A rapidly developing supply chain – what is the key to success?

WIND ENERGY DENMARK 2021

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Wood Mackenzie

A Verisk Business

Energy Transition Research Offerings

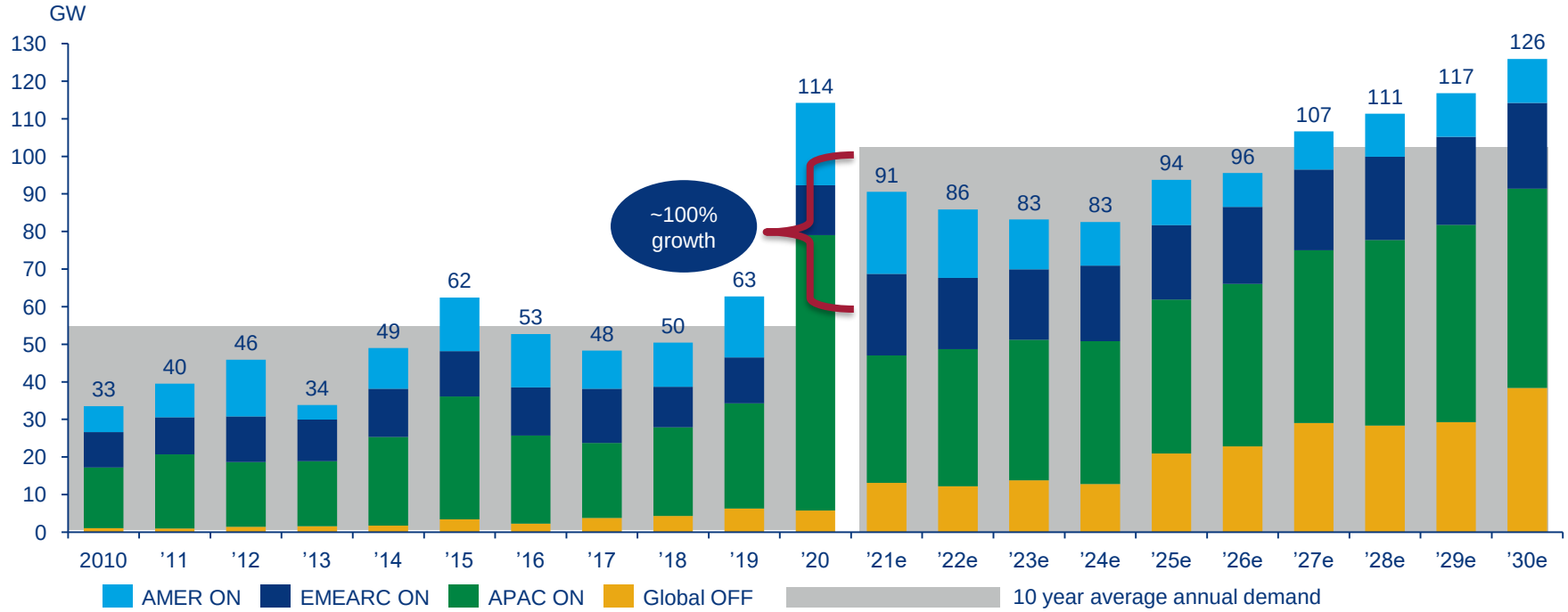
We focus on the critical intersections of technologies, policies and actors reshaping the energy landscape

	Supply Chain	Technology, Systems & Operations	Market Dynamics	Integrated Power Outlooks	Cross Commodity Perspectives
Wind Power	Wind Supply Chain	Wind Technology, Systems & Operations	Global Wind Markets	North America Latin America Southeast Asia China Europe	Energy Transition Service Electric Vehicles
	Offshore Wind				
Solar Power	Solar Supply Chain	Solar Technology, Systems & Operations	Global Solar Markets U.S. Utility Solar U.S. Distributed Solar		
Energy Storage	Energy Storage				
Grid Edge	Grid Edge				

https://www.woodmac.com/research/products/power-and-renewables/

The supply chain is gearing up for a stable average 100GW demand in the next decade, double the past 10 years

Global wind turbine demand 2010-2030e



Note: The data is based on 2021-Q1-Global Wind Market Outlook ; All the supply side forecasts in the report are based on Q1-2021 demand outlook
Source: Wood Mackenzie

1 Cost pressure 2.0

2 Battle of supply chains

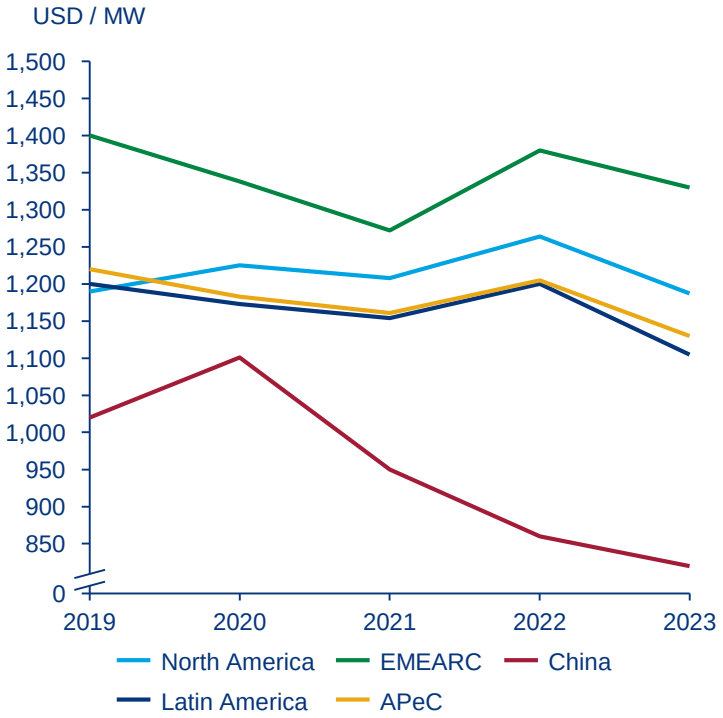
3 Watch your footprint

4 Be smart local

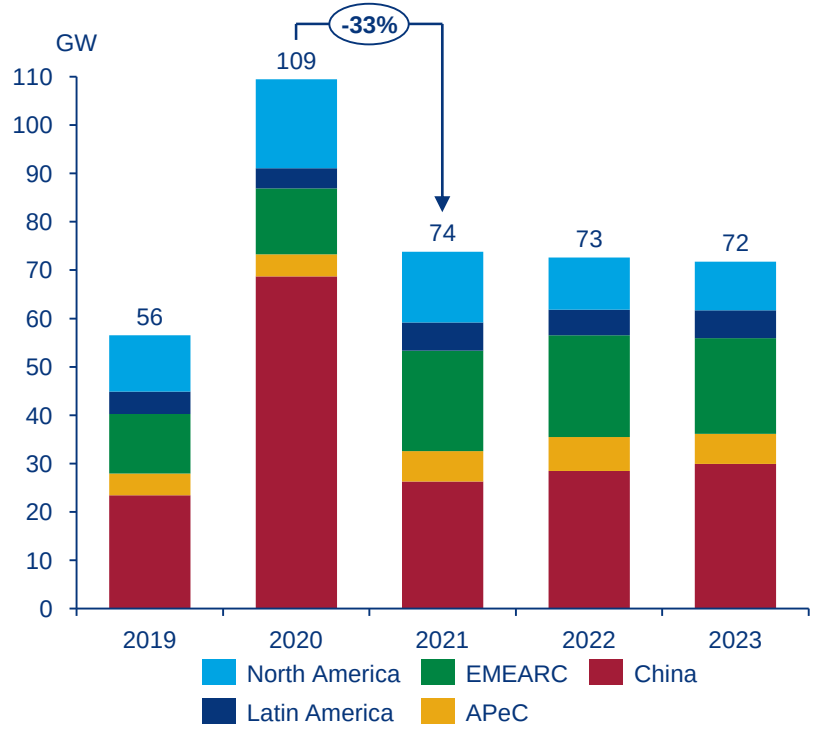
5 Tech2Scale

Supply chain face ‘perfect storm’ of cost escalations, competition from solar and policy phase-out the next two years; resilience is tested

Onshore Wind CAPEX forecasts 2019-2023e



Global onshore wind demand 2019-2023e



Source: Wood Mackenzie

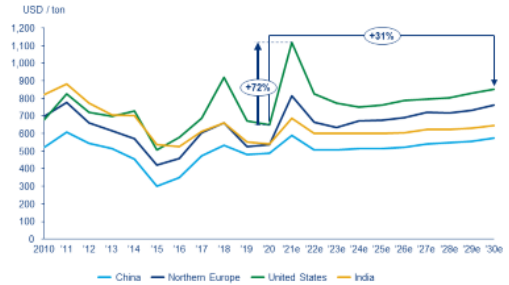
Increase in costs across the value chain

Global wind turbine supply chain trends 2021 — woodmac.com

Surge in steel prices in the near-term is increasing turbine supply chain costs

Turbine OEMs hedging their steel prices; the steep increase will be passed on to customers

Steel price evolution trends 2010-2030e



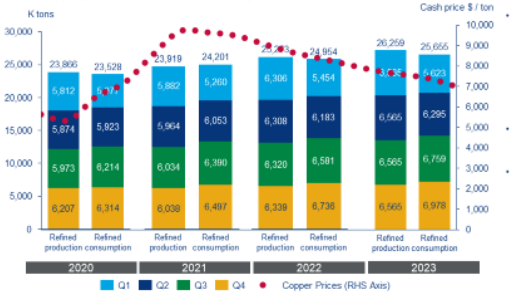
- The surge in steel prices is putting a damper on wind industry growth
- Wood Mackenzie expects steel prices to increase by 70+% in 2021 in the United States
- Prices could stay high in Q3 2021, but are expected to ease by year end
- Long lead times, high raw materials costs, and over-filled working inventory all help to keep prices elevated
- **These price increases will be partly passed onto wind asset owners and developers**
- **Vestas has already increased average turbine selling prices for the contracts signed in Q1-2021. More turbine OEMs will follow suit in the next few quarters**

Source: Wood Mackenzie

Global wind turbine supply chain trends 2021 — woodmac.com

Copper has come into the spotlight as an asset class, as investors expect a bullish recovery post pandemic

Global copper production, consumption and price evolution, 2020-2023e



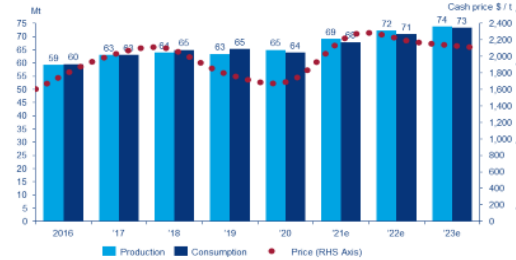
- **Copper has a key role in the energy transition, and this has ignited investor interest in the metal, driving prices to multi-year highs in the first half of 2021**
  - Copper cash prices are currently trading at USD 9700 / ton in the global markets
- Considering the cost composition of copper in wind turbines, the cost of turbines will rise in the near term
- The strong rebound in demand growth in 2021, together with a modest supply response, will result in a deficit that will underpin high prices
  - This trend is set to change over the next two to three years as new supplies from projects come to the market, such as Spence, Mina Justa (Marcona) and KamoaKakula.

Source: Wood Mackenzie

Global wind turbine supply chain trends 2021 — woodmac.com

Global aluminium consumption is expected to increase this year by 6%, but prices increase by 33%, increasing procurement costs

Global aluminium production, consumption and price evolution, 2016-2023e



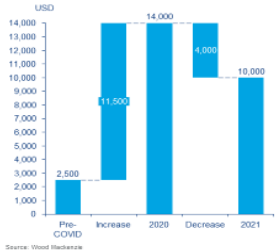
- Despite the increase in demand in 2021, a slowdown is likely in 2H 2021 as policymakers claw back some of the stimulus introduced in 2020
- **Aluminium is increasingly finding its way into wind turbines. A few OEMs and suppliers are choosing aluminium over expensive copper to lower costs while protecting quality and performance**
- Besides its use in generators and transformers, aluminium can also be incorporated into nacelle equipment parts like electrical cabinets, floor sheets, ladders, steps and ventilation channels
- **Aluminium can also be recycled without a loss in quality and save up to 95% of the energy compared to its primary production**

Source: Wood Mackenzie

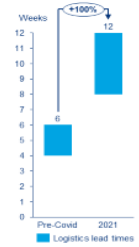
Global wind turbine supply chain trends 2021 — woodmac.com

Costs for freight and raw materials have increased 5X, accentuating the cost burden on supply chain companies

Container shipment prices from China to Europe



Logistics lead times



- The increase in freight costs has led to higher logistics costs for shipping components from China to Europe
  - The Suez Canal blockage amplified the problems at the beginning of the year, as a few components were stuck in transit
- **As the first generation of the latest 6.XMW turbines gains commercial traction in many markets around the world, logistics costs will increase due to the sheer size of the components**
  - Recently SGRE downgraded the FY 2021 guidance due to increased costs in ramping up the 5.XMW platform especially in Brazil
  - The first series of installations will attract higher transportation costs before turbine OEMs and logistics companies find smarter transport solutions

Source: Wood Mackenzie

Source: Wood Mackenzie

How wind supply chain is going to react ??

NEWS RELEASE

Wind turbine prices to rise by up to 10%

16 August 2021

Wind turbine prices are expected to increase by up to 10% over the next 12 to 18 months due to increases in commodity prices, logistics costs, and coronavirus-related challenges, according to new analysis from Wood Mackenzie, a Verisk business (Nasdaq:VRSK).

As noted in a recent Wood Mackenzie report, a rise in steel, copper, aluminium, and fibre prices, coupled with a four-fold increase in logistics costs, have increased turbine prices over the last six months. Wood Mackenzie expects this trend to continue for the next four to five quarters.

Shashi Barla, Wood Mackenzie Principal Analyst, said: "Turbine OEMs and component suppliers face a double whammy of cost increases and demand softening over the coming two years due to the US PTC (Production Tax Credit) and China feed-in-tariff (FiT) phase-outs. Despite this rise in costs, we expect turbine prices to return to normal levels by the end of 2022."

Siemens Gamesa 'to raise wind turbine prices 3-5%'

27 August 2021 by Craig Richard

Turbine manufacturer reportedly set to increase turbine prices and end onshore turbine sales in world's largest wind market

Nordex to raise wind turbine prices 'to pass on additional costs': Europe chief

German manufacturer follows rivals Siemens Gamesa and Vestas by signaling price increase 'in the medium term'

13 September 2021 14:02 GMT UPDATED 13 September 2021 14:03 GMT

By Bernd Radowitz

Nordex became the latest major wind turbine OEM to indicate an increase in the price of

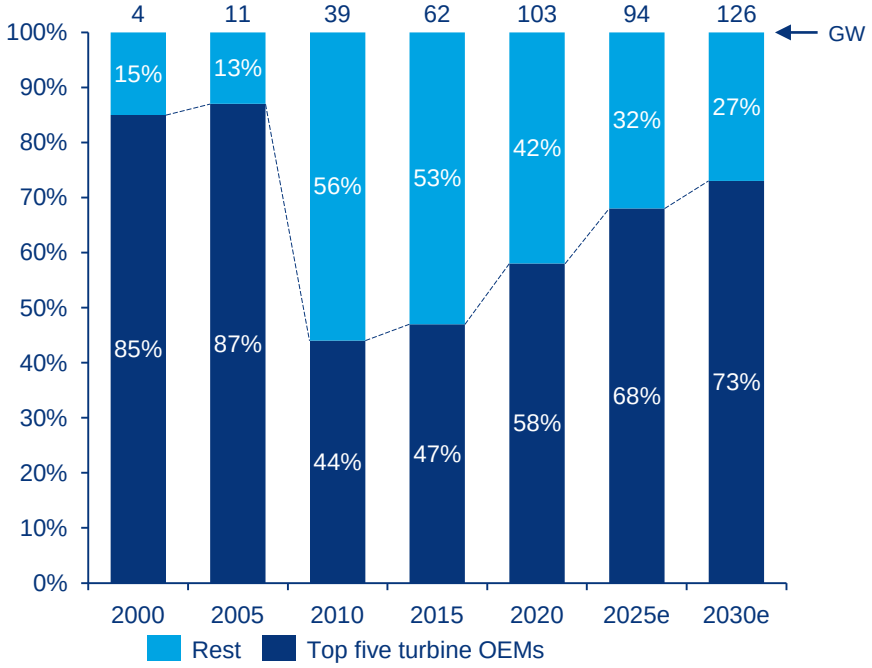
'Customers don't expect if steel goes up 70%, Vestas can do some magic and it disappears': CEO

Cost pressures in turbine market but no reason to fear for wind's competitiveness in energy transition, says Henrik Andersen

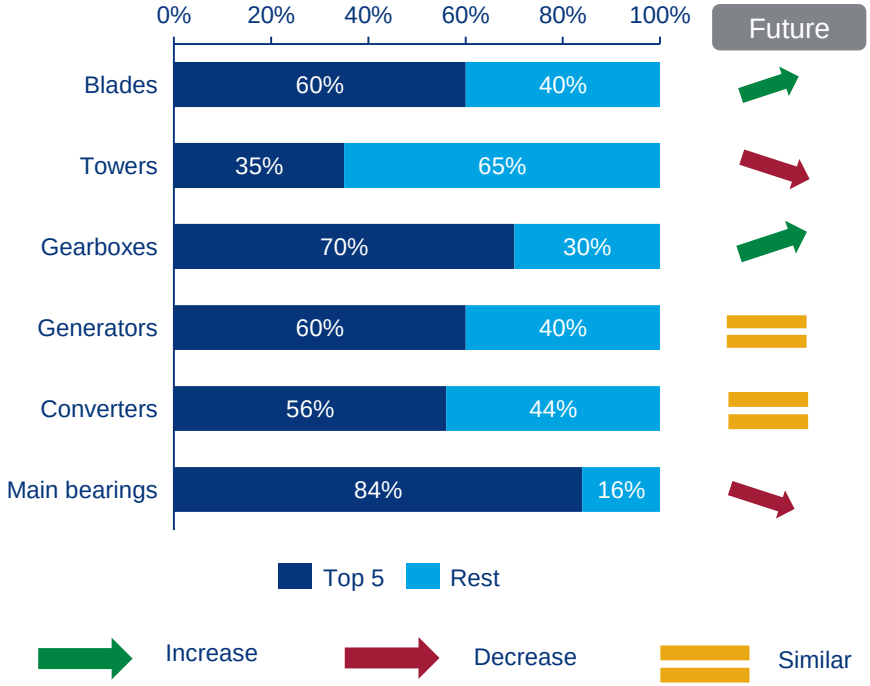
Consolidation across the supply chain to intensify, tier I players garner share

Component suppliers must ride on the future winning turbine OEMs to succeed

Turbine OEMs Market Share Consolidation



Market shares of top five component suppliers vs others 2020e

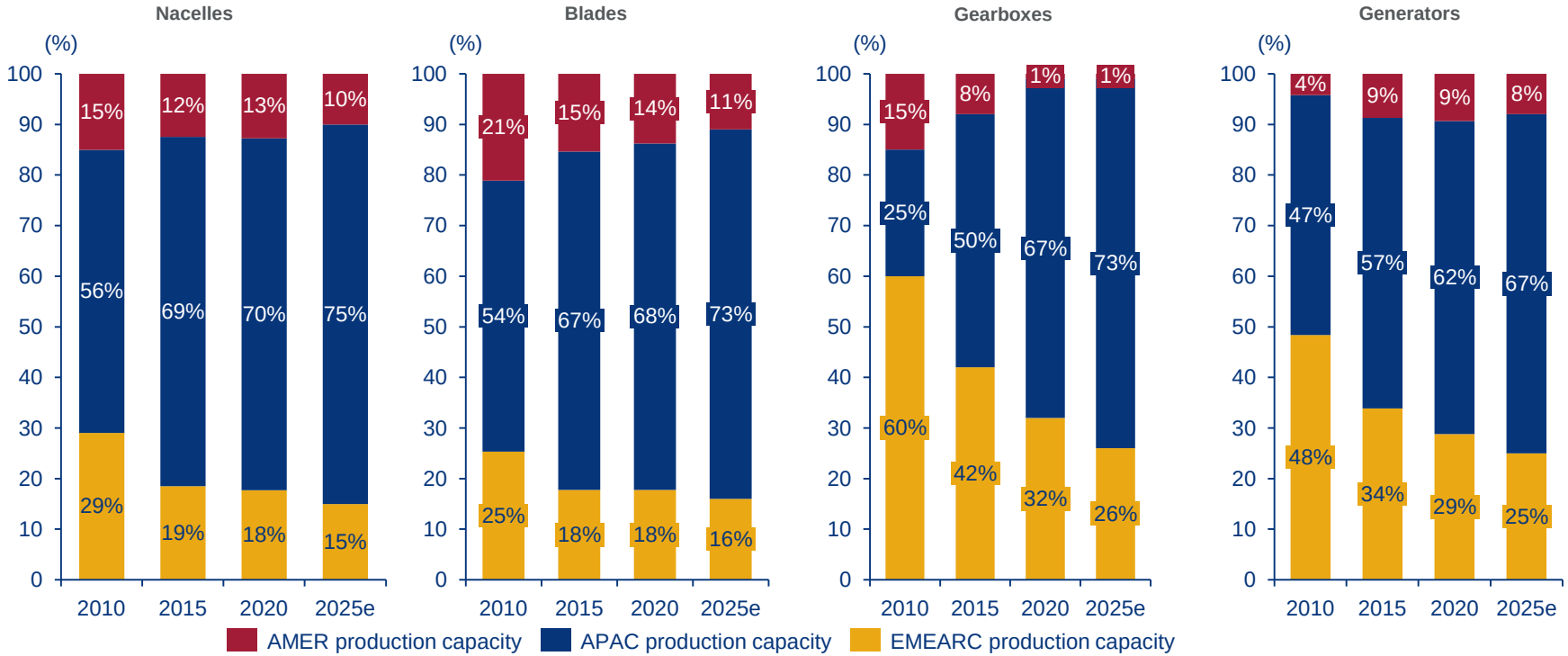


Source: Wood Mackenzie

Key components have seen a consistent shift toward best cost APAC markets

Component suppliers must closely follow OEMs nacelle assembly facilities to remain competitive

Regional production capacity across key regions

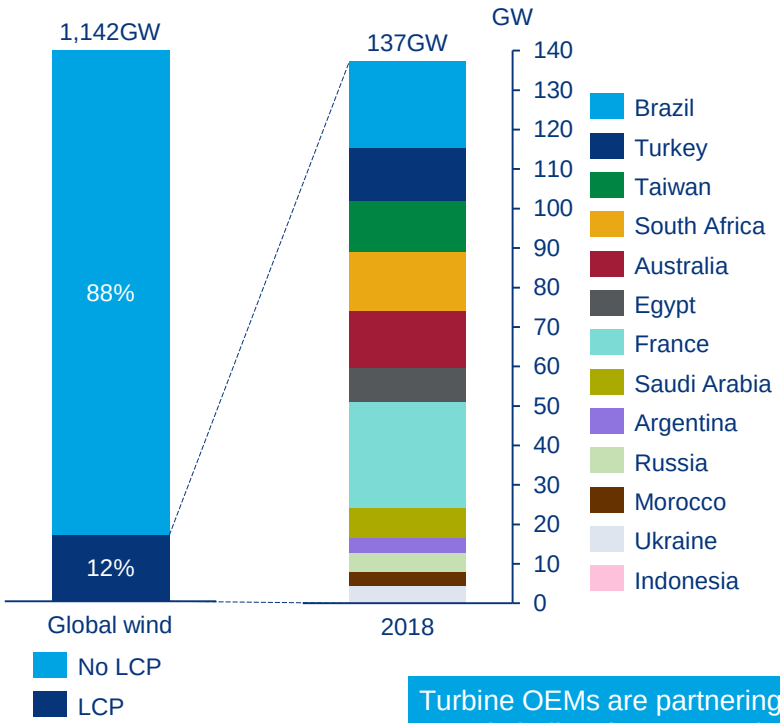


Source: Wood Mackenzie

Supply investments continue to be shaped by LCP despite lower volume

Supply chain must innovate new business models and restructure capacity if needed

LCP markets cumulative demand 2020-2030e



Note: LCP (Local Content Policy)
Source: Wood Mackenzie

Challenges in LCP markets

1 **Volume uncertainty**

- Brazil auction slow down created a demand vacuum in the regions leading to supply chain bruises
- Developers and turbine OEMs are working to address these challenges by commissioning projects ahead of scheduled PPAs to levelized production
- Recent announcement from SGRE about “Onerous” projects, taking a hit of EUR 230mn

2 **Diminishing domestic demand**

- Wind component manufacturing facilities have been shut down in Canada, Argentina due to weaker demand

3 **Currency exchange risks**

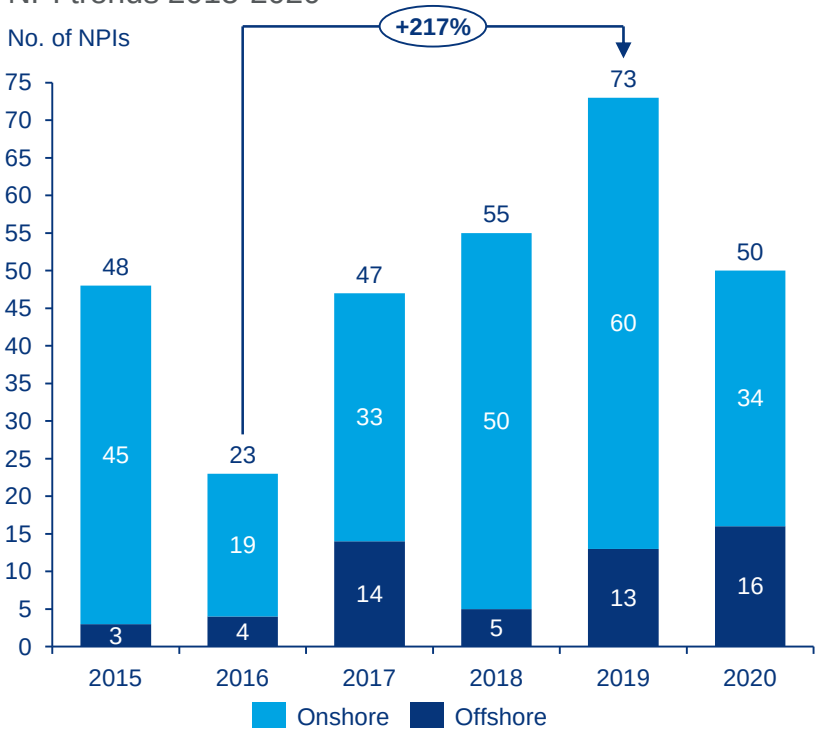
- Currency risks in markets like Argentina and Turkey among others will deter future investments

Turbine OEMs are partnering with industrial companies to manufacture the components to contain ballooning CAPEX investments in LCP markets

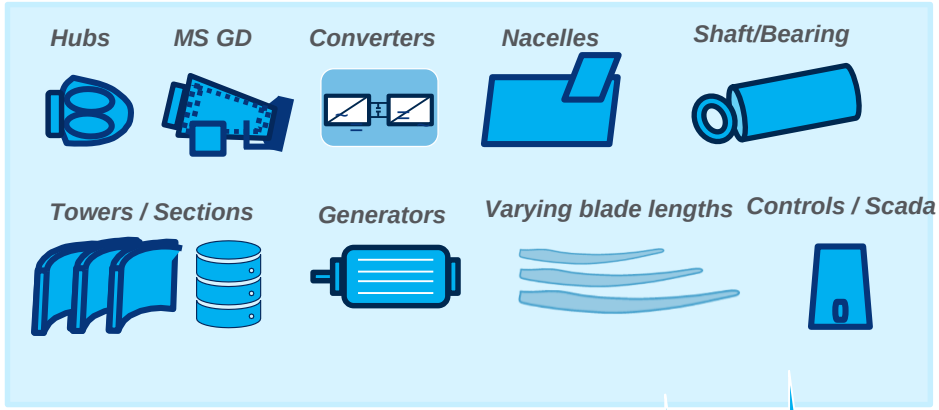
Frenetic pace of NPI led to shorter commercial life cycles

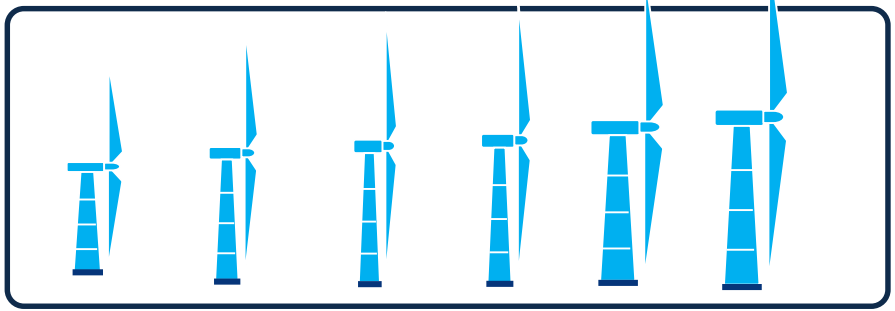
Suppliers must transition to modularization and standardization of components to lower tech and supply costs

NPI trends 2015-2020



Modularization of components





Source: Wood Mackenzie

1	**Cost pressure 2.0**	Will turbine OEMs and component suppliers face a double whammy of cost increases from raw materials and logistics and price pressure from solar PV and policy phase-out ?
2	**Battle of supply chains**	Industry consolidation continue with turbine OEM's still with highly specialized supply chains – are there increasing economies at the end of the tunnel ?
3	**Watch your footprint**	Nacelle assembly is drifting to best-cost markets – where to go to position for the future ?
4	**Be smart local**	Local content requirements escalate costs and drive complexity – how to innovate to counter this challenge ?
5	**Tech2scale**	The frenetic pace of New Product Introductions exert pressure on the supply chain efficiencies – how do suppliers transition to modularization and standardization ?

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Wood Mackenzie is ideally positioned to support consumers, producers and financers of the new energy economy.

- Acquired Genscape, MAKE and Greentech Media (GTM)
- Leaders in the energy transition and cross-commodities
- Over 600 sector-dedicated analysts and consultants globally
- Located close to customers and industry contacts

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