



# Wind Turbine Manufacturing – a case for consolidation

Industry overview and key trends

Hamburg, November 2011

# Five game-changing trends will trigger further cost out and re-shape the industry structure

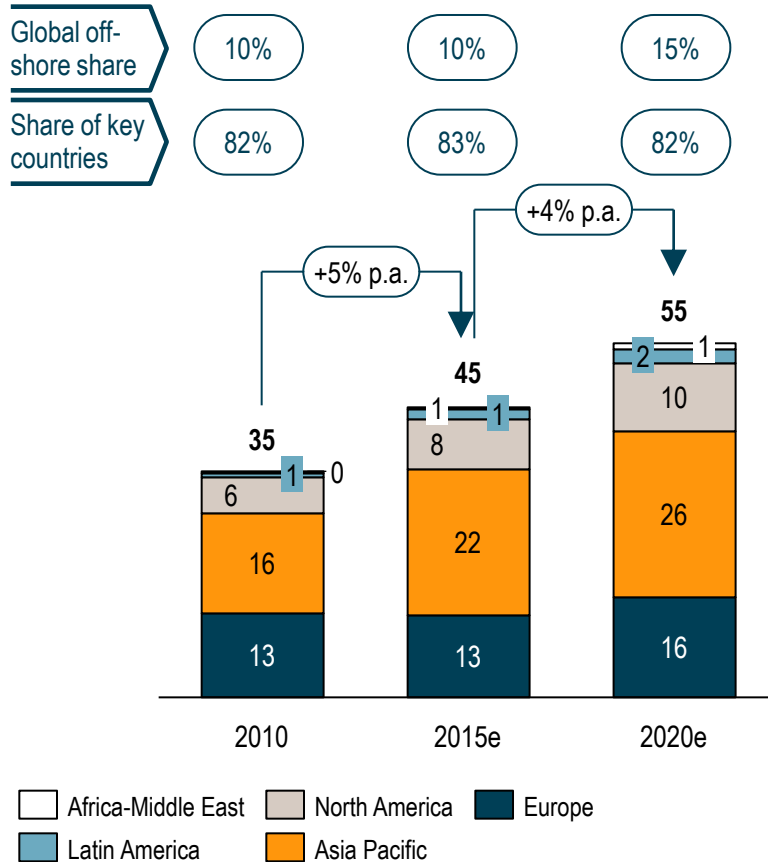
## Overview of key trends in wind energy

- 1 Uncertain growth perspective:** After years of double digit growth, only moderate growth perspective in the coming years – especially in Europe
- 2 Competition by Chinese players:** Not just a major issue in China, but now more and more going global – Aggressive pricing and financing solutions
- 3 Race for grid parity:** Grid parity achievable in the next 3-5 years – Major efforts by leading players to reduce Cost of Energy and differentiate to competition
- 4 Global supply chain patterns:** Shift of growth to Emerging Markets – Changes in supplier structure and operational requirements push further globalization
- 5 Offshore wind taking off:** Industrialization and cost reduction are key – New business models and partnerships across the whole value chain required

Systematic **cost out programs** and upcoming **next wave of consolidation** of European wind industry on all levels

# Moderate global growth in the future – "Size of the pie" will stagnate in Europe













## Annual additions [Global onshore and offshore wind, GW]



- Regulatory uncertainties (e.g. extension of PTC scheme in the US) and cheap, alternative sources of energy (e.g. shale gas) dampen growth perspectives – double digit growth rates as experienced in the past decade will not return
- Overall growth in the onshore business in Europe is stagnating due to increasing saturation and critical state of public finances (e.g. Spain) – perspective for growth has shifted away from home markets of European wind turbine manufacturers to Emerging Markets and China
- Offshore will be the key area for growth in Europe in the next decade

# The global market is driven by 12 key countries – China and Emerging Markets to fuel the future growth

## Annual additions [key countries, GW]

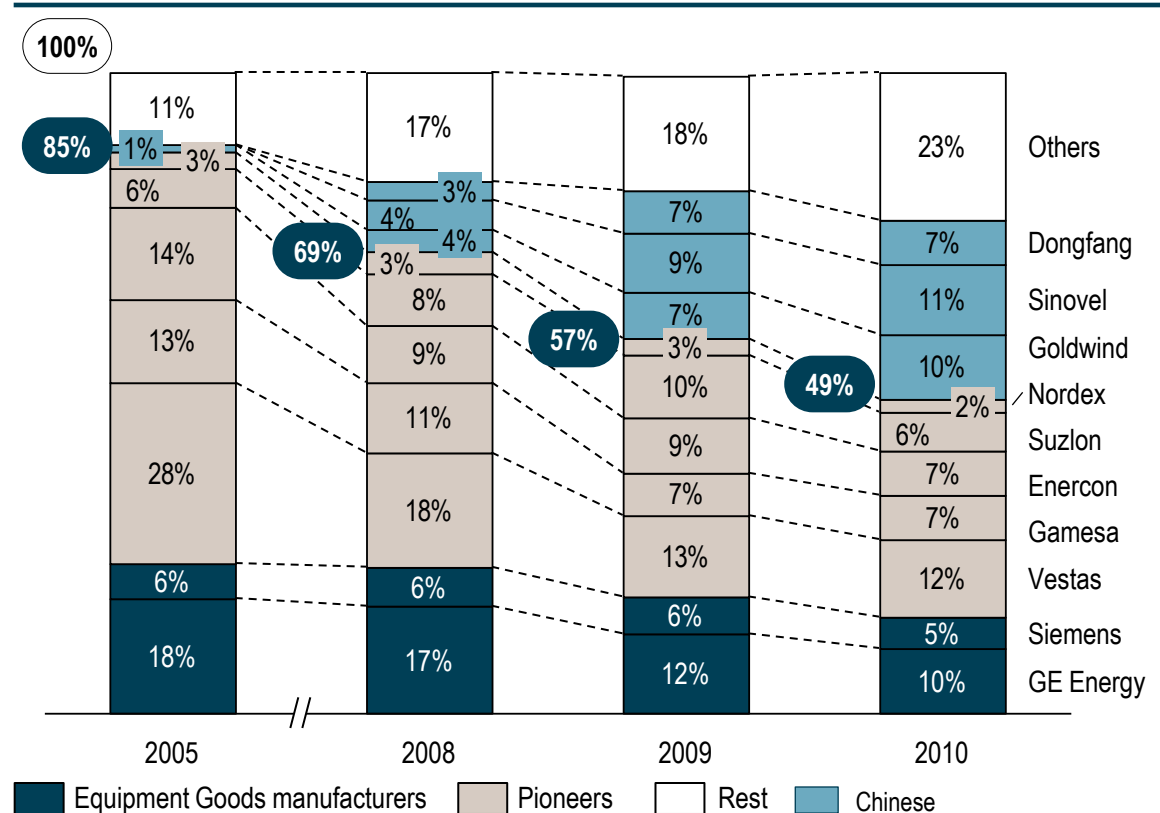
Key countries per region	2010	2015	2020	CAGR <sub>10-15</sub>	CAGR <sub>15-20</sub>	Offshore
Africa/ME 	0.01	0.2	0.2	119%	10%	–
Latin America 	0.3	0.8	1.6	19%	15%	–
North America 	5	7	9	6%	6%	–
	0.7	1.3	1.3	14%	0%	–
Asia 	13	18	20	7%	2%	–
	2	3	3	6%	3%	–
	0.2	0.7	1.2	22%	13%	–
Europe 	1.6	1.9	1.6	3%	-3%	Offshore offsetting onshore decline
	2	1.7	2.3	-3%	6%	Offshore shaping development
	1.2	1.5	2.1	4%	7%	–
	2	1.6	1.9	-5%	5%	–
	0.9	0.7	0.7	-5%	-1%	Rather decline

- More than 80% of annual installations in the next decade will happen in 12 key countries
- Spain and Germany as major growth drivers of the past slowly reach saturation
- China sees major and dynamic growth – Full-scale deployment, which will turn the country into the largest global market
- USA with large growth potential but uncertain political framework
- India, UK, France with untapped potential
- Canada, Brazil, Australia and South Africa with strong growth

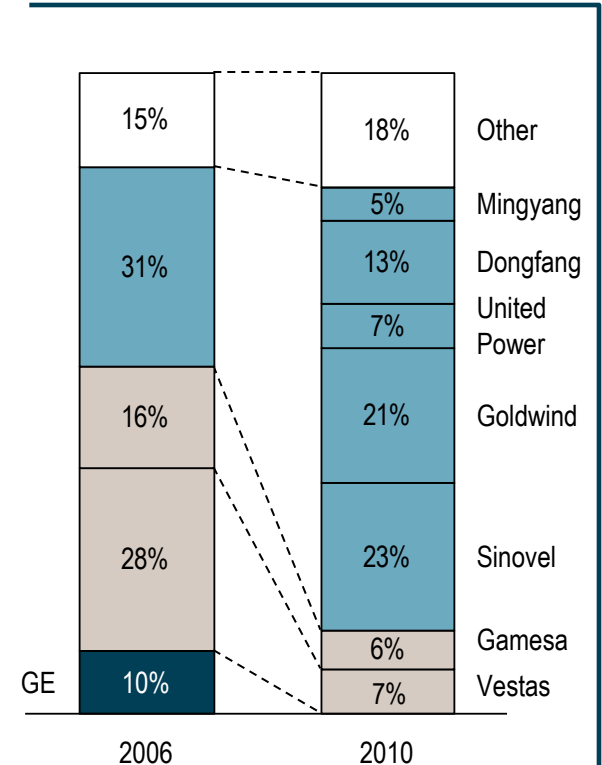
# Chinese manufacturers gained ground over the last years – Western players effectively pushed out of the Chinese market

Overview market shares, 2005-2010 [% delivered MW]

## WORLD MARKET



## CHINA

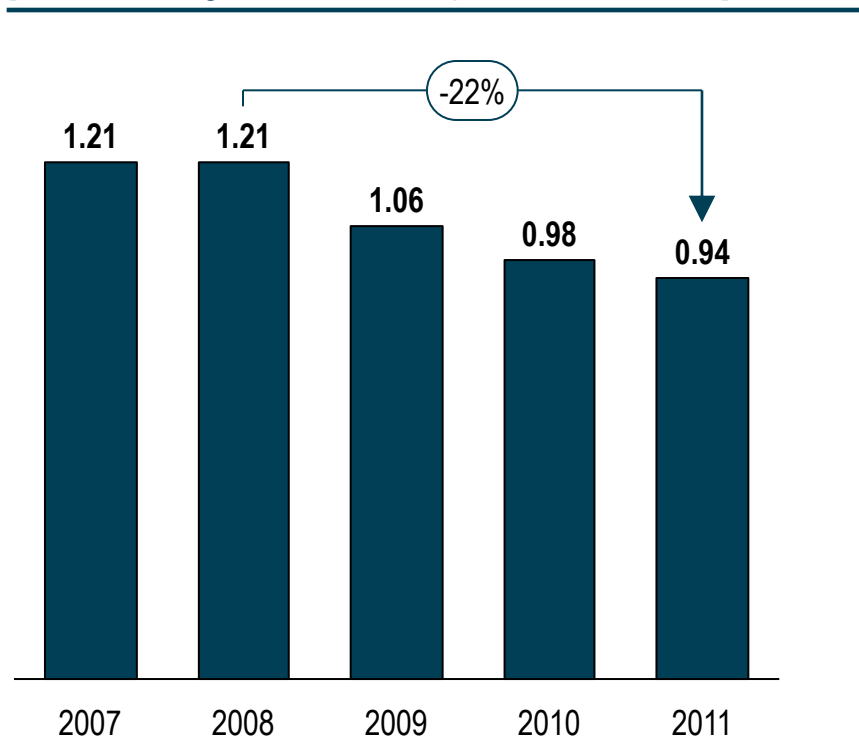


# Exceptionally low prices in China explain this development and have contributed to an overall global price decline

## Price competition

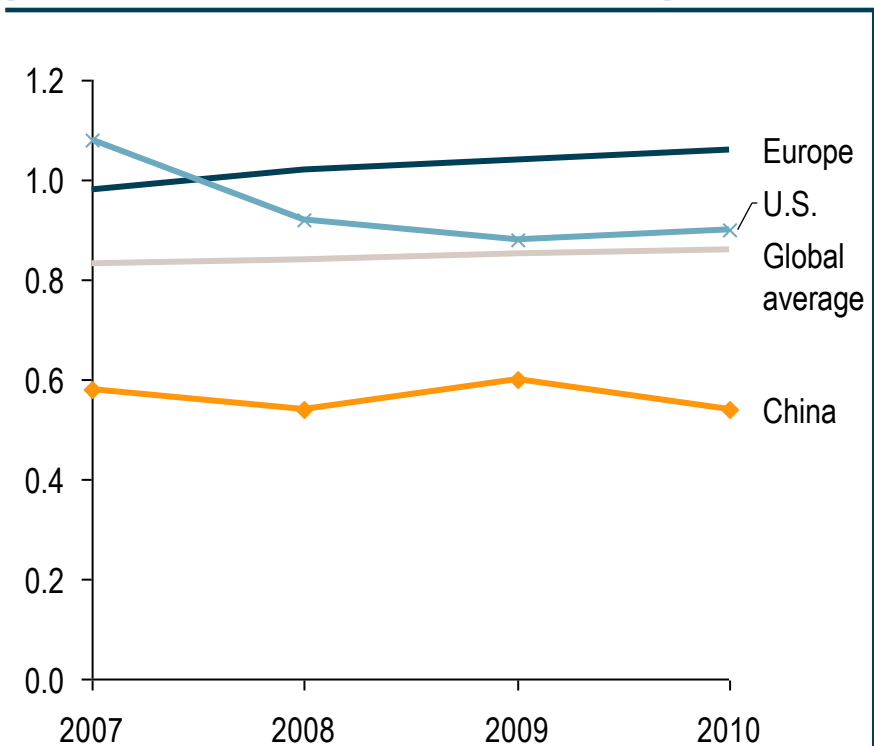
### Steady price decline

[Global average Wind Turbine prices EUR m/MW]



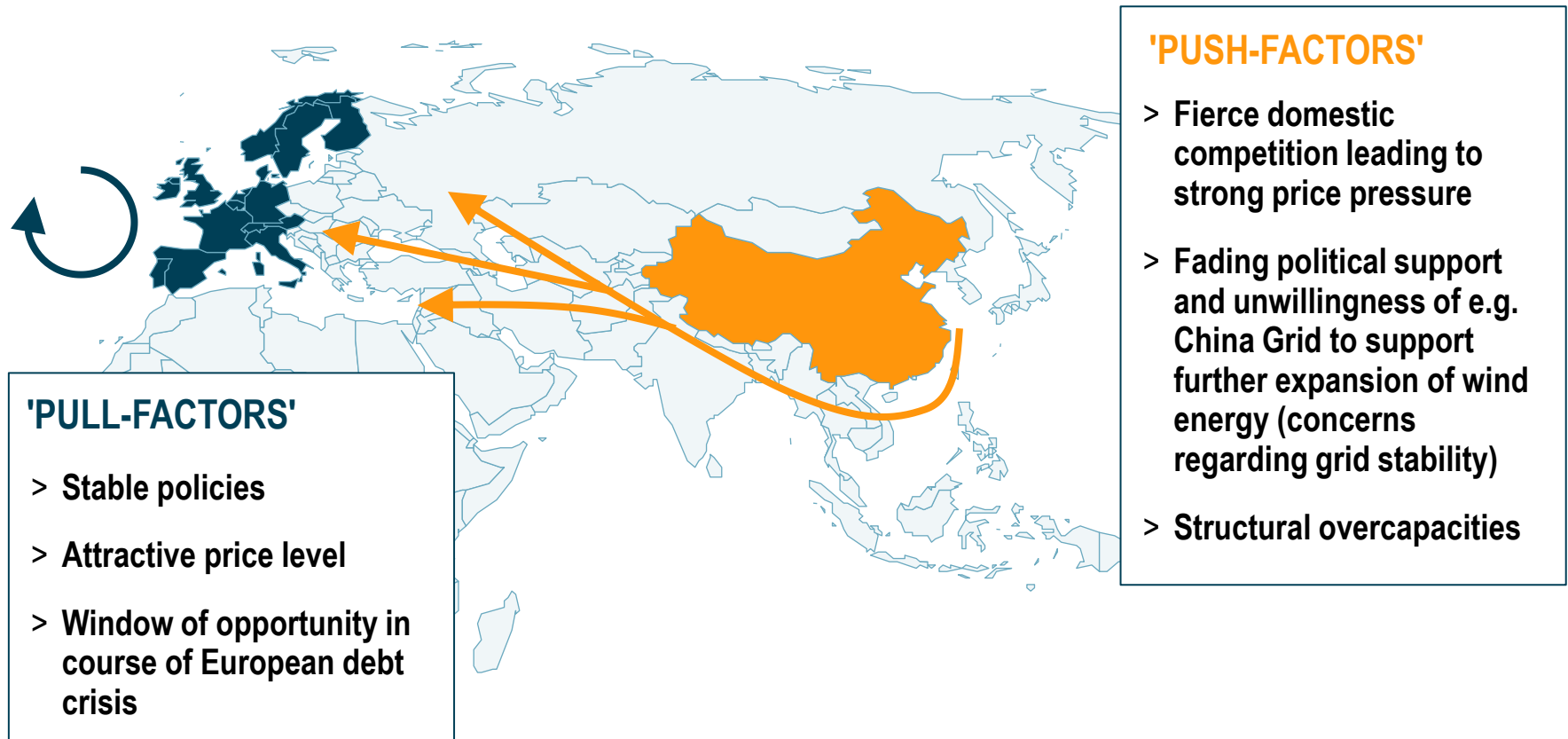
### Significant regional differences

[Normalized Wind Turbine ASPs, EUR m/MW]



# Facing immense competition and pressure in home market Chinese players are already lured by stable conditions in Europe

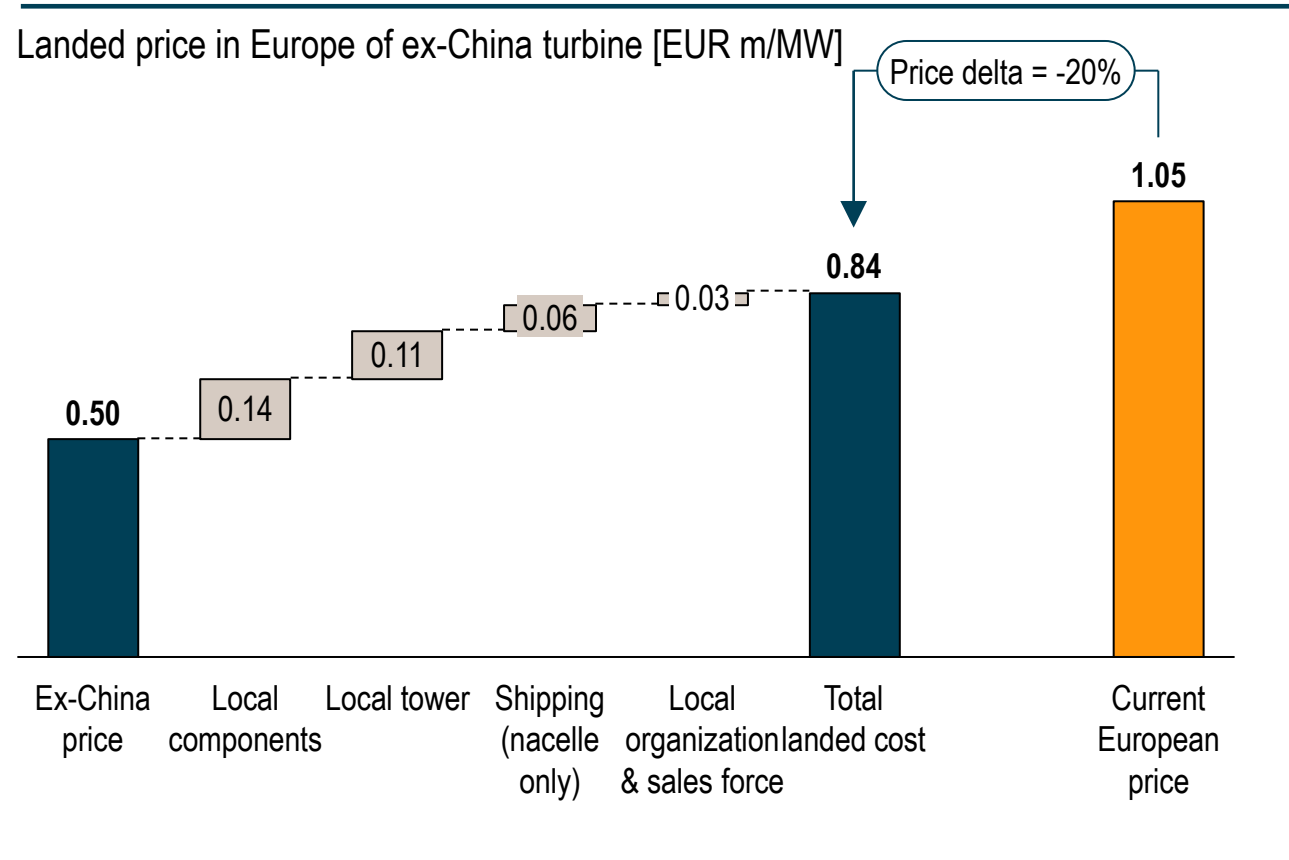
## Push- and Pull-Factors



# Chinese players could undercut European prices by 20% to break into the European market

## Competitive threat from Chinese players

Landed price in Europe of ex-China turbine [EUR m/MW]

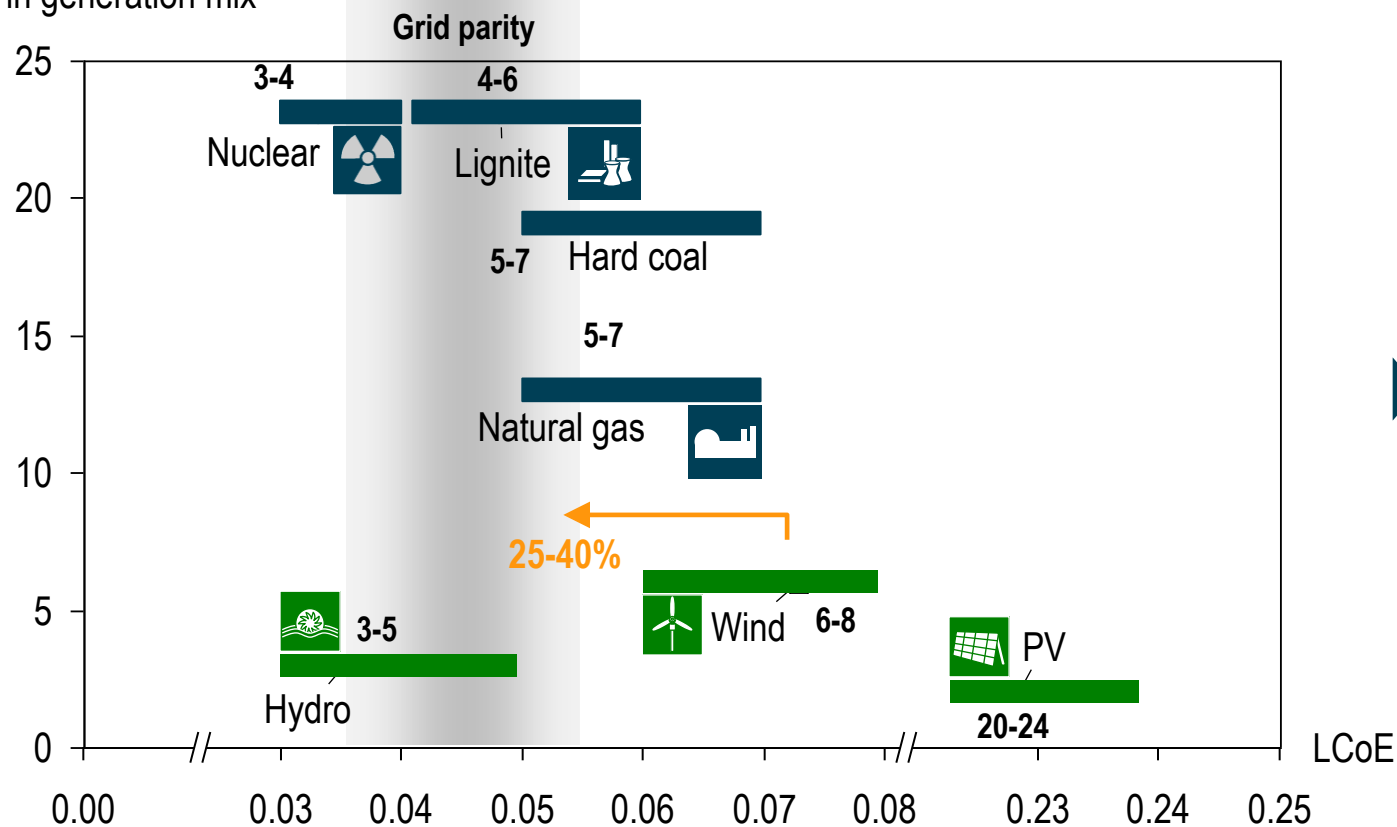


Significant threat for European players

# Grid parity in reach – But Cost of Energy targets of EUR ct. 4-5 / KWh will require a further cost reduction of 25-40%

## LCoE in Germany [EUR ct./KWh]

Share in generation mix



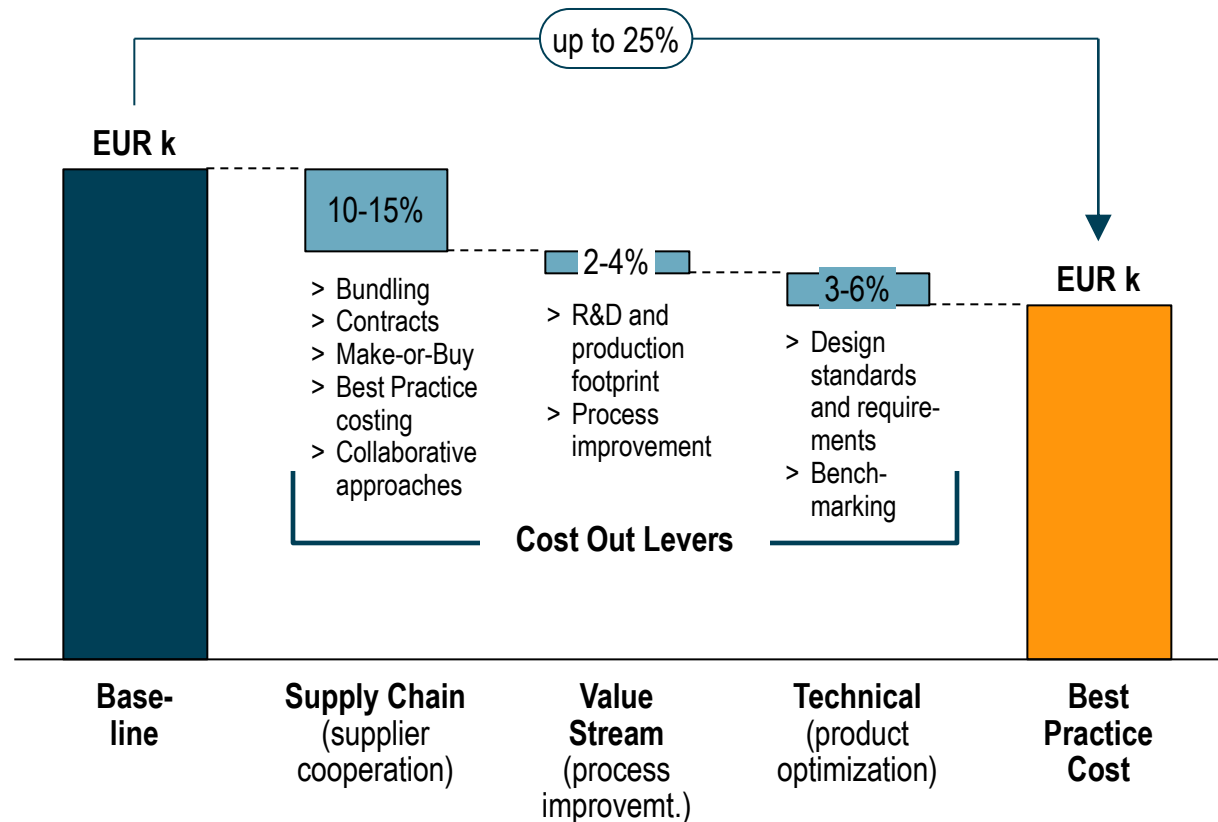
Achieving grid parity will be essential for Western OEMs to sustain own market position and participate in further growth

# Targeted cost-out measures still hold a significant potential and need to be implemented as a key step towards achieving grid parity

## Required cost reductions and potential levers for Design-to-Cost

### Cost of Energy Wind

- > In the past, every 10 years a cost out of 1/3 could be achieved by wind OEMs
- > Further cost reduction potential in the same order of magnitude is needed in the next 3-5 years
- > Innovations, new technical solutions like Direct Drive and enhanced reliabilities support cost of energy improvements



# Systematic Product-Cost-out activities are currently being performed by major OEMs

## Design-to-Cost potential for wind turbines

### BLADES AND ROTOR

#### Potential

> Blades

> Rotor Bearings

> Hub

> Pitch System



- > Larger rotors with better aerodynamics (new materials, e.g. CFRP, stiffness, dynamic design, load control, etc.)
- > Manufacturing constraints
- > Endurance to environmental damage (e.g. weather, lightning)

### TOWER AND FOUNDATION

#### Potential

> Steel shells

> Flanges, bolts

> Painting

> Internals



- > New foundations design, construction techniques and materials, specially for offshore
- > New tower concepts with cost optimized structural design
- > Weight reduction

### DRIVE TRAIN & GENERATOR

#### Potential

> Gearbox

> Yaw System

> Generator

> Main Shaft

> Yaw Bearing

> Transformer

> Main Frame

> Control System

> Cover/Housing

> Power Converter

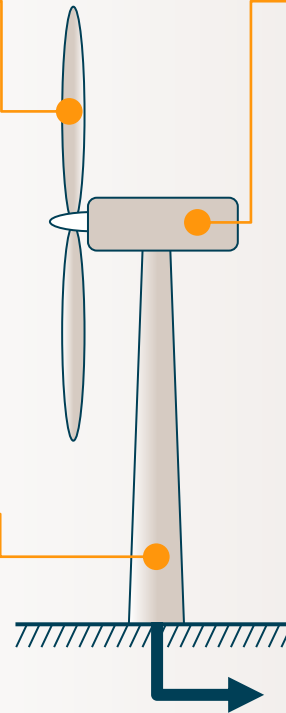
> Mechanical Brake

> Screws

> Cables



- > Direct drives or hybrid concepts
- > Lighter, more compact housings (e.g. integration of drive train and generator, less bearings)
- > New generator technologies (e.g. super-conducting components)

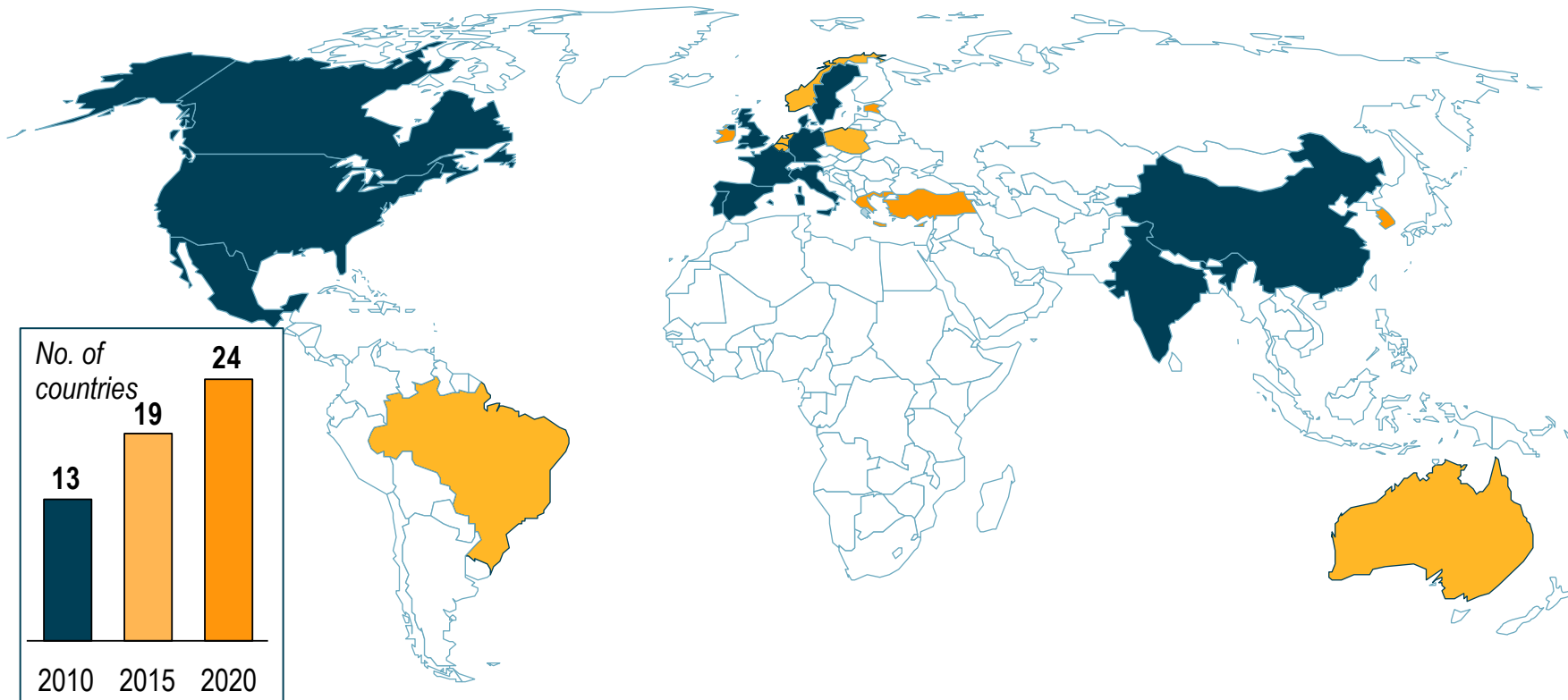


**Significant activities across the turbine by major OEMs – others will have to follow**

Low → High

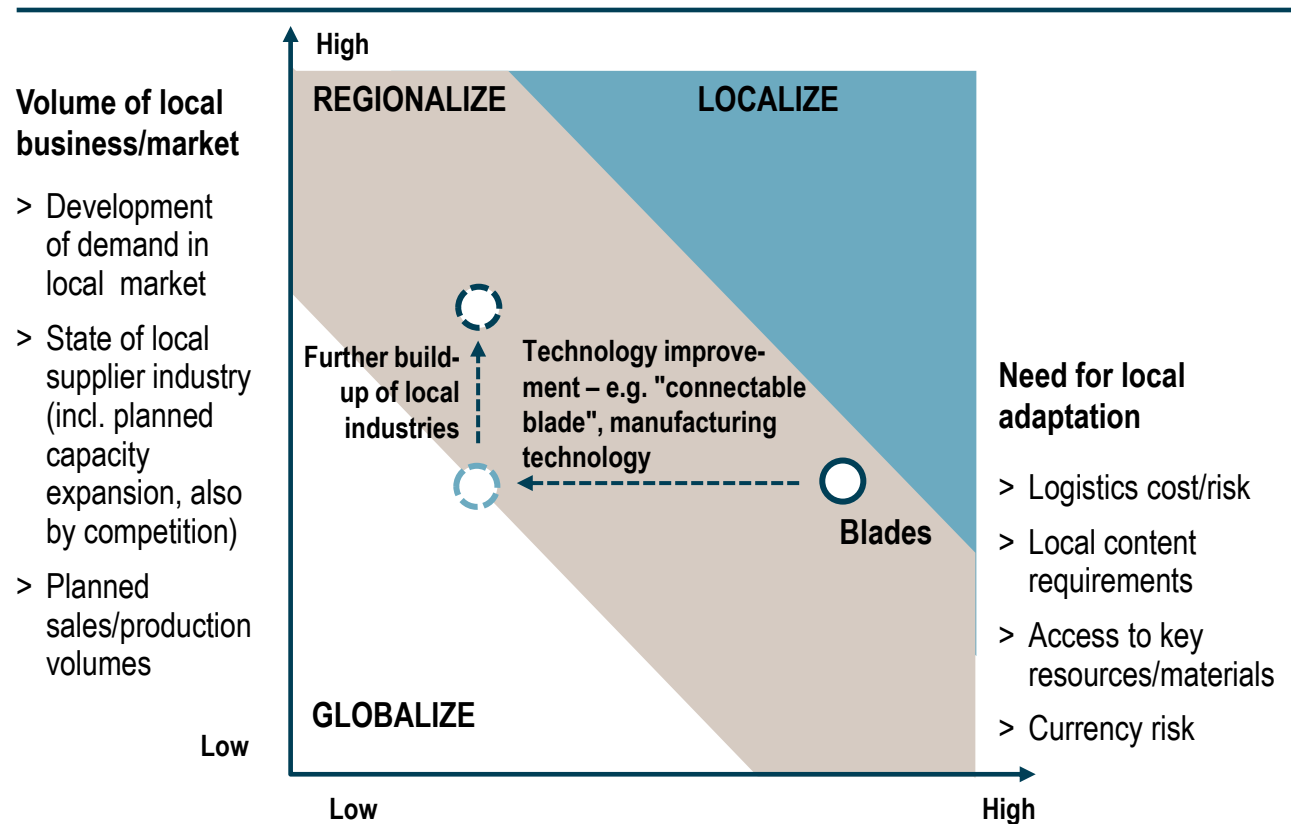
# Increasing importance of Emerging Markets has to be reflected – OEMs need to combine local and global to remain successful

Countries exceeding annual installations of 500 MW (conservative scenario)



# The required degree of localization and ability to work in a global setup will be key determinants

## Structural questions regarding global setup



### EXAMPLE: BLADES

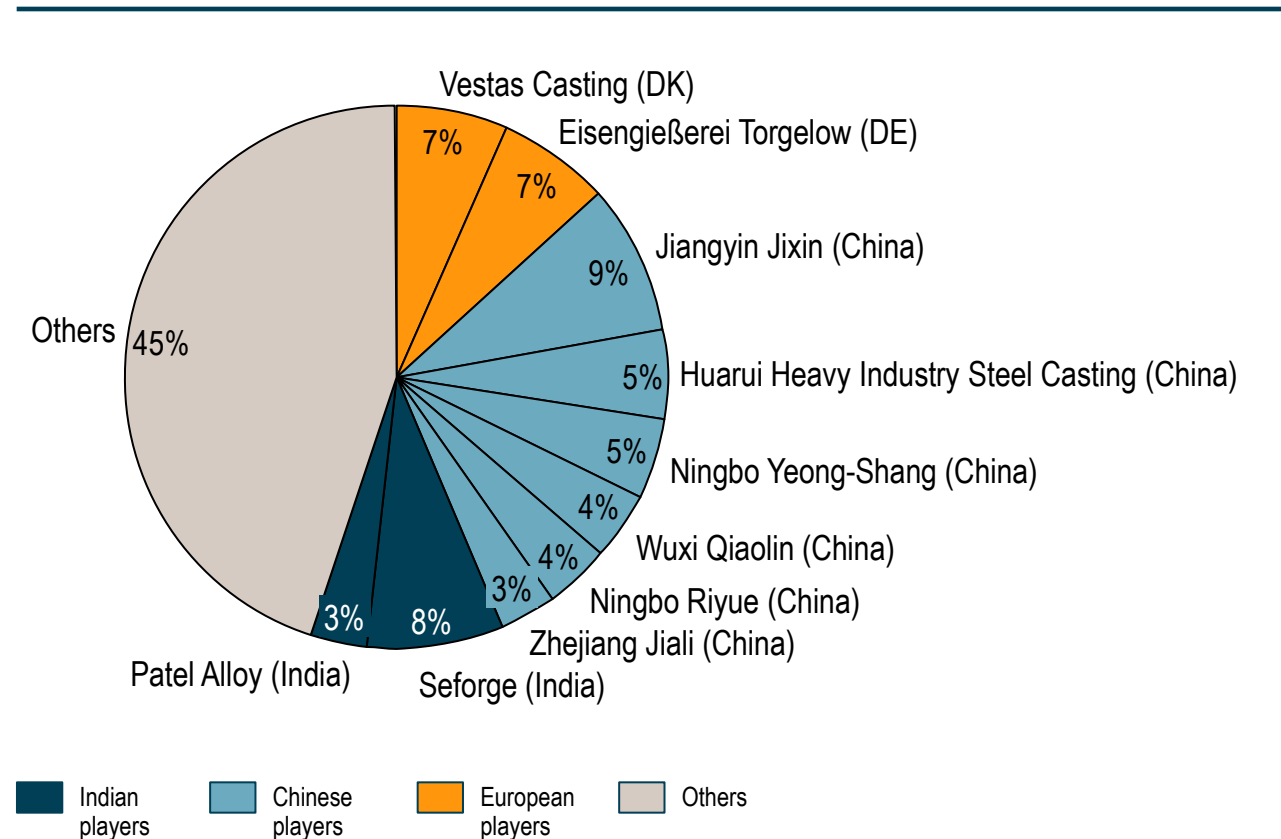
Today, **Blades structurally should be procured on a regional scale**

- > High need for local adaptation primarily driven by large size which inflates logistics costs
- > Local sourcing is difficult – Apart from Western Europe/ China lack of local supplier industry
- > Demand fluctuations in local markets can at most be balanced on regional level

This **business is likely to remain regional** – Technology improvements likely to be offset with concurrent build-up of local industries

## Example Castings – Re-alignment of supply chains can also be forced by fundamental shift of production capacities to Asia

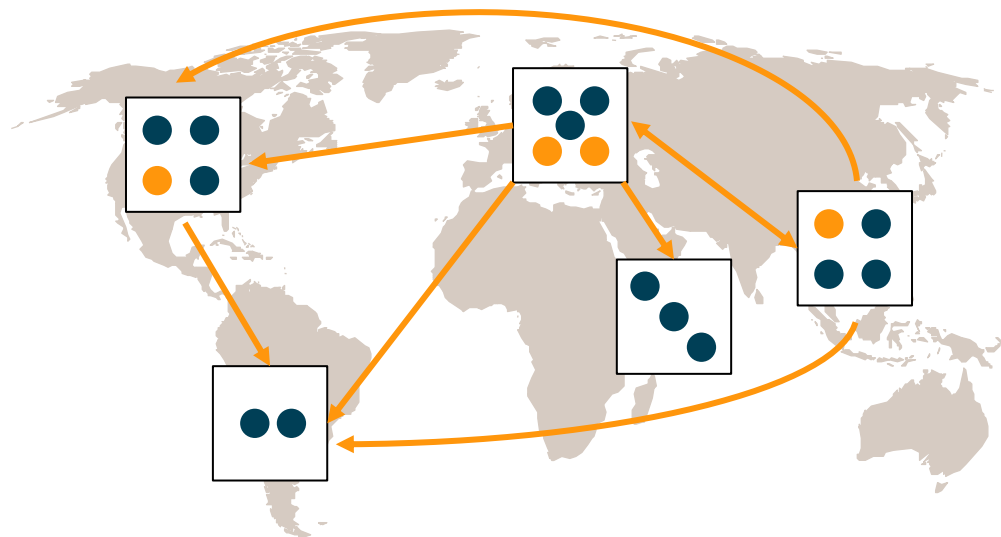
### Top 10 suppliers' market share in castings for wind turbines



**Eight of the 10 largest casting suppliers already today coming from Asia – Geographic shift will be inevitable to secure capacities**

# Siemens balances global and local supply in a "Hub & Spoke"-configuration to achieve cost efficiency, quality and secure supply

## Example – Siemens supply chain approach

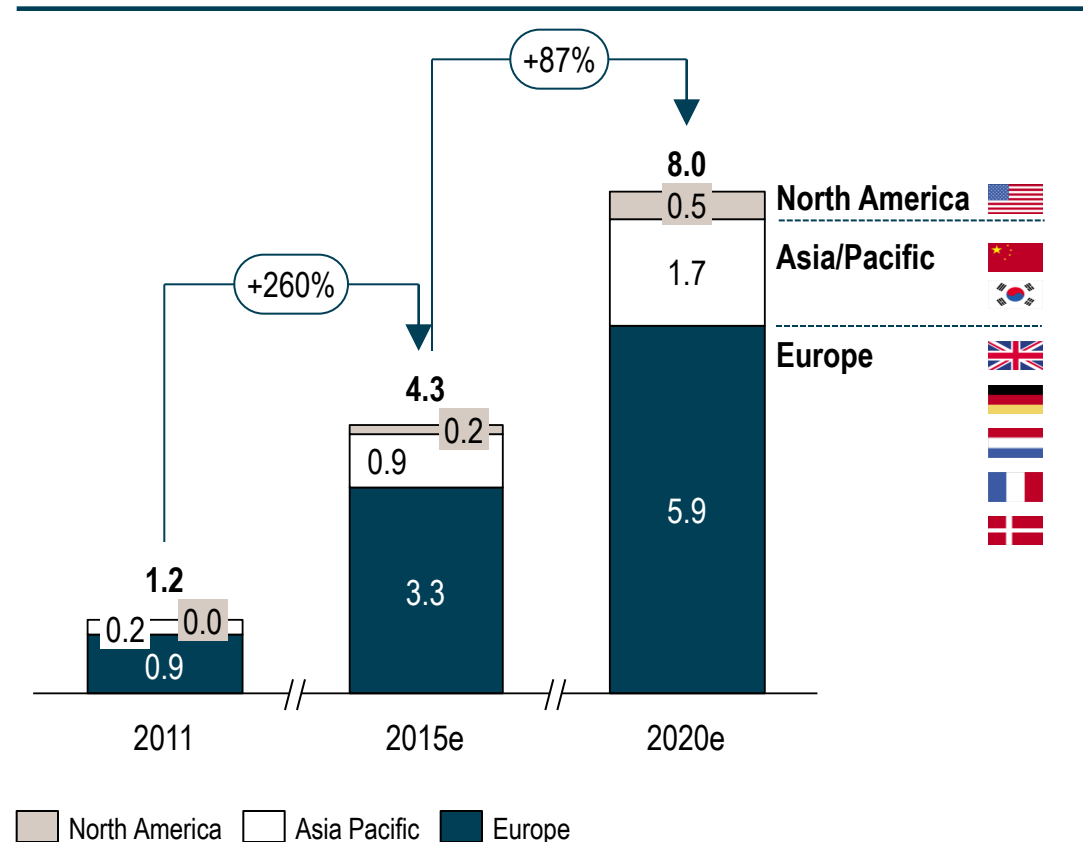


- Cluster of Excellence for global/regional supply
- Local sourcing
- Elements of value chain, e.g. production of blades, nacelles, etc.



# Growth of Offshore Wind will accelerate with Europe as key driver – Annual installations expected to double every 4-6 years

Worldwide yearly installed offshore wind power [GW]



Players now have to prove their "Offshore Wind capabilities" by delivering projects along agreed timeframes, cost targets and with promised quality and performance

Those who can't will face difficulties to participate in development due to lack of track-record and will be confronted with unfavorable conditions (e.g. project financing constraints)

This could trigger unconventional action – E.g. Nordex taking 39% share in Arcadis Ost 1

# Apart from player-specific situation, the offshore wind industry in general has to address four key challenges to achieve break-through

1

## DEVELOPMENT



- > Consider technical, legal, environmental and financial aspects in integrated EPC approach

2

## FINANCING



- > Secure bankability of wind offshore projects

3

## LOGISTICS/ CONSTRUCTION



- > Secure ship capacities
- > Reduce construction cost
- > Address Health, Safety and Environment challenges

4

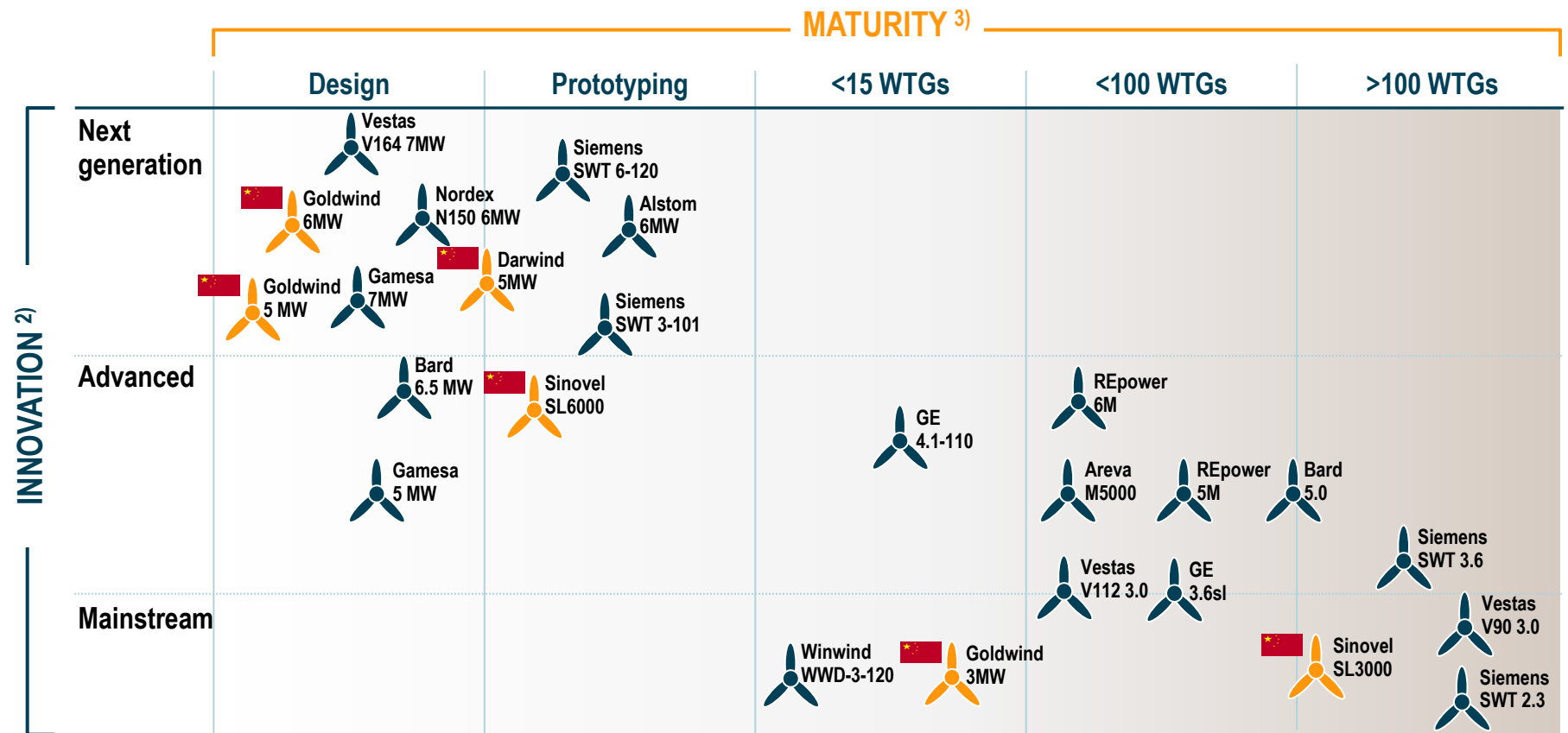
## OPERATIONS & MAINTENANCE



- > Develop capabilities and secure capacities for offshore services

# Major Chinese players also have to be expected in the offshore arena as they are catching up in terms of technology

## WTG technology for offshore wind<sup>1)</sup>

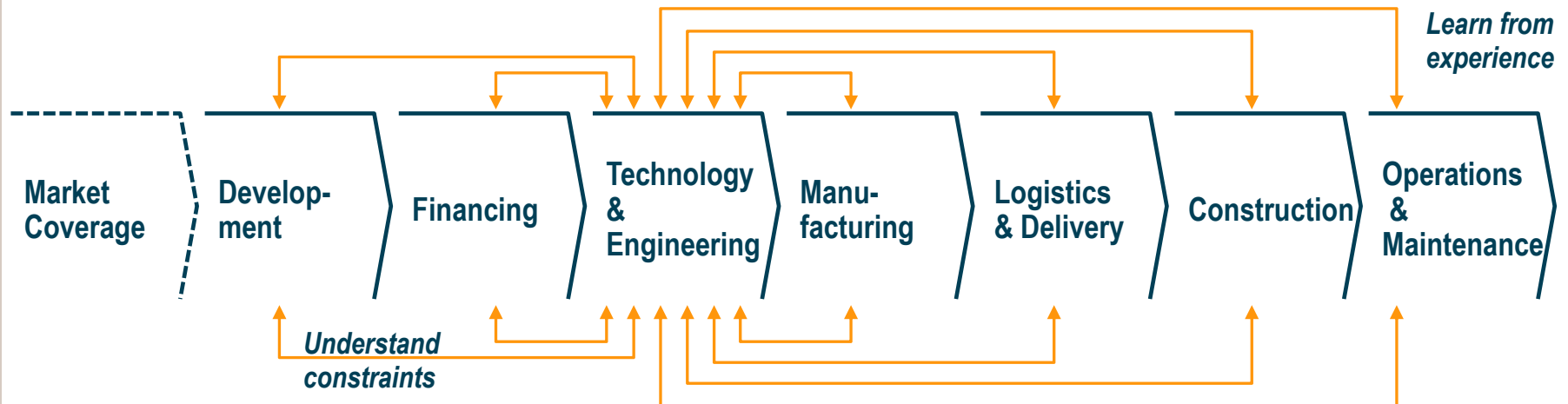


1) Based on publicly available information 2) Scoring based on rated power, drivetrain technology, rotor diameter, tower height and top head mass 3) No. WTG in operation

# Partnerships along the value chain emerge as a key factor for success – New cooperation models expected

## Partnering logic in Offshore Wind

### Joint learning curve to avoid "serial error"



### Partnerships allow

- > to **combine experience and competences** of different players with complementing strengths along value chain (OEMs, project developers/EPCs, Banks/Financiers, utilities and service providers)
- > to **reduce own investments and/or risk**
- > to **achieve faster progress** through establishment of 'functioning tag-teams'



It's  
character  
that  
creates  
impact

**Roland Berger**  
Strategy Consultants