

# Winds of Change – China’s Emerging Role in Global Wind Power



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I. Introduction

Overview

BDA is pleased to launch a new series looking at sector trends in cross-border M&A. As part of this inaugural issue, we examine developments in wind power, a sector undergoing dramatic change. Wind energy, like solar energy, exhibits technology clustering and early adoption; rapidly decreasing cost of energy production; increasing power generation in Asia; and a fundamental shift from developed markets to China.

From this author’s seat in London, striking parallels with solar energy are clear. Whereas wind power was once a niche alternative with an uncertain future, it now clearly commands significant private investment and an important share of overall power generation. And like solar power, China looms large as a global disruptor. The International Energy Agency (IEA) estimates that “China has one-third of the world’s wind power, a quarter of its solar capacity, six of the top ten solar-panel manufacturers and four of the top ten wind-turbine makers.” In this report we examine some of these exceptional trends and cast our sights over the horizon for what will come next.

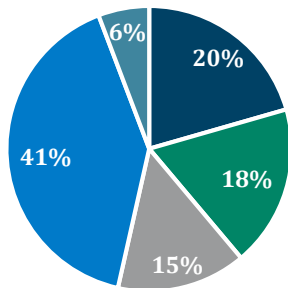
Renewable market trends

Renewable energy is growing rapidly. While global primary energy (energy harvested directly from natural resources) consumption grew at a CAGR of 2.7% from 2006 to 2016 (19PWh to 24PWh), global renewable energy generation grew at 5.6% (4PWh to 6PWh) over the same period. Renewable energy’s share of global electricity production rose from 18% to 24%.

Among the primary sources of renewable energy (hydropower, wind and solar), wind has been growing exceptionally fast in terms of power generation, at a CAGR of 22.1% (133TWh to 981TWh). Wind power significantly increased its share of renewable electricity production, from 4% in 2006 to 16% in 2016.

Global Electricity Production by Source<sup>1</sup>

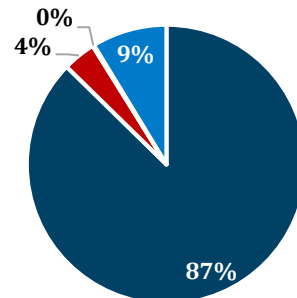
2006



■ Natural Gas ■ Renewables  
■ Nuclear Energy ■ Coal  
■ Oil

Global Renewable Electricity Production by Source<sup>1</sup>

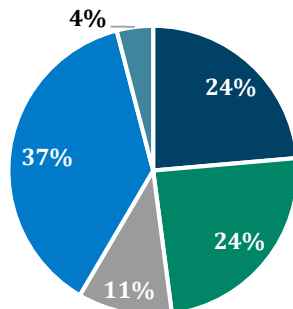
2006



■ Hydropower ■ Wind ■ Solar ■ Others

Global Electricity Production by Source<sup>1</sup>

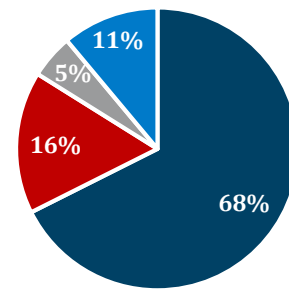
2016



■ Natural Gas ■ Renewables  
■ Nuclear Energy ■ Coal

Global Renewable Electricity Production by Source<sup>1</sup>

2016



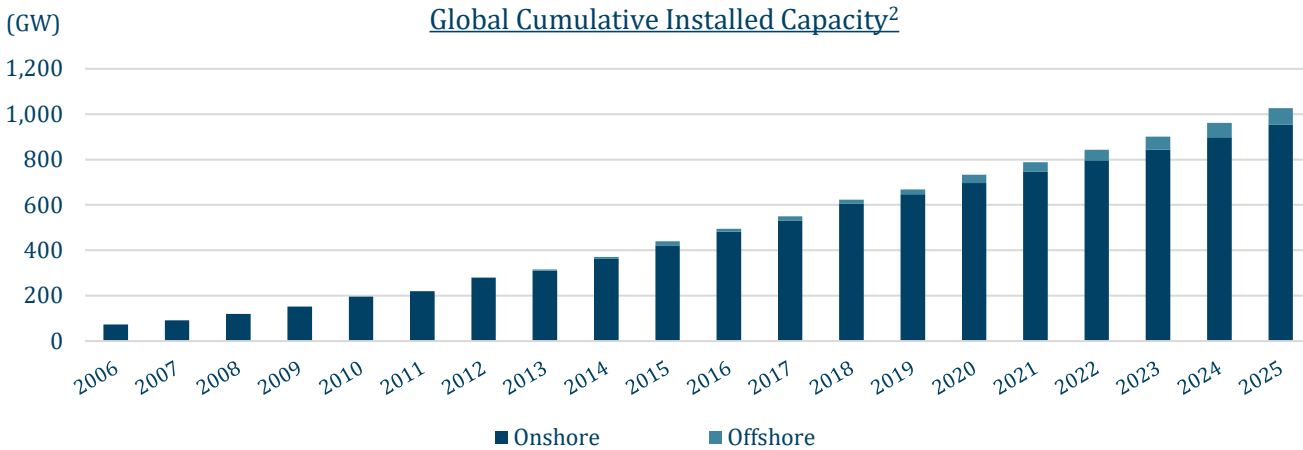
■ Hydropower ■ Wind  
■ Solar ■ Others

<sup>1</sup> [www.iea.org/weo](http://www.iea.org/weo), International Energy Agency website, World Energy Outlook 2017. Economist. March 15, 2018

II. Market Overview

i. Wind Power Generation & Forecasts

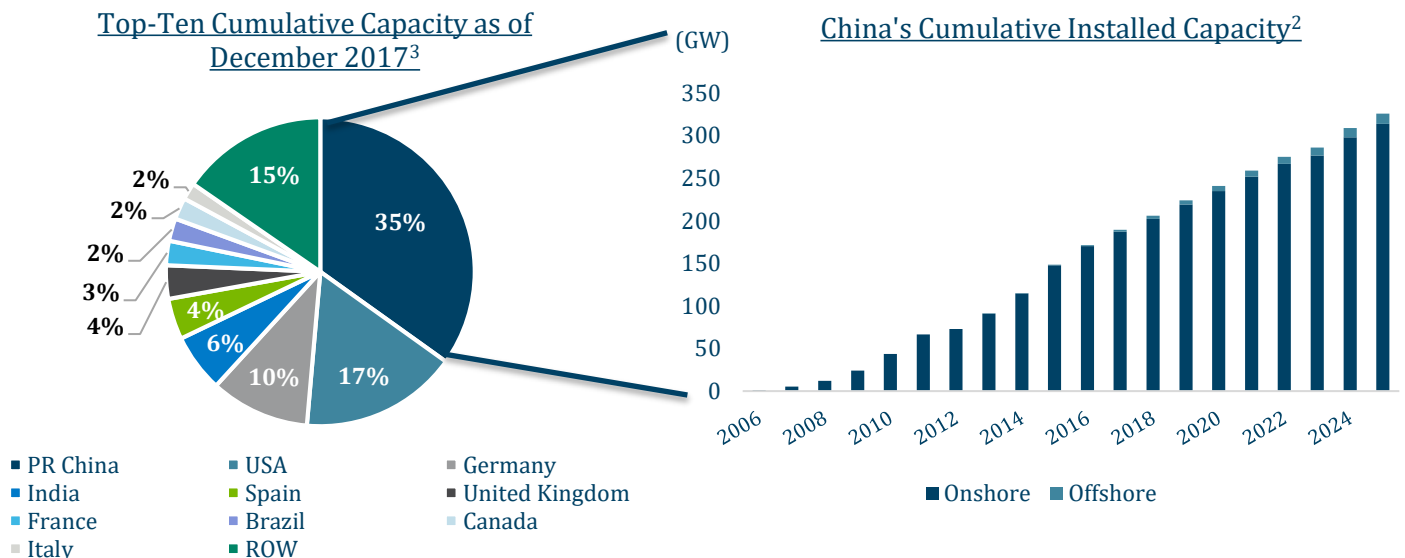
Between 2006 and 2016 the global wind power market grew at a CAGR of 20.9%, on an installed capacity basis. It is expected to grow at a more modest but still healthy rate of CAGR 8.0% from 2017 to 2025 (496.7GW to 1,024.1GW). Growth and efficiency in energy production is being driven by decreasing costs of production, technological innovation in wind turbine components (including blade size) and a diversifying mix of onshore/offshore generation.



Wind power generation has increased from 136.8TWh in 2006 to 977.2TWh in 2016. Offshore generation represented only 4.4% (43.0TWh) of total wind power generation in 2016. However, offshore presents new challenges (technical and installation) and opportunities (increased power generation), as we will examine later in this report.

ii. Wind Power by Geography

China is by far the largest market in terms of cumulative installed capacity, with a 35% global share (2017) double that of the second-largest country (USA). Europe collectively accounted for just under one-third of the market. At the end of 2016 China had a total installed wind power capacity of 172GW, of which 23GW was added during 2016.















² Global Data, Wind Power Market, Update 2017

³ Global Wind Energy Council, Global Wind Statistics 2017

What is striking is that, in a just a few years, China has catapulted itself to a leadership position in wind energy capacity; however, unlike the solar sector, Europe’s wind power ecosystem remains robust and is supported by technology excellence, accommodative government policies and critical proximity of suppliers to highly localized wind farm production. Below we examine differences by key region.

iii. Comparative Overview by Region

2017			
<b>Market Overview</b>	<ul style="list-style-type: none"> <li>• 37% new installed capacity</li> <li>• Government will invest US\$377bn in renewable power generation by 2020</li> <li>• Renewable energy and wind power a key plank of China’s energy security</li> </ul>	<ul style="list-style-type: none"> <li>• 32% new installed capacity</li> <li>• Governmental support to sustainable energy; targets to be reviewed after 2020</li> <li>• Germany is the largest market, followed by Spain, the UK and France</li> </ul>	<ul style="list-style-type: none"> <li>• 13% new installed capacity</li> <li>• Government support uncertain due to the Trump administration</li> <li>• Direct corporate energy purchases and public awareness is increasing (Google, Apple, Nike, Facebook, etc.)</li> </ul>
<b>Biggest Players</b>			
<b>Cumulative Installed Capacity (MW)</b>	<b>Total: 188,232</b> Onshore: 185,444 (98.5%) Offshore: 2,788 (1.5%)	<b>Total: 169,319</b> Onshore: 153,534 (90.7%) Offshore: 15,785 (9.3%)	<b>Total: 89,077</b> Onshore: 89,047 (~100%) Offshore: 30 (~0%)
<b>Outlook</b>	 Government support  Offshore wind	 Government support  Offshore wind	 Government support  Offshore wind

iv. Growing Investment in Offshore Wind Energy

Onshore/Offshore Split (2017)

	Onshore Wind	Offshore Wind
<b>Total Installed Capacity</b>	521GW (96.5% of total wind power capacity)	19GW (3.5% of total wind power capacity)
<b>Historical Growth</b>	2006-2017 CAGR of 19.4%, from 73.8GW in 2006	2006-2017 CAGR of 33.2%, from 0.8GW in 2006
<b>Leading Countries</b>	#1 China #2 USA #3 Germany	#1 UK #2 Germany #3 China (More than 85% of offshore wind is located off European coasts)

Onshore wind turbines have until recently predominated, owing to:

- ✓ Lower installation and maintenance costs
- ✓ Easier integration with electrical grids
- ✓ Longer-lasting turbines and less erosion

But in the last few years, especially in 2017, there has been a noticeable shift towards offshore energy. 2017 was a record year for offshore wind installations in Europe, with 3,148MW additional net installed, twice as much as in 2016. The Horizon 2020 project of the European Commission was also launched in 2017 with the goal of decreasing offshore operation costs by integrating new technologies.

The advantages of offshore wind are numerous:

- ✓ Higher and more constant wind speed
- ✓ Larger blades increasing energy production potential
- ✓ Less impact/interference with landscape aesthetics

In China, the onshore wind industry has developed at a remarkable pace thanks to government support. However, offshore wind has lagged due to a technological gap that remains to be filled. Offshore offers promised increased energy production tied to larger blade sizes which will drive additional attractive investment economics.

Onshore/Offshore Outlook (2025)

2025	Onshore Wind	Offshore Wind
<b>Expected Total Capacity</b>	~950GW (92.6% of total share)	~76GW (7.4% of total share)
<b>Expected Growth</b>	2017-2025 CAGR of 7.8%	2017-2025 CAGR of 18.9%
<b>Leading Countries</b>	China is expected to remain the largest wind turbine player. The US and Europe are expected to remain key players. India should become a key country	China is expected to overtake the UK by 2022 to become the leader in offshore wind energy







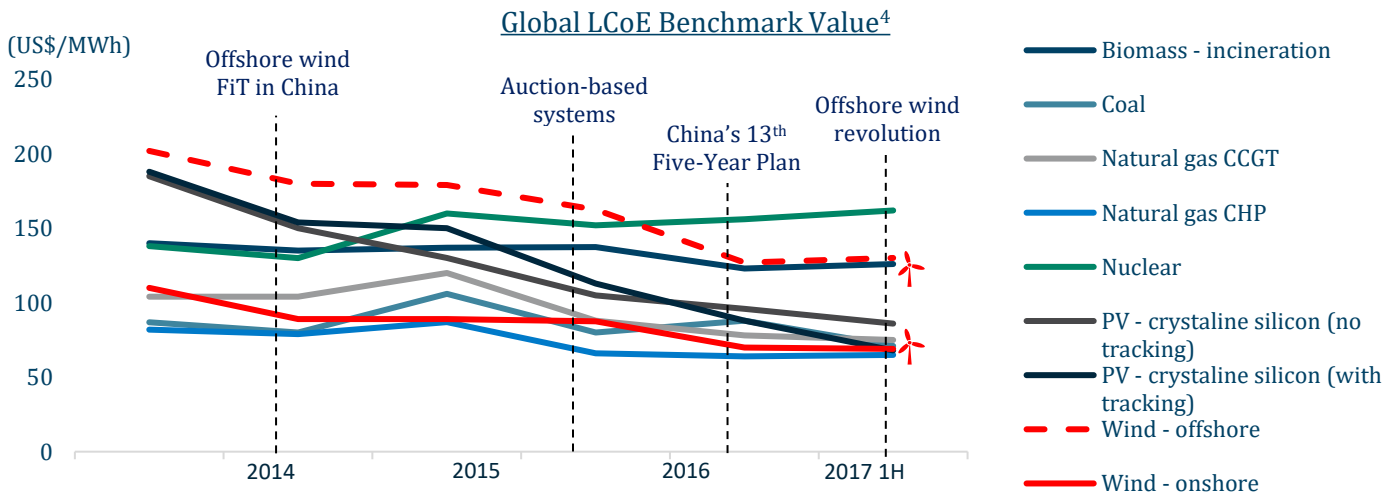
III. Decreasing LCoE Driving Wind Power Growth

The levelized cost of energy (LCoE) of wind power, defined as the net present value of the unit cost of electricity over the lifetime of a generating asset, has been falling dramatically in recent years. It is a useful metric for comparing different forms of energy production, and is therefore a barometer of wind energy’s relative attractiveness to other forms of energy.

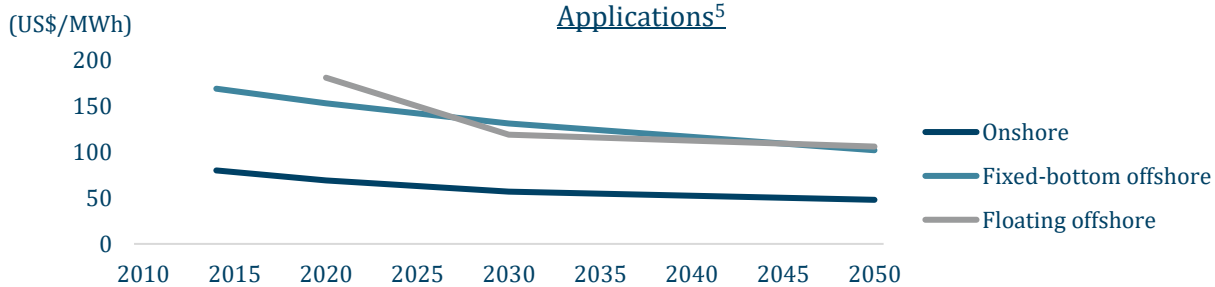
Historically public tax incentives, subsidies, FITs (feed-in tariffs) and other programs were key drivers for wind energy development. Now the industry is moving away from government subsidy schemes towards projects that involve private investment auctions. Wind prices declined by 49% between 2009 and 2016, and close to 68% on a LCoE basis, removing the need for public sector backstops.

LCoE by Geography and Energy (2017)<sup>4</sup>

(US\$/MWh)				
Wind	~60	~65	~65	~75
Solar	~70	~85	~70	~85
Natural Gas	~58	~52	~105	~81
Coal	~70	~55	~45	~42



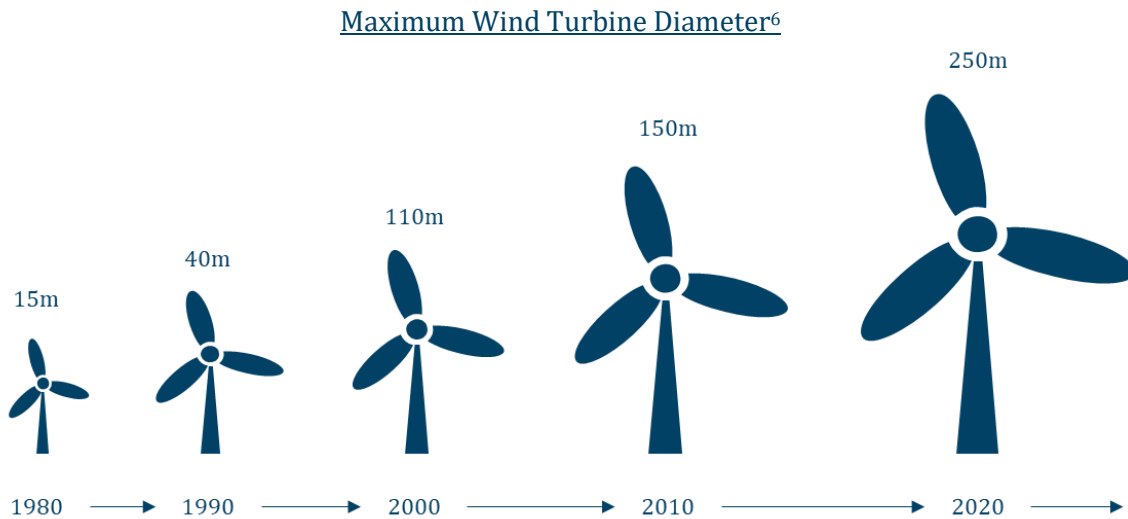
Expert Estimates of Median-Scenario LCoE for All Three Wind Applications<sup>5</sup>



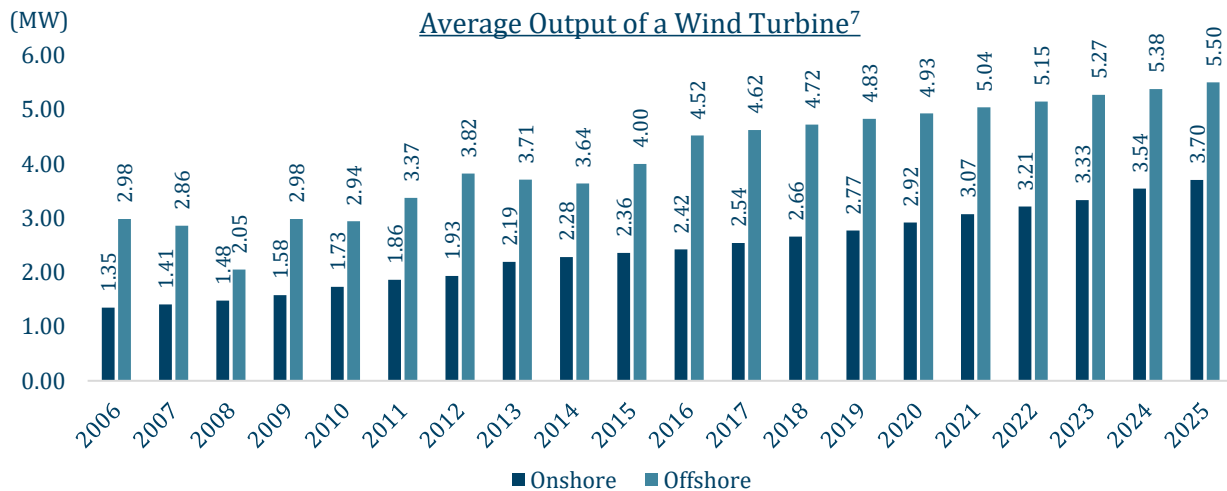
<sup>4</sup> J.P. Morgan, Alternative Energy 2018 Outlook, December 2017

<sup>5</sup> IEA, Forecasting Wind Energy Costs & Cost Drivers, June 2016

Another key factor behind the fall of the LCoE is the increased size of turbines and greater hub heights. Bigger blades allow wind turbines to increase the “capacity factor”, i.e. to produce more power per year at a given site. Bigger blades also enable wind farms to operate fewer turbines and thus lay fewer cables, thereby curbing construction and maintenance costs. “This helps the customers when they are competing at auctions to build offshore farms and enter the lowest bid per kilowatt-hour,” said John Lavelle, CEO of GE Renewable Energy’s Offshore Wind unit, which in March announced the launch of the Haliade-X, the biggest wind turbine ever built. Haliade-X has a 12MW generator and a diameter of 220m.



The bigger the blade, the higher the output of each wind turbine. The increasing size of wind turbines means that the access to technology, both to manufacture and to transport and install them, is of critical importance. Offshore wind turbines in particular need more advanced manufacturing and installation technology and knowhow.



These trends of greater energy production, a move to larger offshore installations that demand increasingly sophisticated technical solutions, provide fertile ground for future M&A. The first evidence of this can be found with the end turbine OEMs which are experiencing consolidation and increasing exposure to China. However, we predict that the entire ecosystem that supplies these turbine OEMs will also experience various forces of consolidation, specialization and internationalization. Below we examine the value chain and some salient recent developments.

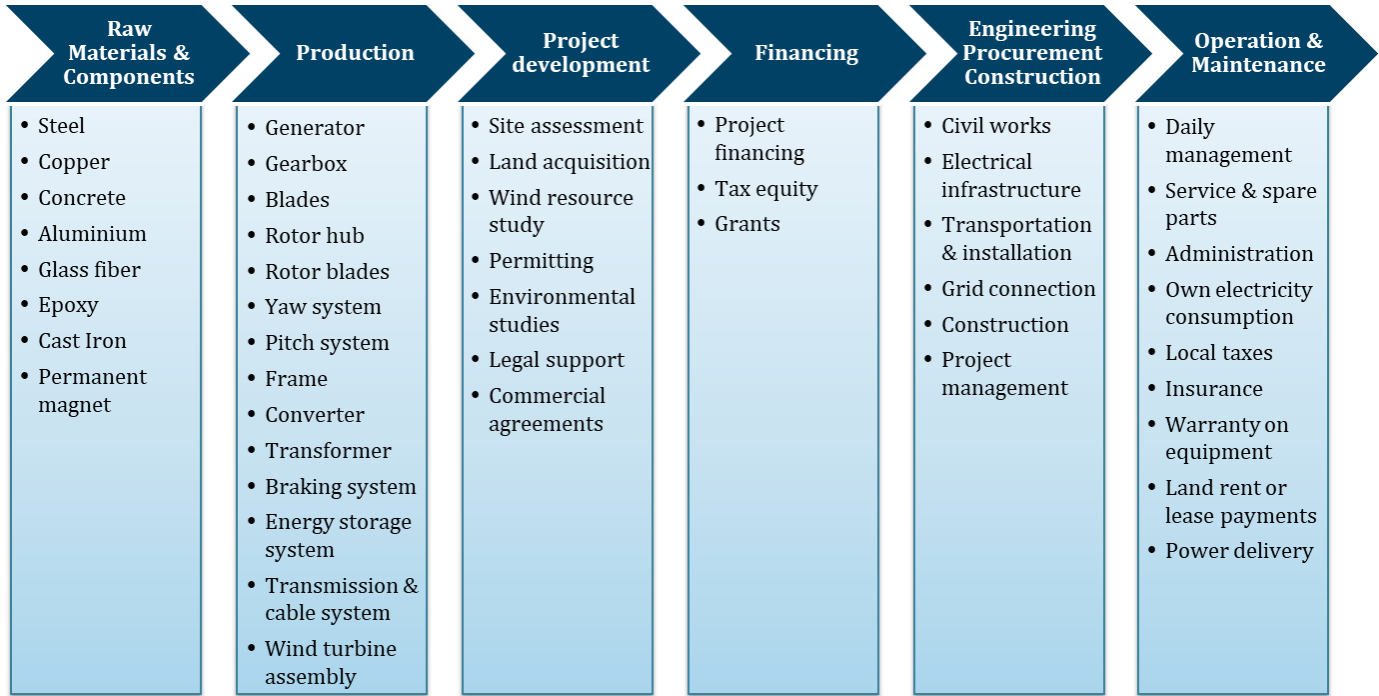
<sup>6</sup> European Wind Energy Association, Roland Berger

<sup>7</sup> Global Data, Wind Power Market, Update 2017



IV. Wind Market Structure & Players

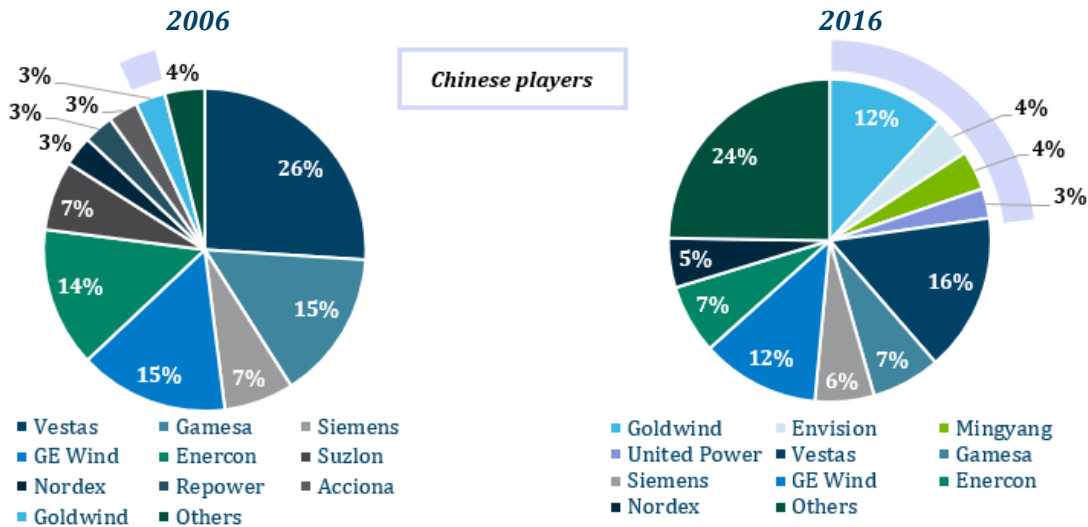
i. The Wind Power Ecosystem<sup>8</sup>



ii. Key Wind Turbine Manufacturers

From 2006 to 2016, the Chinese wind turbine players grew significantly and they now represent more than 25% of the market. Goldwind is the largest Chinese wind turbine firm, with a global market share of 12% in 2016. Putting aside GE in the USA, the world market is essentially divided between China and Europe. We expect that domestic Chinese turbine OEMs will continue to act as a “pull” on local suppliers and in time these suppliers will look internationally as seek to provide global solutions.

Global Wind Turbine Players, Market Share<sup>9</sup>



<sup>8</sup> Global Data, Wind Power Market, Update 2017

<sup>9</sup> BTM Consult ApS 2007 and Global Data, Wind Power Market, Update 2017

Key Players by Geography (2017)<sup>10</sup>**iii. Recent Consolidation of Turbine OEMs**

Since the 2001 Vestas and Gamesa JV, several medium-to-large-size transactions have been completed in the wind industry.

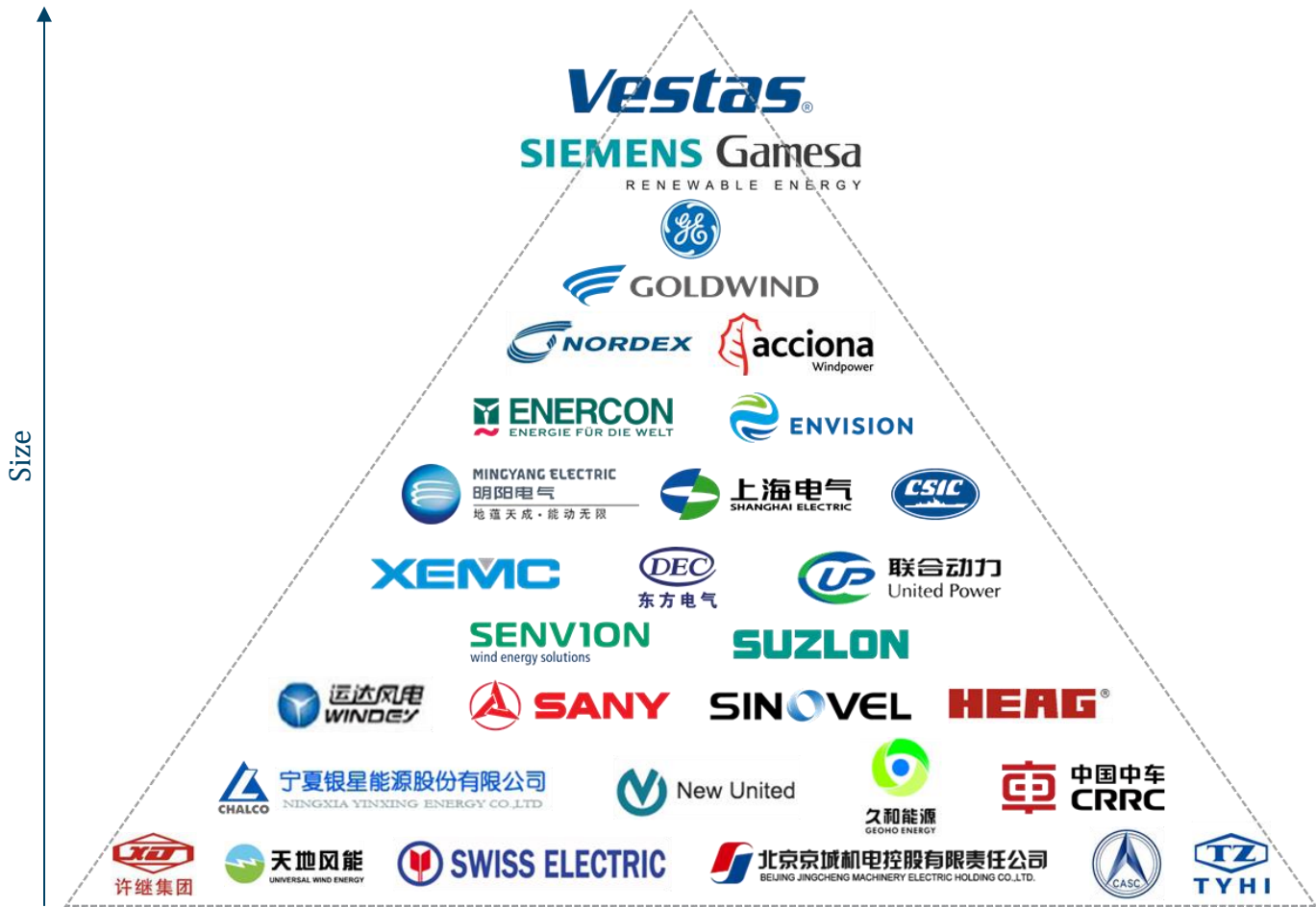
In April 2017, Siemens and Gamesa merged to become the second-largest wind turbine manufacturer in the world (after Vestas). The merger combines R&D capabilities, complements geographical presence and enlarges product portfolio and technologies. It also cut costs, making wind energy more competitive.

The transaction followed GE's acquisition of Alstom's energy business; Nordex's acquisition of Spanish-owned turbine manufacturer Acciona Windpower, and Senvion's takeover of Indian turbine maker Kenersys, all high-profile examples of the on-going consolidation in the wind turbine market. These deals are having a significant impact on the competitive landscape of turbine OEMs and represent the canary in a coal mine – a prelude to further M&A in the sector.

In China, the market exhibits pockets of fragmentation with 22 local turbine OEMs in 2016, of which the last five turbine vendors only accounted for less than 1% of local market share. Rapid growth in that market will entail further consolidation.

<sup>10</sup> Wind Power Monthly website, Top Ten Turbine Makers of 2017

Turbine OEMs Global Market Outlook in 2020<sup>11</sup>

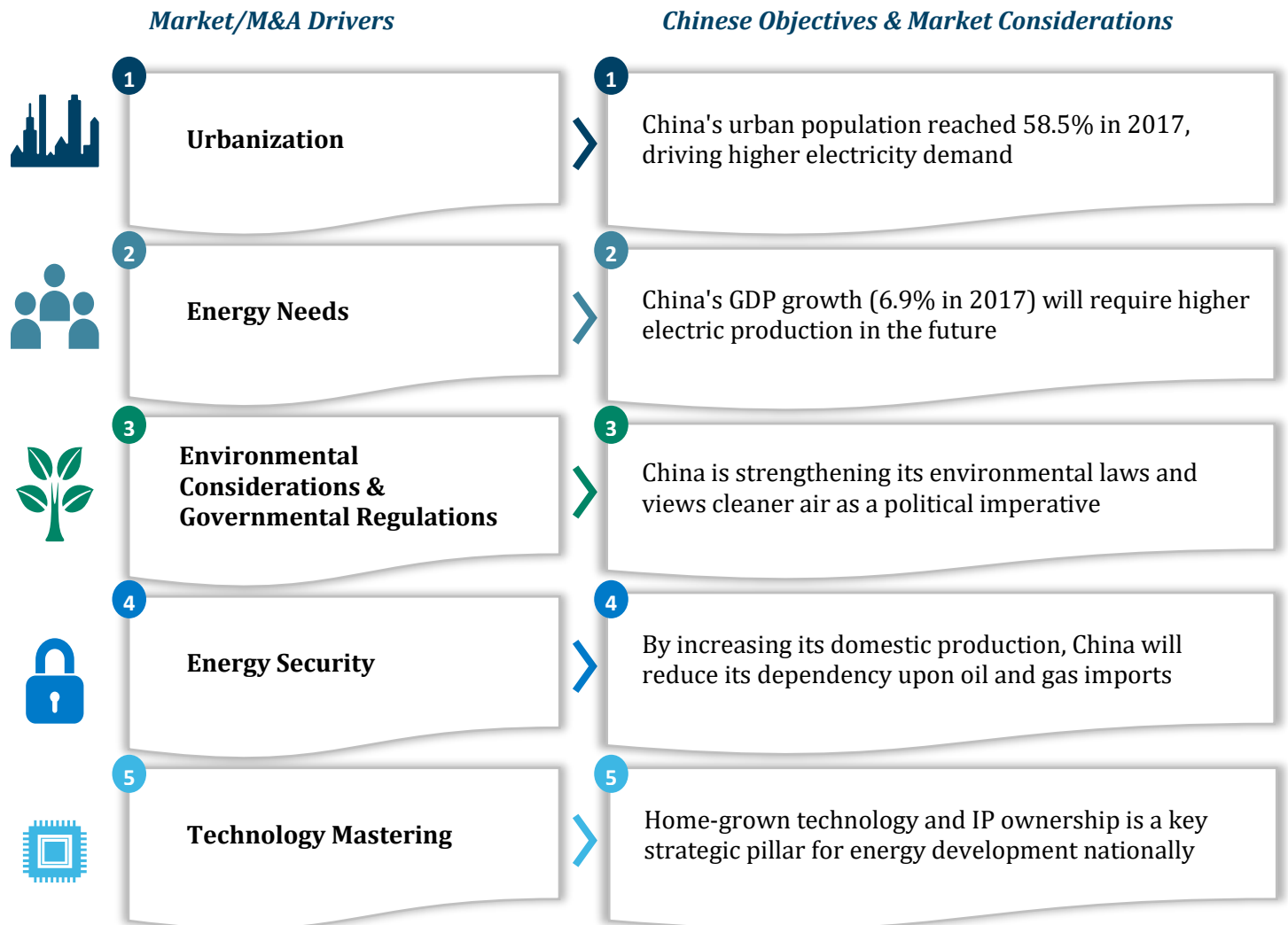


<sup>11</sup> FTI Intelligence, April 2016

V. Chinese Investment in Wind Power

Key Drivers for Chinese Wind Power Investments in Europe:

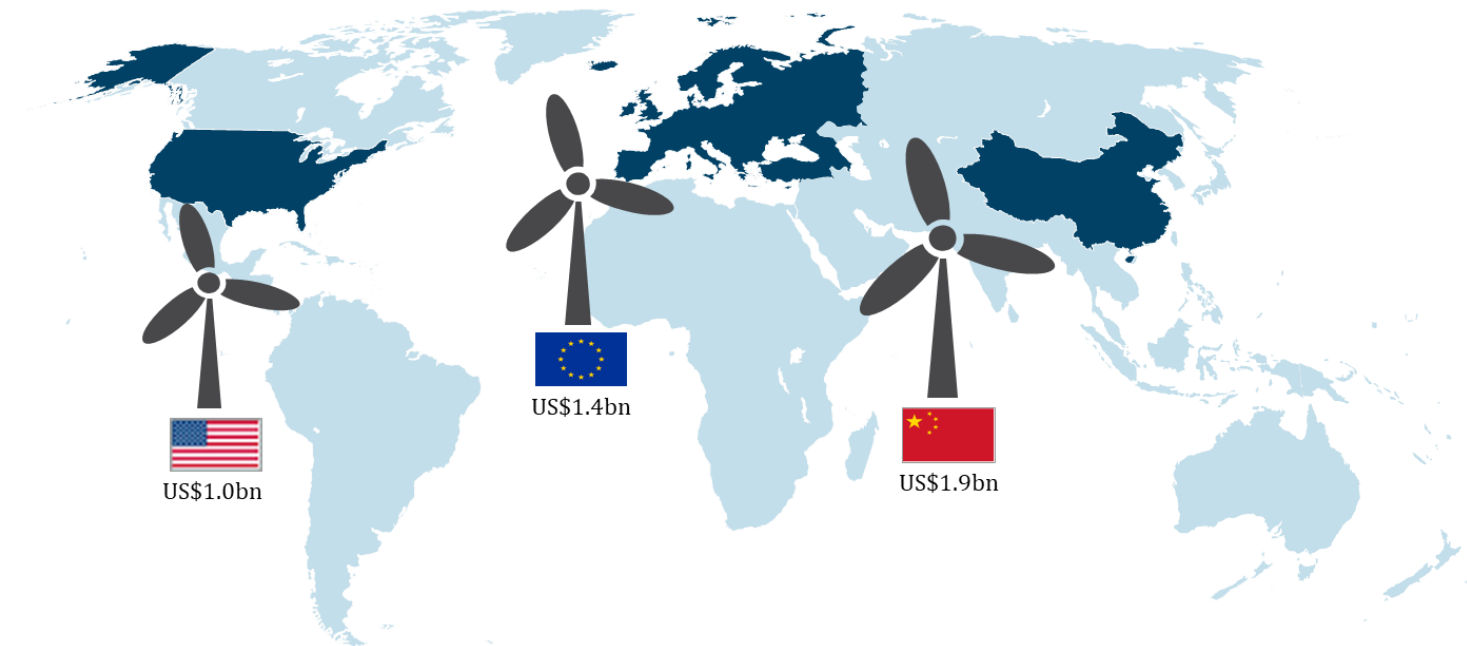
Having examined the various recent developments in the wind sector, we close this report by identifying nascent drivers for M&A in the two largest markets, China and Europe, with a particular focus on increasing Chinese outbound investment drivers into Europe.



*i. Government Support & Investment*

The Race for Renewable Energy Domination<sup>12</sup>

*Countries/regions with the highest governmental renewable energy R&D spending in 2016*



**Government Support & Investment**

The Chinese government announced at the start of 2017 that it would invest US\$377bn in renewable power generation by 2020. The government also encourages SOEs to enter overseas markets in order to acquire expertise in offshore wind. The target for the 2016-2020 Five-Year Plan for wind are:

- Onshore wind: 205GW
- Offshore wind: 5GW

**Energy Independence**

China sees diversified, sustainable energy production and reduced reliance on fuel imports as a strategic security imperative

**Greater International Influence**

As evidenced by China’s participation in the 2015 Paris Climate Agreement, wind power provides an extension of “soft power” in alternative energy

**Reducing Technology Gap in Offshore Wind**

China is attracted by Europe’s leadership in energy efficiency, technology and innovation

**Reducing Costs of Wind Energy**

There are important transportation and logistics constraints/costs as nacelles, blades and towers are too large and too expensive to transport. This increases the need for local presence and will drive M&A

**Market Consolidation**

Proximity to the wind farms is crucial – wind will remain a regional market. These challenges will also act as a driver for consolidation and cross-border M&A

<sup>12</sup> Frankfurt School – UNEP Collaborating Centre for Climate & Sustainability Energy Finance

*ii. Investing in Europe to Reduce the Technology Gap in Offshore Wind*

China's offshore wind sector still lags Europe's in grid connection, turbine model selection, wind farm location and turbine hub heights. Chinese companies such as Envision, Mingyang and Goldwind have established R&D centers in European countries, notably in Denmark, in an attempt to overcome this gap. Some have formed partnerships with European companies for technology transfer (Mingyang, Shanghai Electric, Envision and Zhejiang Windey with Aerodyn of Germany).

Others have taken the inorganic approach. In 2017, Goldwind acquired an additional stake (75% in total) in Best Blades GmbH, a German-based turbine-efficiency retrofitter. In August 2017, Goldwind also signed a letter of intent with the Sweden-based storage company SaltX, to develop a "solution for wind power with integrated energy storage".

Similarly, Envision invested in Sonnen GmbH in October 2016 and acquired Baze Technology AS, a Norwegian software company engaged in developing real-time information technology systems, in May 2016.



## VI. Concluding Thoughts

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A decade ago, solar power captivated Western imagination. Today the industry is dominated by China. Will the same forces exert themselves on wind power? Urbanization, energy consumption, environmental considerations, energy security and technology ownership still loom large for policy makers and private investors – however this time may be different: alternative energy has reached a critical tipping point and a wind tower cannot easily be boxed and shipped.

There is reason to believe that wind power, as a second act in Europe, will also benefit from longer-term strategic actions to maintain its status as a technology innovation hub *par excellence*. Nonetheless, the recent cross-border forces that have been unleashed will be hard to contain. As this report demonstrates, the stage is now set for increasing cross-border consolidation, investment and innovation. Watch this space.

## BDA Contact



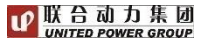
















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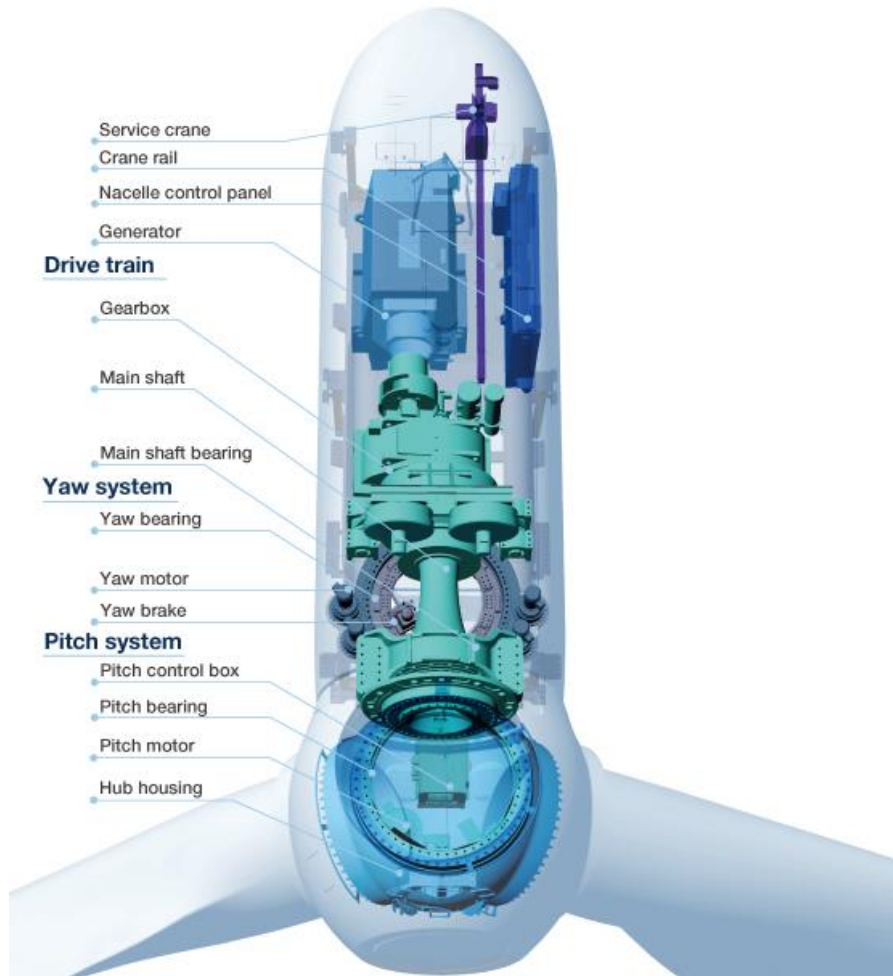
## Appendix

## i. Largest Wind Turbine Manufacturers

Company	Country	Installed Capacity in 2016 (GW)	Overview	Financials (US\$m)
 GOLDWIND		38	<ul style="list-style-type: none"> <li>- China's most active OEM overseas.</li> <li>- Its American subsidiary won a 1.9GW deal in Wyoming in 2017, due before 2022.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 3,970</li> <li>- EBITDA: 699</li> <li>- Market Cap: 9,853</li> </ul>
 联合动力集团 UNITED POWER GROUP		17	<ul style="list-style-type: none"> <li>- SOE leading supplier of total solutions for wind turbine generator systems.</li> <li>- Standard offering is 1.5MW turbine with a 86m rotor diameter, designed by German-based Aerodyn Engineering.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 2,000+</li> </ul>
 ENVISION		9	<ul style="list-style-type: none"> <li>- One of the world's largest smart energy management companies, specialized in wind turbines.</li> <li>- Has teamed up with Microsoft and Accenture to develop an IoT program.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 1,047</li> </ul>
 MINGYANG WIND POWER PERFORMANCE BY NATURE		10	<ul style="list-style-type: none"> <li>- Largest private wind turbine manufacturer in China.</li> <li>- R&amp;D offices in Asia, Europe and North America</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 1,074</li> <li>- EBITDA: 69</li> <li>- Market Cap: 401</li> </ul>
 Vestas®		823	<ul style="list-style-type: none"> <li>- World's largest wind turbine manufacturer.</li> <li>- Wind turbines installed in over 76 countries.</li> <li>- MHI Vestas JV is the largest offshore wind turbine manufacturer.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 12,229</li> <li>- EBITDA: 1,850</li> <li>- Market Cap: 14,352</li> </ul>
 SIEMENS Gamesa	 	75	<ul style="list-style-type: none"> <li>- Second-largest wind turbine manufacturer after the merger of Siemens and Gamesa in April 2017.</li> <li>- The two businesses complement each other in terms of product offering, global reach and R&amp;D capabilities.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 10,711</li> <li>- EBITDA: 733</li> <li>- Market Cap: 10,773</li> </ul>
 ENERCON ENERGY FOR THE WORLD		44	<ul style="list-style-type: none"> <li>- Operates as an independent conglomerate</li> <li>- Market leader in German</li> </ul>	<ul style="list-style-type: none"> <li>~6,900</li> </ul>
 NORDEX We've got the power.		22	<ul style="list-style-type: none"> <li>- Global manufacturer of multi-megawatt wind turbines.</li> <li>- Expanding its service division (up 24% in 2016).</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 4,147</li> <li>- EBITDA: 298</li> <li>- Market Cap: 1,043</li> </ul>
 SENVION wind energy solutions		15	<ul style="list-style-type: none"> <li>- Manufacturer of onshore and offshore wind turbines</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 2,379</li> <li>- EBITDA: 148</li> <li>- Market Cap: 759</li> </ul>

		<p>60</p> <ul style="list-style-type: none"> <li>- Manufacturer of onshore and offshore wind turbine platforms and technology, part of the US\$121bn revenue GE group.</li> <li>- By 2020, it aims to install 50GW of new wind power.</li> <li>- In May 2017, announced order of ~200MW for projects in China.</li> <li>- In March 2018, announced the launch of Haliade-X, the largest wind turbine ever built</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue from wind: 9,167 (10,300 for the renewable energy segment)</li> </ul>
		<p>16</p> <ul style="list-style-type: none"> <li>- One of India's largest renewable energy solutions provider, providing wind turbine generators and related components.</li> <li>- A market leader in India with 100+ wind farms with an installed capacity of over 11 GW spread across all wind rich states.</li> </ul>	<ul style="list-style-type: none"> <li>- Revenue: 1,699</li> <li>- EBITDA: 220</li> <li>- Market Cap: 956</li> </ul>

ii. *Composition of a Wind Turbine Nacelle<sup>13</sup>*



<sup>13</sup> Hitachi, [www.hitachi.com/products/power/wind-turbine/feature/nacelle/index.html](http://www.hitachi.com/products/power/wind-turbine/feature/nacelle/index.html)

