

Wind turbines: Technologies, applications, and global markets

By BCC Publishing Staff

The global market for wind turbines reached a value of \$85.3 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 6.5% to reach \$116.6 billion by 2027.

The Global Wind Energy Council estimates that the world will need to install up to 280 GW of new wind energy annually from 2030 onwards to maintain a pathway compliant with meeting net zero by 2050. Fortunately, through technological developments (Table 1) and economies of scale, the global wind power market has nearly quadrupled in size over the past decade. Onshore wind capacity grew from 178 GW in 2010 to 707.4 GW in 2021, while offshore wind capacity grew from 3.1 GW in 2010 to 35.3 GW in 2021. Table 2 shows how the market is segmented based on end-use sector.

A modern utility-scale wind turbine can consist of up to 8,000 individual subcomponents. The major components are

- **Rotor**, including the blades, hub, and pitch drive.
- **Tower and electrical components**, including the tower, generator, power electronics, balance station, and installation.
- **Gearbox and drivetrain**, including the bearings, gearbox, and high-speed shaft.
- **Nacelle and controls**, including the nacelle frame, brakes, anemometer, and yaw drive.

While most of the materials used to produce wind turbines can be readily recycled or reused, it is extremely difficult to recycle the turbine blades as currently constructed. New materials and recycling methods are being developed to improve the sustainability of turbine blades, such as detailed on pages 24–27

Table 2. Global market for wind turbines, by end-use sector, through 2027 (\$ millions)

End-use sector	2021	2022	2027	CAGR % (2022–2027)
Residential	7,031.8	7,289.5	8,948.3	4.2
Industrial	15,788.5	16,722.7	23,857.9	7.4
Commercial	11,972.7	12,985.1	20,180.1	9.2
Utility	46,616.8	48,257.7	63,611.7	5.7
Total	81,409.8	85,255.0	116,598.9	6.5

in this issue, “Manufacturing the impossible: Supporting the development of a circular economy in the composites industry.”

Areas that experience an average annual wind speed of at least 13 miles per hour are considered good wind resources. These resources are found in many places around the world, but in the United States, the East Coast, Appalachian Mountains, Great Plains, and Pacific Northwest are relatively rich in wind resources.

About the author

BCC Publishing Staff provides comprehensive analyses of global market sizing, forecasting, and industry intelligence, covering markets where advances in science and technology are improving the quality, standard, and sustainability of businesses, economies, and lives. Contact the staff at Helia.Jalili@bccresearch.com.

Resource

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Table 1. Current achievements in the wind turbine industry, 2022

Achievement	Company	Specifications
Largest capacity for conventional-drive turbine	Vestas (V164-8.0 MW)	The Vestas V164 has an overall height of 220 m (722 ft) and a diameter of 164 m (538 ft). It has a rated capacity of 9 MW and is meant for offshore use.
Largest capacity for direct-drive turbine	SG (14-236 DD)	The SG 14-236 DD features a rotor diameter of 236 meters and has a capacity of up to 15 megawatts with a power boost.
Largest single-bladed turbine	SG (14-236 DD)	The SG 14-236 DD has 115-meter-long blades, a rotor diameter of 236 meters, and a swept area of 43,500 square meters.
Largest double-bladed turbine	Seawind (6-126)	The Seawind 6-126 has a rated capacity of 6.2 MW, rotor diameter of 126 meters, and rotor speed of 20.8 rpm at rated power.
Largest swept area	Goldwind (GWH 252-13.6 MW)	The Goldwind GWH 252-13.6 MW has a swept area of about 50,000 square meters.
Tallest	GE (Haliade-X 14.7 MW)	GE Haliade-X 14.7 MW has a 220-meter rotor, 107-meter blade, and height of 260 meters.
Highest tower	Vestas (V172-7.2 MW)	The Vestas V172-7.2MW has a hub height of 199 meters.
Largest floating wind turbine	Hywind Tampen	The Hywind Tampen floating wind farm, located about 140 kilometers (86.9 miles) off the coast of Norway, has a capacity of 88 MW.