



From Pioneer to Mainstream

Evolution of wind energy markets and implications for manufacturers and suppliers

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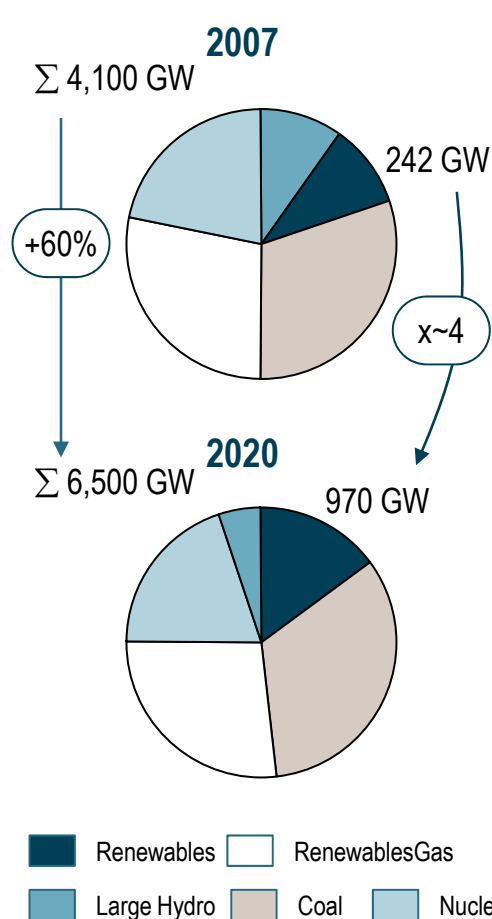


A. Continuous growth and maturing of the market expected

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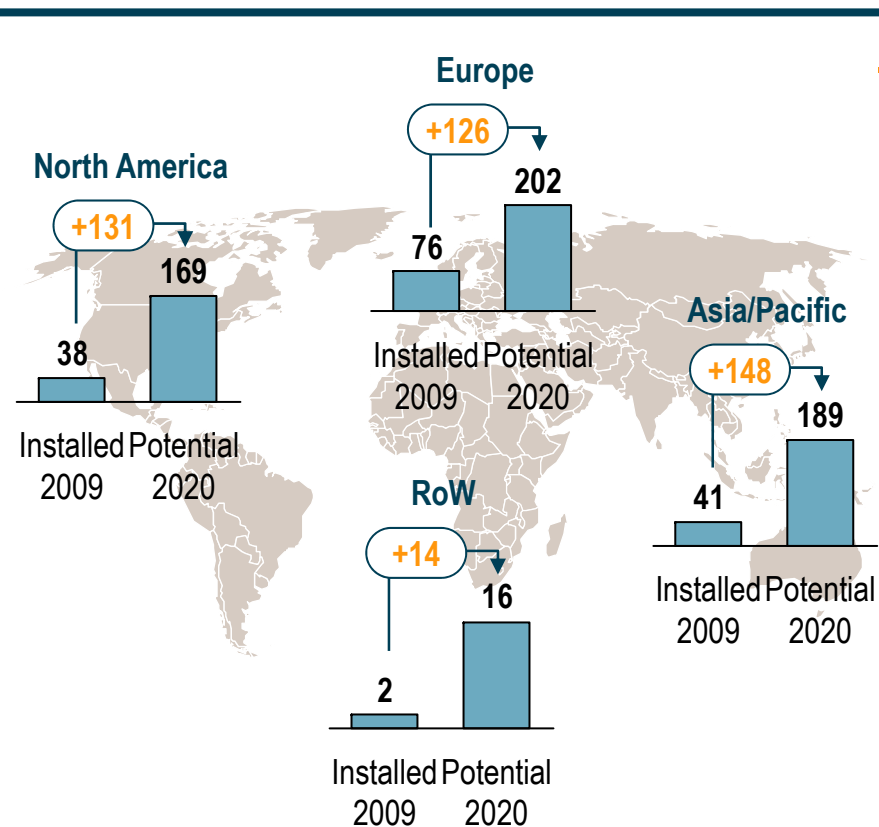
Due to its technological maturity wind will continue to take a major part of the growth market in the next decade



Examples		Wind		Solar		Marine energy	
	2008	2020	2008	2020	2008	2020	
Global capacity [GW]	120	600	15	157	0.3	1.2	
Long-term feasible potential worldwide [GW]	2,000-6,000		50,000-80,000		3,000-6,000		
Revenue potential (in 2020)	EUR 90-110 bn		EUR 50-80 bn		EUR 0.5-2.0 bn		
Current technology maturity	[Small pie chart]		Solar PV [Medium pie chart]	Solar thermal (CSP) [Small pie chart]	[Empty pie chart]		
Current cost per MWh	EUR 50-80		EUR 100-270	EUR 145-200	EUR 190-270		

Governments are establishing ambitious investment and growth plans for wind energy all over the world

Worldwide actual and potential wind power capacity 2008-2020 [GW]



TOP GROWTH MARKETS

EU countries

- > Proposed target of 20% of renewable energy sources by 2020 – wind contributing to 11-14% of electrical energy with 180 GW, including 40 GW offshore
- > Total investments between 2011-2020 accounting for EUR 120 bn

USA

- > Proposed target of 20% wind power by 2030
- > Economic stimulus bill including USD bn ~67 for clean energy, including extension of production tax credits and offering of investment tax credits
- > Investment plans include initiatives for the transmission system which constrains the wind energy growth today

CHINA

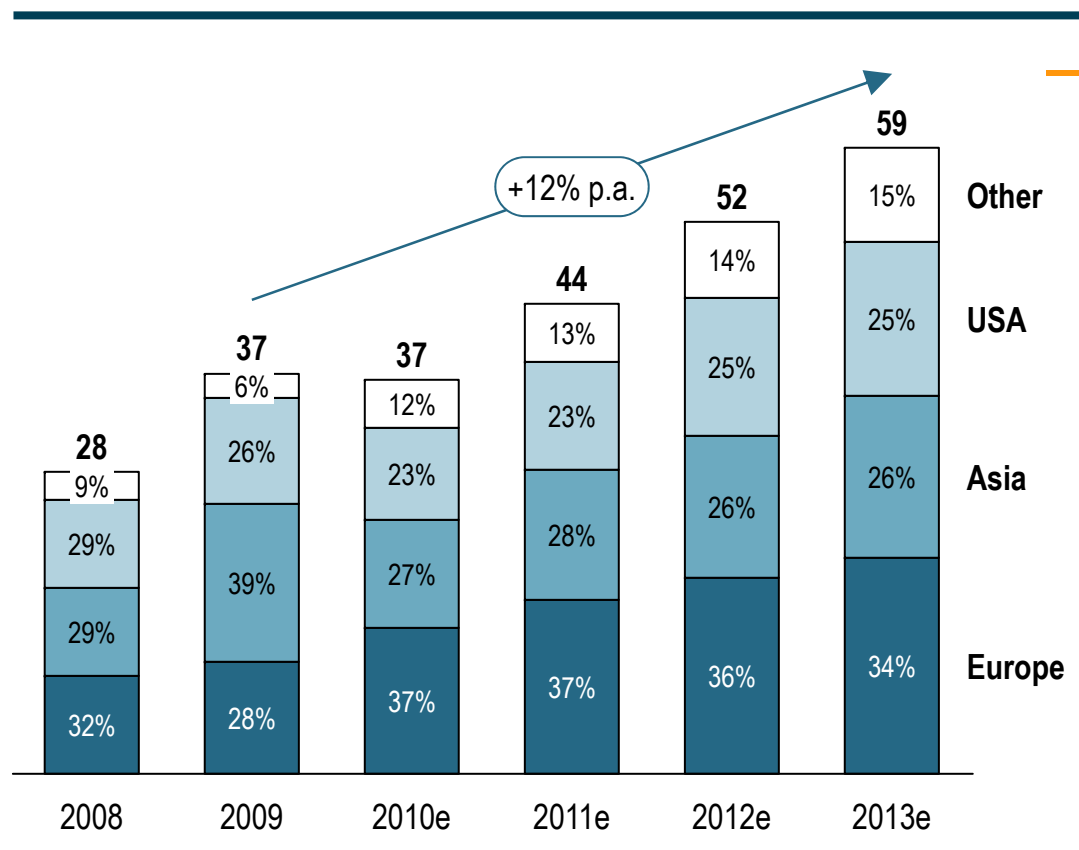
- > 3% target of non-hydro renewable electricity production by 2020 – 120 GW of wind power capacity by 2020
- > "10 GW Size Wind Base" program planning large scale deployment of 10 GW of wind power in four key regions until 2020

INDIA

- > Government plans for wind power capacity of 40 GW by 2022
- > Offshore wind, currently untapped in India, has significant potential – India has 7,000 miles of coast line

In spite of the slowdown expected in 2010, mid term expectations for wind energy are buoyant – 12% growth p.a. until 2013

Worldwide yearly added capacity [GW]



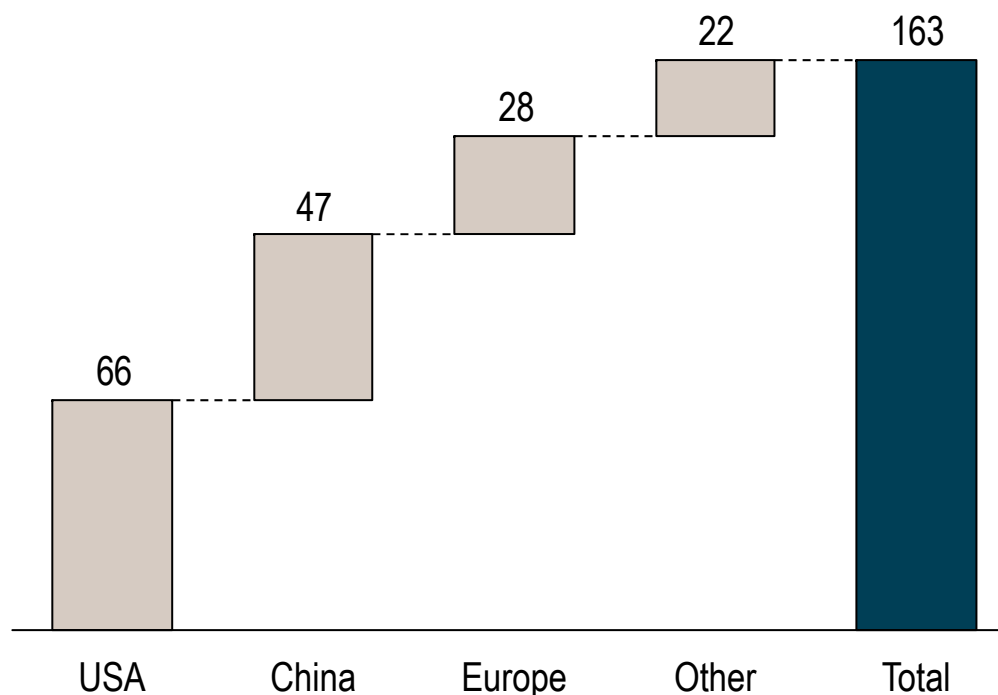
Growth trend still intact

- > Economic stimulus packages strongly support renewable energies, especially wind
- > Strong growth in 2009 mainly due to capacity going online and accounted for WTGs already delivered in 2007/2008
- > Slowdown in 2010 due to lower order intake and deliveries during 2009
- > Strong growth share in countries less dependant on financial markets (China)
- > Ambitious government goals for renewable energy share in core markets (e.g. USA, Europe, China, India...)
- > Cost penalties for fossil energies in Europe (ETS)
- > Offshore plans included

Announced economic stimulus programs will further push wind energy

Announced governmental clean energy stimulus spending until 2013 [USD bn]

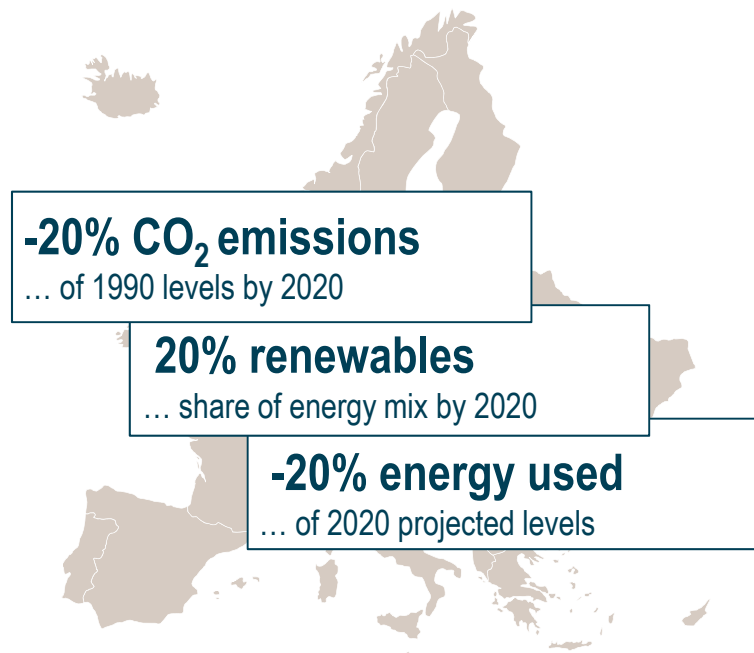
- > **USD 163 bn** between 2009 and 2013 in clean energy – 70% of it in 2010-2011
- > By sector the stimulus target:
 - Efficiency 26%
 - **Renewable industry 24%**
 - Grid 20%
 - R&D 20%
 - Other 15%



"20-20-20" targets bind EU countries to produce 20% of their power with renewables – Wind best positioned to fill the supply gap

Impact of the EU ETS on utilities – EU Climate and Energy Package, December 2008

Europe "20-20-20" targets 2020



IMPACT ON UTILITIES

- > **Utilities** are responsible for around $\frac{3}{4}$ of **CO₂ emissions** of all branches of industry
- > Utilities will be allowed to emit only as much CO₂ as they have **emissions allowances** (certificates)
- > From 2013 on utilities will have to buy **100% of their certificates¹⁾ in auctions** and may trade them afterwards (EU ETS²⁾)
- > By **2020** the total number of available certificates will be **reduced by 21%**
- > A considerable number of coal-fired power plants will have to be substituted – **wind** is the most mature renewable source to **fill the supply gap** and to reach the national **quotas of renewable energy**

1) Utilities in East European countries are exempted and will get 70% of their required certificates for free after 2013 until 2020

2) Emissions Trading Scheme

The current legislative environment in the US is clearly in favor of growth of renewable energy market

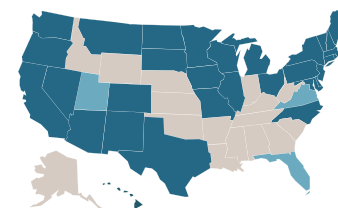
Regulatory framework

AMERICAN RECOVERY AND REINVESTMENT

- > USD 20 bn tax incentives for clean energy
- > USD 8 bn available as loans for renewable energy generation and transmission projects
- > USD 2 bn available for clean energy R&D
- > Goal to unleash USD 100 bn in private sector co-investment capital

RENEWABLE PORTFOLIO STANDARD

- > RPS commitments vary by state and range from 10-25% with target dates from 2010 to 2025



State renewable goal
Mandatory RPS

Renewable energy

- > RGGI states will distribute a set amount of CO₂ allowances through regional auctions, 188 million tons
- > Utilities will be forced to look at renewable solutions as the CO₂ allowances are decreased 10 percent by 2018



Participating States

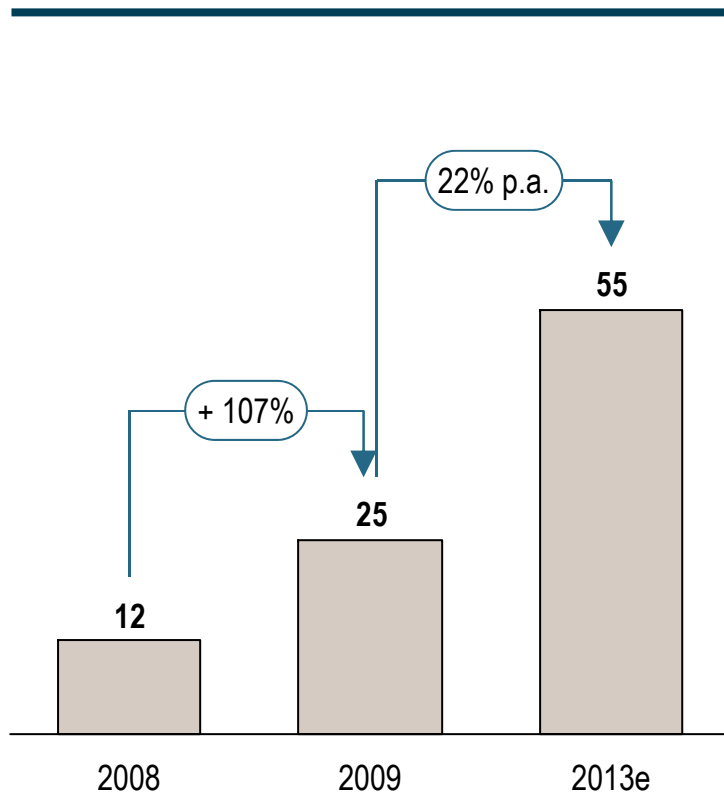
- > Production tax credit, PTC, was renewed for 3 years in October 2008
- > Investment tax credit, ITC, was extended by Congress in October 2008 for 8 years
- > Allow PTC or ITC to be replaced with a grant from the US Treasury Department

CARBON REDUCTION INITIATIVE

PRODUCTION AND INVESTMENT CREDITS

The Chinese wind energy market will also continue to grow strongly – Significant support of domestic manufacturers

Estimation of China cumulative installed capacity 2008-2013 [GW]

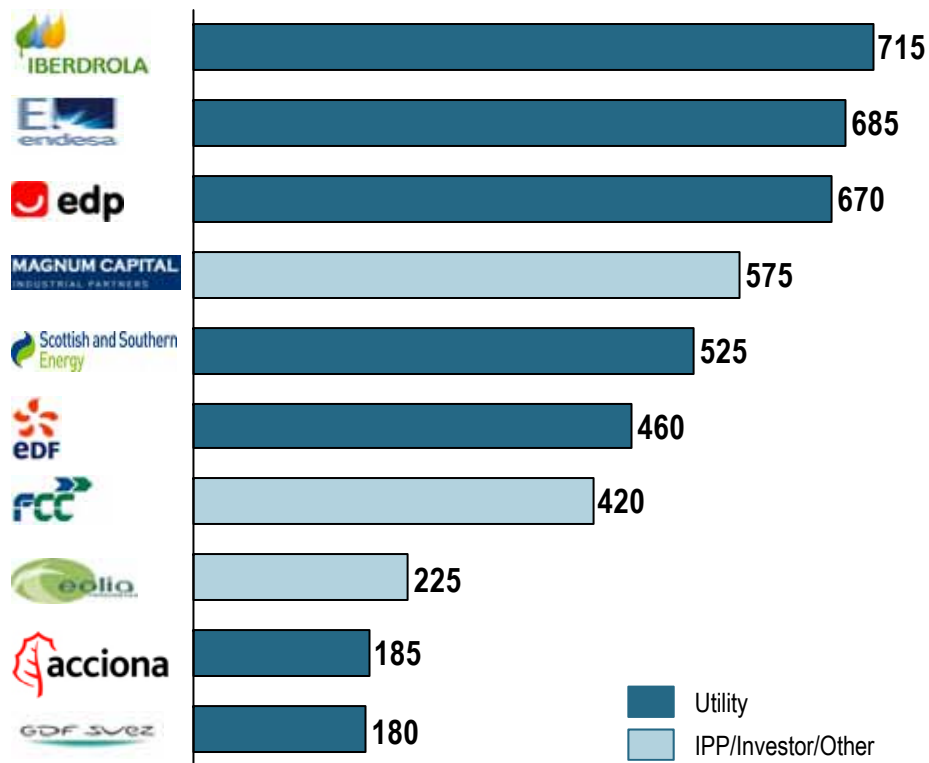


COMMENTS

- > Ambitious 120 GW target promoted in the "Wind Base Program" planning large scale deployment in selected regions
- > Better resilience than western markets facing the financial crisis – Chinese wind industry's development is mostly directed by the state with 80% of the market concentrated in large state-owned enterprises
- > Strong promotion of domestic manufacturing – In 2008 local players accounted for 75% of China WTG market up from 30% in 2004
 - Higher taxes for importing wind turbines and key components
 - Specific incentives (cash subsidies pro MW) for the manufacturing of turbines for domestic brands (>51% Chinese)
 - 70% localization must be achieved in order to participate in supply to state-owned wind farm operators
- > However, local manufacturing base is currently suffering from overcapacity (over 40%) and significant fragmentation

Wind energy production has increasingly become a large utilities game

2008 Europe Top 10 wind portfolio additions [MW]



COMMENTS

- > Utilities are increasingly taking over the wind industry and positioning themselves as consolidators
- > Aggressive portfolio extensions through building of new capacity or acquisitions, e.g.
 - S&S Energy acquisition of Airtricity (327 MW)
 - RWE acquisition of Urvasco (148 MW)
 - FCC (public services company) acquisition of Babcock & Brown' wind energy assets in Spain (420 MW)
 - Magnum Capital (PE) acquisition of Babcock & Brown wind energy assets in Portugal (515 MW and 156 MW in construction)
- > Several large mergers are as well restructuring the market
 - Vattenfall-Nuon
 - RWE-Essent
 - GDF Suez - Electrabel

Six key factors are driving the utilities to further increase wind in their portfolio, broadening their energy mix

OIL AND GAS RISK

- > Oil and gas prices and supply uncertainty increases the need for utilities to reduce their exposure
- > Wind broadens the energy mix cost-effectively

CRISIS "WINDOW OF OPPORTUNITY"

- > Problems for small and medium wind players to access financing
- > Acquisition of locations, equipment and know-how at low prices relying on strong cash flow from operations

EU "20-20-20" TARGETS FOR 2020

- > Utilities are forced to auction 100% of required CO₂ certificates after 2013
- > Operation with CO₂-intensive energies (e.g. coal) will become more expensive

Utilities' growth in wind energy market

- > **Strong focus on reliability and yield**
- > **Global supply of wind turbines**
- > **Own project management and O&M organizations**

SHORT LEAD TIME OF WIND

- > Global energy demand grows by 10-20% each year
- > Building a standard wind park takes only 3-5 years, a much shorter lead time than that of a conventional plant

PROMOTE GREEN IMAGE

- > General public increases awareness on environmental issues
- > Utilities need to promote a green image opposed to the traditional "polluter" one

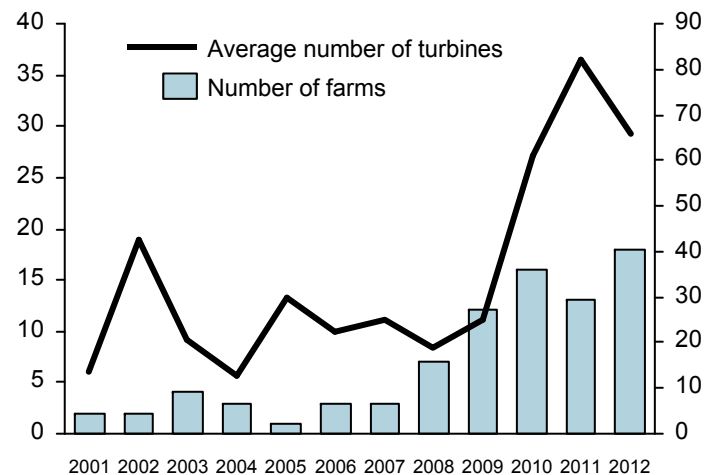
POLITICAL INCENTIVES

- > Support by political initiatives making wind energy production more attractive (e.g. tax incentives, feed-in tariffs)

The large scale entry of utilities will further increase project size leading to framework agreements

Bigger wind park projects and framework agreements

TOWARDS BIGGER WIND PARK PROJECTS



- > Average **wind farm size** increased by 20% in the last four years – larger projects over 50 MW are expected in the next years, specially offshore
- > Wind park size is a key factor for the **industrialization** of wind energy

FEWER BUT LARGER ORDERS

- > **Harder competition among WTMs**
- > **Crucial importance of partnerships and key account management**

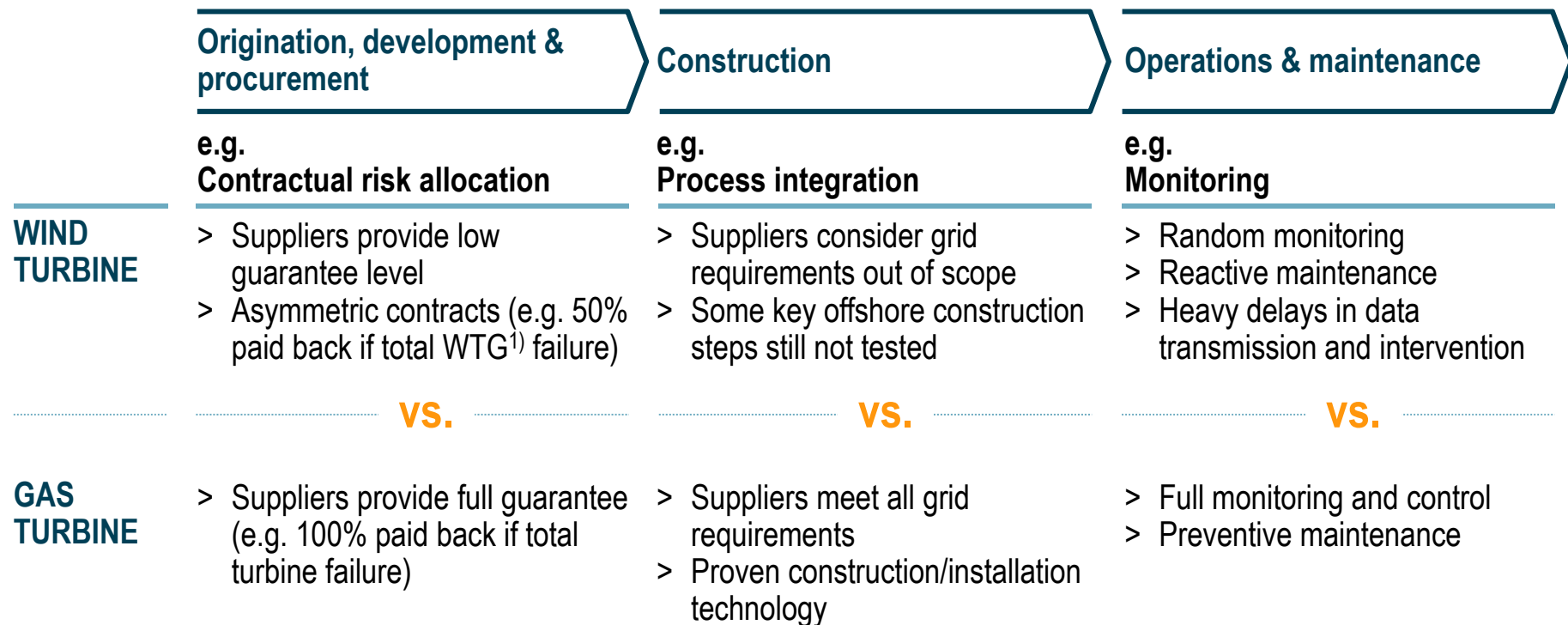
TOWARDS FRAMEWORK AGREEMENTS



Competitors have entered into major deals with utilities

- > Siemens agreement with Dong Energy for 1800MW
- > REpower will manufacture wind turbines for RWE Innogy amounting to 1900 MW
- > Utilities are allocating large orders and establishing **framework agreements** with selected suppliers – partnerships focusing to develop joint growth approaches
- > Number of suppliers to the major utilities is reduced

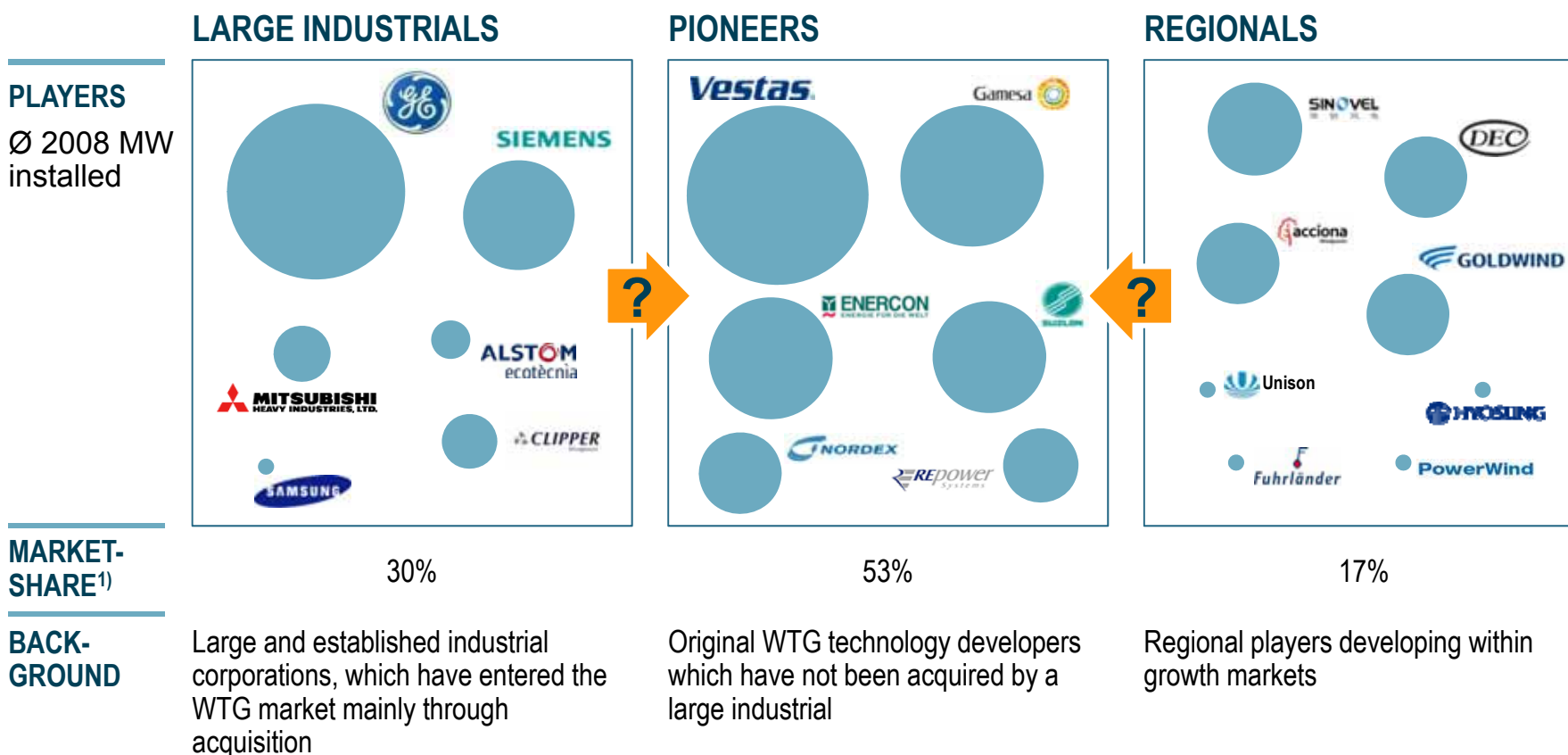
There will be strong demands from the utilities towards systematic industrialization of the wind value chain



1) Wind Turbine Generator

The wind turbine manufacturers' market is still heterogeneous – final structure has yet to emerge

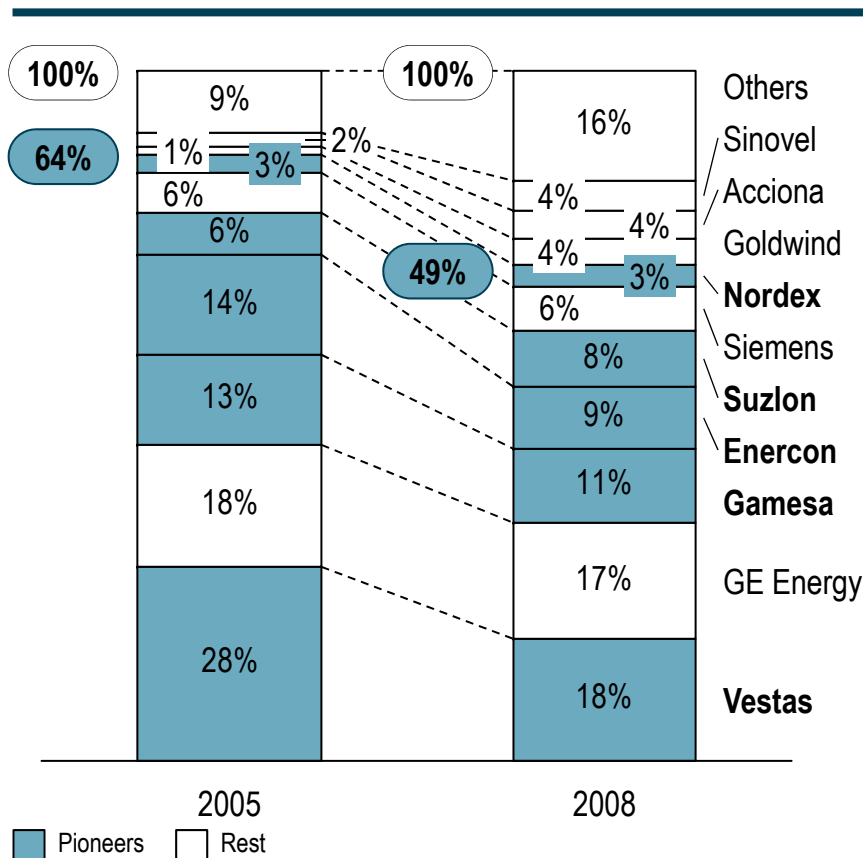
Overview WTG OEMs clusters



1) Installed capacity 2008 MW

Fragmentation of the OEM market has been observed in the past years – pioneers have been relative losers

Overview market shares 2005-08 [% MW delivered]



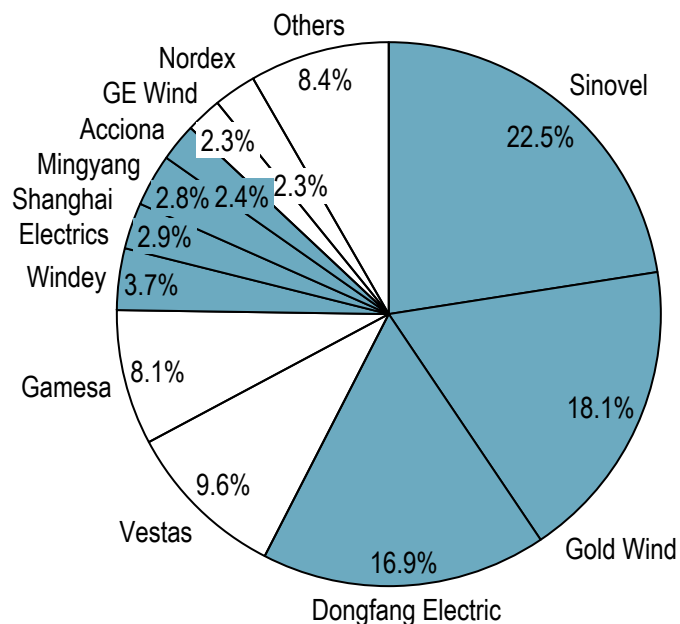
REMARKS

- > Pioneers market share decreased from 64% to 49% in 3 years
- > Large industrials as Siemens and GE lost relatively low or no market share since 2005
- > Strong market competition with a fragmentation of the overall the market
 - Small players increased market share from 9 to 16% between 2005-2008
 - Strong growth Chinese and American markets strengthen local suppliers (e.g. China Sinovel/Goldwind and USA Clipper)

Leveraging their strong home base Chinese manufacturers are preparing to go global

Market share of China annual installed turbine capacity

Wind turbine suppliers' market share in China 2008 [MW %]



Σ top 3 market share : 57.4%

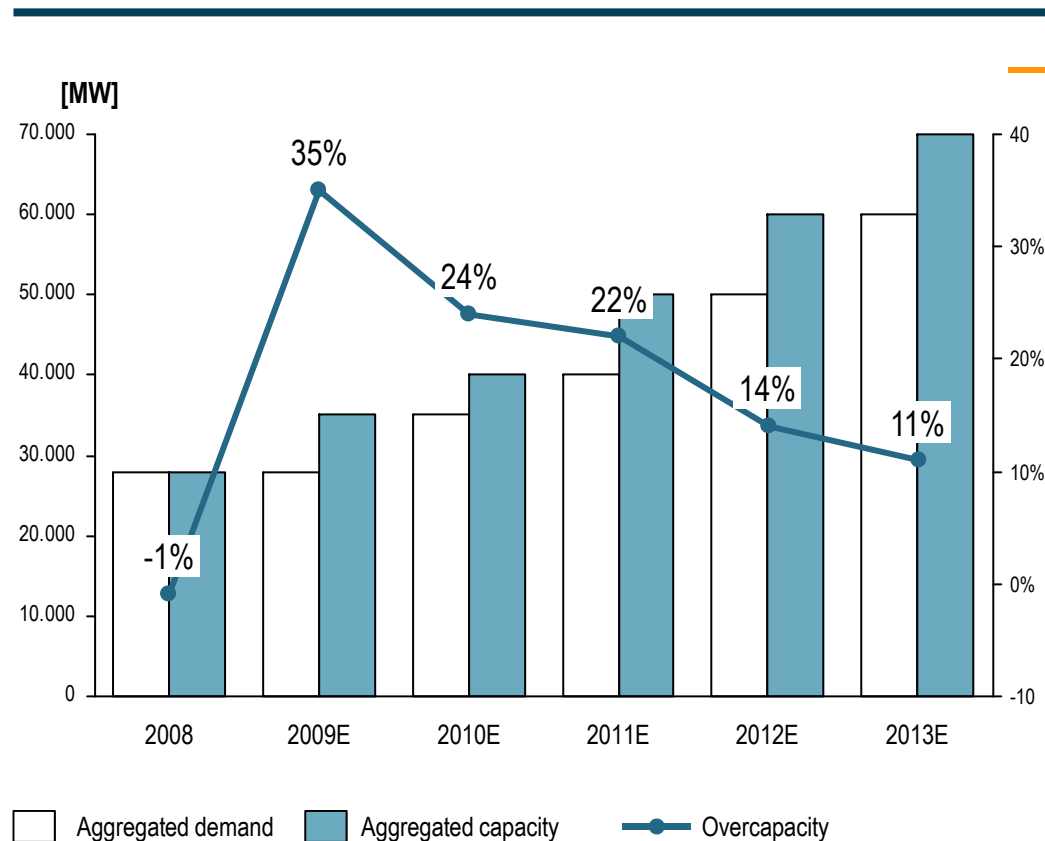
Local and JVs

Suppliers structure in China

	Development stage	Companies
local	Tier 1 Large capacity products with licensed technology	Gold Wind Sinovel Dongfang electrics
	Tier 2 Have prototype and preliminary small production capacity	Zhejiang Windey Xiangdian Huayi Electrics
	Tier 3 Completed prototype design and plan to build	Tianwei baobian Yuanjing Energy Changzheng Electrics
Foreign	Foreign companies with mature design and process technologies	GE Gamesa Vestas Suzlon
JV	Leverage foreign technology	Acciona JV in Nantong REpower, Honiton JV

The financial crisis and the emergence of new OEM players has led to structural overcapacity – shift to a buyers' market

Expected overcapacity evolution (%; 2009 – 2013)



IMPLICATIONS FOR OEMs

> Short-term:

- Maximize sales deals in an environment of WTG manufacturers overcapacity, ensuring '10 production and being ready for the re-launch
- Maintain margins and payment conditions during current turbulent times (as far as possible; potential buyer will ask for significant price reductions – from 10 to 20%)

> Mid-term:

- Prepare the sales organization for a "buyers' market" environment

Conclusion: The WTG market is changing from being a "pioneering" market into a mainstream industrial market

PIONEERING MARKET (UNTIL 2008)

Main market growth in a few Western European markets (Germany, Spain, Denmark) – US starting with delay

Technology development occurring in parallel to WTG manufacture with fast evolving model ranges – bottlenecks in component development and supply capacity

WTGs were mainly purchased by developers or financial investors who primed delivery capability over price

WTG industry was dominated by pioneers like Vestas and Gamesa

MAINSTREAM MARKET (EXPECTED AS OF 2011)

Growth broadening to all large and non fossil fuel exporting markets (Rest of EU, USA and China)

Product development following standard industrial practices and speeds – supply chains more stable and local

Utilities are increasingly becoming buyers, who apply similar price/performance criteria as for conventional generation equipment – price squeeze is expected

Large industrial players (Siemens, GE) and local players (Goldwind, Sinovel, etc.) are increasing their market share at the expense of the early pioneers – overcapacity will trigger consolidation

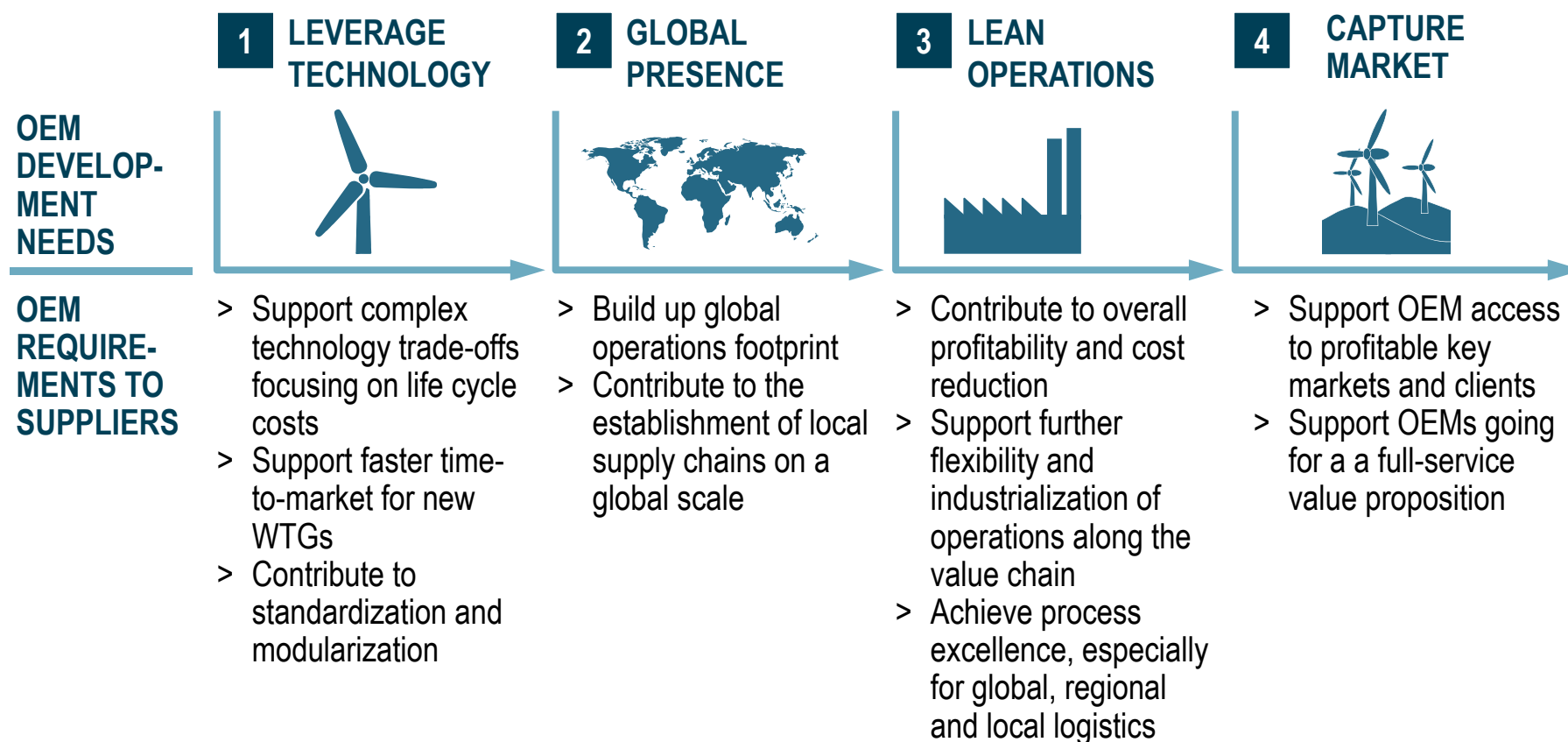
"Get large and industrially lean or exit!"



B. Wind turbine manufactures will need to get large and industrially lean – Suppliers must follow suit

OEMs need to develop along four axis – support from suppliers required on all of them

OEM development needs and key requirements to suppliers along the value chain

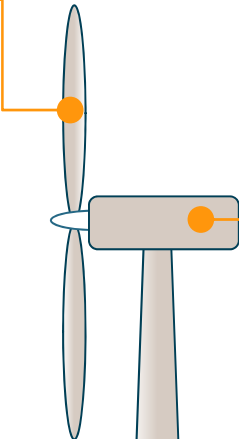


Complex technological challenges ahead – Close collaboration with supplier base is required

Main technical challenges – Towards improved reliability, life-cycle-costs and yield

BLADES AND ROTOR

- > Introduction of new materials (e.g. CFRP)
- > Manufacturing constraints
- > Endurance to environmental damage (e.g. weather, lightning)



DRIVE TRAIN AND GENERATOR

- > Lighter and more compact housings (e.g. integration of drive train and generator)
- > Simplification and new design solutions for drive trains (e.g. reduction of bearings and roller parts)
- > Integration of new generator technologies (e.g. superconductor generators)

GRID CONNECTION & INTEGRATION

- > Adaptation to grid requirements (e.g. stability, voltage fluctuations)
- > Industrial customization and modularization of wind turbines
- > New integration technologies

TOWER AND FOUNDATION

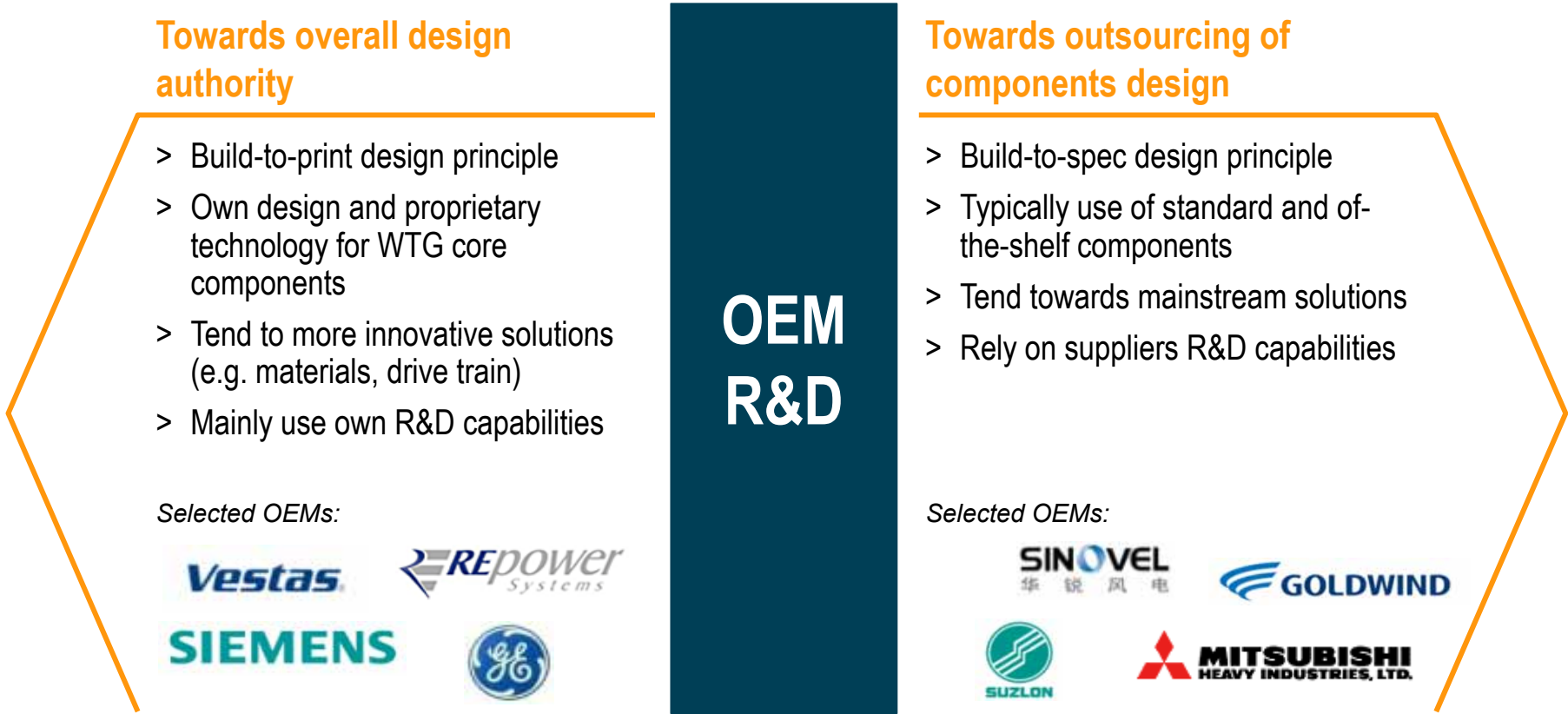
- > New foundations design, construction techniques and materials, specially for Offshore

OPPORTUNITIES FOR SUPPLIERS

- > Position as a critical partner actively supporting OEMs overcoming complexity of technical challenges on critical components
- > Pursue risk sharing and partnering strategies for new developments of proprietary technology
- > Support reduction of manufacturing costs by establishing industrialization requirements early in the development

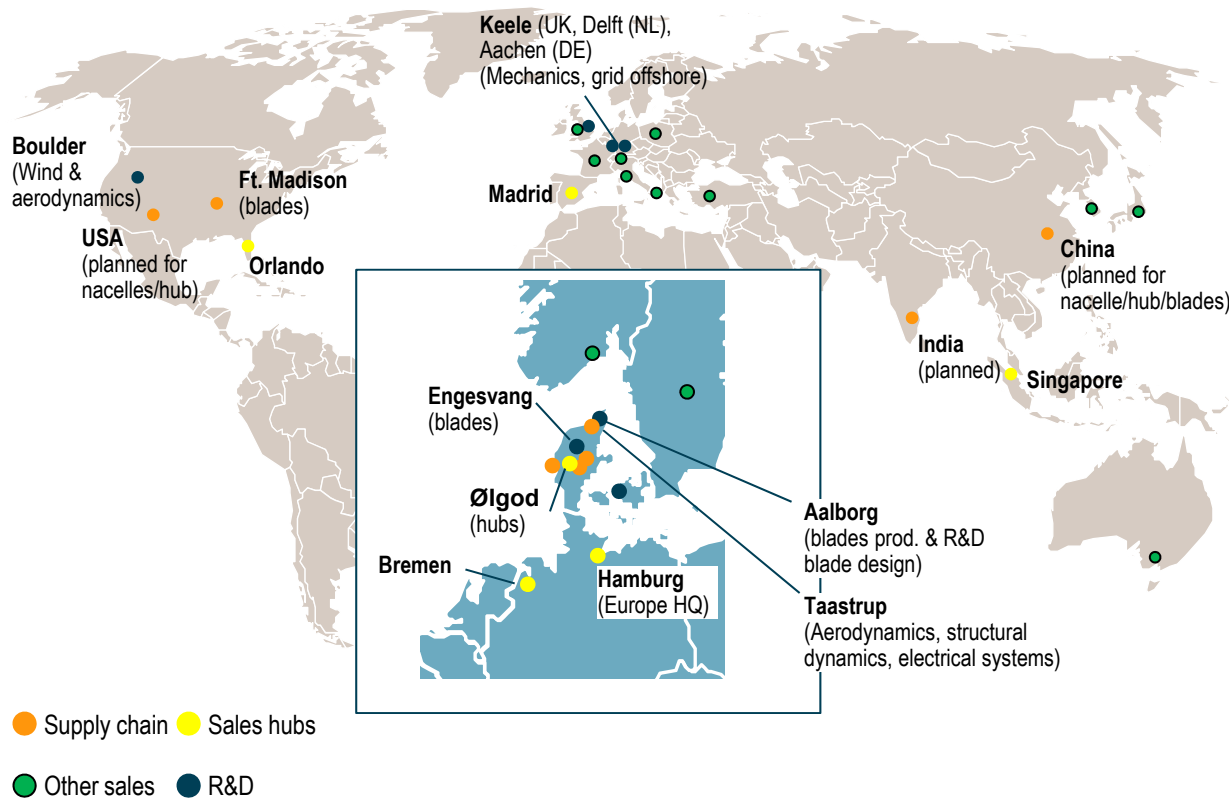
OEMs approach for R&D is diverging – Suppliers will have to adapt their portfolio and capabilities to target clients

Diverging OEMs approaches for R&D



Large industrial players are systematically expanding their footprint

Example – Siemens global footprint



Underlying rationale

First:

- > Establish an industrially lean processes in the home base

Then:

- > Transfer (duplicate) industrial set up to international locations

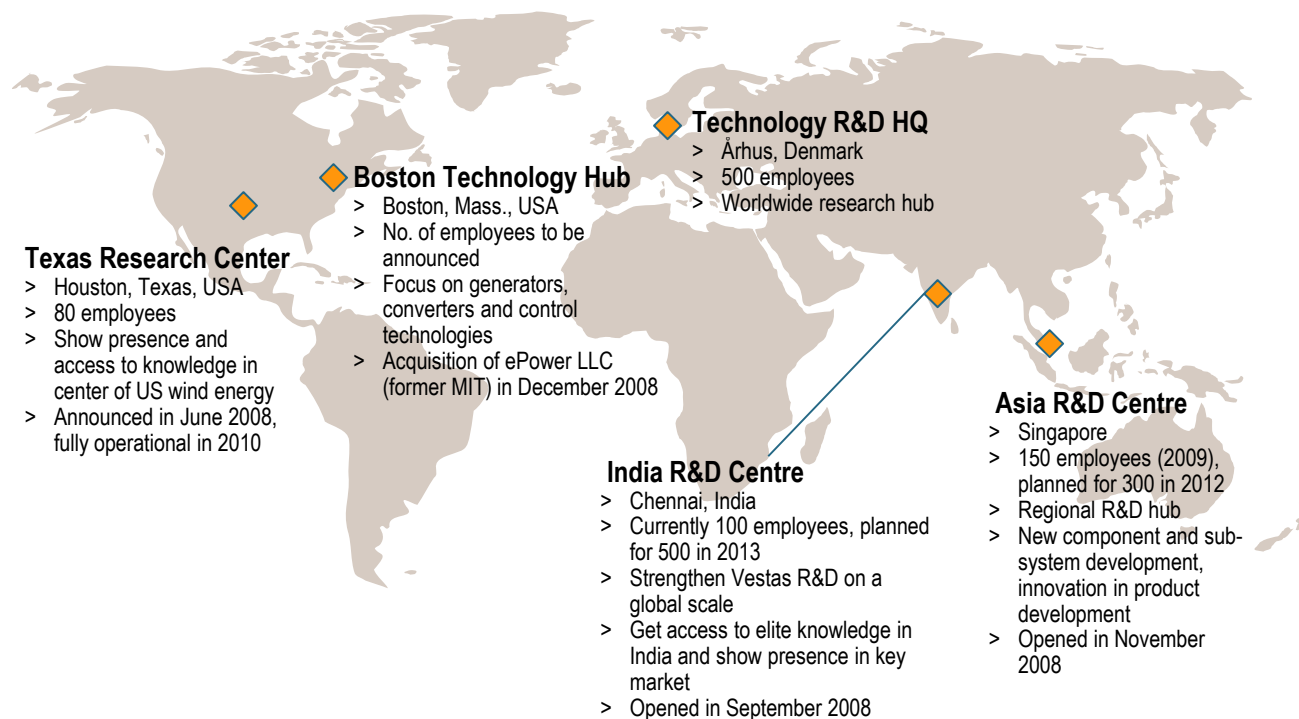
Expectations towards suppliers

- > Follow international moves of OEMs

- > Implement and continuously improve lean manufacturing locally while benefiting from the volumes generated by the OEM

R&D capabilities and footprint are also being globalized – Vestas R&D works 24 hours a day around the globe

Example – Vestas global R&D footprint

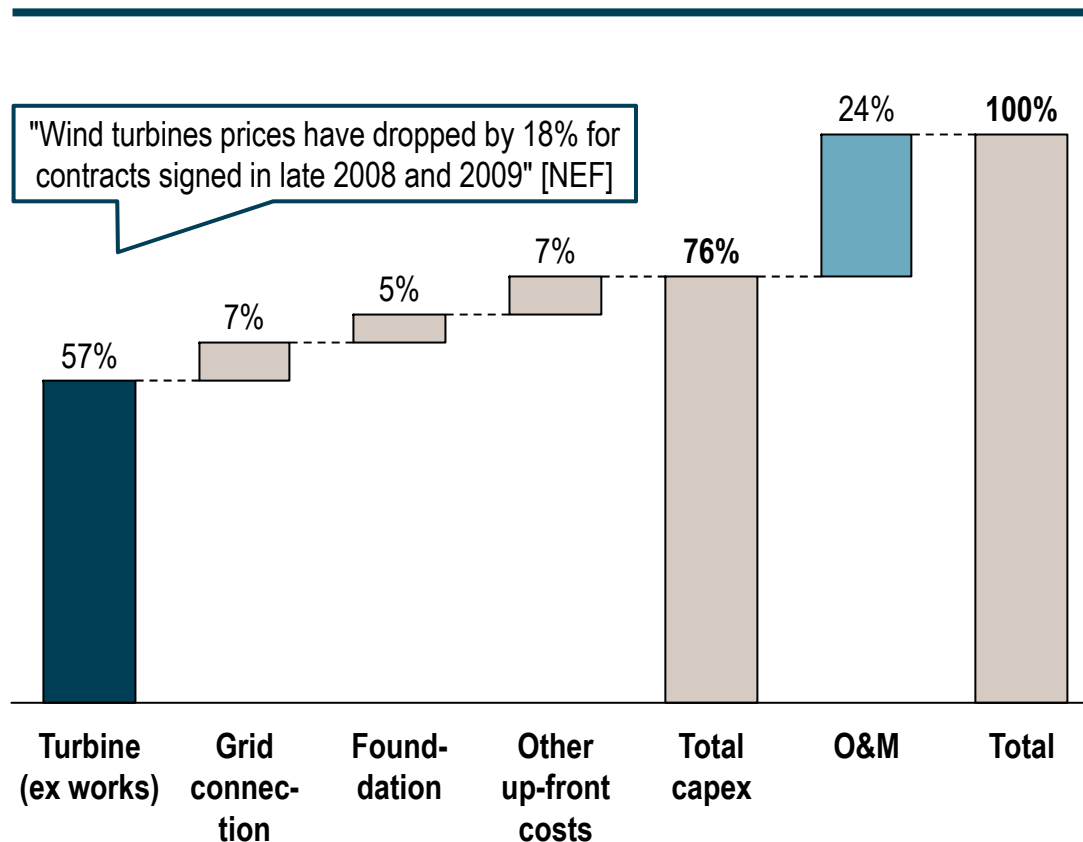


Challenges of global R&D

- > Efficient alignment of roles and responsibilities, including:
 - Competences of locations
 - Interfaces between sites
- > Consistent target setting and tracking of engineering activities
- > Danger of loss of intellectual property in international engineering locations
- > Cultural and communication obstacles

Strong pressure on reducing the cost of wind turbines will subsist

Typical life cycle costs of a 2-MW onshore wind turbine [%]

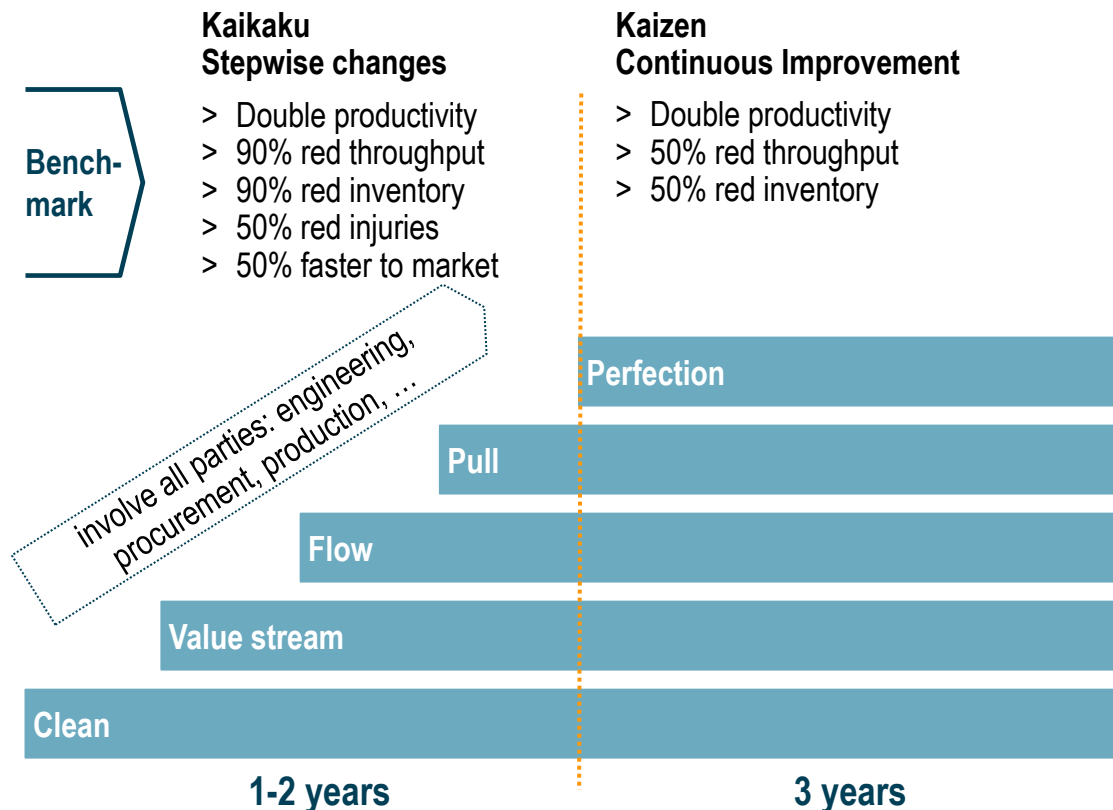


REMARKS

- > Current over capacities in the market are putting strong pressure on turbine prices
- > Wind turbine acquisition costs is the main lever for operators to reduce overall wind energy costs

OEMs have engaged in systematic "lean operations" programmes and expect suppliers to contribute

Example Siemens – "Lean as driver of transformation"

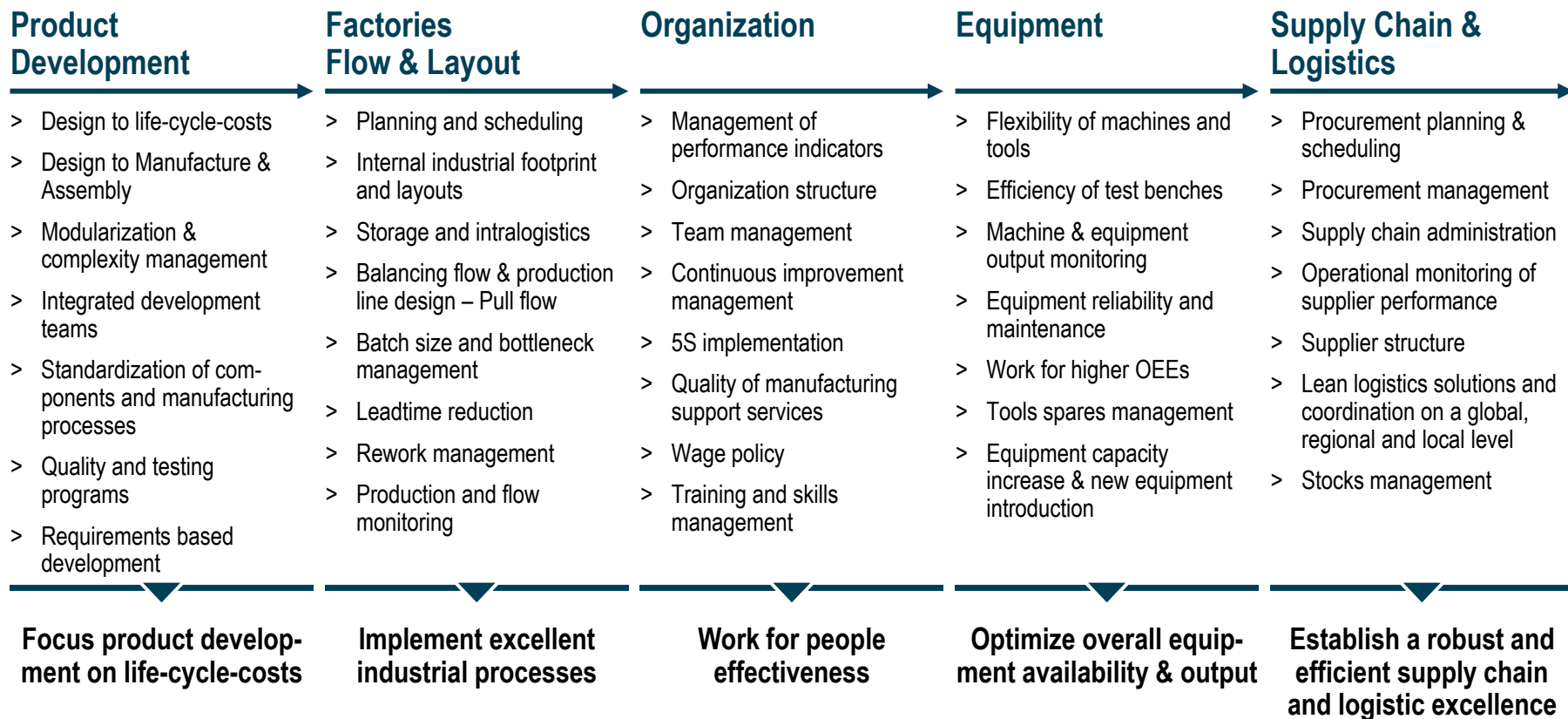


IMPLICATIONS FOR SUPPLIERS

- > Suppliers will be required to contribute to increase capacity flexibility and cost performance of OEMs
- > Lean initiatives already launched in the OEM manufacturing activities will be extended to the overall value chain
- > Launch of joint improvement projects especially for logistics
- > Adaptation of supplier footprint to OEM needs will be a key factor to a lean overall industrial set-up

A robust industrialization of operations is key to face pressure on profit margins

Key levers for a robust industrialization



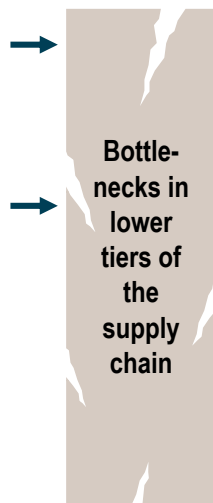
Bottlenecks on lower-tier levels need to be pro-actively managed

Context and challenges of bottlenecks on lower tier levels of the supply chain

CONTEXT

Symptoms

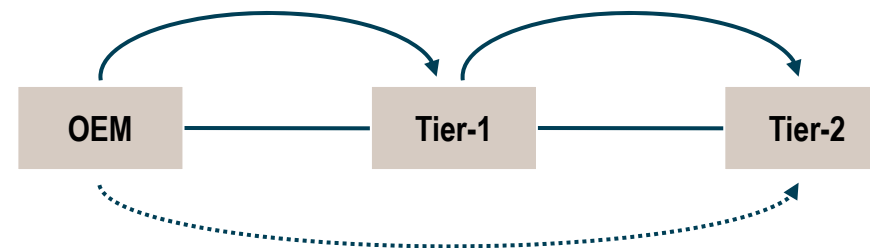
- > Increasingly quality problems of components (quantity over quality)
- > "Blame game" between different parties involved



Causes

- > Dynamically growing industry with CAGR > 20%
- > Lack of predictability of sales plan
- > Lack of commitment
- > Lack of communication regarding requirements and volumes (reactive rather than pro-active)

CHALLENGE FOR SUPPLIERS

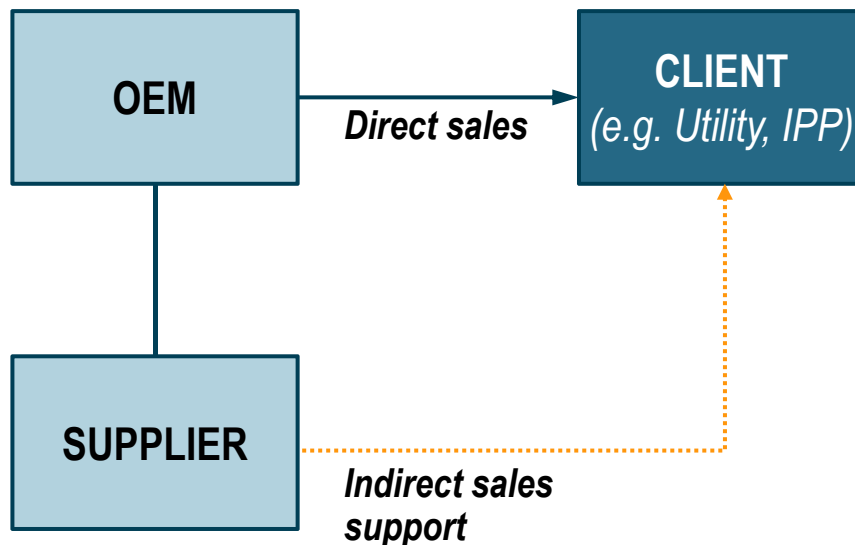


- > How pro-actively identify bottlenecks at Tier-2 level?
- > How to mitigate them?
- > How to avoid sandwich positioning (OEM directly controlling Tier-2)?

Main challenge for OEM
Supply chain ramp-up (quantity and quality) in times of difficult prediction of own market share

Build a comprehensive supply chain capacity model to identify hidden bottlenecks early on

Sales will become the key priority for OEMs – Indirect support will be a key factor of success for suppliers

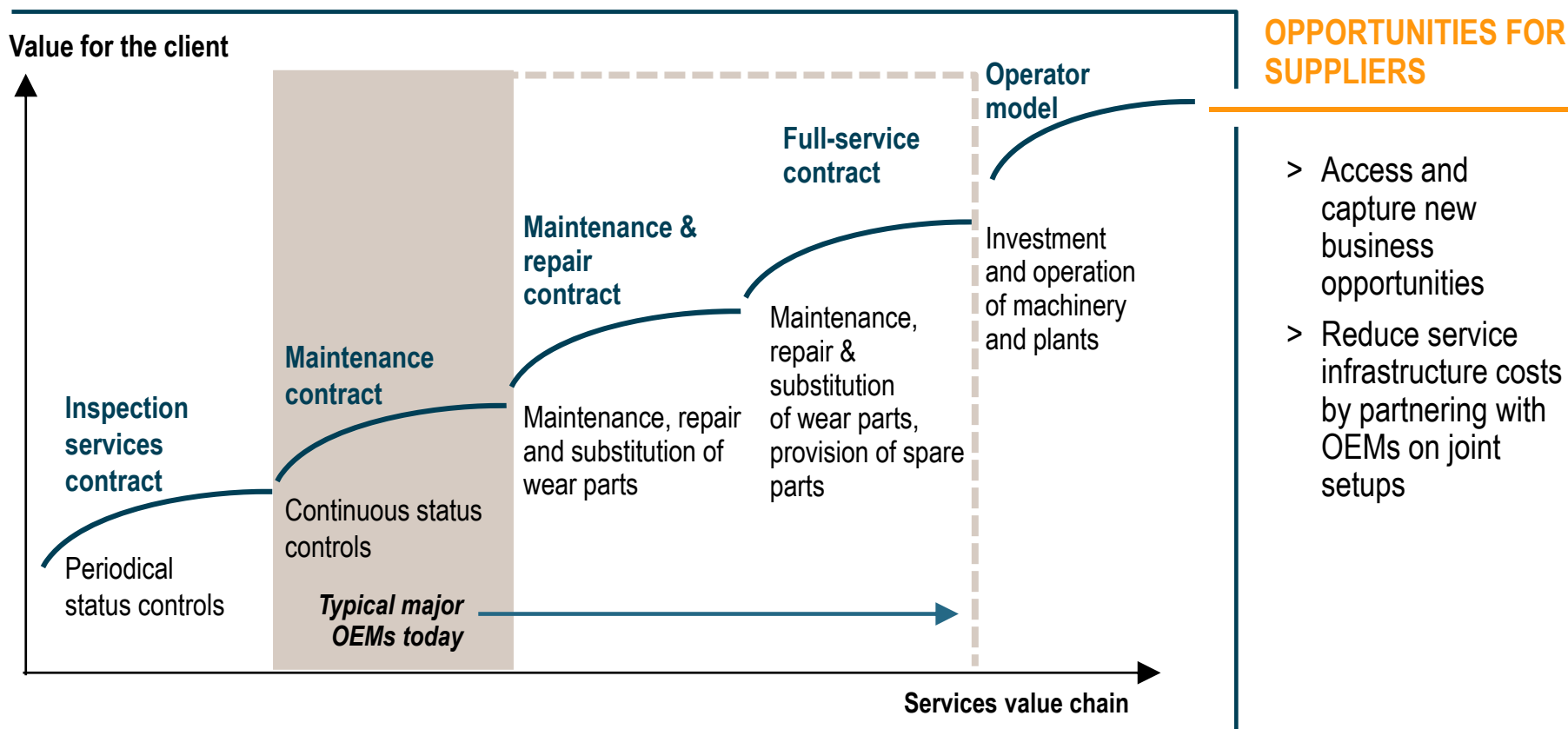


INDIRECT SALES SUPPORT THROUGH...

- > Establishing industrial setup in target markets helping to contribute the OEM with local content requirements with a reliable partner
- > Lobbying
- > Reputation of components reliability and performance
- > Joint operational performance optimization e.g.:
 - Cost reduction
 - New products time to market
 - Service
 - Logistics

New after sales value propositions and contractual offers need to be developed between OEMs and suppliers

Transition from selling to full service model



Conclusion – OEMs requirements to suppliers are changing as the market goes mainstream on a global scale

PIONEERING MARKET (UNTIL 2008)

Supplier R&D and production footprint essentially European based

Technology development of critical WTG components driven together by specialized suppliers and the OEMs

High profit margins along the WTG manufacturing value chain fueled by the ever increasing demands and capacity bottlenecks

Fragmentation of the OEM market due to the continuous flow of new entrants – Experienced suppliers for critical components in demand

MAINSTREAM MARKET (EXPECTED AS OF 2011)

Global footprint to serve OEMs international network of local production clusters

Development of critical components for new and larger WTGs driven by the OEMs (incl. ownership of IP). Low end and smaller turbines make use of industrially standardized components

Capacity fluctuation and pressure on profit margins push for flexibility, an efficient industrialization and cost performance from supplier to OEM

Market will consolidate as it matures – Supplier positioning with successful OEMs will be key not to be left out of the big game

"Actively support OEMs achieving a sustainable global growth or exit!"