Wind energy generating system

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In 2022 wind electricity generation increased by a record 265 TWh (up 14%), reaching more than 2 100 TWh. This was the second highest growth among all renewable power technologies, behind solar PV. However, to get on track with the Net Zero Emissions by 2050 Scenario, which envisages approximately 7 400 TWh of wind electricity generation in 2030, the average annual generation growth rate needs to increase to about 17%. Achieving this will require increasing annual capacity additions from about 75 GW in 2022 to 350 GW in 2030. Far greater policy and private-sector efforts are needed to achieve this level of capacity growth, with the most important areas for improvement being facilitating permitting for onshore wind and cost reductions for offshore wind.

Countries and regions making notable progress to advance wind electricity include:

The amount of electricity generated by wind increased by 265 TWh in 2022 (up 14%), the second largest growth of all power generation technologies. Wind remains the leading non-hydro renewable technology, generating over 2 100 TWh in 2022, more than all the others combined.

China was responsible for almost 40% of wind generation growth in 2022, followed by the United States at 22%. Generation in the European Union rebounded in 2022, increasing 14% after unusually long periods of low wind conditions in 2021.

Aligning with the wind power generation level of about 7 400 TWh in 2030 envisaged by the Net Zero Scenario calls for average expansion of approximately 17% per year during 2023-2030. Policy support for wind power is increasing in major markets such as China, India, the European Union and the United States, but much greater efforts are needed to get on a pathway consistent with the Net Zero Scenario.

In 2022, of the total 900 GW of wind capacity installed, 93% was in onshore systems, with the remaining 7% in offshore wind farms. Onshore wind is a developed technology, present in 115 countries around the world, while offshore wind is at the early stage of expansion, with capacity present in just 20 countries. Offshore reach is expected to increase in the coming years as more countries are developing or planning to develop their first offshore wind farms. In 2022, 18% of total wind capacity growth of 74 GW was delivered by offshore technology.

Global wind capacity additions in 2022 were 20% lower than in 2021, and 32% below the record 2020 growth. The slowdown resulted mostly from project commissioning delays in China related to lockdowns due to the Covid-19 pandemic and lower installations in the United States due to the phase-out of tax incentives. Wind capacity additions are expected to rebound in 2023 and further accelerate in the following years, driven by increased policy support in the United States and the European Union, and policy targets and high economic competitiveness in China. Offshore deployment is also expected to accelerate in existing markets, such as the

European Union, the United Kingdom and China, as well as to enter new markets such as Japan, Chinese Taipei and the United States.

Getting on track with annual wind electricity generation of about 7 400 TWh in 2030, as envisaged under the NZE Scenario, will require increased support for both onshore and offshore installations. Efforts should be focused on facilitating permitting, supporting the identification of suitable sites, decreasing costs and reducing project development timelines.

In 2022, manufacturing capacity for the main wind power components (nacelles, towers and blades) remained mostly unchanged from the previous year at 110-120 GW. According to announced expansion plans, global production capabilities are expected to increase in line with anticipated demand in the next 3 years, resulting in approximately 120-140 GW of capacity. China is expected to remain the largest manufacturing hub for all main wind energy components in the medium term, with 60-80% share of global capacity.

Realisation of announced projects would bring global wind manufacturing capacity to only about one-third of what is required in 2030 to meet demand envisaged in the NZE Scenario. A rapid increase in co-ordinated efforts from both government and private stakeholders is needed to accelerate wind power deployment and manufacturing capacity investments.

Wind technology innovation is focused on increasing the productivity of turbines, especially in areas with low wind conditions, by developing turbines with longer blades and higher towers. However, the maximum height of onshore wind turbines is often restricted in certain regions for environmental and public acceptance reasons, which limits the scope of possible innovation.

In the offshore wind segment, in contrast, there is no such size restriction; innovation is therefore focused on designing larger turbines, which allow reductions in the overall cost of power generation. In parallel, the development of cost-competitive and safe floating offshore wind turbines is accelerating. Floating wind farms could unblock the vast potential of ocean areas with a water depth too great for fixed turbines and they could be a vital energy transition tool. Deep, relatively near-shore areas in France, Japan, Korea, Norway, Portugal, the United Kingdom and the west coast of the United States are expected to be the first to see large-scale deployment of this technology.