used to run pumps that take water from the ground through windmills. Third, wind energy is also used to run flour mills, which grind grains such as wheat and corn into flour. Fourth, wind energy is used to generate electricity. In summary, these are the four areas of wind power

to lift water, wind power to generate electricity, wind power to aid navigation, and wind power to heat water. Wind energy can be considered as the fastest growing energy source in the world. With the development of technology, wind energy may become the most economical and environmentally friendly source of electricity in many countries in the next 10 to 20 years. The next section will describe in detail the principles, equipment, and results of each of these four applications. （University Of Nairobi 2009.）

2.3.1 Wind-powered water lifting

A windmill is a machine used to harness the kinetic energy of the wind, which blows through the blade rotor assembly and causes it to rotate on its shaft. The resulting shaft power is used to provide mechanical work for pumping water. As one of the main ways of wind energy utilization, wind water lifting is a simple, reliable and effective practical technology in solving irrigation and drainage in agriculture and animal husbandry, drinking water for people and animals in remote areas, as well as coastal fish farming and salt production. The development and application of wind power water lifting technology is of great practical significance for saving conventional energy, solving the power shortage in the vast agricultural and pastoral areas, and improving the ecological environment. It consists of wind turbine, intelligent controller and electric pump. Compared with the traditional wind power direct water lifting technology, it has a wide range of application, high energy conversion efficiency, easy installation and maintenance and low manufacturing cost, It is also the future development direction of wind power water lifting technology. (Jones & Olsson 2017.)

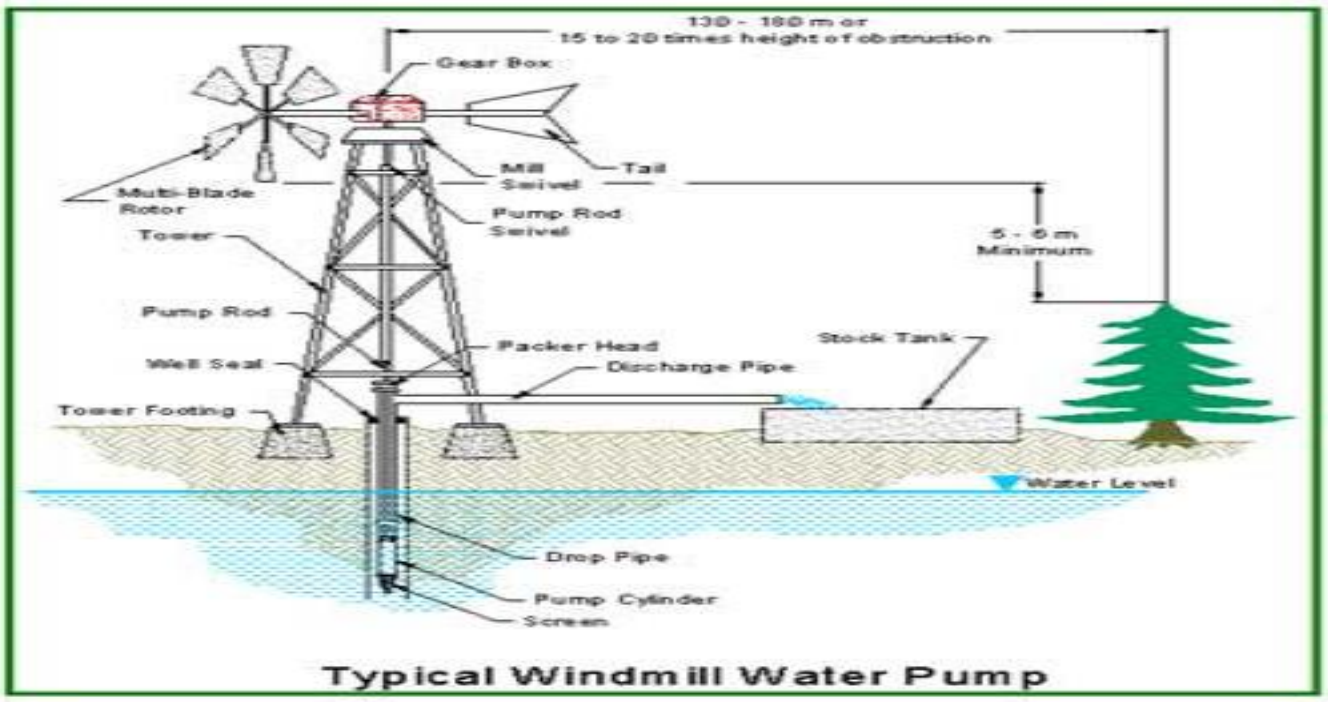

Figure2, Wind carry water (iklim 2020.)

The principle of wind turbine water lifting is to use wind turbine as power,it drive motor or mechanical device, it drive water pump from low to high process. The whole system is composed of wind turbine, electric motor or mechanical drive mechanism, and water pump and reservoir. It is suitable for lifting water from deep wells with small flow and high head and lifting water from shallow wells with large flow. The efficiency of electric wind turbine can be about twice as high as that of mechanical wind turbine. There are three main types of wind-powered water lifting equipment: reciprocating, rotary, and fluid-acting. The rotor is connected to a reciprocating pump with a diameter of 50-150 mm connecting rod. This windmill starts lifting water when the wind speed approaches 8-10 kilometers (km) per hour. (ScienceDirect 2019.)

For many years, windmills have used wind energy to provide water to livestock and humans in remote areas. However, in order to manage the unpredictable energy source and secure a daily water supply, a large water storage tank is required, which leads to increased evaporation. Constant wind can lead to overflowing storage tanks and additional waste. This is no longer acceptable with the growing concern about dwindling water resources. Therefore some times wind pumps with compressed air energy storage, also known as Contained Compressed Air Energy Storage (CAES), are used. The system will use a wind turbine to directly drive an air compressor to power an air storage tank at the well site. The compressor and air tank will be connected using low-cost air piping, allowing the compressor tower to be placed in the optimal wind location, such as a nearby hill. To maximize energy storage in a small

footprint while allowing compressor heat to be used to help prevent stock water from freezing in cold conditions. The stored air will drive a compressed air submersible water pump (already commercially available). CAES will provide about 60 percent energy storage allowing water to be pumped on demand during periods of no wind. Unlike batteries, CAES is resistant to freezing conditions, does not require regular maintenance or replacement, and does not use toxic materials. There are also other advantages at the same time, such as excess air to aerate the tank to reduce biofouling, stagnation and mosquito larvae. (Khashan 2016.)

2.3.2 Specific operation of wind power generation

Wind power refers to obtaining electricity by converting wind energy into rotational energy of the blades, and then converting the rotational energy into electrical energy through a generator. Wind power increases with wind speed, so wind turbines should be installed in areas where wind speed is high. Converting the kinetic energy of the wind into mechanical kinetic energy, and then converting the mechanical energy into electrical kinetic energy is wind power generation. The principle of wind power generation is to use the wind to drive the windmill blades to rotate, and then increase the speed of rotation through the speed increaser to promote the generator to generate electricity. According to the windmill technology, a breeze speed of about three meters per second is enough to start generating electricity. Wind power is becoming popular worldwide because it does not require fuel and does not produce radiation or air pollution. The device needed to generate electricity from wind power is called a wind turbine.

This wind turbine can be broadly divided into three parts: the wind turbine (including the rudder), the generator and the tower. Large wind power plants basically do not have a rudder, generally only small (including household type, will have a rudder). The wind turbine is an important part of the wind kinetic energy into mechanical energy, it consists of a number of blades. When the wind blows to the blade, the paddles produce aerodynamic force to drive the wind wheel rotation. The material of the paddle requires high strength and light weight, and is mostly made of FRP or other composite materials (such as carbon fiber). There are a loy of vertical wind turbine, s-type rotating blade, its role is also the same as the conventional propeller blade. Because the wind turbine speed is relatively low, and the size and direction of the wind often changes, which makes the speed is unstable; so, before driving the generator, it must also be attached to a gearbox to increase the speed to the rated speed of the generator, and then add a speed control mechanism to keep the speed stable, and then connected to

the generator. In order to keep the wind wheel always aligned with the wind direction to obtain the maximum power, it is also necessary to install a rudder similar to the wind vane at the back of the wind wheel. (Prasad, Swami, Tambe, Kamate & Bagade 2016.)

The tower is the structure that supports the wind turbine, the rudder and the generator. It is generally built high in order to obtain a larger and more uniform wind force, but with sufficient strength. The height of the tower depends on the impact of ground obstacles on the wind speed, as well as the diameter of the wind turbine size, generally in the range of 6 to 20 meters. The role of the generator is to transfer the constant speed obtained from the wind turbine to the power generation mechanism through the ascending speed to run evenly, thus transforming mechanical energy into electrical energy. The small wind power system is very efficient, but it is not composed of only one generator head, but a small system with certain technology content: wind turbine , charger and digital inverter. A wind turbine consists of a head, a rotor, a tail, and a blade.Each part is important. (TOSHIBA 2019.)

The function of each part is: the blade is used to receive the wind and turn into electricity through the head; the tail makes the blade always to the direction of the incoming wind so as to obtain the maximum wind energy; the rotor can make the head rotate flexibly to achieve the function of the tail to adjust the direction; the rotor of the head is a permanent magnet, the stator winding cutting magnetic lines to produce electricity. However, from the perspective of economic rationality, wind speed greater than 4 meters per second is suitable for power generation. According to the measurement, a 55-kilowatt wind turbine, when the wind speed is 9.5 meters per second, the output power of the unit is 55 kilowatts; when the wind speed is 8 meters per second, the power is 38 kilowatts; when the wind speed is 6 meters per second, only 16 kilowatts; and when the wind speed is 5 meters per second, only 9.5 kilowatts. It can be seen that the greater the wind power, the greater the economic benefits (TOSHIBA 2019.)

Attempts to use wind power generation began as the early twentieth century. Denmark, Sweden, the Soviet Union and the United States applied the rotor blade technology of the aviation industry to successfully develop some small wind power generation devices. These small wind turbines were widely used on windy islands and in isolated villages. However, the power generation capacity at that time was low, mostly below 5 kW. The 200 kilowatts of wind turbines were built in the town of Clayton, New Mexico in January 1978, with a blade diameter of 38 meters, generating enough electricity for 60 households. In the early summer of 1978, a wind turbine was put into operation on the west coast of Jutland, Denmark, with a capacity of 2,000 kilowatts and a windmill height of 57

meters. 75% of the electricity generated was sent to the power grid and the rest was supplied to a nearby school. (Prasad, etac 2016.)

2.3.3 Using wind power to help navigation

Wind navigation directly or indirectly uses wind as the driving force of navigation. People have been using wind to propel ships for 5,000 years. In China, the great navigator Zheng He led a huge fleet of ships to sail the West China Sea from 1405 to 1433, reaching an ocean voyage unprecedented in human history, just as the invention of steam engine and internal combustion engine in the 18th and 19th centuries. But the advent of steam engines and steamboats gradually replaced the monopoly of sailing winds. By the middle of the century, sailing ships had all but disappeared from ocean transportation. But with the emergence of the world oil crisis in the early 70s and the serious concern of mankind about environmental pollution. With significant energy-saving effect and reduce the advantages of pear pollution, such as chicken sail propulsion system to attract the attention of ship workers, wind propulsion in modern commercial shipping in a wide range of applications - from wind-assisted motor boats (by the wind to provide auxiliary propulsion) to primary wind ships with auxiliary engines. (National Geographic, 2018.)

Research into navigation began at a very early stage. Germany started working on a large wind booster aircraft carrier in the 1960s. They designed the six-masted sail booster "DYNA" with a length of about 160 meters. It was of particular interest to ship owners, especially when international oil prices were expensive. The United States has also taken notice of sails since the 1970s and has created sails specifically for the prospect of passage, developed sail passage plans, and improved traditional and modern sails in barges, fishing and floating drilling vessels, offshore and marine vessels. European and American countries are slightly ahead of Japan in the development of modern sails, but Japan is in practical application. Japan began research on sails in the 1980s. 1980 saw the construction of the world's first ship, the "New Edgemaru", which sailed with modern sails. The ship has a deadweight of 2400t, a displacement of 1600t, and is equipped with two rolls of folding fiber reinforced plastic sheets and a low-speed diesel engine as auxiliary power for both. The ship sails by wind power, so it can save fuel. The ship can save 50% of fuel compared with an ordinary power ship with the same load, but the transportation time will increase by 20%. This shows that wind-powered navigation has been accompanying human development. (International Windship Association 2021.)

Wind aids to navigation are also used in the navigation of aircraft. In air navigation, the wind triangle is a graphical representation of the relationship between aircraft motion and wind. It is widely used in track projection navigation. The wind triangle is a vector diagram with three vectors. The air vector represents the movement of the aircraft through the air mass. The airspeed is the vector difference between the ground speed and the wind speed. On a perfectly stationary day, the airspeed is equal to the ground speed. However, if the wind is moving in the same direction as the aircraft, the airspeed will be less than the ground speed. (Aldea & Kopacz 2017.)

The development of wind energy has been advancing. But now that it is aware of the ecological consequences of burning fossil fuels and the International Maritime Organization has imposed binding international emission limits, wind-assisted shipping is once again attracting attention. While wind may make navigation more uncertain, and shipping companies that must obey delivery schedules may be reluctant to risk using sailboats. The frequency of oil crises and the dire climate warming situation the world has faced, combined with severe pollution, sending us a warning that oil can no longer be used as the only reliable source of energy. The rising "economy", the sun will become the mainstream of future global energy. It is clear that the issue of developing wind power is the trend of the times. Sail to the sea is to save energy and reduce pollution, it will open a new era of sail to the sea of science and technology. (Aldea & Kopacz 2017.)

2.3.4 Wind heating

The process of converting wind energy into heat using wind machines and heat generating devices is called wind energy heating. The wind turbine is generally composed of wind turbine, transmission mechanism, heat production equipment, heat storage equipment and heat exchanger components. The heat production equipment contains elements that interact directly with the medium to transfer energy to the medium.(Dimoulkas, Amelin & Levihn 2017.)

Wind power generates heat in three ways: by converting electricity back into heat; Heat pump is used to generate heat energy. When the moving blade rotates, the liquid is stirred to produce vortex movement, and the kinetic energy of the liquid is converted into heat energy when the static blade is impacted. The principle of liquid extrusion heat is that the wind turbine power output shaft drives the hydraulic pump, the working fluid (such as oil,) is pressurized, so as to convert mechanical energy

into liquid pressure energy, the liquid flow rate drops and the temperature rises. (Dimoulkas et al. 2017.)

Wind turbine power output shaft drive a rotor, the outer edge of the rotor and the stator is equipped with magnetization coil, when the weak current from the battery through the coil generated when the magnetic lines of force, then the rotor rotation cut the magnetic lines of force and generated eddy current, this eddy current makes the stator and the outer edge of the rotor near the heat. The outer layer of the stator is a ring-shaped coolant sleeve, and the coolant absorbs heat energy and transforms into a high-temperature liquid, thus producing heat. There are a total of four types of wind-powered heating devices: agitated liquid heaters, oil-pressure damping hole heaters, solid friction heaters, and compressed air heaters. (Dimoulkas et al. 2017.)

The stirring liquid heater is driven by the drive mechanism to rotate the rotor of the stirrer in the heat making barrel, and there are multiple blades on the inner wall of the barrel, and there are multiple blades (stator) between the blades of the corresponding rotor. Cold water (oil can also be used as a medium) is injected into the heat making barrel, and the hot water tank is connected to the heat making barrel by pipes. When the rotor rotates, the water is stirred to form a vortex, and the friction between the water flow and the blades, and between the wall and the water mass produces output heat, making the temperature of the water gradually rise. When the water in the bucket reaches the desired temperature, the hot water is stored in a hot tank on top of the cold water, and when hot water is needed, the valve is opened to release it. (REUK.co.uk 2019.)

Oil pressure damping hole heating, also known as extruded liquid type heating, is a way to obtain energy by using hydraulic pump and damping hole together. The power of the wind turbine is transmitted from the transmission mechanism to the hydraulic pump, which pressurizes the working fluid (such as oil), converting the mechanical energy into oil pressure energy, and then cause the pressurized oil to be ejected from the narrow damping hole at high speed. The pressure energy of the liquid is converted into kinetic energy of the liquid in an instant. As the damping hole of the tail flow tube is also filled with oil, the high-speed oil ejected with the tail flow tube of the low-speed oil impact, high-speed oil and low-speed oil mixture, back to the normal flow rate of the tube. In this process, the kinetic energy of the liquid is converted into heat energy by the impact and friction between the liquid, which raises the temperature of the oil. (Loe-Tech Magazine 2018.)

Solid friction heat maker is when the wind machine drive shaft rotation, in the centrifugal force and spring pressure under the action . Friction block press against the inner wall of the friction cylinder, and rotate in the direction of the circumference. Friction block and cylinder body is due to friction and heat and the heat of the cylinder body will be heat transfer to the water in the water jacket. Control the required temperature, the appropriate time to inject cold water and release hot water. (CCGH 2011.)

Compressed air thermoelectricity is a relatively mature heating technology, available the wind turbines driven by air compressors to compress air and generate heat. Compressed air can obtain a higher temperature (some tests up to 170 ℃), because the working medium is air, more suitable for heating and drying and other purposes. In the compressed air heating system, the main equipment is the air compressor. The common air compressors on the market are centrifugal and piston type two. Piston air compressor adapts to a wide range of pressure, can reach a higher pressure, its power consumption is also smaller than other types of air compressors, commonly used double-cylinder water-cooled piston air compressor. (CCGH 2011.)

In the United States, the United Kingdom, Japan and other countries, wind power heating technology has entered the practical stage, mainly used for hot water supply in baths, residential heating, greenhouse heating, aquaculture pool water insulation, field operations, such as anti-freezing. In many areas of China, the colder wind energy is converted into heat to supply households, livestock houses, vegetable sheds, which can be regarded as the best match between wind energy advantages and heating needs.(Dimoulkas, Amelin & Levihn 2017.)

2.4 The scale of wind energy applications in China and Europe

At the beginning of 2016, China's accumulated wind power installed capacity reached 145GW, exceeding the total installed capacity of 28 European Union countries of 3,000 megawatts. This is despite the fact that China started developing its wind power industry 30 years after the first EU countries. China is the world's largest wind power producer, generating 236GW in 2019, or about 36.3 percent of the total. The United States is the second largest wind generator in the world, generating 105GW in 2019. In 2020, 14.7 GW of new wind capacity will be installed in Europe (10.5 GW in the EU27). This figure represents a 6% decrease from 2019 due to the impact of the COVID-19 pandemic on the onshore wind industry. Eighty percent of new wind facilities are onshore. The Netherlands ranked first in installed wind power capacity in the world in 2020, thanks to strong development of

offshore wind power facilities. Norway had the largest number of onshore installations, while Germany had its worst year for onshore installations since 2010. If governments take the steps they have already committed to and commit to the targets set out in national energy and climate plans, Europe could install around 105GW of new wind capacity over the next five years from 2020. with 70-72% of new installations coming from onshore wind. According to reach latest Annual Report on the European Power Generation Mix 2020, wind power already accounted for 15% of total electricity generation in Europe in 2020. Wind power is widely used in Europe. EnAppSys said all wind farms in Europe generated 429 terawatt hours of electricity last year, an increase of 4 percent from 2019. The total for Europe as a whole was 2,727 terawatt hours. Overall, renewables accounted for 41 percent of Europe's electricity generation in 2020, while nuclear, at 25 percent or 688 TWH hours, remained the largest single source of electricity generation in Europe. The market share of fossil fuels fell to 33%, with natural gas at 19% and coal/lignite at 14%. Nuclear, natural gas, hydro and wind were the top four in the change in power generation by fuel/technology type, with a total of 1,116 TWH-hours of low-carbon clean generation, up 8% from 1,035 terawatt-hours in 2019. In 2020, all renewable energy generation will increase, but garbage generation will decline. Hydropower remains the largest component of renewable power generation in Europe, generating 477 terawatt-hours last year, or 43 percent of all clean power generation. In second place is wind at 36%, Overall, wind power accounts for a large share of energy use in countries around the world.

2.5 Wind Energy and the economy

The economy of wind energy is mostly similar to that of photovoltaic power generation but in a limited range. It is often said that since no one can charge the wind, the electricity generated by the wind is free. This statement is not correct. A modern wind turbine can generate 2 megawatts of electricity (MWe) when there is wind, and the installation cost is about $3.5 million. Installing 500 such turbines in a wind farm, capable of generating 1000 megawatts of electricity, will cost $1.75 billion. Together with other costs, such as operation and maintenance and transmission lines, the total amount may be equivalent to about $4 billion required to build a nuclear power plant. All these expenses need to be recycled from customers or taxpayers. Therefore, the cost of wind power is not free, even a little expensive. A typical wind farm will generate electricity about 30% of the time, and not necessarily when electricity is needed. There is a great difference between intermittent power sources such as wind farms and base load sources such as nuclear power. And even nuclear power has

downtime, but these refueling and maintenance downtime are mainly planned when power demand is low (in spring and autumn). (Hawk 2022.)

Transmission cost is an important issue in the development of wind energy. Transmission losses, as transmission lines from remote wind farms may be longer, wind farms may need to be larger to provide the same amount of power as standby power. For example, if it is assumed 10% power loss per 100 miles, the wind farm 500 miles away needs to be doubled. Transmission line costs, a remote wind farm will need expensive transmission lines to transmit power. For example, the proposed 12000 MW new high-voltage transmission line connecting wind resources in New England will cost $19 billion to $25 billion . Transmission line costs may not be borne directly by power suppliers, so these costs may be hidden in any direct cost comparison, but ultimately paid by consumers or taxpayers. Some of the main locations where wind energy is generated are a long distance from the industrial and population centers where it is consumed. Therefore, it is necessary to carry out large-scale upgrading of transmission lines across the country through the State Grid, and use high-voltage DC rather than high-voltage AC to develop these distant energy sources. In places with abundant water sources such as seaside or internal lakes or rivers, the generated electricity can be used to extract hydrogen from water through electrolytic process. Then hydrogen can become the storage medium and energy carrier of wind energy. It will be transported or transmitted to energy consumption sites through the existing natural gas pipeline system covering the United States. Another option is to convert hydrogen and coal into methane gas, CH4, which can be distributed through the existing natural gas distribution network without major modifications. Methane itself can be converted into methanol or methyl alcohol, and CH3OH can be used as liquid transportation fuel. In order to reduce the loss of power transmission, it can imagine a superconducting transmission line cooled by low-temperature hydrogen to transmit power and hydrogen from wind energy production to consumption at the same time. Such a visionary future power transmission system can also provide power for modern mass transportation systems, which use maglev high-speed trains to transport goods and personnel, such as the current highway system in the United States. Generally speaking, wind energy economy is not a profiteering project, but it is worth applying. As a clean energy, it can not only protect the environment, but also obtain some profits. (Electropadia 2019.)

3 IMPACT OF WIND ENERGY ON ENVIRONMENTAL PROTECTION

The use of wind energy for the the ultimate goal of mankind's continuous development of science and technology is to make people live a better life in the country. Wind power has developed rapidly, and the role and status of wind power is becoming more and more prominent. Wind energy is a clean and renewable energy source, rich in resources, friendly to the environment, no emission of harmful substances, no pollution to air and water and it's good for the environment. The development of wind power generation can also avoid the dependence on fossil fuels, and is also the protection of non-renewable energy. (Wind Energy Technologies Office 2018.)

Wind power is a renewable energy source and very environmentally friendly. As a pollution-free and renewable new energy, wind energy has great development potential. However, it is still difficult to reach coastal islands, remote mountainous areas with inconvenient transportation and vast grasslands and pastures. In rural areas and border areas, wind energy is of great significance as a reliable method to solve the energy of production and life. Wind turbines have a very important impact on the environment, and their use can not only effectively control atmospheric pollution, but also further avoid over-exploitation of land. It is remarkable that the negative impact is relatively small, so the application and development of wind power technology is undoubtedly of great importance, not only to promote the friendly development of man and nature, but also to achieve truly sustainable development. However, as with all energy supply options, wind energy can have adverse environmental impacts, including the potential to reduce, destroy or damage wildlife, fish and plant habitats. In addition, spinning turbine blades can pose a threat to flying wildlife such as birds and bats. However, on the whole, the benefits of wind energy compared to traditional energy sources outweigh the drawbacks for environmental protection. In the following section, Wind energy will be compared with traditional energy sources to illustrate its role in environmental protection. (Panwar, Kaushik & kothari 2011.)

3.1 The environmental impact of conventional energy versus wind energy

Conventional energy sources are generally non-renewable sources of energy that have been used for a long time. These energy sources have been used so extensively that their known reserves have been depleted. The exact type and intensity of the environmental impact depends on the specific technology

used, the geographic location, and several other factors. By understanding the current and potential environmental issues for each type of renewable energy source. There are steps people can take to effectively avoid or minimize these impacts as they make up an increasing proportion of the electricity supply. All energy sources have an impact on environment. By most measures, fossil fuels coal, oil and natural gas cause far more harm than renewable energy sources, including air and water pollution, damage to public health, loss of wildlife and habitat, water use, land use and global warming emissions. Rural residents need fuel wood or timber for everyday cooking, which comes from natural forests and plantations. Due to rapid deforestation, the supply of firewood or fuel wood has become difficult. This problem can be avoided by large-scale afforestation (plantation) in degraded forest land, arable wasteland and barren grazing land. But coal ash, a substance left behind when coal is burned to generate electricity, contains a toxic mixture of mercury, cadmium, arsenic and other heavy metals. It can pollute waterways, poison wildlife, and cause respiratory disease in people living near large ponds where the waste is stored. Oil and gas resources are found worldwide in oil deposits in Saudi Arabia, Iraq, Iran, Kuwait, the United States, Mexico, Russia and other places. According to current surveys, it has been found that the world's oil reserves are decreasing at a very rapid rate. If no precautionary measures are taken, the available oil will last for a maximum of 40 years. Citizens generally report that drilling and production activities contaminate wells, surface water and the soil around well sites; air emissions from drilling sites, wellheads, compressor stations, pipelines and other oil and gas field infrastructure also contribute to air quality problems. (Environmental Pollution 2020.)

The exploration, extraction and use of oil has several environmental impacts. Oil pollution is one of the major problems facing coastal ecosystems. Petroleum pollution can be described as the introduction of any hydrocarbon material, especially crude oil and its refined products, into the environment by humans, either directly or indirectly. Refined products into the environment. The physical environment of Nigeria has been negatively impacted by the activities of oil companies. Oil pollution, mainly from oil spills, has a serious impact on biodiversity as most of the biological habitats have either been destroyed or altered to make them uninhabitable. Oil spills can be classified into four categories: minor, moderate, major and catastrophic. A minor spill occurs when less than 25 barrels in inland waters or less than 250 barrels in land, offshore or coastal waters does not pose a threat to public health or welfare. A moderate spill is 250 barrels or less in inland waters or 250 to 2,500 barrels in land, offshore and coastal waters in land, offshore and coastal waters, while a major spill is more than 2,500 barrels in land, offshore or coastal waters or more than 2,500 barrels in coastal waters. The most severe oil spills affect marine and coastal areas, including creeks and water distribution areas. The overall impact of oil on ecosystem health and biota is multifaceted. Oil interferes with the

functioning of various organs and systems of plants, and animals. It creates environmental conditions that are not conducive to life. For example, oil forms a layer on the water surface that prevents oxygen from dissolving in the water. Crude oil also contains toxic components that can cause the immediate death of plants and animals, as well as other sub-lethal effects. Extracted water may contain high concentrations of salts and other contaminants and is often stored in pits or disposed of in evaporation ponds. The spilled produced water will kill the vegetation and disinfect the soil. Contaminants that enter the soil do not necessarily remain in place. They can move down through the soil and contaminate groundwater, or move up through the soil and be released into the air. There are many examples of leaks from tankers, refineries and storage tanks, as well as from pipelines. Between 1976 and 1997, there were spills that released about 2.8 million barrels of oil onto land. Most of the oil spills that occurred in the Niger Delta were considered minor and were not reported in the swamps, estuaries and coastal waters of Nigeria. (Wind Enery The Facts 2012.)

Some notable oil spills recorded in the oil industry in the Niger Delta include the Bomu-II well blowout, 1970; Forcados terminal oil spill, 1980; Funiwa-5 well blowout, 1988; the Oyakana pipeline spill, 1980; Okana pipeline spill, 1985; Oshika pipeline spill, 1993 and the Goy Trans-Niger pipeline spill in 2004, among others. It must be admitted that traditional energy sources have indeed given us a great deal of energy, but along with them comes a lot of irreversible harm to the environment. (Wind Enery The Facts 2012.)

Figure 3, The environmental pollution

Wind power generation is one of the cleanest and most sustainable power generation methods, because it will not produce toxic pollution or global warming emissions. Wind energy is abundant, inexhaustible and cheap, which makes it a feasible and large-scale substitute for fossil fuels. Although wind power has great potential, its impact on the environment should be recognized and mitigated. They include land use issues and challenges to wildlife and habitats. Generally speaking, the direct air pollution caused by wind energy is zero. In the construction and maintenance phase, wind energy will release a small amount of carbon dioxide. However, this amount of carbon dioxide is much less than other fossil fuel power plants. For example, wind turbines produce almost no emissions during operation and almost no emissions during manufacturing, installation, maintenance and disassembly. Compared with the impact of traditional energy on the environment, the impact of wind power on the environment is relatively small. However, at the same time, the construction and operation of onshore and offshore wind turbines will have potential negative local environmental impacts on birds and whales, landscape, sustainable land use (including protected areas) and marine environment. The negative impact of wind power generation on the environment is much lower than that of traditional energy, but it still needs to be evaluated and mitigated when necessary. (Wind Enery The Facts 2012.)

Although the efficiency of traditional energy is higher than that of wind energy, but in the context of today's greatly increased importance of environmental protection issues, the use of traditional energy to the environment is far more harmful than wind energy, even if it brings energy to people, but in the long run, the damage to the environment is equivalent to the reduction of future resources, is more harm than good, so the widespread use of wide application of wind energy use of wind energy has made a great contribution to the protection of the environment. (SolarReviews Blogs 2022.)

It can be seen that although the efficiency of traditional energy is higher than that of wind energy, the environmental hazards of using traditional energy are much greater than those of wind energy, even though it brings energy to people, but in the long run, the damage to the environment is equivalent to the reduction of future resources, which is more harm than good. The widespread use of wind energy has made a great contribution to the protection of the environment. (SolarReviews Blogs 2022.)

3.2 The future of wind energy

Wind power is often the cheapest energy. Today, the cost of generating electricity from new coal-fired or nuclear power plants is two to three times higher. Wind power on land is especially cheap. It is predicted that the cost of wind power generation will be further reduced. By 2030, in areas with great wind power, the cost of wind power generation will be reduced to 0.03 (US $0.04) per kWh. The U.S. Department of energy (DOE) estimates that by 2050, the U.S. wind power generation capacity will reach 404 gigawatts. It is estimated that if demand remains stable, it will be enough to meet more than one third of the country's electricity demand. About 5% of the world's wind energy comes from offshore parks such as the Dutch coast. Turbines like this have an output power of up to 10000 kilowatts. Starting from 2025, their power generation capacity is expected to rise to 15000 kW, providing power for more than 40000 people. At present, half of the world's new wind turbines are installed in China. In 2020 alone, China will build 5.2 gigawatts of wind turbines. This is equivalent to the power generation of 50 nuclear power plants. The pioneers of wind energy development are Denmark and Germany. Denmark has used wind power to meet about 50% of its electricity demand, while Germany has reached 25%. With the continuous development of wind energy. The following four points are the most important. (Eshagberi 2012.)

Wind turbines are developing into new fields. In order to meet the energy needs of people around the world, the development of wind energy continues to expand in innovative ways and new places. For example, the windfloat Atlantic Project 25 megawatt (MW) wind energy project on the coast of Portugal is expected to join Hywind Scotland's five turbine 30 MW project soon, making it one of the two floating wind farms in the world. This offshore wind farm places turbines farther from the coast, where the wind is stronger. The floating chain connects each turbine deep in the ocean, which is a safer and more economical technology than an offshore wind farm with a fixed bottom. Just three months after its launch in 2017, Hywind Scotland exceeded its performance expectations and operated at 65% capacity. Interestingly, Hywind Scotland's turbine is 574 feet above the water. If put together, they would dwarf Big Ben (315 feet) and the statue of Liberty (305 feet) and the Leaning Tower of Pisa (186 feet). However, not all wind turbines are getting bigger. At the other end of the scale, smaller wind turbines are available to homeowners. (Green Energy 2022.)

The second point is that technology is being adjusted to make use of wind energy, and wind energy technology is constantly developing and improving efficiency and cost-effectiveness. A good example is the use of high-altitude equipment with stronger and more stable winds at high altitudes. This new technology using wind, also known as Airborne Wind Energy System (awes), includes wind turbines like Makani Power Inc.'s Energy Suite. Awes technology can eliminate the need for towers and

foundations of traditional wind turbines, as well as their related materials and maintenance costs. The technology also provides more possibilities for offshore and onshore wind turbines. Another exciting development is that turbines have no blades. Companies like vortex bladeless aim to reduce maintenance and construction costs and environmental impact through smooth, compact bladeless turbines. In the past, sailboats transported goods all over the world, but later diesel engines replaced it. Now, modern sails are back. Coupled with wind propulsion, the energy consumption of cargo ships can be reduced by up to 30%. In addition, ships will be able to use green hydrogen as fuel in the future. (Green Energy 2022.)

The third aspect is that the oil industry is now paying attention to offshore wind farms. Facing the pressure from shareholders to expand renewable energy business, Shell has joined other oil companies. They hope to use their own supply chain to have similar experience in offshore drilling. According to the Wall Street Journal, as regarded by some as a technical arms race, the competition to build profitable wind turbines economically is very fierce, and many companies will not disclose their spending in this regard. As oil and gas companies participate in the offshore wind power industry, large-scale wind power projects can produce more wind energy throughout the United States and reduce the cost of energy production and generate more jobs. (Eshagberi 2012.)

The last point is to increase investment and confidence in wind energy. So far, Texas has led the country in the installed capacity of wind power generation. With the development and prosperity of wind energy industry, and more investments are pouring in to meet the growing needs of the industry. In the past, New York has pledged $27.5 million for training related to the increasing employment opportunities of renewable energy. Other advances are aimed at improving the efficiency of the turbine drive system, which generates electricity through its rotating blades. In 2017, MHI Vestas announced that it would invest $35 million in Clemson University to try out its latest 9.5 MW gearbox at its energy innovation center. The gearbox will be the strongest wind turbine on Earth. (Eshagberi 2012.)

About 1.3 million people worldwide work in the wind energy industry. Among them, 550000 are in China, 110000 in the United States, 90000 in Germany, 45000 in India and 40000 in Brazil. The cost of installing and operating wind turbines is higher than that of coal-fired power generation, so the expansion of wind power generation is creating more jobs. It is not difficult to see that the prospect of wind energy can be said to be bright. (Eshagberi 2012.)

3.3 Development trend of wind power in China

With the increasing attention to energy security, ecological environment and climate change in the world, accelerating the development of wind power industry has become the universal consensus and unanimous action of the international community to promote the development of energy transformation and address global climate change. 2019, China added 25.74GW of new wind power grid-connected capacity, including 23.76GW of new grid-connected capacity onshore and 1.98GW of new grid-connected capacity offshore. By the end of 2019, China's installed wind power capacity reached 209.94 GW, which has remained the world's largest since 2008 and accounted for 32.24% of the world's cumulative installed wind power capacity. As China continues to introduce relevant subsidy policies to encourage grid companies to accept wind power, the proportion of grid-connected wind power installed capacity in new wind power installed capacity is increasing. The increase in grid-connected wind power capacity will contribute to the overall development of the wind power industry, and China will establish a number of distributed wind power bases in coastal areas in the future. By 2020, the cumulative capacity of wind power will reach more than 200GW. The rapid development of the wind power industry will strongly drive the demand for gears, bearings and other medium and large forgings required for wind power equipment. (Zhang, Lu, Pan, Tan, Cheng & Li 2022.)

Wind energy, as a carbon-free renewable energy source, is an idealized energy alternative to biofuels. In 2019, China's wind power generation capacity of 405.7 billion kWh exceeded 400 billion kWh for the first time, up 10.9% year by year. The wind power industry has become the second largest renewable energy generation source in China, and the steady development of the wind power industry will effectively drive future market investment in the upstream and downstream of wind power. Data show that China added 1.98GW of offshore wind power to the grid in 2019, up 50.13% from 2018; China's cumulative offshore installed capacity was 5.93GW by the end of 2019, making it the third largest installed offshore wind power country in the world, accounting for 20.45% of the total installed offshore wind power worldwide. China has 18,000 km of coastline, with more than 200GW of installed offshore wind power potential. (Zhang et al. 2022.)

2019 China's offshore wind power installed capacity has replaced the UK as the world's first, benefiting from the maturity of offshore wind turbine technology and supply chain increasingly perfect, the development of offshore wind power has become the main development trend of wind power in the future, which will drive the increase in demand for offshore wind power special equipment, which will

further boost the demand for wind power equipment forgings, wind power forgings industry has huge room for future development. (Zhang et al. 2022.)

4 CONCLUSION

At present, energy and environmental problems are becoming increasingly stressful. The use of wind energy resources not only solves the problem of energy shortage, but also effectively reduces the pollution caused to the environment by the use of human resources. From a comprehensive point of view, traditional energy sources such as coal, oil and natural gas are indeed efficient raw materials for energy generation, but the pollution caused to the environment in the process of using these energy sources is irreversible in some cases, which is a kind of destruction of future resources. Therefore, the disadvantages of traditional energy sources are obvious compared to wind energy, which is a clean energy source.

The wide range of applications of wind energy determines the current situation of its widespread use in the modern energy market. Wind energy is used to generate electricity, navigate, lift water, and heat water, all of which are extremely important functions that humans need today. And while providing these functions, it also protects the environment well and has fewer side effects on the environment and ecology than traditional energy use. By harnessing the unlimited energy from the wind, it can have an environmentally friendly way to power people’s homes and lives and even the scientific field. This is a win-win for both natural ecology and human beings.

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