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Wind Power in 2020s Must Focus on Capability, Not Cost

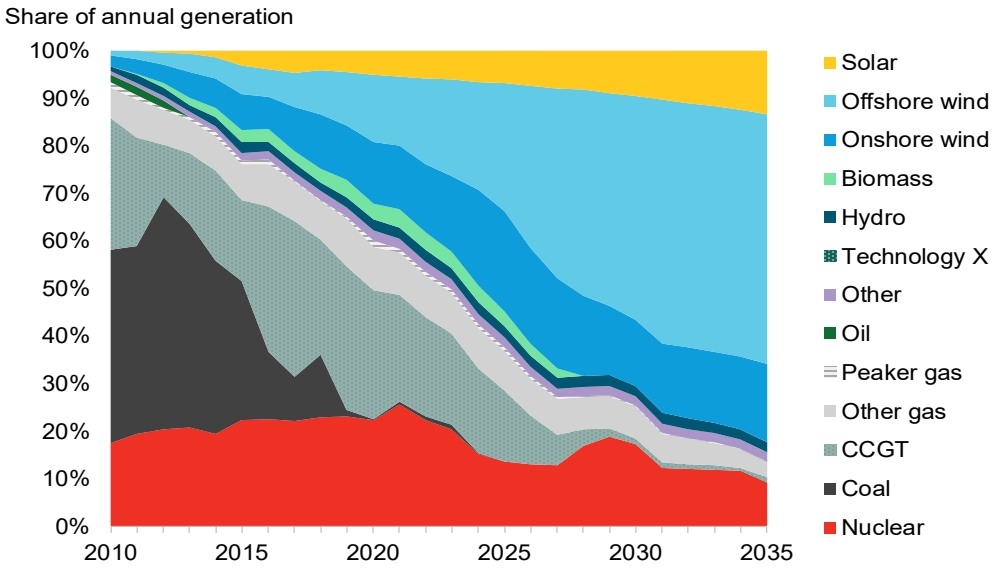
As wind becomes the incumbent technology in many markets, it will shoulder greater power system responsibilities, and face scrutiny over its sustainability. Offshore wind is coming of age, as countries across Asia and the Americas seek to replicate Europe's booming market. The competitive landscape, and how these companies make money, is also changing. The BNEF wind team sat down in April 2021 to discuss these industry trends and more.

1. Wind's role in the future power system

Logan Goldie-Scot: In 2020, wind installations shot up 59%, with almost 100 gigawatts installed worldwide. The sector is on track to become a dominant power supply technology on many grids, making it a great time to sit down with the BloombergNEF wind team to hear about what we should be looking out for. Sanjeet, a lot of your experience since you joined BNEF has been on power systems and networks. In your new role as head of wind, how are expectations changing about how wind power should perform in an integrated power system?

Sanjeet Sanghera: Wind energy is on the road to incumbency. For example, in the U.K. there is 13GW of onshore wind and 10GW of offshore wind today. An additional 10GW of offshore wind is either in construction or in permitting. This amounts to about 33GW of wind on a system that has roughly 45GW of power demand at peak. When we break this out hour-by-hour, by 2025, we start to see periods where the U.K. grid is entirely supplied by clean power. If you fast forward to 2035, those periods are going to be commonplace and as that happens, the role of the wind turbine really needs to evolve.

Figure 1: U.K. generation outlook



Source: BloombergNEF Note: Technology X refers to a carbon-free alternative to gas. Scenario based on 2021 U.K. Power Market Outlook (web | terminal).

40GW

Wind capacity due to reach end of design life by 2030

96.7GW

Global wind capacity commissioned in 2020

94%

Market share of top five turbine suppliers in 2020, excluding China

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Today, the wind industry is focused on cost and not capability, but that needs to change.

Each year, as we successively commission more wind turbines, we are also decommissioning many conventional power plants. The reality is that these conventional power plants were doing most of the heavy lifting on the power system. They were providing a range of grid services such as voltage control, fault current, and black-start capability. The upside is that wind turbines could actually provide many of these services one day. They have the technical capability – there are pilot projects across Europe, Canada, and Australia where turbine manufacturers have proven this. Unfortunately, the incentives aren't there for developers to deploy these at any real scale beyond pilots. Today, the wind industry is focused on cost and not capability, but that needs to change over time.

Logan: In this future clean power system, does wind do more heavy lifting than solar or are responsibilities and capabilities shared evenly across the two technologies?

Sanjeet: Perhaps I am a bit biased, but I do think that wind has more to offer here than solar. Both wind and solar connect to the grid using inverters that in the future will become smart inverters and provide a range of services on their own. The added benefit of a wind turbine is that it still has a spinning component. Our 60 Hertz or 50 Hertz system is built on this principle of having something spinning. Wind turbine manufacturers are able to leverage the spinning inertia within the turbine blade to provide some services like fast frequency response without having to pre-curtail power generation. This is something that solar cannot do.

Logan: What is the cost associated with all of this, and how does it affect the cost competitiveness of wind energy?

Sanjeet: Adding capability to a wind turbine will add to the cost. Meaning higher capital expenditures and potentially a higher levelized cost of energy. A slowdown in cost reductions for wind turbines isn't a totally disruptive idea. The pace of cost reductions is already slowing down for onshore wind turbines. From 2025, we will start to see the emphasis shift toward turbine capability and away from cost-competitiveness. As power grids all over the world start to wrestle with hours, days and weeks of high renewables, change will need to follow. This may come in the form of stricter grid codes or revenue incentives from ancillary service markets.

2. Implications for wind's aging asset base

Logan: So, wind is on the path to incumbency and it has also been around for longer than most other clean power technologies. What are the implications of this ageing asset base?

Oliver Metcalfe: Wind was one of the first clean energy technologies supported at scale, starting back in the 1980s. The upshot is that many turbines in early markets have reached the end of their design life, which is usually 20 years. Owners have to make difficult decisions about what to do with those assets, deciding whether they can eke out additional revenues or whether they will have to start thinking about decommissioning costs. We estimate around 4GW of projects reached that 20-year lifetime point in 2020 alone around the world. That will balloon to almost 40GW by 2030.

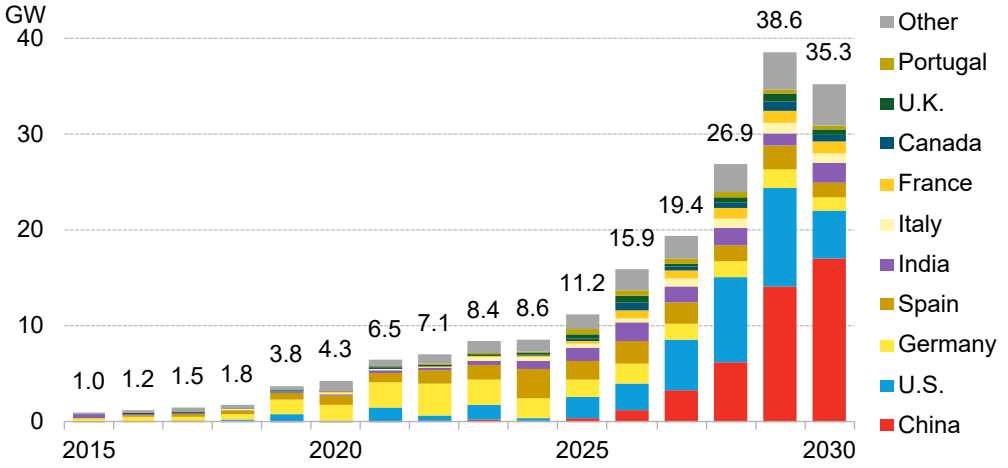
Around 4GW of wind projects reached their twentieth year of service in 2020 alone. That will balloon to almost 40GW by 2030.

Logan: Where is the problem most evident today and will that stay constant over the next decade or so?

Ollie: So the three big ones are Germany, Spain, and the U.S., and that will stay constant over the next few years. From 2025, we will see assets reach that end-of-lifetime point in many more countries including the U.K., France, Italy and even India.

Asset owners are making different decisions about their aging fleet, depending on the subsidy schemes that are in place and the regulatory framework

Figure 2: Onshore wind capacity reaching the end of its 20-year design life



Source: BloombergNEF Note: Repower or Life Extend: Wind's Retirement Plan (web | terminal)

Asset owners are making different decisions across markets, depending on the subsidy schemes that are in place and the regulatory framework. The cheapest and easiest option is what we call lifetime extension. This involves a few safety checks, structural checks of the turbine tower and foundation and then running your turbine for as many years as possible. If you invest a little bit more, then owners can opt for repowering. This involves upgrading the turbine technology at project sites. This comes in two forms – partial or full repowering. Developers in the U.S. favor partial repowering projects due to tax incentives. This involves adding longer blades onto a turbine, which can capture more energy at low wind speeds, and upgrading some of the equipment in the turbine nacelle, but leaving the structural elements intact. In a full repower, you rip out all the old turbines and install new modern machines in their place. This means a new tower is needed and often new access roads and electrical infrastructure as well. It the most capital-intensive option but attractive in markets with limited site availability.

Isabelle Edwards: You would think that these sites are a bit of a headache for project owners, but many often come with strong wind speeds. This is attractive to investors looking for new projects in saturated wind markets, or where permitting restrictions are halting the development of greenfield sites. Project developers typically sell their assets to investors during construction or commercial operation, but they are now returning to the scene at a later stage, as buyers of mature projects, For now, projects which have surpassed ten years of operational life account for about 5% of acquisition volumes each year.

There is still no commercially viable way to fully recycle the composite materials like glass fiber in blades

Logan: Oh, fantastic. So changing scale, technology and perhaps owner profile. Whether at repowering or at decommissioning, what happens to the discarded items? Our colleagues from Bloomberg Green put out a piece last year on sustainability challenges associated with blades. Does wind have a sustainability problem?

Ollie: If you think about the recyclability of an entire wind farm, almost all of the project components are recyclable. The problem really boils down to the blades. There is still no commercially viable way to fully recycle the composite materials like glass fiber in blades. At the moment, these materials have to be down-cycled, (meaning used in less valuable applications) or sent to landfill.

There has been some progress on this front. Major asset owners are forming partnerships across the industry. Asset owners, turbine makers and academic institutions are working together to improve the commercial viability of recycling technologies. Vestas recently announced it is three years from commercializing a blade recycling technology. Blades can be used as part of building materials or as a feedstock for cement. Even for making park benches in Denmark, or children's playgrounds. So people are getting creative, but this won't be an option for all demand.

Wind is also not the only industry facing challenges with this type of materials. The boating industry uses a huge amount of glass fiber as well. If a company is able to create a viable recycling alternative then the potential opportunity stretches beyond the wind industry.

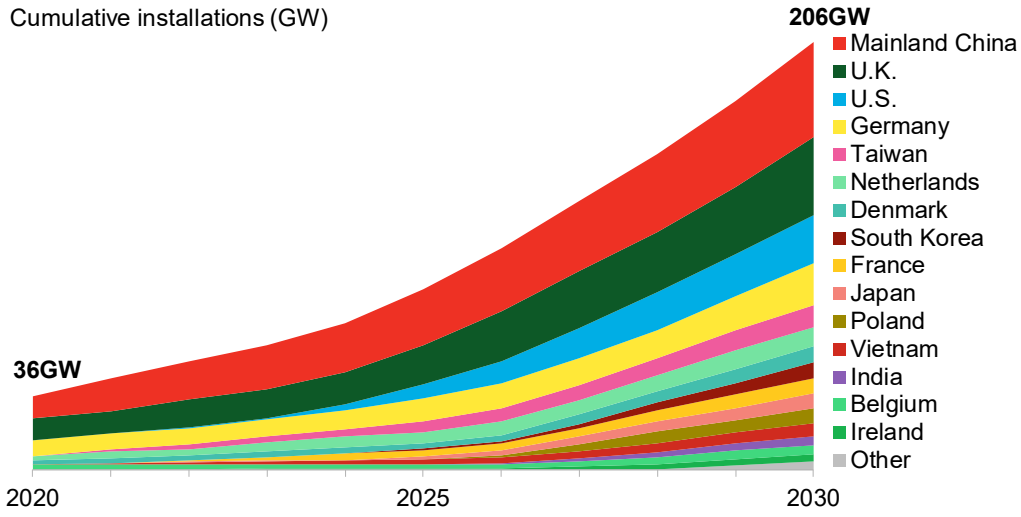
3. Offshore wind reaches the tipping point

Logan: A shameless pivot here from boats to offshore wind. Why is it the space to watch?

We are projecting about a six-fold growth in offshore wind from 30GW today to more than 200GW by the end of the decade

Imogen Brown: Offshore wind is a very exciting sector for us. We are projecting about a six-fold growth from 30GW today to more than 200GW by the end of the decade. Much of the momentum will come from new markets, particularly in Asia. Any market with a coastline is now considering offshore wind. This is a sharp contrast to when the industry was concentrated in a handful of European countries. The U.S. has also committed to longer-term targets for offshore wind.

Figure 3: Cumulative offshore wind installations



Source: BloombergNEF Note: See 2H 2020 Offshore Wind Market Outlook (web | terminal)

A key driver is that bulk decarbonization requires a lot more green electrons and offshore wind projects are huge, typically gigawatt-scale as opposed to the onshore projects, which often are only a few hundred megawatts. These projects are larger and can also access high wind speeds at sea, meaning they generate huge amounts of electricity.

Logan: What has held back offshore wind until now?

Imogen: It is more expensive to build and operate offshore rather than onshore wind. You need huge ships, to coordinate many more contractors offshore and in general, it entails expensive logistical arrangements. The upfront equipment costs are also higher. However, this is being driven down on a per-megawatt basis as the turbines get bigger.

Logan: Is the current surge in uptake due to falling costs or because there is growing appreciation for offshore wind's other attributes?

The biggest driver for cost reductions in offshore wind is the scale up to bigger turbines

Imogen: It is both. Costs are coming down across the board and offshore wind is more attractive as a source of bulk clean generation on the path to net zero. The biggest driver for cost reductions in offshore wind is the scale up to bigger turbines. For a typical offshore project, the turbine will account for up to 50% of the total capex. Bigger turbines means fewer turbines for a project of the same capacity. Which mean fewer foundations, array cables and fewer trips off shore.

Many nations are stepping up to think about reaching net-zero emissions. They appreciate that they need to decarbonize quickly and offshore wind provides large scale and renewable bulk generation.

Logan: Due to relatively long development lead times, we already have a clear(ish) idea of the offshore pipeline up to 2030. What comes next?

Imogen: Typical development timeframes for offshore wind projects are between six to 10 years. We pretty much know that 200GW or so will get built out to 2030. New offshore wind markets will emerge, often aligned with net-zero goals. We are also seeing some exciting new technologies crop up.

The industry has focused around bottom-fixed foundations turbines that are secured to the seabed. Floating wind technology, which is essentially a turbine on a boat pushed out to sea, means you can access deeper waters and that unlocks new markets.

Offshore wind can also be used to produce hydrogen, which further strengthens the deep decarbonization opportunity.
Hydrogen from Offshore Wind: A Primer (web | terminal)

Offshore wind can also be used to produce hydrogen, which further strengthens the deep decarbonization opportunity. There are already some demonstration projects popping up but there are many unknowns. Should the hydrogen be produced onshore or offshore? How do you transport your electricity or hydrogen to shore, and what is the cheapest option?

Sanjeet: Hydrogen and offshore wind could have a symbiotic relationship. Network congestion is a concern for many power networks, which can make it hard to integrate offshore resources. Co-location of an electrolyzer with an offshore site can make use of the energy even when there is congestion on the network. There is a huge value add when you're able to capture that wind and do something useful with it, as opposed to effectively spill that energy and not generate any power.

4. U.S. makes a big splash in offshore wind

Logan: Let's take a step back and look at some of these new markets. The offshore wind market in the U.S. appears to be gaining momentum. Is that a fair assessment?

The U.S. offshore wind market has had a lot of false starts and delays, but it does finally look like it's picking up

Chelsea Jean-Michel: The U.S. offshore wind market has had many false starts and delays, but it does finally look like it's picking up. In the past, the federal permitting process was quite complex and inefficient. When we look at Cape Wind, there was an incredible amount of stakeholder pushback. States didn't have clear targets and there was a lack of clear offtakers. When we look at targets today by comparison, New York has a target for 9GW by 2035, New Jersey has 7.5GW by 2035 and Massachusetts recently increased its target to 5.6GW. These big targets attract offtakers and secure revenue.

The Northeast was a natural starting point for offshore wind in the U.S. The region boasts high wind speeds so can realize great capacity factors, and the seabed is relatively shallow so you can use bottom-fixed foundations. Many northeast states also have decarbornization targets that help.

The generation profiles also align nicely with high winter power prices caused predominantly by natural gas constraints.

The Biden administration has set an ambitious offshore wind target of 30GW by 2030 and is pushing a host of initiatives to speed up the federal permitting and leasing process. Activity across the Northeast has got other states thinking about entering the industry and now we're seeing state targets pop up on the West Coast in California and Oregon, as well as in some floating markets up in the Northeast, like New Hampshire. Deeper waters mean floating wind is needed there. Yet, it is a pretty nascent technology, which will add to the project timelines.

Logan: This all sounds fairly rosy. What are the big hurdles ahead or reasons for pessimism over the coming months or years?

It can take eight years from when a lease auction is held to when a project is built

Chelsea: Permitting, which is handled by the Bureau of Ocean Energy Management or BOEM in the U.S., has been a major constraint in the market. If everything goes smoothly, it can take eight years from when a lease auction is held to when a project is built. So speeding up the permitting process is key to getting projects already in the pipeline up and running. In newer markets, states will need to identify suitable areas for leasing as well as further develop floating wind as a technology.

5. Competitive dynamics evolve among turbine makers

Logan: Almost 100GW of onshore wind was added last year and the offshore wind market is expected to exceed 200GW by 2030. What are the mix of companies supplying turbines to these projects?

Issy: The market for turbine supply has changed quite a lot over the past five to 10 years, often depending on whether onshore or offshore was booming. Last year, the onshore wind market increased by 69% and that boosted capacity manufacturing for onshore wind turbines. In years where offshore wind has had a bigger presence, it has been a different story.

Five manufacturers accounted for 94% of all wind turbine installations outside of China in 2020

It also depends on where in the world you look. Outside of China, there are about five major players, down from about 10 in 2015. This includes leaders like Vestas, GE, and Siemens Gamesa. There has been significant M&A activity in this space in recent years and last year just five companies accounted for 94% of all installations outside of China.

There is little room for further consolidation among the remaining players, but it will be interesting to see how the smaller players respond since they risk being priced out the market. Senvion and Suzlon together accounted for 10% of installations in 2017 and that fell to just 2% last year. In 2019, Senvion filed for insolvency and Siemens Gamesa was able to acquire its service portfolio, which is a high-margin business compared to wind turbine sales, and its intellectual property and manufacturing facilities. So it looks like the players will stay the same for now, although there is still room for the big companies to continue to get bigger.

Logan: How much work remains to be done to level out the playing field among the remaining suppliers?

Issy: Outside of China, the three biggest players are GE and Vestas – which both installed over 12 gigawatts each in 2020 – plus Siemens Gamesa, which installed more than seven gigawatts. There is then a sizable gap to Nordex, Acciona and Enercon, which each installed less than 3.5 gigawatts last year. Both of these companies saw strong year-on-year growth in installations, but they have quite a lot of catch-up to do in order to keep competing with the bigger players.

Ollie: There is a gap here between companies with a global versus regional reach. The smaller firms focus on a narrower set of markets and are less able to ride the policy ups and downs in their markets. Compared to firms with global sales that are more sheltered.

Issy: Enercon is a really interesting example here. It previously relied on continued growth in its home market, Germany, for new turbines sales. But this strategy saw its installations in 2019 fall by 50% year-on-year. Last year, its largest market was Turkey, and in the last quarter of 2020, Enercon booked a 400MW turbine order for projects in Vietnam. So, we are seeing a move toward a more global pipeline, although it is too early to say if it will be enough.

Turbine size is key for manufacturers to maintain or growing market share over time

Turbine size is key to maintaining or growing market share over time. We are seeing a big step-up in the size of turbines being installed today. Last year there were about 8GW of turbines larger than 4MW installed worldwide. This year that is set to grow to more than 13GW, accounting for 20% of expected installations this year, compared to only 10% last year. Right now, only a few turbine makers have these larger models in their line-up, including the Enventus turbines from Vestas and GE's Cypress platform.

Logan: The market share increased faster there than the absolute numbers. That implies a shrinking market year-on-year. Why is this?

China added 57.8 gigawatts of new wind capacity last year, including 53.8 gigawatts of onshore wind

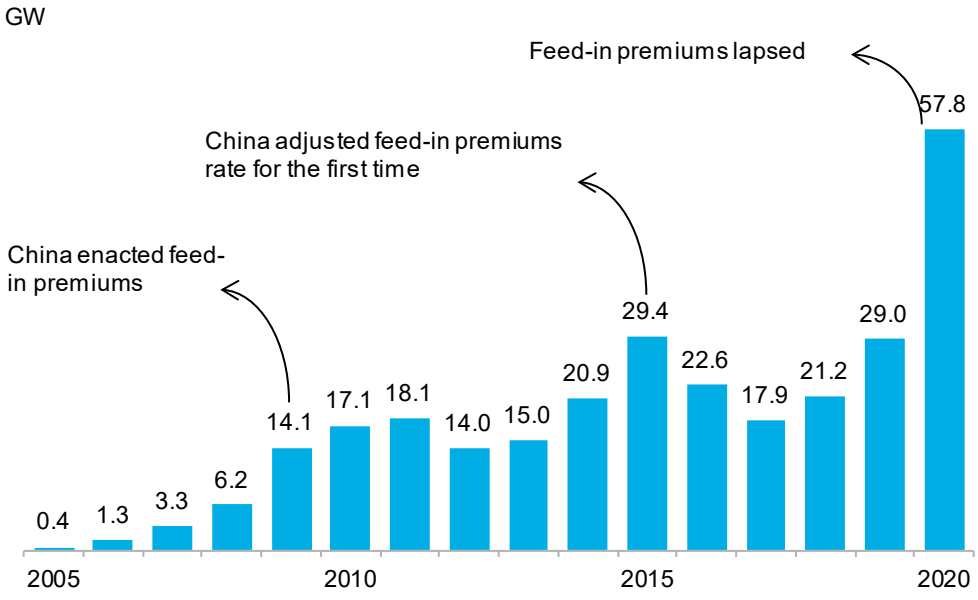
Leo Wang: China is a big part of the reason. China added 57.8 gigawatts of new wind capacity last year, including 53.8 gigawatts of onshore wind. That was 100% higher than China's 2019 annual installation number, which in itself was a bumper year. It is also only two gigawatts short of total global installations in 2019, which helps put an extraordinary year into perspective.

Logan: Wow, so a huge year for wind in China and globally. Why the sudden flurry of activity?

Leo: The feed-in premium – the subsidy scheme in China – has done a really good job of supporting wind installations. It wrapped up at the year-end of 2020 and many developers rushed to commission projects, resulting in the record year. The driver is now changing from the subsidy to climate policy. In September 2020, China's President Xi Jinping announced a nationwide carbon neutral target by 2060. China has around 2,200GW of capacity including coal, gas, nuclear, hydro, wind and solar. Wind today makes up around 13% of total capacity in the country. So there's lots of room for growth there.

Over the coming years, domestic demand will be driven by the government push to increase renewables penetration. That will play out at the national level, but local government and state-owned developers will play an important role too. In China, state-owned companies were investing in 60 to 80% of wind farms coming online each year, and this is likely to rise further in the coming years. Deep pockets, access to cheap financing and improved relationships with government will allow state-owned developers to build wind farms at a large scale, which matters even more in the absence of the subsidy scheme. They have a key role to play in helping China reach its decarbonization targets.

Figure 4: China annual wind installations, 2005-20



Source: BloombergNEF

6. Wind's supply chain continues to be tested

In China, construction crews worked close to 24-hour days to deliver projects on time

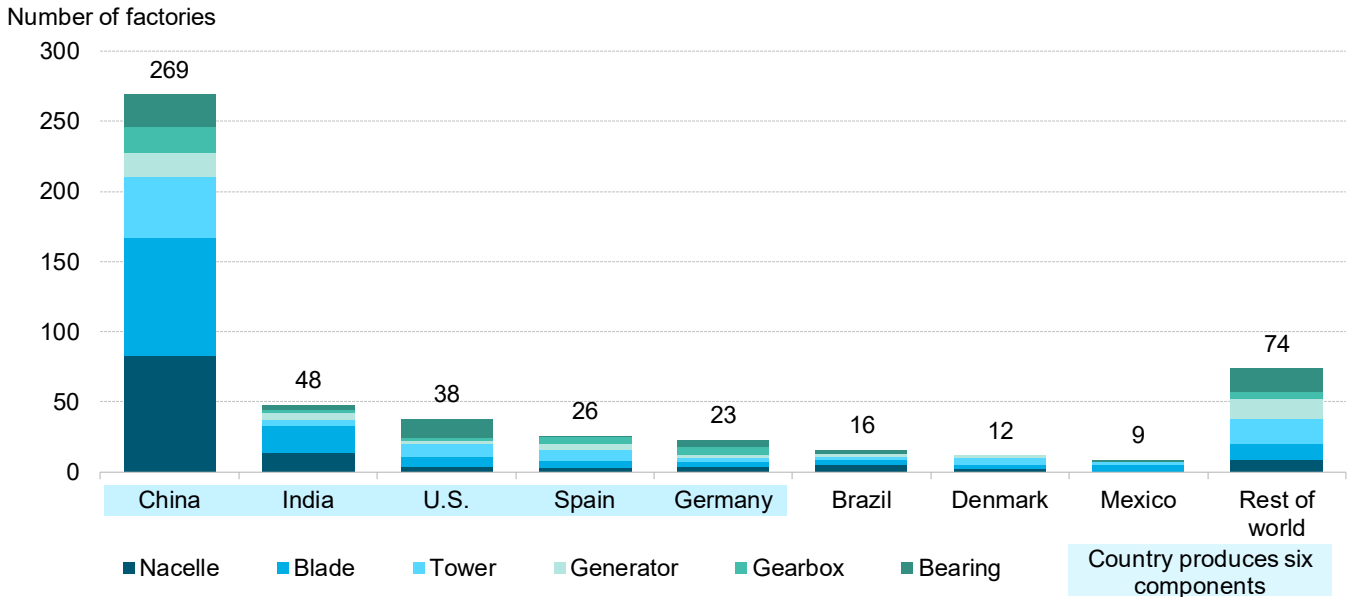
Logan: The industry needs to scale quickly to keep pace with accelerating decarbonization targets. Will the wind supply chain be able to keep up with demand?

Ollie: 2020 provides us with an amazing example of how responsive the supply chain can be when required. In China, there was such a large volume of installations that construction crews worked close to 24-hour days to deliver projects on time. The volumes surprised the industry there but, given enough warning, I wouldn't underestimate its power to scale.

Logan: Where are all the different pieces of the wind supply chain made today?

Leo: Today's global wind supply chain comes from four major regions: Europe, India, China, and the U.S. Each of these regions can essentially produce all the major components in a wind turbine. These are nacelles which house all the equipment, the blades, generator, gearbox and bearings. Each component has a slightly different distribution pattern. Nacelles, blades and towers are large and so are typically located near where the demand is, whereas gearboxes, generators and bearings are easier to transport so there is more of a global trade for them.

Figure 5: Number of onshore wind factories, by country



Source: BloombergNEF Note: Global Wind Supply Chain Footprint (web | terminal), Wind Trade and Manufacturing: A Deep Dive (web | terminal)

We expect this dynamic to remain largely the same for the next couple of years. With newer, emerging markets and local content requirements, there will be a push for supply chain companies to set up new factories in the U.S., Taiwan, Korea or Japan. They can benefit from lower transportation costs as well.

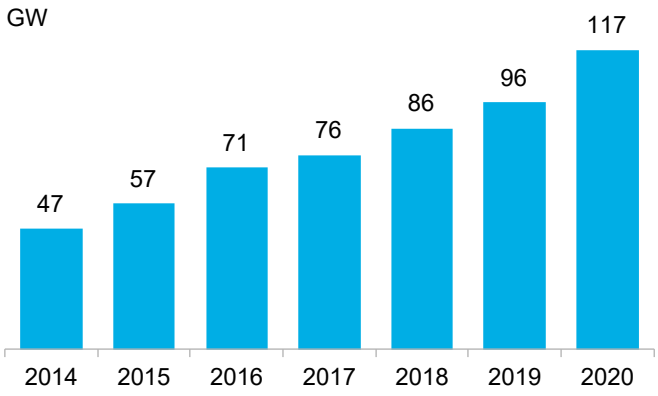
Companies are also building new factories in China even though there is sufficient capacity to meet current demand. A motivation here is to curry favor with developers and local government. Setting up local supply chains improves the chance of securing future orders from these customers.

Vestas' operating profit from the service business surpassed the operating profit from turbine sales for the first time since 2013

Imogen: Much of today's focus is on selling turbines. That is clearly a big part of the business but service contracts are also growing in importance. A key differentiator between turbine makers is the quality of their servicing product. The margins on these is much greater than those for the upfront turbine sale and this will be an increasing focus for leading manufacturers going forward.

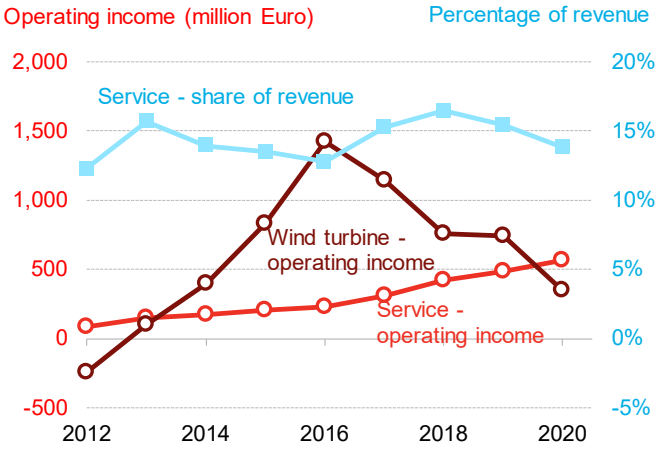
Ollie: Vestas provides us with a couple of good examples on this front. Last year, it reached 100GW of turbines under service, and for that, it was not just Vestas turbines in the mix. Companies are increasingly willing and eager to offer service contracts on competitor machines. Vestas' operating profit from the service business also surpassed the operating profit from turbine sales for the first time since 2013.

Figure 6: Vestas wind capacity under service contracts



Source: Company filings, BloombergNEF

Figure 7: Vestas' operating income and share of revenue by segment



Source: Company filings, BloombergNEF

Imogen: Developers of onshore projects are signing long-term service agreements with wind turbine makers but the opposite is happening for offshore projects. There, many developers are taking operations in-house rather than contracting them out to the turbine supplier. This relates to cost cutting – many asset operators consider they have the capabilities to do this more cost effectively in-house. Part of this may also be due to spatial differences between on- and offshore wind. In offshore wind, you can achieve a clustering effect for projects close to each other where one operation base can serve multiple assets and multiple gigawatts. This is much harder if you are trying to service two onshore wind projects, in Spain for instance, at opposite ends of the country.

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