

Outlook of Renewable Energy (Wind Energy) in China

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Abstract— China's rapidly growing economy, population, and energy consumption are all threatening its future environmental sustainability. China faces many ecological challenges, and its reliance on coal is at the heart of most of the country's ecological troubles. Most of China's air pollution emissions come from the industrial and electricity sectors, and the human health costs of China's air pollution are very high. China is the largest global polluter, with more than 25 per cent of total global carbon dioxide (CO₂) emissions, green development could help mitigate climate change and enhance global welfare. Over the past decades, the demand for energy sources has increased by 150% in China, which has made China among the most energy-consuming countries. Most of China's energy consumption comes from coal energy, which accounts for about 78% of all energy sources in China in 2011. China is one of the world's largest wind energy sources, according to data released by the World Wind Energy Association (WWEA), with about 34% of the world's wind energy sources. According to the road map implemented by the Chinese government by exploiting and generating wind energy sources and benefiting from the rapid economic development that China witnessed late, according to this plan by 2020, China is expected to produce about 250 gigawatts (GW). By 2030, production may reach 400 GW of electrical energy generated from wind energy, and by 2050, production may reach 1,000 GW.

Keywords— Energy consumption, carbon dioxide (CO₂), wind energy, World Wind Energy Association (WWEA).

I. INTRODUCTION

China's science and technology priorities in the energy sector have changed over time with evolving domestic energy needs. The decade that preceded period between (2000–2010) brought new challenges to the relationship between energy consumption, emissions, and economic growth in China. By 2007, China was the most significant national emitter of CO₂ in the world, and by 2010, China became the world's largest energy consumer and producer. Over the past years, China has witnessed significant economic development, with an average annual rate of about 10% of GDP, which has increased the demand for access to new energy sources[1]. Recently, fossil fuels are the primary source of energy consumption in China, and this affects the strategy that China adopts by exploiting renewable energy sources, as well as from environmental pollution while extracting coal from the ground. The pollution problem in China is one of the most important challenges facing the Chinese government, which seeks to reduce environmental pollution of all kinds, such as air

pollution, or water and soil pollution. The pollution problem in China is one of the most critical challenges facing the Chinese government, which seeks to reduce the environmental pollution of all kinds, such as air pollution, or water and soil pollution, and caused by several factors, the most important of which are carbon dioxide pollution from factories and pollution resulting from congestion, traffic and transportation [2,3].

China is the world leader in wind power generation, with the largest installed capacity of any country [4]. And the rapid growth in new wind facilities [5]. With its vast land area and long coast, China possesses exceptional wind energy resources [6]. Some estimates indicate that China has about 1000 GW of electrical energy that wind turbines can produce onshore and 200 GW of electrical power offshore[7]. In 2016, China produced about 149 watts of electrical energy created by wind power, 4% of total electricity consumption throughout China[8]. In 2015, China was the second-largest market for the production of electric energy generated from wind energy after the

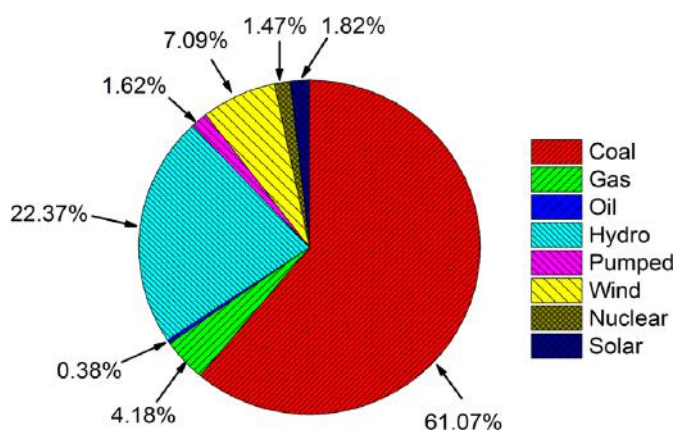
United States with a production capacity of about 7404 GW[9]. By 2020, China's wind power production is expected to reach 250 GW, an increase of about 15% of the total electricity consumed in China[10]. The Chinese government has developed a roadmap for wind energy until 2050. Wind energy targets reach 400 GW by 2030 and 1,000 GW by 2050 [11]. China has identified wind energy as a significant component of growth in the country's economy [12].

RENEWABLE ENERGY IN CHINA.

Recently, the Chinese government has taken several measures to reduce pollution from traditional energy sources such as fossil fuels, as well as the cost resulting from the production of these energy sources and the search for a new, inexpensive, environmentally friendly source. Therefore, the Chinese government must take many measures to advance and develop in this field to provide and produce alternative energy. China ranks first in the rankings of the most available countries for renewable energy, so the government should take advantage of these potentials available in China and take advantage of them. China produced about 728 GW of renewable energy for both wind energy and hydro-power by the end of 2018. Compared to fossil fuel production and nuclear power capacity, renewable energy is growing faster in China. Although vast amounts of renewable energy are available such as solar energy, wind energy and water, the total renewable energy produced in China in 2015 was 24%, and the rest is electrical energy produced is produced by coal power plants [13]. By 2017, hydro-power production reached about 36.6% of the total renewable energy and 26.4% of the total electric energy in China [14]. By 2013, the Chinese government has developed a plan to increase the work of electrical energy production by renewable energy to reduce carbon dioxide emissions and environmental pollution that adversely affects the healthy life of the country and the citizen [15,16]. China currently aims to install 250 (GW) of wind and 50GW of solar photovoltaic by 2020 (see **Table 1**). In addition, it appears likely that China will implement renewable power quotas for major generators and grid companies, formulated as the percentage of total generation coming from non-hydropower renewable energy [17].

Table.1: China's targets for renewable energy development through 2020. Sources: REN21 (2012), NEA (2012), NDRC (2012), State Council (2013).

The capacity of Renewable energy targets (G.W.)	2012	2015	2020
WIND (G.W.)	6.2	104	250
Solar Pv (GW)	13.1	35	50
Biomass (GW)	4.4	13	30



The Pie chart. 1: shows the percentage of total renewable energy in China, according to the China Electricity Council in 2014 [18].

THE HISTORY OF WIND ENERGY IN CHINA.

In 1994, one of the first specific wind energy was introduced to the sources of energy in China, according to the decisions of the Ministry of Electrical Energy (MOEP). Where the estimated rate of increase is one hundred times, where the proportion of wind energy in 1993 was about 10 M.W. to 1000 MW in 2000. With the passage of days, wind power witnessed an unprecedented development, and at the beginning of 2005 the accumulated wind energy production exceeded only 769 MW. In the same year, China ranked 10th in the world in wind power production. China's wind power industry has grown rapidly over the past decade. Since the first renewable energy law was passed in 2006, the cumulative installed capacity of wind energy has reached 44.7 GW by the end of 2010 [19]. The newly installed capacity in 2010 reached 18.9 GW which made up about 49.5% of new windmills around the world. China's wind potential is excellent, although estimates vary from different sources. According to him and others [20].

WIND ENERGY IN CHINA

Wind power is one of the renewable energy which becomes popular because of its availability in huge access. It can be used both small and large scale and also environmentally friendly power [21]. A wind turbine is classified into Horizontal Wind Turbine and Vertical Wind Turbine. wind power is renewable and very flexible. It can be used for various purposes including generating power, lighting in residential buildings, and water pumping for irrigation. Wind energy can be used or constructed everywhere, both in the rural areas, mountains, and plateaus or even in the sea and is also low-cost and environmentally friendly energy sources for communities in rural areas as shown in figure 1.

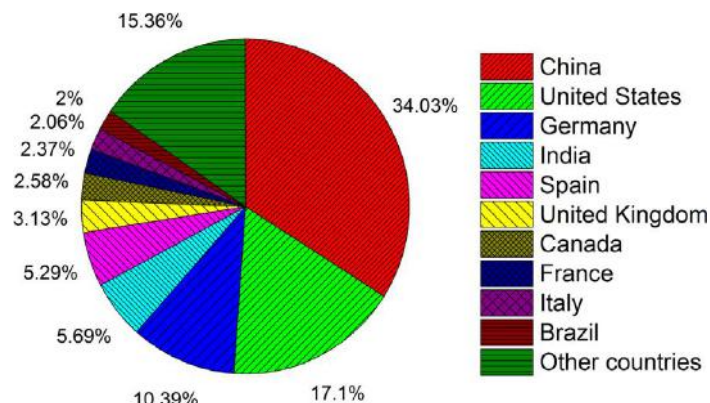


Fig. 1: shows wind turbines to urban areas.

Due to the safety of the network and the lack of available transmission lines By national standards between 2010 and 2016, the overall wind energy rejection rate in China exceeded 10%. In mid-2016, the problem of rejecting wind energy became more acute in China [22].

The total wind energy in the world is around 343,586 GW, as shown in the following graph that shows the top ten wind power countries according to data issued by the World Wind Energy Association (WWE) until the end of 2015, where China ranks first among These are the ten countries, where China can produce wind energy around

148 GW of total wind power by up to 34.03% of the total wind energy in the world.



Pie chart . 2: shows the ten countries with the most significant wind energy in the world, according to the World Wind Energy Association (WWEA) at the end of 2015[23].

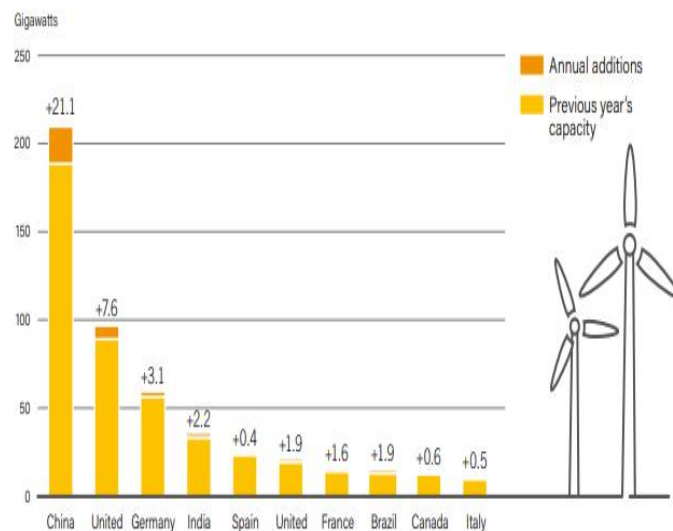
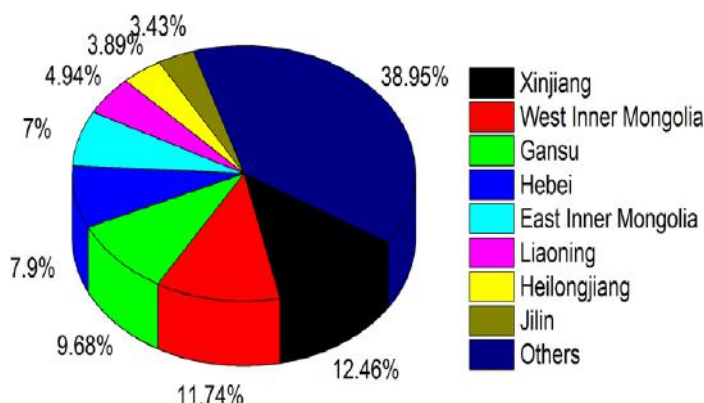


Fig . 2: Wind Power Capacity and Additions, Top 10 Countries, 2018 Source: See endnote 22 for this section [24].

From the bar chart that show the top ten countries for wind power capacity and additions. China in 2018 became the first country to exceed 200 GW of wind power capacity and saw an increase in new installations (up 7.5%) following two years of decline.23 Approximately 21.1 GW was added (19.5 GW onshore and nearly 1.7 GW offshore), bringing total installed capacity to approximately 210 GW [24].



The pie chart . 3: shows the ratio of the total capacity of wind energy in various provinces of China, according to the National Administration of China [25]

From the pie chart that shows the ratio of the total capacity of wind energy in various provinces of China. For the full size of wind energy, the first rank is Xinjiang, that has 12.46 %, and the second rank is West Inner Mongolia, that has 11.74%. the third rank is Gansu, that has 9.68%, from the information . the Xinjiang that have the most of the total capacity of wind energy in China.



Fig. 3: Wind farm in Xinjiang, China

OFFSHORE WIND TURBINE IN CHINA

China set an ambitious goal of 5 G.W. of installed offshore wind capacity by 2015 and 30 G.W. by 2020. However, the development of offshore wind power did not come as fast as expected. Construction of Donghai Bridge Wind Farm, the first offshore wind farm in China started in April 2009, In May 2014, the total capacity of offshore wind power in China was 565 MW, which raised to about 900 MW in 2015, less than a fifth of the expected target.

Installations increased substantially in 2016, with 592 MW of offshore wind power capacity deployed, ranking third in the world behind Germany and the Netherlands. By the end of 2016, the total cumulative offshore wind power capacity in the country was 1.9 GW.

Offshore wind development slower pace in China is mainly due to the lack of experience of domestic turbine manufacturers in the sector. This forces local development to use different products, resulting in Siemens being the largest supplier of offshore wind turbines in China. Another problem is the considerable investment needed and associated risks of offshore development, which discourage private companies.



Fig. 4: Dong Hai Bridge Wind Farm.

II. CONCLUSION

China is one of the countries with the most common air pollution problems that affect life in China. Because of global warming, environmental issue, and reducing fossil energy resources, the use of environmentally friendly energy resources, such as solar and wind power, becomes even more urgent and attractive. Wind energy is one of the most important renewable energy that can be utilized in China, as China is one of the largest countries in the capacity of wind energy, with a rate of about 34% of the total wind energy capacity. According to the road map implemented by the Chinese government by exploiting and generating wind energy sources and taking advantage of the rapid economic development that China experienced late, according to this plan by 2020, China is expected to produce about 250 GW. By 2030, production may reach 400 GW of electrical energy generated from wind energy, and by 2050, production may reach 1,000 GW.

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