Report 2023

CWEA

The Xiangshan I offshore wind farm in China. *Source: CWEA.*

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China continued to have the highest wind power capacity in the world in 2023. New wind power capacity of nearly 80 GW was installed representing a 59.3% increase from the previous year. This increased the accumulated capacity to 475 GW[1].

Grid-connected capacity increased to 441 GW with the addition of nearly 76 GW installed in 2023. The new added and cumulative grid-integrated wind power capacities respectively accounted for 20.8% and 15.3% of installed power capacities nationwide in 2023.

Wind power remains the third largest generation source in China, following thermal and hydro-electricity sources. The average full-load-hour of wind power was 2,259 hours. Wind-generated electricity totaled 885.8 TWh, which increased 16.6% over the previous year. Wind-generated electricity accounted for 9.5% of total electricity generation, an increase of 0.7 percentage points over 2022. The average wind curtailment rate was 2.7%, a decrease of 0.5 percentage points over 2022.

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[1] National capacity of in-service wind turbines (the decommissioned and early decommissioned wind turbines were eliminated,total capacity was 1264MW)

Table 1. Key National Statistics 2023: China

Total (net) installed wind power capacity	474.063 GW
Total offshore capacity	37.697 GW
New wind power capacity installed	79.37 GW
Decommissioned capacity (by the end of 2023)	1.26 GW
Total electrical energy output from wind	885.8 TWh
Wind-generated electricity as percent of national electricity demand	9.5%
Average national capacity factor	23%
Target	600GW by 2025
National wind energy R&D budget	--

In 2023, the Chinese government issued a series of policies and regulations to strengthen wind power development with multi-energy, vigorously develop wind and solar power generation focusing on deserts and Gobi areas, reduce wind curtailment, and promote the development of distributed wind power in rural areas. In addition, Chinese companies made progress in R&D involving larger onshore and offshore wind turbines and an offshore floating wind energy generation demonstration project.

Highlight(s)

- Total wind capacity surpassed 450 GW.

- Total offshore capacity exceeded 35 GW, representing nearly 8% of total wind capacity.

- Record high wind generation of 885.8 TWh, a 16.6% increase over 2022.

- The largest onshore and offshore wind turbine installed in 2023 was 10M W and 16 MW respectively.

Market Development

Targets and Policy

The main targets of the 14th Five-Year Plan for the Development of Renewable Energy are: Renewable energy to account for more than 50% of the increase in primary energy consumption, the increase in electricity generated from renewable energy to account for more than 50% of the total increase in electricity consumption, and the electricity generated from wind and solar energy to be doubled. By 2025, the share of the total national renewable energy consumption should be about 33 percent. The share of non-hydropower consumption should be about 18 percent.

By 2030, China's carbon dioxide emissions per unit of GDP will decrease by over 65% compared to 2005. The proportion of non-fossil energy in primary energy consumption will reach around 25%. Forest stock volume will increase by six billion cubic meters compared to 2005. The total installed capacity of wind and solar power generation will exceed 1,200 TWh.

The targets for 2023 were: The total installed capacity of wind power should reach 430 GW and the increase in installed capacity of wind power and photovoltaic power by about 160 GW.

The relevant policy measures taken to develop wind and solar power generation included:

- Promoted the first batch of large-scale wind power photovoltaic base projects based in deserts. Gobi and desert areas are to be connected to the grid and put into operation and new projects are to follow.

- Actively promote the large-scale development of solar thermal power generation.

- Steadily build offshore wind power bases and plan to start the construction of offshore PV.

- Actively promote the construction of distributed onshore wind power and distributed photovoltaic power generation projects.

- Promote the full coverage of green certificate issuance connecting with carbon trading, improve the renewable energy electricity consumption guarantee mechanism based on green

certificate, and scientifically set the consumption responsibility weight of Provinces (Autonomous Regions and Municipalities).

Progress and Operational Details

By the end of 2023, China installed 79.37 GW of new wind power capacity (excluding Taiwan). This accounted for 49% of new global wind capacity for the year. The accumulated wind power capacity in China reached 474.60 GW, accounting for 45% of wind power capacity worldwide and maintaining the highest wind power capacity in the world.

Matters Affecting Growth and Work to Remove Barriers

In 2023, the number of new installations was a record high, which puts the power grid under enormous strain. NEA has taken multiple measures to ensure grid integration of wind power and improve consumption of the green electricity.

RD&D Activities

National RD&D Priorities and Budget

In 2023, national RD&D focused on building 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, power to X, desert and Gobi wind power, deep-sea offshore wind power and several transmission channels, in addition to a new type of wind turbines and key components, as well as medium voltage, direct current, low frequency technologies, etc.

2023 is the third year in the "14th Five-Year Plan" development. The relevant RD&D actions had made achievements which was mostly invested by the developers, manufacturers and research bodies.

National Research Initiatives and Results

The research and manufacturing of super-large wind turbines and their main components have made great achievements. The first "CNOOC Guanlan" 7.25 MW-158 whole floating wind turbine, developed by CNOOC, standing at a depth of more than 100 m of seawater was put into operation in May, 2023. The first 16 MW-252 offshore wind turbine, developed by Goldwind, was put into operation in July, 2023, and became the main selection for new offshore projects. The first 10 MW-220 onshore wind turbine, developed by Envison, was put into operation in July, 2023, which is anticipated to be the workhorse for new onshore projects.

The longest blades, measuring 131 m, developed by Sany, the biggest main gearbox, developed by NGC Transmission, and main bearings, developed by LYC, for 16/18MW wind turbines. The tallest tower of 185 m was developed by Goldwind and the rotor blade recycling machine developed by Jerell.

Meanwhile, the 15 MW onshore wind turbine, the 16 MW floating wind turbine and the 22 MW offshore wind turbine have been under research and development.
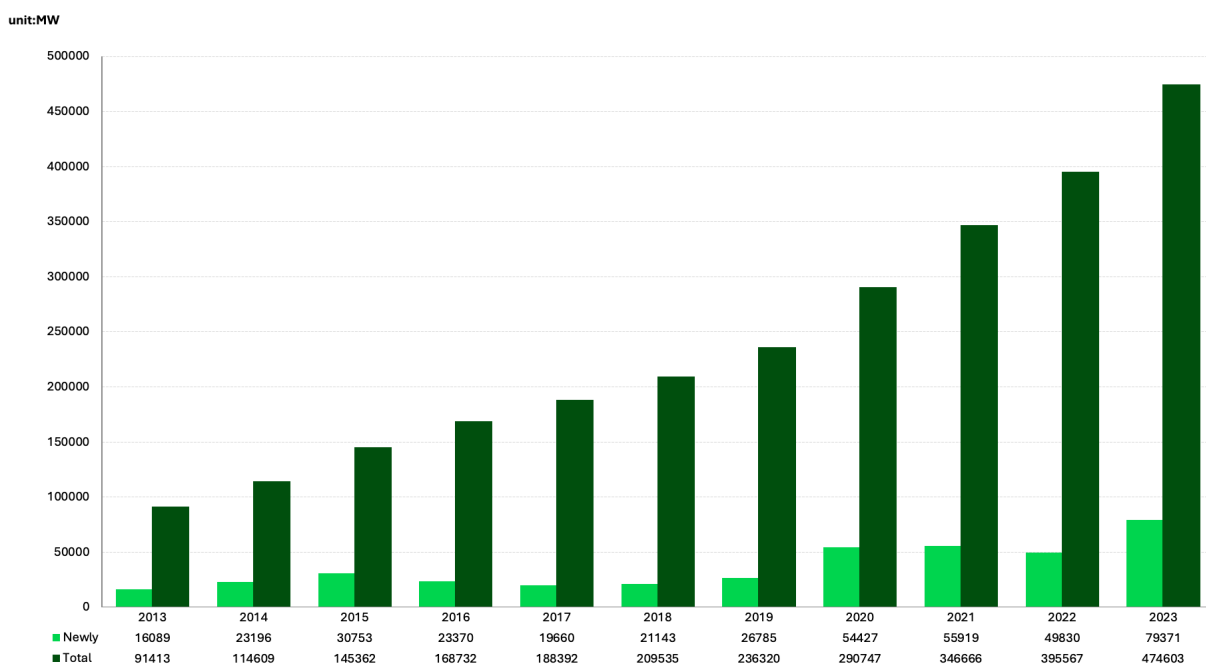
unit:MW

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly	16089	23196	30753	23370	19660	21143	26785	54427	55919	49830	79371
Total	91413	114609	145362	168732	188392	209535	236320	290747	346666	395567	474603

Figure 1. The new installations and cumulative installation from 2013 to 2023. *Data Source: CWEA.*

Test Facilities and Demostration Projects

The full-scale test benches for blades longer than 180 m have been under construction and the test benches for the whole nacelles of 28 MW wind turbines had been planned and ready for construction by the industry independent third parties, such as CGC.

Collaborative Research

By the end of 2023, the CWEA had arranged for 28 domestic wind power companies, research institutes, and universities to attend the following IEA Wind TCP Tasks:

- **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, unCertainty (OC3-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

Figure 2. The 16 MW-252 offshore wind turbine.

Figure 3. The main bearing for 16 MW wind turbine.

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.

- **Task 49:** Integrated Design of Floating Wind Arrays (IDEA).

- **Task 52:** Large-Scale Deployment of Wind Lidar (newly joined in 2023).

Participants of the IEA Wind Tasks from China actively joined research collaboration, combined with their company's needs on the relevant Tasks and achieved some progress and gained praise from the industry.

Impact of Wind Energy

Environmental Impact

In 2023, wind-generated electricity totalled 885.8 TWh, which saved about 283.47 million tons of standard coal per year, and reduced 742.65 million tons of carbon dioxide. It plays an important role in reducing air pollution and controlling greenhouse gas emissions. The industry is on course to realise the "30·60"targets of carbon peak and carbon neutrality in China.
Developing a total of 450 GW in three batches of wind and solar power installations in the desert and Gobi areas will help improve the ecological environment. Developing wind power in collaboration with local cultural, environmental requirements and restoration of greenery, soil and water conservation and roads is the cardinal principle to maintain the ecological environment.

Economic Benefits and Industry Development

In 2023, new installation capacity reached about 79.37 GW, including about 7.2 GW of new capacity in offshore wind power. With a land-based wind power investment of 6,000 CNY/kW (810 EUR/kW; 870 USD/kW) and offshore wind power investment of 15,000 CNY/kW (2,025 EUR/kW; 2,175 USD/kW), the total investment in wind energy in 2022 reached more than CNY 541 billion (EUR 73 billion; USD 78 billion).

The development of the wind energy industry will markedly enhance the development of related industries and increase employment. In 2023, about 15 jobs will be produced for every 1 MW of installed wind power capacity, and it is estimated that more than 1.2 million people was employed in the wind power industry through 2023.

Next Term

The development of wind power has become an important part of China's green development. The domestic wind power industry has made great achievements in both onshore and offshore wind developments. It is expected that during the 14th Five-Year Plan period, desert and Gobi wind power, distributed wind power, and offshore wind power will be the three main forces of wind power development and construction. Coastal areas will promote local consumption of electricity and the imbalance of integrated energy consumption between east and west regions will be reduced. As there are no subsidies, the end market demand will grow substantially. CWEA will continue to do its best to organise national research efforts and participate in related activities of IEA wind.

References

[1] CWEA (2024) China Wind Power Installation Capacity Statistics 2023.

[2] GWEC (2024) Global Wind Report 2023.