

## The Evolution of Global Onshore Wind Turbine Blade Production and Trade

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*Over the last five years, wind turbine original equipment manufacturers (OEMs) reduced onshore wind turbine blade production capacity in developed countries. Onshore blade production (which is a labor-intensive process) for markets outside of China is increasingly located in countries with low labor costs that can cost effectively serve a regional market or global demand. This has led to a significant increase in exports from countries like China, India, Mexico, and Turkey.<sup>1</sup>*

### Shift in production capacity from developed economies to countries with low labor costs

There were significant changes in the onshore market in the last five years, including declining turbine prices (largely due to the shift to auctions, which typically lead to lower prices than policies such as feed-in tariffs) and a diversification of demand beyond traditional markets such as the EU. OEMs changed their product offerings in response to cost pressures, including reducing the number of products, increasing modularity (such that common components can be used across multiple products), and moving toward larger wind turbines and longer blades. These changes enabled an evolution in OEMs' onshore blade manufacturing, as they no longer needed to make unique products for specific markets and could produce (or source) at greater volumes from a single location to achieve economies of scale.<sup>2</sup>

OEMs significantly reduced their onshore blade manufacturing footprint in certain developed countries, closing their least competitive plants and production lines, those making older products (e.g., shorter blades), and/or those oriented primarily toward serving local markets with low demand.<sup>3</sup> Overall, the number of closed onshore plants or production lines during 2016–February 2021 totaled at least a dozen in the EU (particularly in Denmark, Germany, and Spain), three in the United States, and one in Canada. However, most U.S. and European OEMs retain a manufacturing footprint in one or more of these areas.<sup>4</sup>

OEMs are increasingly sourcing blades from locations with low labor costs, particularly China, India, Mexico, and Turkey. Plants in these countries are often located near ports, and are positioned to cost effectively supply a regional market or the global market. This provides OEMs with the flexibility to meet demand in a range of countries and the ability to source from multiple locations depending on which has the lowest landed costs. Brazil has also historically been a major exporter, and continues to supply blades globally. Sourcing from low-cost locations is done either from in-house plants, multinational external suppliers (e.g., U.S.-based TPI Composites and GE subsidiary LM Wind Power), or external suppliers manufacturing primarily in one country (e.g., Chinese suppliers Aeolon and Zhuzhou Times New Material; Brazilian suppliers Aeris and Tecsis). In addition, OEMs and independent suppliers have invested in some countries (e.g., Brazil, Russia, and Turkey) to meet local content requirements (LCRs).<sup>5</sup>

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<sup>1</sup> This analysis covers onshore wind turbine blade production and trade during 2016–February 2021. It will not cover offshore blades since there are differences in blade sourcing and manufacturing investment for the onshore and offshore markets. OEMs (e.g., GE, Siemens Gamesa, and Vestas) produce blades in-house and/or outsource production to other firms.

<sup>2</sup> Company financial reports, earnings call transcripts, and presentations; Blades Global conference.

<sup>3</sup> Some plants also closed as a result of firm bankruptcies. Siemens Gamesa, "[Siemens Gamesa Adjusts](#)"; Radowitz, Bernd, "[Siemens Gamesa Cuts](#)," *Recharge*; Radowitz, "[Thousands](#)," *Recharge*; Siemens Gamesa, "[Siemens Gamesa to Shut](#)"; Vestas, "[To Meet](#)"; Snieckus, Darius, "[Vestas to Lay Off](#)," *Recharge*; Radowitz, "[Siemens Laying Off](#)," *Recharge*; *El País*, "[Siemens Gamesa Closes](#)"; O'Kane, John, "[Siemens Wind Power](#)," *The Globe and Mail*; Flint, Taylor, "[Siemens to Lay Off](#)," *WGEM*.

<sup>4</sup> The U.S. plants that closed are the GE/LM Wind Power plant in Arkansas (2020) and a Vestas plant in Brighton, CO (2021). Siemens Gamesa announced in 2020 that it would lay off workers when it ended production of smaller blades. The remaining U.S. plants are GE/LM Wind Power (ND), Molded Fiberglass (SD), Siemens Gamesa (IA), TPI Composites (IA), and Vestas (Windsor, CO). Compiled from media reports, news releases, company reports/websites, and other publicly available sources.

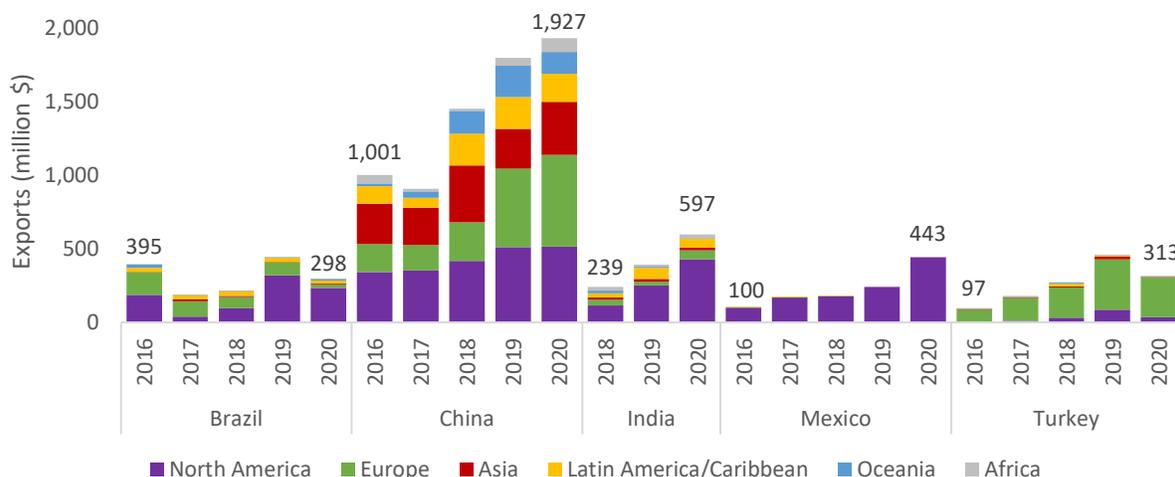
<sup>5</sup> Blade manufacturers have invested in Turkey both to meet LCRs and to serve export markets. Radowitz, "[First](#)," *Recharge*; David, Andrew and Dennis Fravel, "[U.S. Wind Turbine Export](#)"; *North American Windpower*, "[TPI Composites](#)"; LM Wind Power, "[300 New](#)"; David, "[Wind Turbines](#)"; company financial reports and earnings calls.

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### Asian and Latin American exports rise<sup>6</sup>

This shift in sourcing led to a significant increase in exports from China, India, Mexico, and Turkey during 2016–20. China was the largest global onshore blade exporter in 2020, followed by India (figure 1). Exports from Brazil fluctuated, and in 2020 were below 2016 levels. China, India, and Brazil export globally, while Mexico and Turkey primarily export regionally. Global exports by China and India reflect their low costs, according to industry representatives, though China’s blade exports to the United States are subject to 25 percent duties.<sup>7</sup>

**Figure 1:** Exports of blades and other goods in the statistical number, select countries, 2016–20

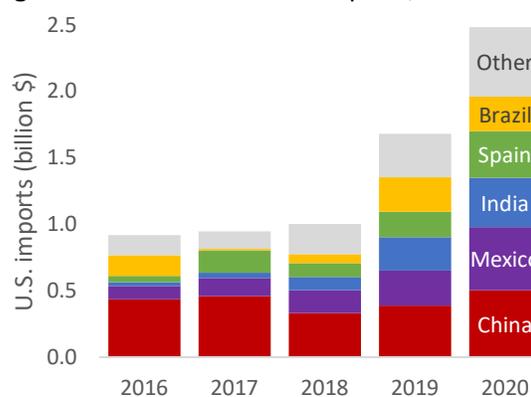


Sources/notes: IHS Markit, Global Trade Atlas [database](#) (Brazil: 8503.00.90; China: 8412.90.90; India: ports and tariff lines identified in transaction level data (only available from 2018); Mexico: 8503.00.06; Turkey: 8412.90.809012 and 8503.00.999019); Trade Data Services, Import Genius [database](#).

### U.S. and EU onshore blade imports grow

The United States and EU are importing more blades. U.S. blade and hub imports rose from \$0.9 billion in 2016 to \$2.5 billion in 2020. (U.S. production capacity was stable during most of this time period as there were no U.S. plant closures during 2016–19.) The largest suppliers in 2020 were China (20 percent), Mexico (19 percent), India (15 percent), Spain (14 percent), and Brazil (10 percent). EU imports (external trade; excluding offshore blades from the UK) rose from \$0.5 billion in 2016 to \$1.1 billion in 2020. China accounted for 61 percent of 2020 imports and Turkey for 20 percent. Exports by the U.S. and key EU exporters (e.g., Denmark, Germany, and Spain) were flat or fell during 2016–20.<sup>8</sup>

**Figure 2:** U.S. blade and hub imports, 2016–20



Source: USITC [DataWeb](#) (general imports). Note: Data include a small volume of offshore blades.

<sup>6</sup> Export values in 2020 were impacted by temporary COVID-19 related plant closures in many countries, so long-term trends are more relevant for understanding blade sourcing trends than a slight increase or decrease in exports in 2020.

<sup>7</sup> Shipping costs can be more than offset by low labor costs, which at \$20 per hour would be 32 percent of blade production costs (for a 63-meter blade) according to an NREL analysis. U.S. import charges for blades and hubs from China, for example, were only 2.5 to 4.3 percent of import values annually during 2016–20. Bortolotti P. et al., “[A Detailed Wind Turbine Blade Cost Model](#),” NREL; USITC [DataWeb](#)/USDOC (HTS 8412.90.9081); company earnings call transcripts.

<sup>8</sup> IHS Markit, Global Trade Atlas [database](#) (CN 8412.90.80); Eurostat [database](#) (CN 8412.90.80); USITC [DataWeb](#)/USDOC.

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