Renewables Global Status Report 2025 – Wind Power - Endnotes

1 Based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 80, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; with adjustments made for 2024 European data based on WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and on J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025. Note that gross global additions in 2024 were 116.97 GW (108,969 MW onshore and 8,001 MW offshore) for a year-end total capacity of 1,135.5 GW (1,052,338 MW onshore and 83,162 MW offshore), from GWEC, "Global Wind Report 2025", 85, op. cit. this note; global additions totalled 121,305 MW in 2024 (down slightly relative to 2023 additions of 121,465 MW) for a year-end total of 1,173,581 MW, based on preliminary data from World Wind Energy Association (WWEA), "WWEA Annual Report 2024", April 2025, 11, https://wwindea.org/AnnualReport2024. WWEA data include capacity that was mechanically installed but not necessarily grid-connected at the end of 2024, from S. Gsänger, WWEA, personal communication with REN21, 8 May 2025. Global additions amounted to 121.6 GW (109.9 GW onshore and 11.7 GW offshore) according to BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025, https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/; net global additions were 113,234 MW in 2024 with a year-end total of 1,132,837 MW according to International Renewable Energy Agency (IRENA), "Renewable Capacity Highlights", 2025, 14, https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025. Note that GWEC reports on installations with turbines larger than 200 kW; projects with smaller turbines are not included. In addition, GWEC data include installed and grid-connected capacity only. During 2024, an estimated 2,078 MW was decommissioned, including 1,389 MW in Europe, followed by North America (275 MW in the United States), Asia (324 MW in China and 40 MW in Japan) and the Middle East (50 MW, all in Jordan), based on data from GWEC, "Global Wind Statistics 2025", op. cit. this note. Data for mechanically installed capacity and related information in the footnote also from GWEC, "Global Wind Statistics 2025", op. cit. this note. Note that the total decommissioned capacity in Europe reported by WindEurope is lower, at 1,332 MW, from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-

2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Annual installations reported in this section are gross additions unless otherwise noted (but most countries did not decommission capacity during the year), and year-end totals account for decommissioned capacity.

2 Based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; with adjustments made to 2024 European data based on WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

3 Based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; with adjustments made to 2024 European data based on WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and based on J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

4 Based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; with adjustments made to 2024 European data based on WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and based on J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025. GWEC estimates that a total of 1,135,500 MW (1,052,338 MW onshore and 83,162 MW offshore) was in operation at the end of 2024, up from a total of 1,020,611 MW (945,449 MW onshore and 75,162 MW offshore) at the end of 2023, from Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport, and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; an estimated global total of 1,173,581 MW was installed (including capacity that was not necessarily grid-connected) at the end of 2024, up from a total of 1,052,276 MW at the end of 2023, from World Wind Energy Association, "WWEA Annual Report 2024", April 2025, 11, https://wwindea.org/AnnualReport2024; an estimated 1,132,837 MW was in place at the end of 2024, up from 1,019,603 MW at the end of 2023, from

International Renewable Energy Agency (IRENA), "Renewable Capacity Highlights", 2025, 14, https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025. **Figure W1** based on historical data from GWEC, "Global Wind Report 2025", op. cit. this note, 83-85, and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; data for 2024 based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

5 World Wind Energy Association, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024; GWEC, "Global Wind Report 2025", 23 April 2025, 2, 12-34, https://www.gwec.net/reports/globalwindreport.

6 GWEC, "Global Wind Report 2025", 23 April 2025, 5, 12, 70-72, https://www.gwec.net/reports/globalwindreport; and based on data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document.

7 Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 76, https://www.gwec.net/reports/globalwindreport; figure of 5% from F. Zhao, GWEC, personal communication with REN21, 5 May 2025.

8 Figure of 55 in 2024, Kazakhstan and Uzbekistan based on data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; figure of 55 in 2023 based on data from Global Wind Energy Council (GWEC), "Download GWEC's Global Wind Report 2024", personal communication with REN21, 16 April 2024; from WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030, and from G. Costanzo, WindEurope, personal communication with REN21, April–May 2024. Note that 51 countries added at least some capacity (and a handful saw capacity levels decline) in 2024, based on data from IRENA, "Renewable Capacity Highlights", 2025, 14-16, https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025. The governments of both Kazakhstan and Uzbekistan signed PPAs with project developers for several gigawatts of capacity in 2024, from Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 65, https://www.gwec.net/reports/globalwindreport.

9 Based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 76, 85, https://www.gwec.net/reports/globalwindreport; and for Europe from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-

energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Installations declined in most European countries during 2024 based on data from idem, both sources, and from WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030.

10 Asia's shares include Türkiye and are based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

11 Regional shares in 2024 based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025. The share for Europe (without Türkiye) was down from 23.7% in 2022 and 15.3% in 2023, while shares also fell in North America (from 12.4% in 2022 and 7% in 2023) and in Latin America and the Caribbean (from 6.7% in 2022 and 5.4% in 2023), and remained stable in the Pacific (1% in 2024 and just under 1% in 2023, though they declined from 1.8% in 2022); by contrast, the share increased in the Africa and Middle East region (from 0.45% in 2022 and 0.82% in 2023 to 1.7% in 2024), all based on data from GWEC, both sources.

12 Based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and data for the United States from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025. These countries have been the top five countries for annual installations for several years, per GWEC, "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport. Note that the top countries (in order of newly installed capacity) were China, Brazil, the United States, India and Australia, followed by Germany and the United Kingdom, from WWEA, "WWEA Annual Report 2024", April 2025, 3, 11, https://wwindea.org/AnnualReport2024. **Figure W2** based on country-specific data and sources provided throughout this section, and drawn largely from the following:

GWEC, "Global Wind Report 2025", op. cit. this note; GWEC, "Global Wind Statistics 2025", op. cit. this note; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 13, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/.

13 Top 10 countries in 2024 based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 75, 85, https://www.gwec.net/reports/globalwindreport, and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document. Top markets in 2023 are based on data from the following: Global Wind Energy Council (GWEC), "Global Wind Report 2024", 2024, https://gwec.net/global-wind-report-2024; from GWEC, "Global Wind Statistics 2024, Status End of 2023", unpublished document; WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, pp. 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030; G. Costanzo, WindEurope, personal communication with REN21, April–May 2024; J. Hensley, American Clean Power, personal communication with REN21, May 2024. Top markets in 2022 are based on data from the following: GWEC, op. cit. this note (both sources); GWEC, "Global Wind Report 2023", 2023, unpublished document; American Clean Power, "Clean Power Quarterly 2022 Q4 – Market Report", February 2023, p. 5, https://cleanpower.org/resources/clean-power-quarterly-market-report-q4-2022; WindEurope, "Wind Energy in Europe – 2023…", op. cit. this note; Costanzo, op. cit. this note; WindEurope, "Wind Energy in Europe: 2022 Statistics and the Outlook for 2023-2027", 2023, pp. 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2022-statistics-and-the-outlook-for-2023-2027; G. Costanzo, WindEurope, personal communication with REN21, 13 March 2023. Top markets in 2021 are based on data from GWEC, "Global Wind Report 2022", 4 April 2022, 112, https://gwec.net/global-wind-report-2022; World Wind Energy Association (WWEA), "World Market for Wind Power Saw Another Record Year in 2021: 97,3 Gigawatt of New Capacity Added," 18 March 2022, https://wwindea.org/world-market-for-wind-power-saw-another-record-year-in-2021-973-gigawatt-of-new-capacity-added; WindEurope, "Wind Energy in Europe: 2021 Statistics and the Outlook for 2022-2026", 24 February 2022, p. 11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2021-statistics-and-the-outlook-for-2022-2026.

14 Countries in Europe that generated more than 25% of electricity with wind energy included Denmark (56%), Ireland (33%), Sweden (31%), Germany and the United Kingdom (both 30%), the Netherlands (29%), Portugal (28%), Lithuania (27%) and Spain (25%), from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 19, https://windeurope.org/intelligence-

platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; Uruguay derived at least 30% of its electricity from wind, from WWEA, "WWEA Annual Report 2024", April 2025, 4, https://wwindea.org/AnnualReport2024; and wind energy made up 38% of the country's energy mix in 2024, from MercoPress, "Uruguay's Green Energy Success Story Takes an Unexpected Turn", 13 February 2025, https://en.mercopress.com/2025/02/13/uruguay-s-green-energy-success-story-takes-an-unexpected-turn. Note that wind generation exceeded fossil gas generation in the United Kingdom for the first time in 2024, from GWEC, "Global Wind Report 2025", 23 April 2025, 68, https://www.gwec.net/reports/globalwindreport.

15 WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 18-19, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. In 2024, record levels of wind generation (475 gigawatt-hours) were driven largely by new capacity, and wind energy's share of output was 16.6% for onshore and 2.5% for offshore. Across Europe, eleven countries generated more than 20% of their electricity from the wind, and 19 met more than 10%. Denmark (56%) continued to lead for share of total generation from wind power, followed by Ireland (33%), Sweden (31%), Germany and the United Kingdom (both 30%), all from idem, 18-20. Generation from wind has increased rapidly from just 313 GWh in 2018, from idem, 34. Wind energy output and share of electricity demand have increased consistently in the EU over the past two decades, with the exception of 2021, when wind energy output was down relative to 2020 due to poor wind conditions, from WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, 18-20, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030; and WindEurope, "Wind Energy in Europe", various editions.

16 World Wind Energy Association, "WWEA Annual Report 2024", April 2025, 4, https://wwindea.org/AnnualReport2024. Estimate of 10% is based on capacity in operation at the end of 2023, per S. Gsänger, World Wind Energy Association, personal communication with REN21, 8 May 2025.

17 Record year and additions based on the following: China added 79,824 MW in 2024 (75,786 MW onshore and 4,038 MW offshore), and decommissioned 324 MW, for a total of 520,600 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport, and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; China added 86,892 MW for a total of 561,492 MW, including mechanically installed capacity that was not necessarily grid connected, from Chinese Wind Energy Association (CWEA), cited in WWEA, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 11, https://wwindea.org/AnnualReport2024; China added 80 GW of wind capacity for a total of nearly 521 GW, from China's National Energy Administration, cited in Enerdata, "China's NEA targets 200 GW of new renewable capacity

additions in 2025", 4 March 2025, https://www.enerdata.net/publications/daily-energy-news/chinas-nea-targets-200-gw-new-renewable-capacity-additions-2025.html; China added a net of 79,851 MW in 2024 for a total of 521,746 MW based on data from IRENA, "Renewable Capacity Highlights", 2025, 14, https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025. Push to meet targets from BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025, https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/. Note that China mechanically installed 5.8 GW of offshore wind power capacity but only 4 GW were commissioned, mainly due to delays in grid connection and complex approval and coordination processes for offshore installations, from CWEA, cited in GWEC, "Global Wind Report 2025", 23 April 2025, 81, https://www.gwec.net/reports/globalwindreport.

18 Figure of 68.3% in 2024 based on data from GWEC, "Global Wind Report 2025", April 2025, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025; figures for 2023 and 2022 based on data from Global Wind Energy Council (GWEC), "Global Wind Report 2024", 2024, https://gwec.net/global-wind-report-2024, GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; from WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, pp. 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030; and from G. Costanzo, WindEurope, personal communication with REN21, April–May 2024. China's share of global additions in 2024 was 71.6%, based on data from World Wind Energy Association (WWEA), "WWEA Annual Report 2024", April 2025, 11, https://wwindea.org/AnnualReport2024; in 2023 it was 66%, from S. Gsänger, WWEA, personal communication with REN21, 7 May 2024, and in 2022 it was 58%, from WWEA, "WWEA Annual Report 2023", 2024, p. 5, https://wwindea.org/AnnualReport2023.

19 China's year-end total based on the following: China ended 2024 with a total of 520,600 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; a total of 561,492 MW, including mechanical installations that are not necessarily grid-connected, from Chinese Wind Energy Association, cited in WWEA, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 11, https://wwindea.org/AnnualReport2024; a total of 520 GW, from China's National Energy Administration (NEA), cited in "China's Solar, Wind Power Installations Soared to Record in 2024", Reuters, 21 January 2025,

https://www.reuters.com/business/energy/chinas-solar-wind-power-installed-capacity-soars-2024-2025-01-21/; a total of nearly 521 GW, from NEA, cited in Enerdata, "China's NEA targets 200 GW of new renewable capacity additions in 2025", 4 March 2025, https://www.enerdata.net/publications/daily-energy-news/chinas-nea-targets-200-gw-new-renewable-capacity-additions-2025.html; and a total of 521,746 MW based on data from IRENA, "Renewable Capacity Highlights", 2025, 14, https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025. China's share of cumulative global capacity based on data from the following: GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

20 Figure of 10% from GWEC, "Global Wind Report 2025", 23 April 2025, 50, https://www.gwec.net/reports/globalwindreport. This was up from 9.2% in 2023, from Chinese Wind Energy Association, 2024, provided by F. Zhao, GWEC, personal communication with REN21, 12 May 2025; 8.8% by the end of 2022, 7.8% in 2021 and 6.1% in 2020; it surpassed nuclear power in 2018 to become China's third largest source of electricity, after coal and hydropower, all from F. Guo, CWEA, participant in WWEA, "WWEA Webinar: Wind Power Markets Around the World 2023", Part 1, 27 April 2023, https://www.youtube.com/watch?v=WsRW1y_FwLk.

21 Fourth consecutive year and since 2014, based on data from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 13, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; ranking based on idem, and on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport.

22 The United States added 4,058 MW (3,926 MW onshore and 132 MW offshore) for a year-end total of 154,783 MW (154,609 MW onshore and 174 MW offshore), from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 13, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/, from J. Hensley, ACP, personal communication with REN21, 15 May 2025, and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document. In addition, 275 MW of capacity was decommissioned for a net increase of 3,783 MW, from GWEC, op. cit. this note.

23 Expectations and delayed commissioning from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 13, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; reasons for delay based on challenges that hampered US project developers, from BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025,

https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/; and on information from GWEC, "Global Wind Report 2025", 23 April 2025, 76, https://www.gwec.net/reports/globalwindreport.

24 The capacity of projects under construction or in advanced development rose 1% to 25.2 GW (25,218 MW), from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 21, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/. The pipeline of projects for onshore included 10.8 GW under construction through 2027, and 3.9 GW of announced capacity, from Wood Mackenzie, "US wind market installations hit a decade low: 3.9 GW of new US onshore wind installations in 2024 lowest in 10 years", press release, 8 April 2025, https://www.woodmac.com/press-releases/us-wind-market-installations-hit-a-decade-low/. PPAs from Wood Mackenzie and ACP, Executive Summary, "US Wind Energy Monitor 2024 Year in Review", April 2025, 4, https://www.woodmac.com/industry/power-and-renewables/us-wind-energy-monitor/.

25 Based on data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10, 17, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030, and from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport. Germany added 4,022 MW, of which 1.1 GW was repowered projects (27% of gross additions), and decommissioned 712 MW, for net additions of 3,310 MW, from idem, both sources. Germany added 3,209 MW for a total of 72,683 MW, from World Wind Energy Association, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 11, https://wwindea.org/AnnualReport2024; and added 4,022 MW for a total of 72,700 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport.

26 GWEC, "Global Wind Report 2025", 23 April 2025, 67, https://www.gwec.net/reports/globalwindreport; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 9, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030.

27 GWEC, "Global Wind Report 2025", 23 April 2025, 67, https://www.gwec.net/reports/globalwindreport.

28 Fourth place based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport.

29 Figure of 52% in 2023, based on data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; figures of 21% and 3.4 GW from India's Ministry of New and Renewable Energy (MNRE), "India's Renewable Energy Revolution", 22 January 2025,

https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2094992; India's year-end capacity was 48,163.16 MW, from MNRE, "Year Wise Achievements: Installed Renewable Energy Capacity (MW) (Excluding Large Hydro Power)", accessed 4 February 2025, https://mnre.gov.in/en/year-wise-achievement/. India's total capacity was up 7.64% over year-end 2023, from MNRE, "India's RE Capacity Registers 15.84% Year-on-Year Growth", 13 January 2025, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2092429. India added 3,427 MW for a total of 48,163 MW from World Wind Energy Association, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 11, https://wwindea.org/AnnualReport2024, and added 3,420 MW for a total of 48,156 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport. Most new capacity (98%) came online in the states of Gujarat (1,250 MW), Karnataka (1,135 MW) and Tamil Nadu (900 MW), from MNRE, "India's Renewable Energy Revolution", 22 January 2025, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2094992.

30 Policy reforms, incentives and increased investment from MNRE, "India's Renewable Energy Revolution", 22 January 2025, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2094992; renewable purchase obligations from G. Hazarika, "Top Developments that Influenced Wind and Hybrid Power Market in 2024", Mercom India, 30 December 2024, https://www.mercomindia.com/top-developments-that-power-market-in-2024. Such obligations affect state distribution companies, for example, from Hazarika, op. cit. this note.

31 GWEC, "Global Wind Report 2025", 23 April 2025, 58, 81, https://www.gwec.net/reports/globalwindreport.

32 I. Fonseca, "Brazil's Wind Power Sector Faces Deepest Crisis as Investment and Output Plunge", The Rio Times, 16 April 2025, https://www.riotimesonline.com/brazils-wind-power-sector-faces-deepest-crisis-as-investment-and-output-plunge/.

33 Rank and four years in third place based on data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document. Fifth place based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport.

34 Brazil added 3,278 MW for a total of 33,727 MW from Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport, and from Associação Brasileira de Energia Eólica e Novas Tecnologias (ABEEólica), provided by F. Zhao, GWEC, personal communication with REN21, 12 May 2025; decline in annual additions based on these 2024 data and 2023 data from GWEC, op. cit. this note. Total capacity included 32,982.1 MW in wind farms that were in commercial operation and 744.6 MW in installations in test operation and also feeding into the grid at the end of 2024, from ABEEólica, provided by F. Zhao, GWEC, personal communication

with REN21, 12 May 2025. Brazil added 3.3 GW for a total of 33 GW, from I. Fonseca, "Brazil's Wind Power Sector Faces Deepest Crisis as Investment and Output Plunge", The Rio Times, 16 April 2025, https://www.riotimesonline.com/brazils-wind-power-sector-faces-deepest-crisis-as-investment-and-output-plunge/; added 3.3 GW in 2024, down from 4.8 GW in 2023, from Associação Brasileira de Energia Eólica e Novas Tecnologias (ABEEólica), cited in "Brazil's onshore wind power sector slows in 2024, growth to resume in 2027", Brazil Energy Insight, accessed 23 April 2025, https://brazilenergyinsight.com/2025/01/17/brazils-onshore-wind-power-sector-slows-in-2024-growth-to-resume-in-2027/; and added 4,261 MW in 2024 for total of 29 GW, from National Electric Energy Agency (ANEEL), cited in https://www.enerdata.net/publications/daily-energy-news/brazil-added-11-gw-new-capacity-2024-91-which-were-solar-and-wind.html. Note that Brazil's capacity additions increased 19% in 2024 to 5.4 GW, for a year-end total of 34,000 MW, from World Wind Energy Association, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 7, 11, https://wwindea.org/AnnualReport2024. In 2024, Brazil's annual market experienced the most significant slowdown since the cancellation of some auctions in 2018/2019, from ABEEólica, cited in "Brazil's onshore wind power sector slows in 2024, growth to resume in 2027", Brazil Energy Insight, accessed 23 April 2025, https://brazilenergyinsight.com/2025/01/17/brazils-onshore-wind-power-sector-slows-in-2024-growth-to-resume-in-2027/.

35 I. Fonseca, "Brazil's Wind Power Sector Faces Deepest Crisis as Investment and Output Plunge", The Rio Times, 16 April 2025, https://www.riotimesonline.com/brazils-wind-power-sector-faces-deepest-crisis-as-investment-and-output-plunge/. Challenges include grid transmission constraints, cancelled auctions and other regulatory issues, from GWEC, "Global Wind Report 2025", 23 April 2025, 81, https://www.gwec.net/reports/globalwindreport. Goldwind from GWEC, op. cit. this note, 51.

36 I. Fonseca, "Brazil's Wind Power Sector Faces Deepest Crisis as Investment and Output Plunge", The Rio Times, 16 April 2025, https://www.riotimesonline.com/brazils-wind-power-sector-faces-deepest-crisis-as-investment-and-output-plunge/.

37 Europe ranking based on data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; and World Wind Energy Association (WWEA), "WWEA Annual Report 2024", April 2025, 11, https://wwindea.org/AnnualReport2024. Canada added 1,387 MW (all onshore) for a total of 18,373 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; added 1,449 MW for a total of 18,435 MW, from WWEA, op. cit. this note; and Canada's year-end total was over 18

GW, from Canadian Renewable Energy Association, "By the Numbers", accessed 29 April 2025, https://renewablesassociation.ca/by-the-numbers/. Türkiye added 1,310 MW (all onshore) for a total of 13,793 MW, from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; added 1,310 MW for a total of 13,652 MW, from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; added 1,058 MW for a total of 12,864 MW, from WWEA, op. cit. this note; and the total capacity reached was 13,042 MW as of 13 February 2025, per Turkish Wind Energy Association cited in Gülşen Çağatay, "Türkiye'nin rüzgar enerjisi kurulu gücü 13 bin megavatı geçti" [Türkiye's Installed Wind Energy Capacity Exceeds 13 Thousand Megawatts], Enerji Terminali, 15 February 2025, https://www.aa.com.tr/tr/enerjiterminali/yenilenebilir/turkiyenin-ruzgar-enerjisi-kurulu-gucu-13-bin-megavati-gecti/47542.

38 Figure of 16.1% based on additions (without Türkiye) in 2023 of 17,934 MW, from WindEurope, "Wind Energy in Europe – 2023 Statistics and the Outlook for 2024-2030", 2024, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2023-statistics-and-the-outlook-for-2024-2030; and additions (without Türkiye) in 2024 from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; additions in Europe (excluding Türkiye) totalled 15,042 MW (12,477 MW onshore and 2,565 MW offshore) for a cumulative year-end total of 271,121 MW (234,464 MW onshore and 36,657 MW offshore); Europe decommissioned 1,332 MW of capacity and 1.6 GW of new capacity was added in the form of repowered projects (mostly in Germany and Spain), all from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, 17, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030.

39 WWEA, "WWEA Annual Report 2024", April 2025, 7, https://wwindea.org/AnnualReport2024; GWEC, "Global Wind Report 2025", 23 April 2025, 87, https://www.gwec.net/reports/globalwindreport. Note that the EU's Clean Industrial Deal, launched in early 2025, aims to (among other things) reduce fossil fuel imports, speed up permitting for renewable energy projects, boost the production of renewable technologies in the EU, and decarbonise energy-intensive industries, from European Commission, "Clean Industrial Deal: A Plan for EU Competitiveness and Decarbonisation", accessed 1 May 2025, https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en; European Commission, "The Green Deal Industrial Plan: Putting Europe's Net-Zero Industry in the Lead", accessed 1 May 2025, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en; and E. Schumacher, "EU Launches Clean Industrial Deal to Overhaul Energy Sector",

DW, 26 February 2025, https://www.dw.com/en/eu-launches-clean-industrial-deal-to-overhaul-energy-sector/a-71750700.

40 WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 7, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Challenges also included rising costs, global supply chain competition and inefficient auction designs, from idem, 36.

41 Top markets in Europe and their national additions based on data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, 14, 17, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; among top 10 based on data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document. Germany added 4,022 MW for a total of 72,672 MW, the United Kingdom added 1,916 MW for a total of 31,636 MW, France added 1,739 MW for a total of 24,383 MW, and Finland added 1,414 MW for a total of 8,357 MW, all from WindEurope, op. cit. this note, 10-11. Note that Germany added 4,022 MW for a total of 72,760 MW, the United Kingdom added 1,917 MW for a total of 31,533 MW, France added 1,739 MW for a total of 24,571 MW, and Finland added 1,414 MW for a total of 8,287 MW according to GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; and Germany added 3,209 MW for a total of 72,683 MW, the United Kingdom added 2,197 MW for a total of 32,360 MW, France added 909 MW for a total of 24,383 MW, and Finland added 1,412 MW for a total of 8,358 MW, all according to World Wind Energy Association, "WWEA Annual Report 2024: A Challenging Year for Windpower", April 2025, 11, https://wwindea.org/AnnualReport2024. Together, the top five countries in Europe accounted for over 68% of the region's 2024 installations, based on data from WindEurope, op. cit. this note, 10-11.

42 WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030.

43 Based on 2024 data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10, 17, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and 2023 additions (16,112 MW) from G. Costanzo, WindEurope, personal communication with REN21, 12 May 2025. Europe decommissioned more than 1.3 GW (Germany 712 MW, Spain 435 MW, Italy 76 MW, the Netherlands 57 MW, Austria 20 MW, Sweden 18 MW, France 13 MW and the United Kingdom 1 MW); 1.6 GW of newly installed capacity was from repowering projects: 1.1 GW in Germany, plus Italy (155 MW), France (116 MW), Netherlands (114 MW), Belgium (41 MW), Austria (31 MW), and the United Kingdom (2 MW). On average, repowering triples project output while reducing the number of

turbines by 25%, all from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 9, 17.

44 GWEC, "Global Wind Report 2025", 23 April 2025, 77, https://www.gwec.net/reports/globalwindreport; and WindEurope, "Wind Energy in Europe – 2024 Statistics and the Outlook for 2025-2030", 2025, 8, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Below what is needed to meet targets based on EU renewable energy target of 42.5% by 2030 and an installed wind power capacity target of 425 GW (reduced in 2023 from 440 GW); WindEurope expects that the EU will build an average of 23 GW of new wind projects annually between 2025 and 2030, increasing cumulative wind power capacity to 351 GW, or 74 GW short of the EU target, from WindEurope, op. cit. this note, 8. REPowerEU strategy from WindEurope, "Wind Power Package: Game-changer for Europe's Energy Security", 24 October 2023, https://windeurope.org/newsroom/press-releases/wind-power-package-game-changer-for-europes-energy-security.

45 Number of countries in Asia based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; number of countries in Europe from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; number in North America from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 14, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; and from GWEC, op. cit. this note, both sources. Global additions and year-end total based on data from the following: GWEC, op. cit. both sources, WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030, and J. Hensley, ACP, personal communication with REN21, 15 May 2025. Note that GWEC has four countries in Europe adding offshore wind power capacity in 2024, including the Netherlands (132 MW), for global additions of 8 GW offshore and a year-end total of 83.2 GW, from GWEC, "Global Wind Report 2025", 23 April 2025, 78, 85, https://www.gwec.net/reports/globalwindreport; see endnotes for Europe below for more details. Global capacity added in 2024 and year-end global total are based on data from idem, all sources. Note that offshore installations totalled 11.7 GW, up 6% over 2023, with China accounting for 6.1 GW, or more than half, despite a decline in additions in China of 1.6 GW relative to the previous year, BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025, https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/.

46 Decline relative to 2023 based on data from the following: GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 14, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot; and J. Hensley, ACP, personal communication with REN21, 15 May 2025. Fourth highest based on 2024 data from sources in this note and historical data from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document. Declines relative to previous years were due to complicated maritime approvals and coordination, supply chain delays and delays in grid connection, as well as component failures, from GWEC, "Global Wind Report 2025", 80.

47 Based on data from the following: GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 14, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; and from J. Hensley, ACP, personal communication with REN21, May 25, 2025.

48 China added 4,038 MW of offshore wind power capacity for a total of 41,813 MW, and 36% decline, based on data from GWEC, "Global Wind Report 2025", 23 April 2025, 78, 85; project delays from BloombergNEF, cited in S. Mittal, "Wind Turbine Installations Hit Record Levels in 2024, Report Reveals", Edie, 18 March 2025, https://www.edie.net/wind-turbine-installations-hit-record-levels-in-2024-report-reveals/.

49 Taiwan added 933 MW, followed by Japan (112 MW) and the Republic of Korea (100 MW), from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport.

50 Record year in 2023 from WindEurope, "Lots of Good News – and Good Numbers – Again in Offshore Wind", 18 January 2024, https://windeurope.org/newsroom/press-releases/lots-of-good-news-and-good-numbers-again-in-offshore-wind; figure of 2.6 GW and causes of decline, based on WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 13, 16, 24, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; figure of 31.3% based on 2,565 MW added in 2024 and 3,737 MW added

in 2023, from G. Constanzo, WindEurope, personal communication with REN21, 12 May 2025.

51 The United Kingdom installed 1,178 MW, followed by Germany (730 MW) and France (658 MW), from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Note that the Global Wind Energy Council (GWEC) has four countries in Europe adding offshore wind power capacity in 2024, including the Netherlands (132 MW), from GWEC, "Global Wind Report 2025", 23 April 2025, 78, 85, https://www.gwec.net/reports/globalwindreport. GWEC data include all near-shore capacity for the WindPlanBlauw project as offshore additions in 2024, from F. Zhao, GWEC, personal communication with REN21, 12 May 2025. WindEurope does not include all 132 MW in 2024 and counts this capacity as onshore, from G. Costanzo, WindEurope, personal communication with REN21, 13 May 2025. The project is not counted as offshore in this section to keep a consistent methodology for capacity in Europe, and because the construction method of the project was expected to differ from that of regular offshore wind projects, from "Windplanblauw (Wind Plan Blue)", Power Technology, 4 August 2020, https://www.power-technology.com/projects/windplanblauw/. The final blade was installed in early 2024, from "Windplanblauw Turbine installation Reaches Completion", Wind Power NL, 20 March 2024, https://windpowernl.com/2024/03/20/windplanblauw-turbine-installation-reaches-completion.

52 WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, 16, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030.

53 American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 14, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; and J. Hensley, ACP, personal communication with REN21, 15 May 2025. Note that US developers installed 101 MW offshore in 2024, from Wood Mackenzie and ACP, Executive Summary, "US Wind Energy Monitor 2024 Year in Review", April 2025, 3, https://www.woodmac.com/industry/power-and-renewables/us-wind-energy-monitor/.

54 American Clean Power Association, "Snapshot of Clean Power in 2024", 5 March 2025, 20, 21, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/. Offshore projects with a total capacity of 4,097 MW were under construction in US waters at the end of 2024, and fewer contracts were cancelled in 2024 than during the previous year, from American Clean Power Association, "Snapshot of Clean Power in 2024", 5 March 2025, 21, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/. The pipeline of projects under construction or in advanced development

fell by 4% during the year, a smaller decline than that in 2023, from idem. However, in January 2025, President Trump issued an Executive Order that paused offshore (and onshore) wind leasing, and in April the Administration issued a stop-work order for the construction of Empire Wind, a project off the coast of New York, from A. Memija, "RWE Freezes US Offshore Wind Activities, Citing Political Uncertainty", Offshore Wind, 28 April 2025, https://www.offshorewind.biz/2025/04/28/rwe-freezes-us-offshore-wind-activities-citing-political-uncertainty/. The threats of tariffs and potential rollback of tax credits also have affected the industry, from C. Marshall, "Project Cancellations Threaten US Clean Energy Manufacturing Boom", E&E News, 28 April 2025, https://www.eenews.net/articles/project-cancellations-threaten-us-clean-energy-manufacturing-boom-2/.

55 Total of 19 in 2024 (and in 2023 and 2022) includes China, Japan, the Republic of Korea, Taiwan and Viet Nam in Asia; Germany, Spain, the United Kingdom, France, Italy, Sweden, Portugal, Denmark, the Netherlands, Ireland, Belgium, Norway and Finland in Europe; and the United States. The list included the same countries in 2021, except for Italy. All countries in Europe based on data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; countries in Asia based on data GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; United States from American Clean Power Association (ACP), "Snapshot of Clean Power in 2024", 5 March 2025, 6, 14, https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/; and from GWEC, op. cit. this note, both sources.

56 China and Taiwan data as well as list of top countries from GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; European country data from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Note that year-end offshore capacity in Germany was 9,041 MW and in the Netherlands was 4,891 MW, from GWEC, "Global Wind Report 2025", op. cit. this note.

57 Based on data from the following: GWEC, "Global Wind Report 2025", 23 April 2025, 85, https://www.gwec.net/reports/globalwindreport; and from GWEC, "Global Wind Statistics 2025, Status End of 2024", unpublished document; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 10-11, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030; and from J. Hensley, American Clean Power Association, personal communication with REN21, 15 May 2025.

58 Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 76, https://www.gwec.net/reports/globalwindreport. FITs have played a role

particularly in Japan, and in 2024 also in Israel and Kazakhstan, from idem. Grid parity information also from idem.

59 Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 76, 79, https://www.gwec.net/reports/globalwindreport.

60 Based on data from Global Wind Energy Council, "Global Wind Report 2025", 23 April 2025, 76, 79, https://www.gwec.net/reports/globalwindreport, and from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 24, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. GWEC reports that projects totalling 56.3 GW of offshore wind capacity were awarded in 2024, mostly in Europe (23.2 GW) and China (17.4 GW); offshore auctions include China (17.4 GW), Europe (23.2 GW), United States (8.4 GW), South Korea (3.3 GW), Taiwan (2.7 GW), and Japan (1.4 GW); 1.9 GW of the total was for floating wind power capacity in France, South Korea and the United Kingdom, from GWEC, op. cit. this note, 79. In Europe, a record amount of new capacity (17 GW onshore and 19.9 GW offshore; up 35% over 2023) was awarded through auctions and tenders in 2024 across 12 countries, with Germany alone awarding 19 GW, followed by the United Kingdom (6.3 GW) and the Netherlands (4.1 GW), from WindEurope, op. cit. this note.

61 New targets include, for example: the Australian state of Victoria legislated an offshore wind target of 9 GW by 2040 (with interim targets) under the Climate Change and Energy Legislation Amendment Act of 2024; Azerbaijan targets 6 GW of combined solar, wind and hydropower capacity by 2030; China set a target for non-fossil energy sources (80% of total energy consumption by 2060), all from GWEC, "Global Wind Report 2025", 23 April 2025, 12, 54, 66, 87, https://www.gwec.net/reports/globalwindreport. In Europe, Greece revised its national energy and climate plan to set more aggressive goals for wind and solar power capacity, from "Greece's New Climate Plan Sets More Ambitious Renewable Energy Goals", Reuters, 11 October 2024, https://www.reuters.com/sustainability/greeces-new-climate-plan-sets-more-ambitious-renewable-energy-goals-2024-10-11/. In India, Telangana announced a target to achieve 4.5 GW of wind power capacity by FY 2035, from U. Sowndhiga, "India's Installed Wind Capacity Rose 45% YoY in Q4 2024", Mercom India, 31 January 2025, https://www.mercomindia.com/indias-installed-wind-capacity-rose-45-yoy-in-q4-2024; and Rajasthan set a target for 25 GW of wind and hybrid power capacity by 2030, from A. Joshi, "Rajasthan's Clean Energy Policy Targets 125 GW Renewable Energy Capacity by 2030", Mercom India, 5 December 2024, https://www.mercomindia.com/rajasthan-clean-energy-policy-2030. The US state of California set a target of 7.6 GW offshore wind capacity by 2035, from J. St. John, "California Aims for 7.6GW of Offshore Wind by 2035", 24 July 2024, https://www.canarymedia.com/articles/wind/california-aims-for-7-6gw-of-offshore-wind-by-2035. Drivers from, for example: GWEC, "Global Wind Report 2025", 23 April 2025, 87, https://www.gwec.net/reports/globalwindreport; and from

US Department of Energy, Office of Energy Efficiency and Renewable Energy, "Land-based Wind Market Report: 2024 Edition", 2024, vi, https://www.energy.gov/eere/wind/land-based-wind-market-report. Cost-competitiveness of wind power based on W. Mathis, "Renewable Power's Big Mistake Was a Promise to Always Get Cheaper", Bloomberg, 7 November 2022, https://www.bloomberg.com/news/articles/2022-11-07/wind-giant-rues-promise-that-renewable-power-could-be-free; BloombergNEF, "Global Cost of Renewables to Continue Falling in 2025 as China Extends Manufacturing Lead: BloombergNEF", 6 February 2025, https://about.bnef.com/insights/clean-energy/global-cost-of-renewables-to-continue-falling-in-2025-as-china-extends-manufacturing-lead-bloombergnef/; wind energy has become one of the world's most cost-competitive sources of energy, and it has helped to lower consumer electricity prices where scale has been achieved, from GWEC, "Global Wind Report 2025", op. cit. this note, 9; US benefits compared to levelised costs from US Department of Energy, Office of Energy Efficiency and Renewable Energy, "Land-based Wind Market Report: 2024 Edition", op. cit. this note, xi.

62 **Australia** and Victoria from GWEC, "Global Wind Report 2025", 23 April 2025, 52, 54, https://www.gwec.net/reports/globalwindreport. **Brazil** from GWEC, "Global Wind Report 2025", 23 April 2025, 72, https://www.gwec.net/reports/globalwindreport. Brazil's regulatory framework was finalised in 2024 and signed and approved in January 2025; the country also enacted the Brazilian Emissions Trading System in 2024 to regulate carbon emissions, from GWEC, "Global Wind Report 2025", 23 April 2025, 72, https://www.gwec.net/reports/globalwindreport. **China** priority development and rural areas from GWEC, "Global Wind Report 2025", 23 April 2025, 50, https://www.gwec.net/reports/globalwindreport; benefit financially from S. Gsänger, WWEA, personal communication with REN21, 8 May 2025. China's Energy Law was adopted in November and provides a legal foundation for achieving China's goals for peak carbon by 2030 and carbon neutrality by 2060, prioritising development of renewable energy; the "Thousands of Townships and Villages Embracing Wind Power Initiative" promotes project construction in rural areas, where market potential is estimated to be 2,000 GW, all from GWEC, "Global Wind Report 2025", 23 April 2025, 50, https://www.gwec.net/reports/globalwindreport. **India** from MNRE, "Year End Review 2024 of Ministry of New & Renewable Energy", 31 December 2024, https://pib.gov.in/PressReleseDetailm.aspx?PRID=2089056&reg=3&lang=1. India approved a funding scheme for 1 GW of offshore wind capacity, including 500 MW each off the coasts of Tamil Nadu and Gujarat, plus funding for related port upgrades and logistics support. The government also invited bids for 4 GW of wind power capacity off the coast of Tamil Nadu, from MNRE, "Year End Review 2024 of Ministry of New & Renewable Energy", op. cit. this note. **Saudi Arabia** from GWEC, "Global Wind Report 2025", 23 April 2025, 70-71, https://www.gwec.net/reports/globalwindreport. **United Kingdom** from GWEC,

"Global Wind Report 2025", 23 April 2025, 10, 68, https://www.gwec.net/reports/globalwindreport. The UK's 2024 reforms aimed to deliver national targets of up to 50 GW of offshore wind capacity and 30 GW onshore by 2030, from GWEC, "Global Wind Report 2025", 23 April 2025, 10, https://www.gwec.net/reports/globalwindreport. The onshore ban applied only to England, from G. Costanzo, WindEurope, personal communication with REN21, 12 May 2025.

63 BloombergNEF, "Energy Transitions Investment Trends 2025" (database), provided to REN21 on 17 February 2025.

64 BloombergNEF, "Energy Transitions Investment Trends 2025" (database), provided to REN21 on 17 February 2025. Investment was up an estimated 513% in Mexico, and increased in Germany (180%), Australia (168%), and China (2%), based on data from idem; Chile based on record investment in 2024, from F. Zhao, GWEC, personal communication with REN21, 12 May 2025.

65 BloombergNEF, "Energy Transitions Investment Trends 2025" (database), provided to REN21 on 17 February 2025.

66 GWEC, "Global Wind Report 2025", 23 April 2025, 2, 6, https://www.gwec.net/reports/globalwindreport. Also see, for example, GWEC, "Mission Critical: Building the Global Wind Energy Supply Chain for a 1.5°C World", 1 December 2023, https://gwec.net/supplychainreport2023; and D. Alexandrou, "APAC's Enormous Wind Energy Potential Can Only Be Unlocked with a Scaled Up, Regional Supply Chain Fit for Growing Demand and Net Zero Ambitions, Says New GWEC Report," GWEC, 25 November 2024, https://www.gwec.net/gwec-news/apac-supply-chain-report-2024/.

67 Macroeconomic challenges from GWEC, "Global Wind Report 2025", 23 April 2025, 3, 5-6, 9, https://www.gwec.net/reports/globalwindreport; F. Zhao, GWEC, personal communication with REN21, 12 May 2025. Fossil fuel subsidies from WWEA, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024. Market frameworks from Global Wind Energy Council (GWEC), "Global Wind Report 2024", 2024, pp. 3, 43, https://gwec.net/global-wind-report-2024. Planning and permitting from WWEA, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024; and from GWEC, "Global Wind Report 2025", 23 April 2025, 3, 6, 19, 20, 21, 23-24, 92, https://www.gwec.net/reports/globalwindreport. Planning and permitting processes take more than 5 years, and even 10 years or longer in some countries, from WWEA, op. cit. this note. Trade barriers and tariffs from WWEA, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024; GWEC, "Global Wind Report 2025", 23 April 2025, 14, 19, 29, https://www.gwec.net/reports/globalwindreport. Grid challenges (including a lack of grid infrastructure, weak existing infrastructure, and lack of access to existing infrastructure), from GWEC, "Global Wind Report 2025", 23 April 2025, 23-24,

https://www.gwec.net/reports/globalwindreport; WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 9, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. Grid issues are considered the most significant bottleneck preventing accelerated deployment of wind energy at scale in Europe, from WindEurope, op. cit. this note. Also see "Report Reveals Outdated Grid Planning Delays Europe's Renewable Shift", Energy Monitor, 14 May 2025, https://www.energymonitor.ai/news/outdated-grid-planning-delays/.

68 GWEC, "Global Wind Report 2025", 23 April 2025, 19, https://www.gwec.net/reports/globalwindreport.

69 GWEC, "Global Wind Report 2025", 23 April 2025, 19, https://www.gwec.net/reports/globalwindreport.

70 GWEC, "Global Wind Report 2025", 23 April 2025, 9, 18, 19, https://www.gwec.net/reports/globalwindreport.

71 GWEC, "Global Wind Report 2025", 23 April 2025, 18-19, https://www.gwec.net/reports/globalwindreport; and from C. Jenns, "The Supply Chain Limitations Facing the Wind Turbine Market", Power Technology, 24 April 2025, https://www.power-technology.com/features/the-supply-chain-limitations-facing-the-wind-turbine-market/. In some key regions (Europe, Americas) investment in the supply chain has been insufficient to meet ambitious targets and expected future demand, from GWEC, "Global Wind Report 2025", op. cit. this note. Supply chain bottlenecks have stalled projects and led developers to opt out of tenders, from Jenns, op. cit. this note. In Europe, investments have been made in the wind energy supply chain to meet demand for the next couple of years, but more will be required to meet future demand, from G. Costanzo, WindEurope, personal communication with REN21, 12 May 2025.

72 F. Zhao, GWEC, personal communication with REN21, 12 May 2025; C. Jenns, "The Supply Chain Limitations Facing the Wind Turbine Market", Power Technology, 24 April 2025, https://www.power-technology.com/features/the-supply-chain-limitations-facing-the-wind-turbine-market/.

73 BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025, https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/. China captured the top four spots for the first time since BNEF started publishing the ranking in 2013; the top five were Goldwind, Envision, Windey, MingYang, with Vestas (Denmark) falling to fifth, from idem. The top three globally were Goldwind, Envision and MingYang (all China), with Vestas leading outside of China, from Wood Mackenzie, "Chinese OEMs Sweep the Global Wind Podium for the First Time", 14 March 2025, https://www.woodmac.com/press-releases/2024-press-releases/chinese-oems-sweep-the-global-wind-podium-for-the-first-time/.

74 BloombergNEF, "Chinese Manufacturers Lead Global Wind Turbine Installations, BloombergNEF Report Shows", 17 March 2025, https://about.bnef.com/blog/chinese-manufacturers-lead-global-wind-turbine-installations-bloombergnef-report-shows/; and from GWEC, "Global Wind Report 2025", 23 April 2025, 51, https://www.gwec.net/reports/globalwindreport. For example, Goldwind opened a manufacturing base in Brazil; SANY was constructing an assembly plant in Kazakhstan; Envision is establishing production capacity in India and investing in Kazakhstan and Saudi Arabia; MingYang is involved in joint ventures in Italy and South Korea, all from GWEC, op. cit. this note.

75 Wood Mackenzie, "Chinese OEMs Sweep the Global Wind Podium for the First Time", 14 March 2025, https://www.woodmac.com/press-releases/2024-press-releases/chinese-oems-sweep-the-global-wind-podium-for-the-first-time/.

76 GWEC, "Global Wind Report 2025", 23 April 2025, 18, 32, https://www.gwec.net/reports/globalwindreport; US Department of Energy, Office of Energy Efficiency and Renewable Energy, "Land-based Wind Market Report: 2024 Edition", 2024, xiii, https://www.energy.gov/eere/wind/land-based-wind-market-report.

77 Average turbines delivered to market from F. Zhao, GWEC, personal communication with REN21, 12 May 2025. For onshore projects, European manufacturers introduced new machines in the 6-7 MW range; Chinese manufacturers were scaling up beyond 10 MW, with China's SANY installing a 15 MW prototype, from GWEC, "Global Wind Report 2025", 23 April 2025, 32, https://www.gwec.net/reports/globalwindreport; D. Proctor, "'World's Largest': Chinese Company Installs 15-MW Onshore Wind Turbine", Power Magazine, 9 October 2024, https://www.powermag.com/worlds-largest-chinese-company-installs-15-mw-onshore-wind-turbine/. Offshore, Siemens Gamesa (Spain) announced a 21.5 MW model in 2024; by year's end, six Chinese manufacturers had launched machines over 20 MW, with Dongfang announcing a 26 MW turbine, expected to meet the electricity needs of 55,000 Chinese households, from A. Memija, "Siemens Gamesa to Test 'World's Most Powerful' Wind Turbine Prototype in Denmark", Offshore Wind, 12 January 2024, https://www.offshorewind.biz/2024/01/12/siemens-gamesa-to-test-worlds-most-powerful-wind-turbine-prototype-in-denmark/; W. Pluta, "Siemens Gamesa Builds 21.5 Megawatt Wind Turbine in Denmark", Heise, February 11, 2025, https://www.heise.de/en/news/Siemens-Gamesa-builds-21-5-megawatt-wind-turbine-in-Denmark-10278349.html. Six manufacturers from GWEC, "Global Wind Report 2025", 23 April 2025, 32, https://www.gwec.net/reports/globalwindreport; Dongfang from "The World's Largest 26MW Offshore Wind Turbine Rolls Off Production Line", Dongfang, October 12, 2024, J. Malayil, "26MW: China Builds Typhoon-Proof Monster Wind Turbine to Power 55,000 Homes Yearly," Interesting Engineering, 15 October 2024, https://interestingengineering.com/energy/26mw-china-builds-typhoon-proof-monster-wind-turbine; and from J. Malayil, "26MW: China Builds Typhoon-Proof Monster Wind Turbine to Power 55,000 Homes Yearly,"

Interesting Engineering, 15 October 2024, https://interestingengineering.com/energy/26mw-china-builds-typhoon-proof-monster-wind-turbine. A prototype of Siemens Gamesa's turbine was installed in early 2025, from Pluta, op. cit. this note.

78 GWEC, "Global Wind Report 2025", 23 April 2025, 7, 18, 32-33, https://www.gwec.net/reports/globalwindreport.

79 Production process and learning curve from GWEC, "Global Wind Report 2025", 23 April 2025, 32, https://www.gwec.net/reports/globalwindreport; supply chains from C. Jenns, "The Supply Chain Limitations Facing the Wind Turbine Market", Power Technology, 24 April 2025, https://www.power-technology.com/features/the-supply-chain-limitations-facing-the-wind-turbine-market/.

80 GWEC, "Global Wind Report 2025", 23 April 2025, 18-19, https://www.gwec.net/reports/globalwindreport.

81 GWEC, "Global Wind Report 2025", 23 April 2025, 19, https://www.gwec.net/reports/globalwindreport.

82 GWEC, "Global Wind Report 2025", 23 April 2025, 33, https://www.gwec.net/reports/globalwindreport.

83 GWEC, "Global Wind Report 2025", 23 April 2025, 13, https://www.gwec.net/reports/globalwindreport, and from WindEurope, "Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030", 27 February 2025, 7, 13, https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030. In Europe, for example, such challenges have resulted in construction and connection delays, from WindEurope, op. cit. this note.

84 GWEC, "Global Wind Report 2025", 23 April 2025, 26, 28, https://www.gwec.net/reports/globalwindreport; World Wind Energy Association, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024. Key markets experiencing rising opposition to wind power include Australia, Brazil, the United Kingdom and the United States, from GWEC, op. cit. this note. Other markets include: Mexico, from C. Arsenault and P. Le Billon, "A Simmering Conflict Over One of Latin America's Biggest Wind Hubs Confronts Mexico's Next President", Climate Change News, 9 July 2024, https://www.climatechangenews.com/2024/07/09/a-simmering-conflict-over-one-of-latin-americas-biggest-wind-hubs-confronts-mexicos-next-president/; Colombia, from S. Grattan, "Renewable Energy Ambitions in Northern Colombia Collide with Indigenous Worries", Associated Press, 20 February 2025, https://apnews.com/article/wind-energy-colombia-wayuu-indigenous-resistance-clash-cemetery-renewable-e55077418352f19349dc27b09f1eee18; across much of Europe, from G. Anca, "Fake News Causes Headaches for Europe's Wind Industry", Cipher News, 11 Jun 2025, https://www.ciphernews.com/articles/fake-news-causes-headaches-for-europes-wind-industry/; parts of rural Europe, from

"Opposition to Wind Turbines: Resistance Grows in Rural Areas Across Europe", energynews, 14 October 2024, https://energynews.pro/en/opposition-to-wind-turbines-resistance-grows-in-rural-areas-across-europe/; and several countries in Asia, from L. Lei, "Asian Wind Power Development Faces Growing Storm with Local Communities", Eco-Business, 19 April 2024, https://www.eco-business.com/news/asian-wind-power-development-faces-growing-storm-with-local-communities/.

85 GWEC, "Global Wind Report 2025", 23 April 2025, 6, 26, https://www.gwec.net/reports/globalwindreport.

86 World Wind Energy Association, "WWEA Annual Report 2024", April 2025, 5, https://wwindea.org/AnnualReport2024. Also see "Opposition to Wind Turbines: Resistance Grows in Rural Areas Across Europe", energynews, 14 October 2024, https://energynews.pro/en/opposition-to-wind-turbines-resistance-grows-in-rural-areas-across-europe/.

87 GWEC, "Global Wind Report 2025", 23 April 2025, 67, https://www.gwec.net/reports/globalwindreport.