



Report 2021

China

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China continues to have the highest wind power capacity in the world. The wind power capacity growth presented a higher rate, and 55,919MW of new wind power capacity was installed, representing a 2.74% increase in growth from last year.

ACCUMULATED CAPACITY INCREASED to 346,666MW. Grid-connected capacity increased to 328,480 MW with the addition of 47,570 MW installed in 2021. The new added and cumulative grid-integrated wind power capacities, respectively, accounted for 27% and 13.8% of installed power capacities nationwide in 2021.

Wind power remains the third largest generation source in China, following

thermal and hydroelectricity sources. The average full-load-hour of wind power was 2,246 hours in 2021, an increase of 149 hours from 2020. Wind-generated electricity totaled 655.6TWh, an increase 40.5% over the previous year. Wind-generated electricity accounted for 7.9% of the total electricity generation, an increase of 1.7 percentage points over 2020. The average wind curtailment rate was 3%, at the same level as 2020.

Table 1. Key National Statistics 2021: China

Total (net) installed wind power capacity*	346.67GW
Total offshore capacity	25.35GW
New wind power capacity installed	55.92GW
Decommissioned capacity (in 2020)	0 GW
Total electrical energy output from wind	655.6 TWh
Wind-generated electricity as percent of national electricity demand	7.9%
Average national capacity factor**	23.4%
Target	536GW by 2025
National wind energy R&D budget	---

*Installed wind power capacity: Calculated using nameplate power ratings of the installed wind turbines

In 2021, the Chinese government issued a series of policies and regulations to implement the grid parity of the wind power project, reduce wind curtailment, promote the development of distributed wind power, and push developing of wind power in desert and Gobi areas. In addition, Chinese companies made progress in R&D, including wind energy developments in low wind-speed areas and offshore wind energy generation. 2021 is the last year for offshore wind power to enjoy government subsidies, and the installed offshore wind power capacity has increased significantly.

Highlight(s)

- Record high offshore installation 14.5GW, more than doubling cumulative offshore wind to 25 GW (grid-integrated capacity 26GW).
- Total wind capacity surpassed 300 GW to reach nearly 350 GW.
- Record high wind generation 655 TWh, 40% increase over 2020.
- The largest onshore and offshore wind turbine capacity is 6MW and 10MW, respectively.

Market Development

Targets and Policy

Under the requirements and guidance of the “carbon peak and carbon neutrality” goals, the Fourteenth Five-Year Plan released on March 12 put forward raising the share of non-fossil energy in total energy consumption to about 20%. This includes vigorously increasing the scale of wind and photovoltaic power generation, speeding up the development of distributed energy in the eastern and central regions, and orderly development of offshore wind power, as well as building a number of clean energy bases with multiple and complementary energy sources. Nine clean energy bases, five offshore wind power bases, and several transmission channels will be arranged and improve the utilization rate of ultra-high voltage (UHV) transmission lines.

Further, the development and construction of wind power will be promoted, and grid integration will be speeded up by optimizing and integrating the local power plant, grid, and load resources and exploring the development path of building a new type of power system with high integration of power plant,

grid, load, and energy storage, supported by advanced technological breakthroughs and system and mechanism innovation. On October 20, NEA issued the Notice on Actively Promoting the Relevant Works of New Energy Power Generation Projects to be Grid-connected and Electricity-generated as much as possible. And pointed out: In the case of continued tight power supply and demand, speeding up the construction and grid-connection of wind power and photovoltaic power projects, increasing clean power supply will not only help ease the tension between power supply and demand but also facilitate to achieve the goal of dual control of energy consumption, and promote low-carbon energy transformation.

Multiple measures to ensure renewable energy consumption, such as wind power, will be taken. On March 17, to implement the “carbon peak, carbon neutrality” decision and arrangement and the central ecological and environmental protection supervision requirements, NEA issued the “Comprehensive Supervision Work Program for Clean Energy Consumption”, focusing on supervision of local governments, grid companies,

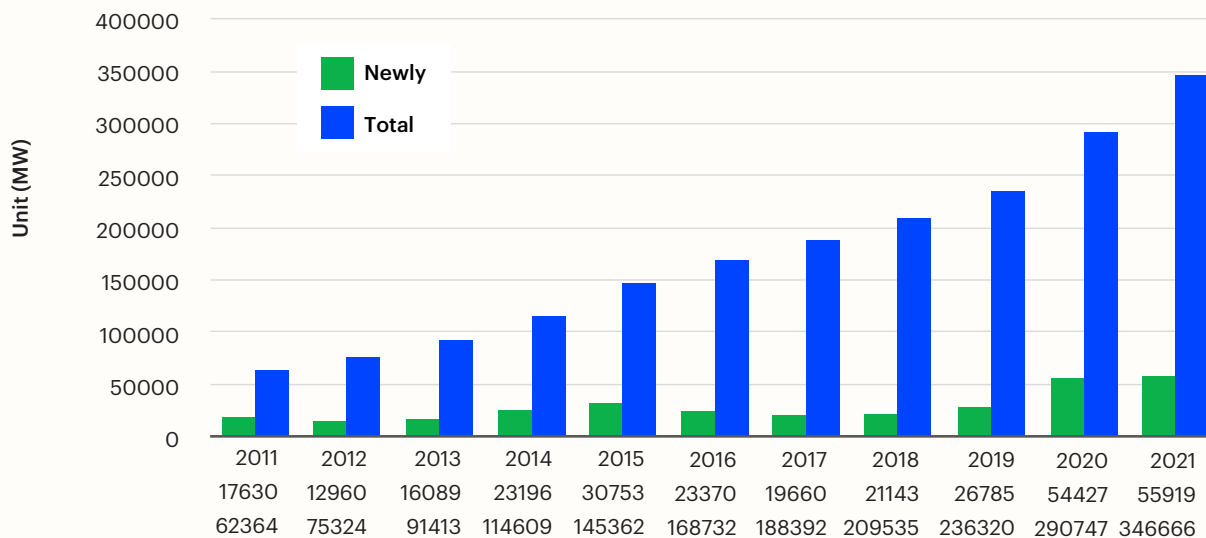


Figure 1. The new installations and cumulative installations from 2011 to 2021.

power dispatching agencies, power trading agencies, and power generation companies to implement clean energy consumption targets, responsibility weights for renewable energy power consumption, grid connection, optimal dispatching, trans-provincial transactions, and participation in the auxiliary service market, etc.

On June 7, the National Development and Reform Commission issued a notice on the 2021 new energy feed-in tariffs policy, which clarified the 2021 wind power, photovoltaic power, and other new energy feed-in tariffs policy. From 2021, the central government will no longer subsidize newly filed centralized photovoltaic power stations, industrial and commercial distributed photovoltaic projects, and recently approved onshore wind power projects (hereinafter referred to as “new projects”) and implement grid parity. The notice specifies that the feed-in tariffs for new projects in 2021 will be based on the local benchmark price for coal-fired power generation. New projects can voluntarily participate in market transactions to form the feed-in tariffs, to better reflect the green power value of photovoltaic and wind power generation.

Progress and Operational Details

By the end of 2021, China had installed 55.92GW of new wind power capacity (exclusive of Taiwan). This accounted for 55% of the new global wind capacity for the year. The accumulated wind power capacity in China reached 346.67GW, accounting for 41% of wind power capacity worldwide, maintaining the highest wind power capacity in the world.

total of 15,911 new wind turbines were installed in 2021, bringing the national total of operating turbines to 171,166. The average capacity of newly installed wind turbines was above 3.51MW, an increase of 31.7% compared to 2020.

The top five provinces with the newest installed capacity were:

- Jiangsu (6.2 GW).
- Guangdong (5.4 GW).
- Inner Mongolia (4.3 GW).
- Henan (4.2 GW).
- Gansu (3.8 GW).

Together, these accounted for 42.8% of the new capacity nationwide. The middle, eastern, and southern regions of China account for 55%

of new installations. The average weighted full-load-hour of operating wind farms was 2,246 hours, an increase of 149 hours compared to 2020.

In 2021, a total of 5,237 offshore wind turbines were installed. The new installation is about 14.5GW, representing a 277% increase in growth from last year. The cumulative installation exceeded 25GW. Among the newly installed wind turbines, the turbines below 5MW and above 5MW (including 5MW) account for 19.5% and 80.5%, respectively. The new installation is distributed in Jiangsu, Guangdong, Zhejiang, Fujian, Liaoning, Shandong, and Shanghai. The installation in Jiangsu was about 5GW, accounting for 34.4% of the new capacity.

Matters Affecting Growth and Work to Remove Barriers

In 2021, the new installation is again record high, and the power grid is under enormous strain. NDRC NEA issued some policies and took multiple measures to ensure the grid integration of wind power and improve the consumption of renewable energy.

Low resolution



The first 5.5MW floating wind turbine

R,D&D Activities

National RD&D Priorities and Budget

In 2021, the national RD&D focused on building the multi-energy complementary clean energy bases, including the integration development of wind, solar, hydro, ocean energy, clean coal-fired plants, grid, load and energy storage projects, nine clean energy bases, five offshore wind power bases and several transmission channels, the new type of wind turbines and key components, and medium voltage, direct current, low frequency technologies, etc.

2021 is the first year of the “14th Five-Year Plan” development. The relevant RD&D actions had made achievements, which were invested by the developers, manufacturers, and research bodies though the national budget has not been released yet.

National Research Initiatives and Results

In 2021, the first 5.5MW floating wind project put into operation, the floating platform called “Fuyao” for a 6.2MW floating wind turbine was off the production line, the 16MW offshore wind turbine passed the concept design assessment by the accredited third party, and the largest onshore wind turbines of 6.25MW were connected to the grid in batches. The longest blade of 102m had finished the static test and fatigue test, which will be applied to the 10MW wind turbines. The offshore wind farm installed 100 wind turbines and firstly used a 400kV VSC-HVDC system was put into operation in Rudong, Jiangsu.

Yangzhou University, NUAU, Gold Wind, MYwind, Chinawind, Shanghai Electric, and CGC jointly take part in the research on low noise wind turbine technology, including improvement of the wind turbine aerodynam-

ic noise source model, development of PE noise propagation models in complex terrain, research of coupling method of PE model and CFD in complex terrain and so on.

Test Facilities and Demonstration Projects

The National Offshore Wind Power Equipment Quality Supervision and Inspection Center invested by CGC in Yangjiang has finished static test and fatigue test of the longest blade of 102m made by Shuangrui and is ready for a test of the new longest blades up to 150m. The relevant manufacturers had also constructed the test benches for generators and gearboxes of 10+ MW wind turbines.

Collaborative Research

By the end of 2021, the CWEA had arranged for 28 domestic wind power companies, research institutes, and universities to attend IEA Wind TCP Tasks:

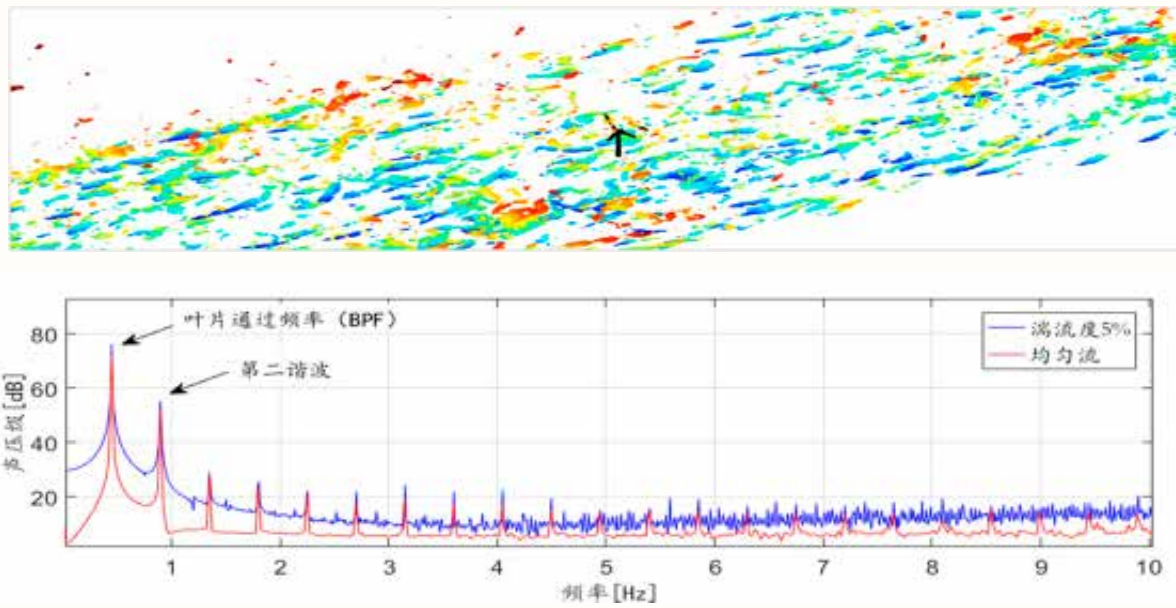
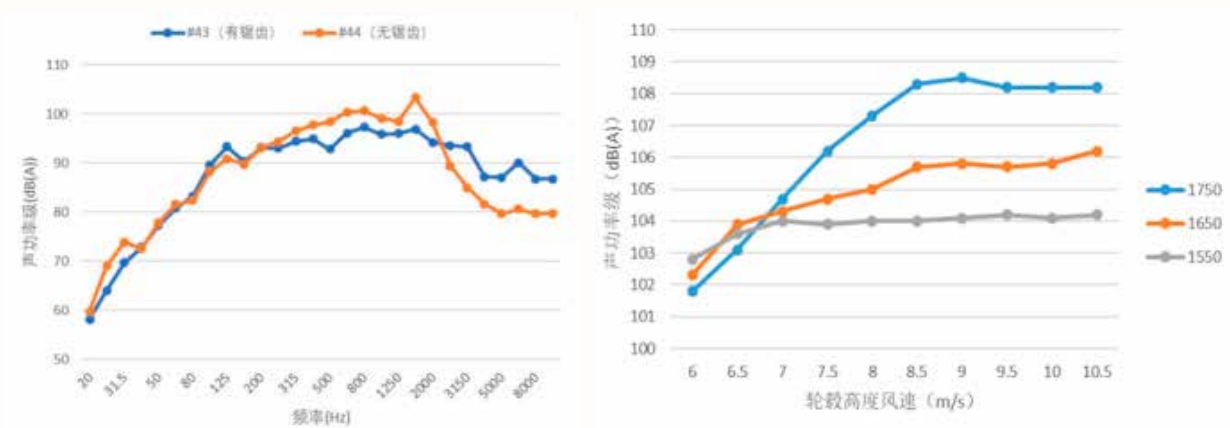


Figure 2. Low-frequency noise (LFN) and harmonics in homogeneous and turbulent environments.



Left: noise reduction of sawtooth trailing edge.

Right: noise reduction of limited speed.

Figure 3. Comparison of sound power levels of units with noise reduction measures.

- **Task 11** Base Technology Information Exchange
- **Task 19** Wind Energy in Cold Climates
- **Task 25** Design and Operation of Power Systems with Large Amounts of Wind Power
- **Task 27** Small Wind Turbines
- **Task 29** Mexnext: Analysis of Wind Tunnel Measurements and Improvement of Aerodynamic Models
- **Task 30** Offshore Code Comparison, Collaboration, Continued, with Correlation (OC6)
- **Task 31** Benchmarking of Wind Farm Flow Models
- **Task 32** Lidar Systems for Wind Energy Deployment
- **Task 33** Reliability Data: Standardizing data Collection for Wind Turbines
- **Task 35** Full-Size Ground Testing
- for Wind Turbines and Their Components
- **Task 36** Forecasting for Wind Energy
- **Task 37** Systems Engineering
- **Task 39** Quiet Wind Turbine Technologies
- **Task 41** Enabling Wind to Contribute to a Distributed Energy Future
- **Task 42** Wind Turbine Lifetime Extension Assessment



Low resolution

The first 102m long blade under full-scale test

Impact of Wind Energy

Environmental Impact

In 2021, wind-generated electricity totalled 655.6TWh, which saved about 209.8 million tons of standard coal per year, and reduced 549.7 million tons of carbon dioxide. It plays a vital role in reducing air pollution and controlling greenhouse gas emissions, marching to realize the “30-60” targets of carbon peak and carbon neutrality in China.

Economic Benefits and Industry Development

The Austrian wind power industry in 2021, the new installation capacity will reach about 55.9GW, including more than 14.5GW of the new capacity of offshore wind power. With land-based wind power investment of 6,500 CNY/kW (897EUR/kW; 1,021 USD/kW) and offshore wind power investment of 20,000 CNY/kW (2,760EUR/kW; 3,140USD/kW), the total investment in wind energy in 2021 reached more than 558.98 billion CNY (77.14 billion EUR; 87.76 billion USD).

The development of the wind energy industry will markedly enhance the

development of related industries and increase employment. In 2021, about 15 jobs will be produced for every 1 MW of installed wind power capacity, and it is estimated that more than 838000 people was employed in the wind power industry through 2021.

Next Term

2021 sees the start of China’s 14th Five-Year Plan and the second year of the double growth of the domestic wind power industry in both onshore and offshore wind developments. It is expected that during the 14th Five-Year Plan period, offshore wind power will become the main force of wind power development and construction. Coastal areas will promote local consumption of electricity, and the imbalance of integrated energy between east and west regions will be reduced. As subsidies recede, the end market demand will grow substantially. CWEA will continue to do its best to organize national research efforts and related activities of IEA Wind TCP.

References

- [1] Xinhua (2021)
The Fourteenth Five-Year Plan, P.R.C.
- [2] CWEA (2022)
China Wind Power Industry Mapping 2021.
- [3] GWEC (2022)
Global Wind Report 2022.