



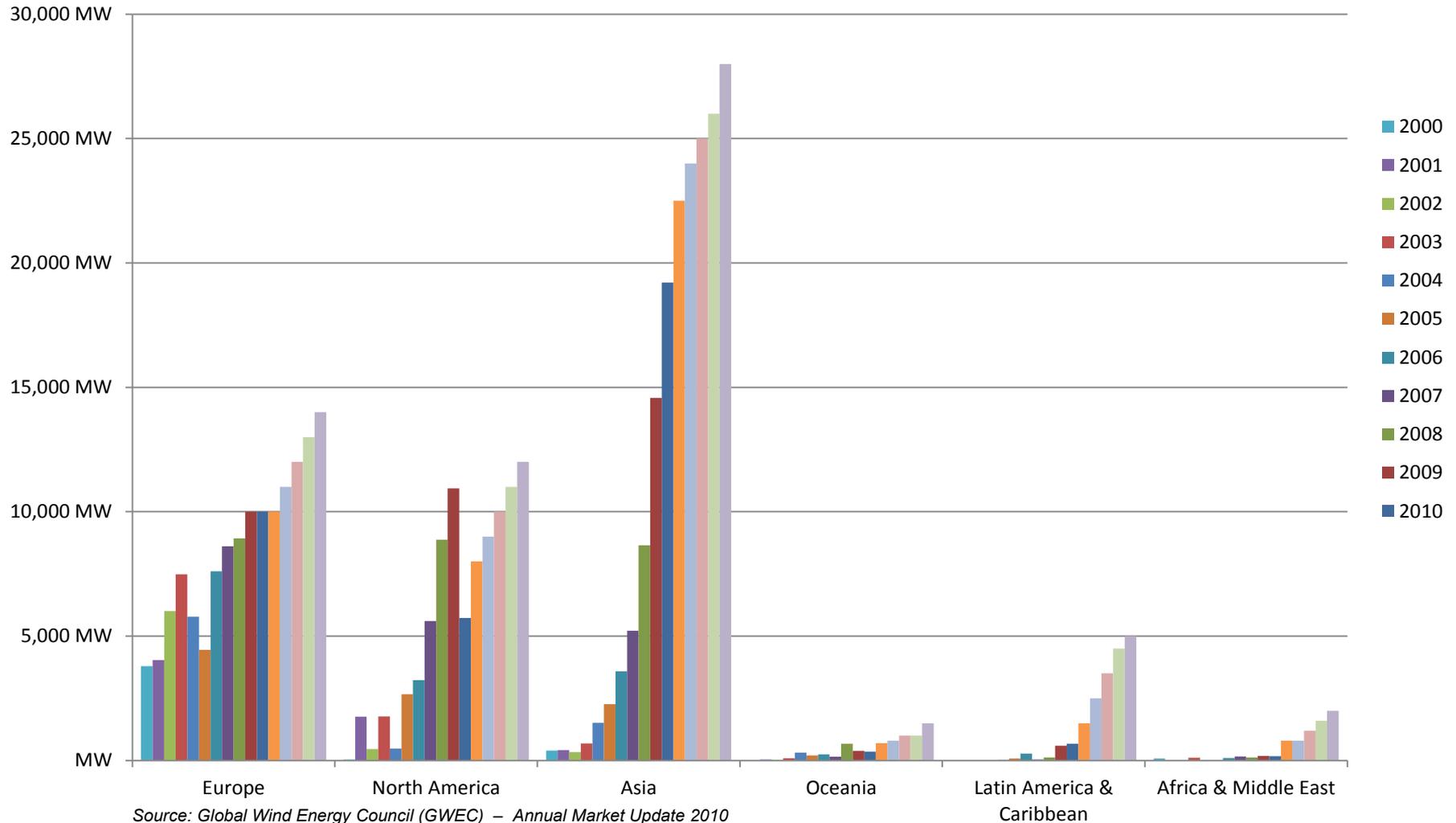
Wind Power Potential in Developing Countries

Kasper Dalsten
Senior Specialist, Government Relations
Vestas Mediterranean

The Developing World is Ready for Wind Power

Wind power: a natural part of modern energy supply with appropriate regulatory framework

Annual installed wind capacity by region 2000-2010, and estimates 2011-2015

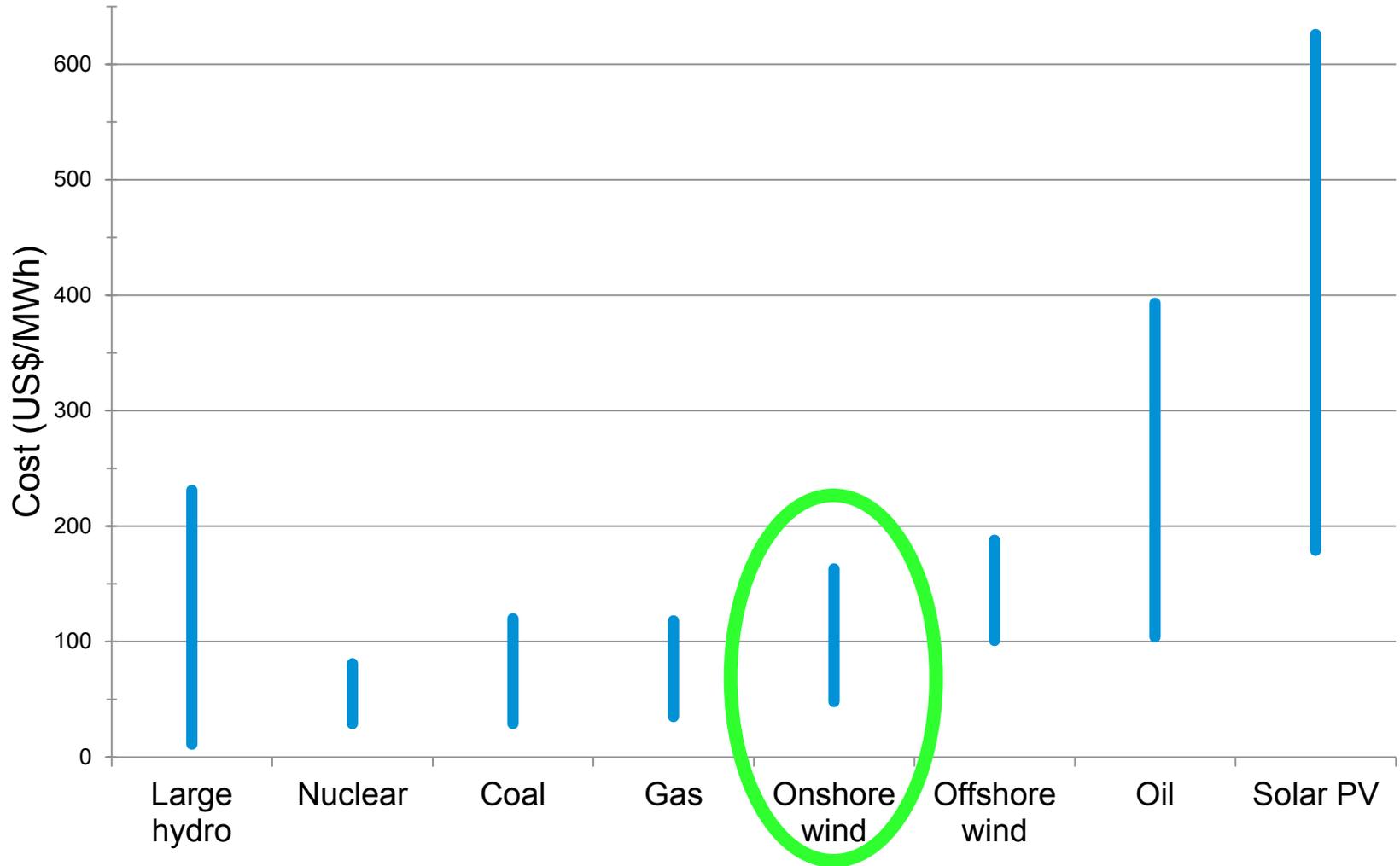


Source: Global Wind Energy Council (GWEC) – Annual Market Update 2010

The Developing World is Ready for Wind Power

Wind power: mature technology with low and competitive costs

Cost ranges (USD/MWh) for newly built power plants in OECD and BRIC countries (IEA 2010)

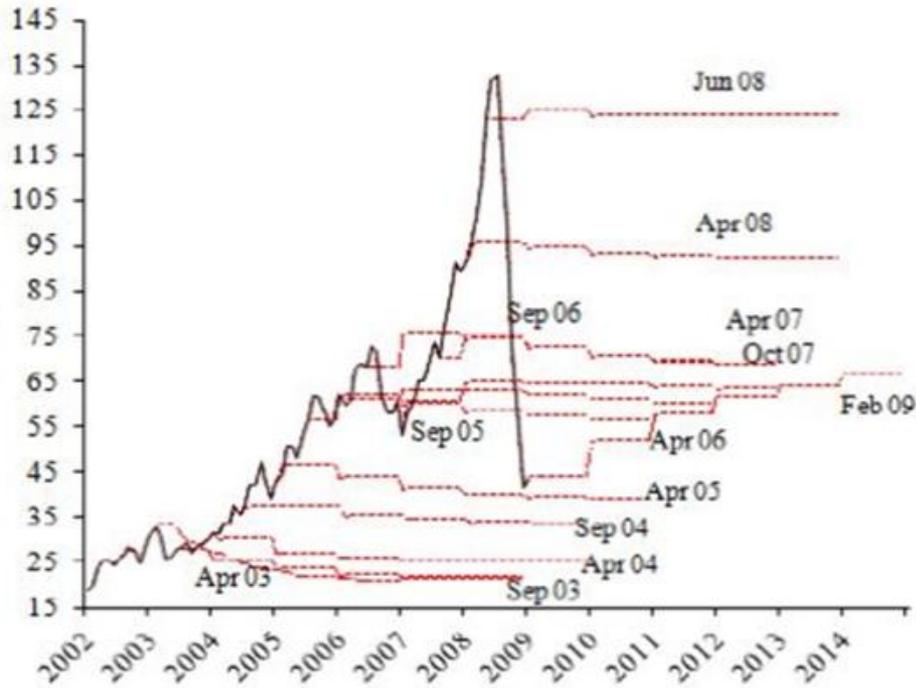


The Developing World is Ready for Wind Power

Wind power: predictable cost of energy and a natural hedge against fuel price volatility

WEO Oil Price Forecasts, 2003-2009 (US\$/barrel)

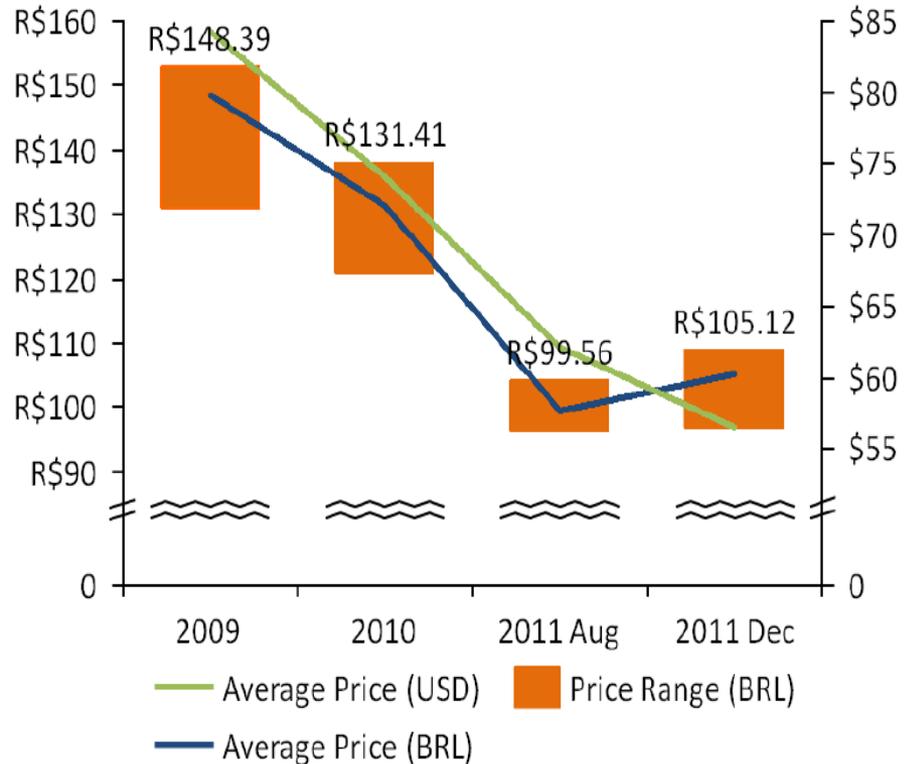
Fossil fuel prices are volatile and unpredictable



Source: IMF WEO various years, after Ossowski et al. (2008)

Brazilian Wind Tender Pricing (BRL vs. USD/MWh)

Wind power is competitive in open auctions

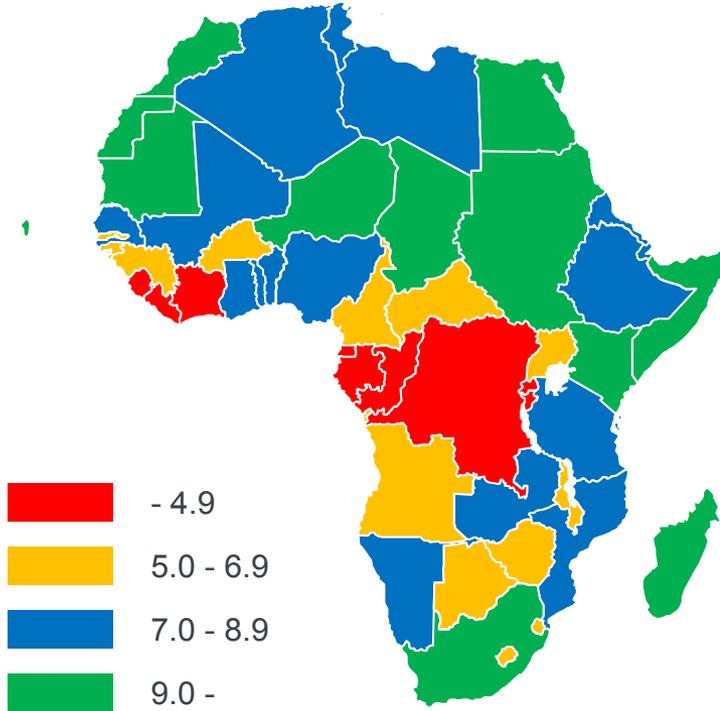


Source: MAKE Consulting 2011

The Developing World is Ready for Wind Power

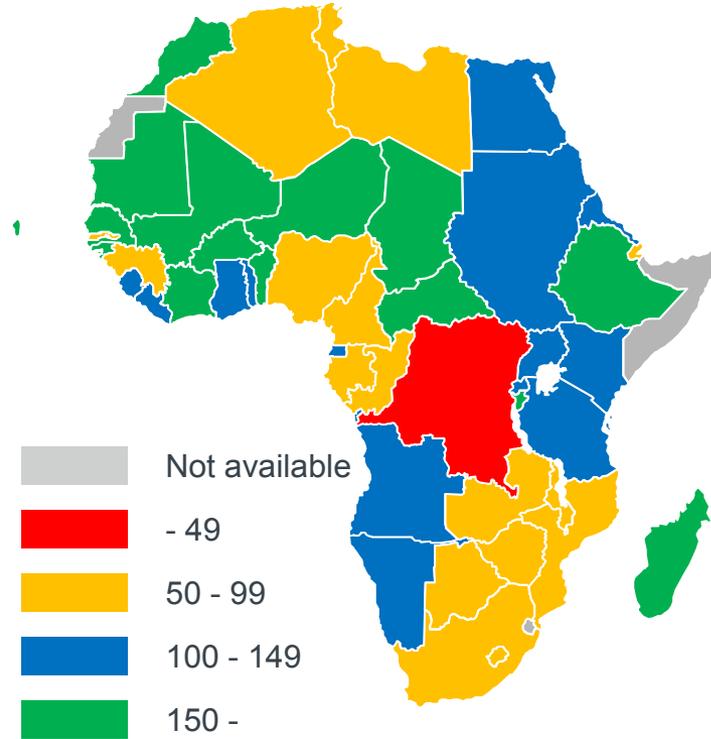
Great wind resources offering competitive power generation

Best wind spot in average m/s at 80 meters



Source: Vestas MesoMap

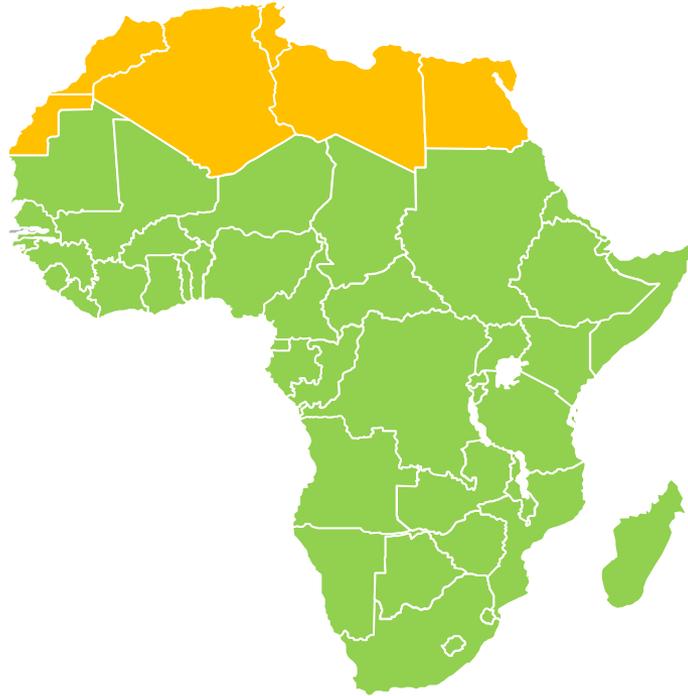
Marginal cost of electricity in USD/MWh



Sources: Econ Pöyry for sub-Saharan Africa
RCREEE for North Africa

The Developing World is Ready for Wind Power

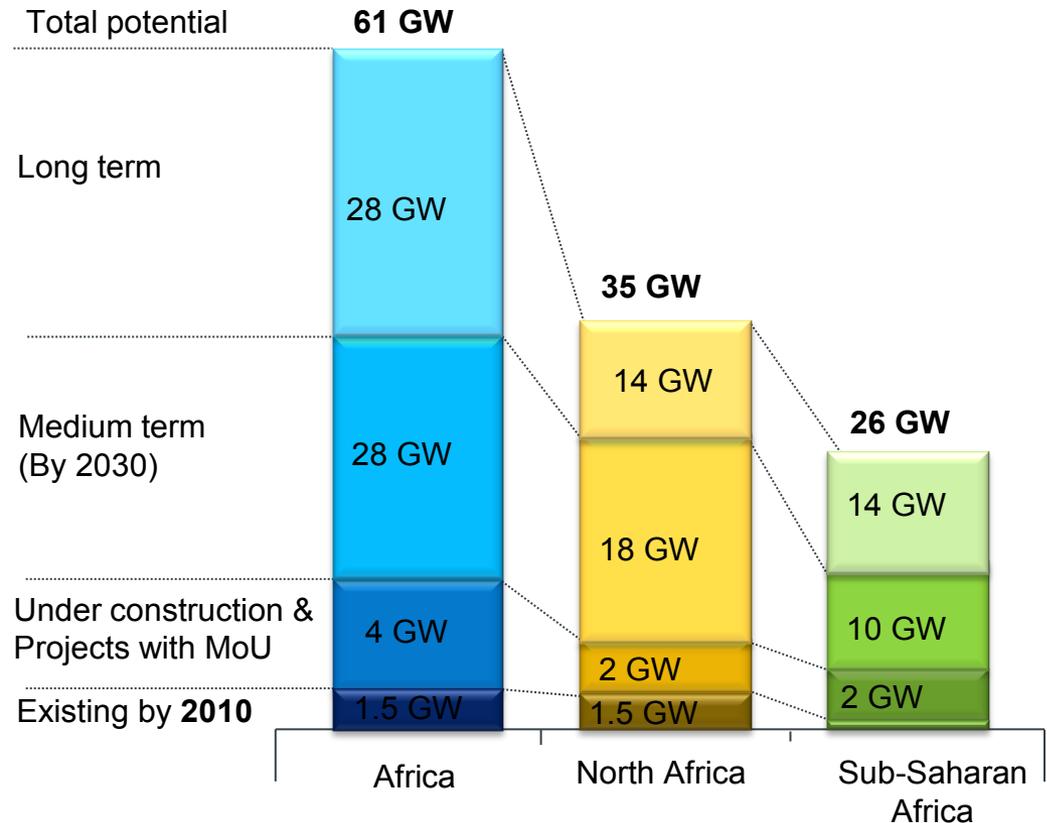
Large wind power potential in the short term and the long term



- Sub-Saharan Africa
- Northern Africa

Wind potential in Africa

Estimation based on wind resources, accessibility and bankability



Sources: HIS Energy Research 2011; Energy Policy - The International Journal of the Political, Economic, Planning, Environmental and Social Aspects of Energy 2011; and Vestas estimates



Wind Projects Long Term Service Agreements. Operations and Maintenance of Wind Farms in Developing Countries

Jean-Christophe Paupe – jcpau@vestas.com
Vice President, Service –MED, LAC, Africa



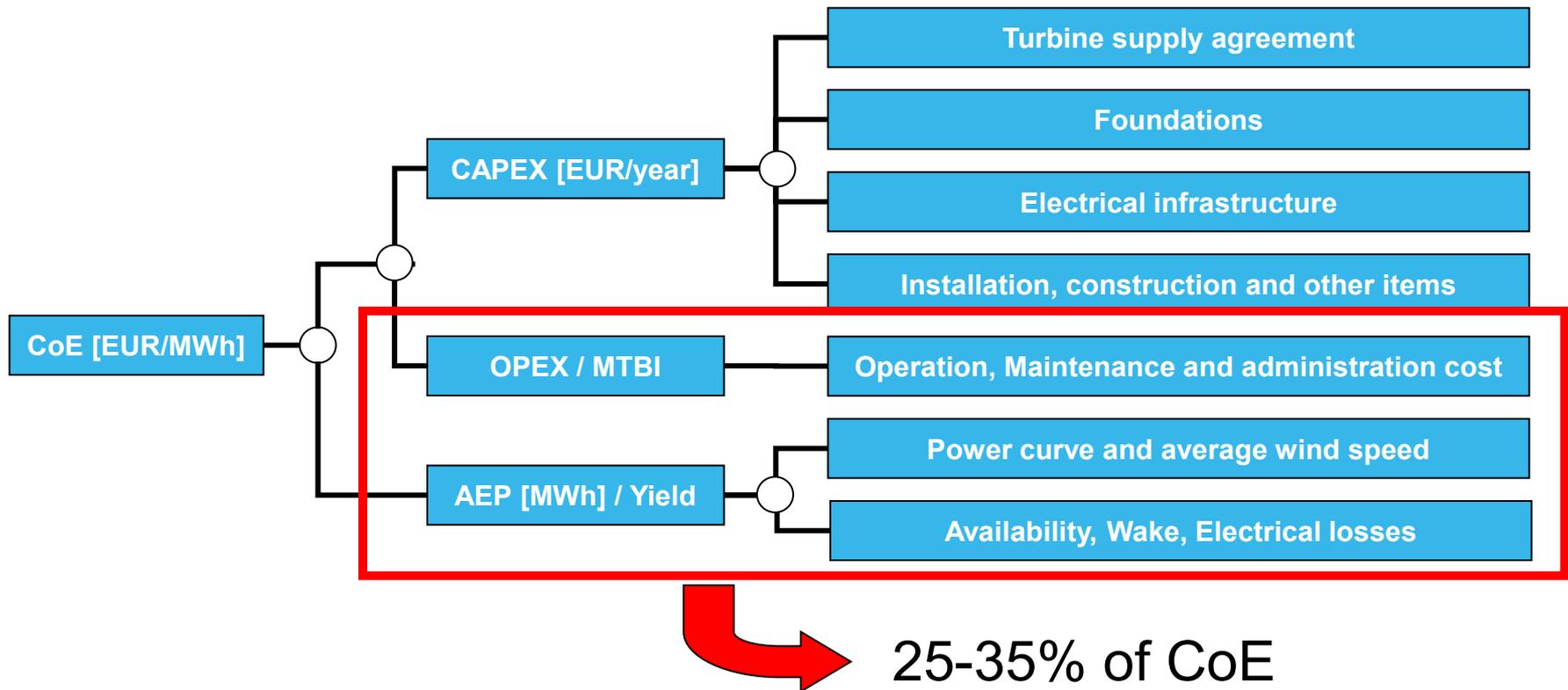
If your new car
drove as much as
a wind turbine,
it would have to
be scrapped
after 6 months*.

*The average car is scrapped after 4500
hours of operation. This equals 6 months
Operation of a wind turbine (www.dkwind.dk).



Cost of Energy embraces all aspects in wind power performance

$$\text{CoE} = \frac{\text{Annualized CAPEX} + \text{Annualized OPEX}}{\text{Annual Energy Production}}$$

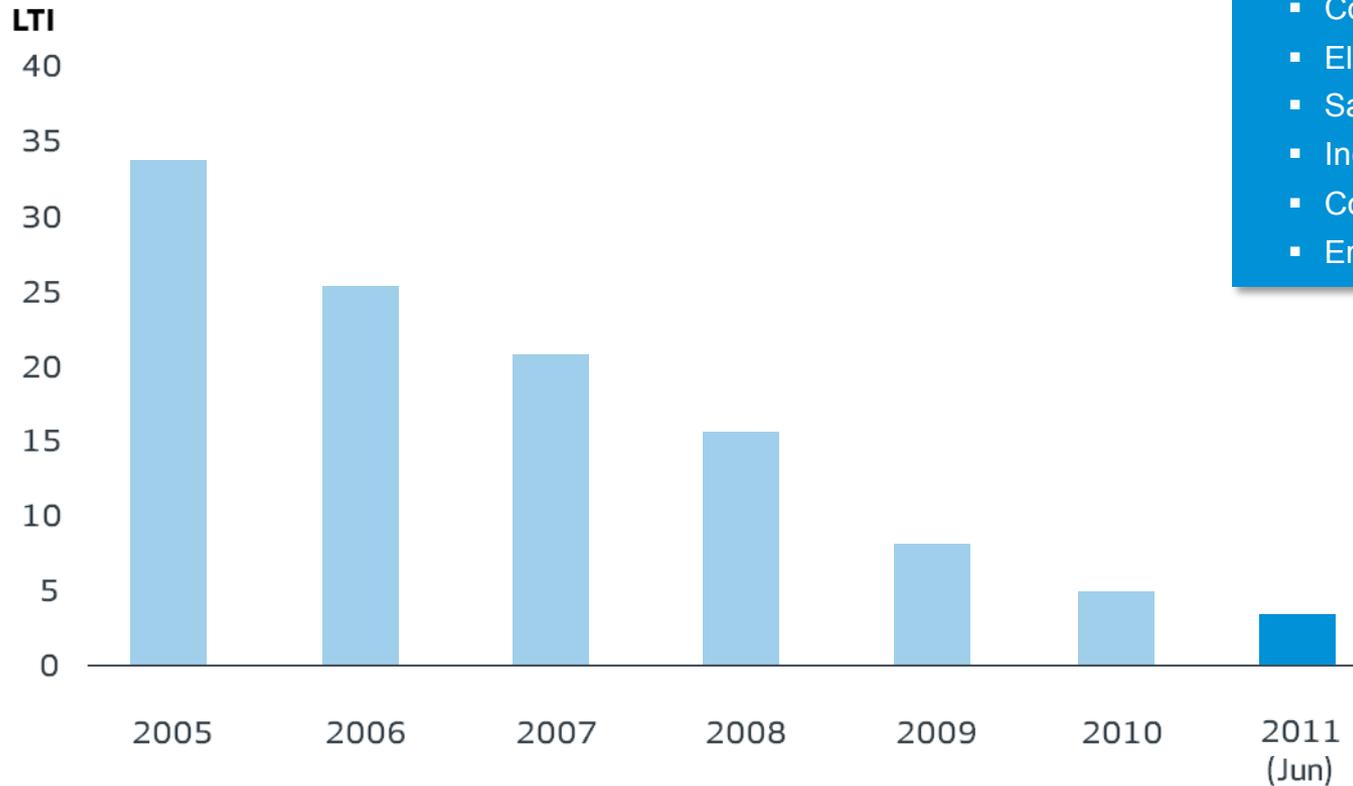


Safety

Highest service quality at highest safety standard.

Lost Time Injury Rate (LTI)

Injuries pr. 1.000.000 hours of work:

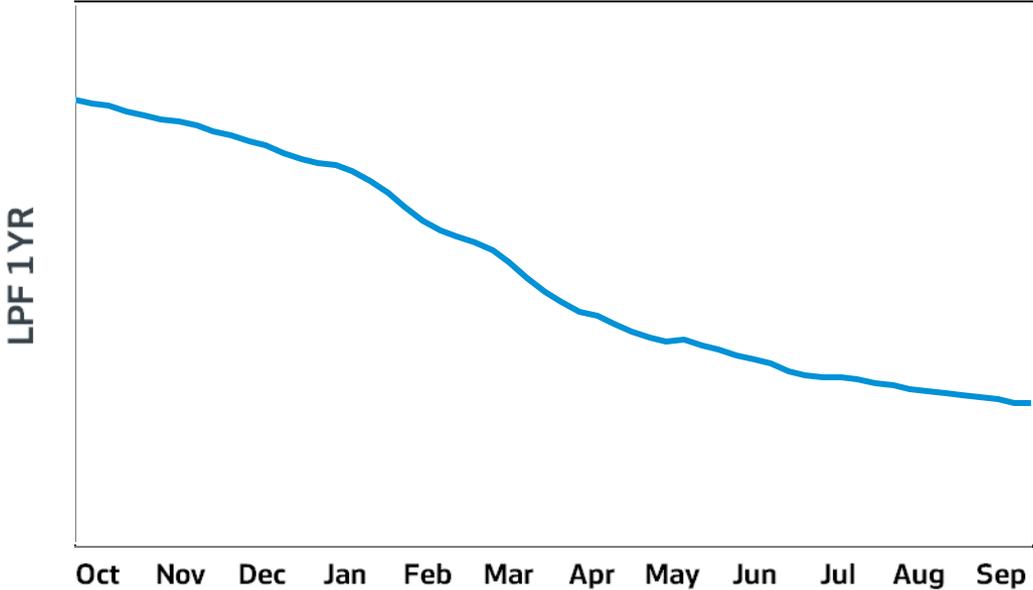


Vestas Standards

- Control of Hazardous Energy
- Electrical Safety
- Safety Awareness
- Incident Management
- Contractor Management
- Ergonomics

Lost Production Factor (LPF) Improvement

VMED Lost Production Factor 2010-2011



Our fleet performance has improved by **50%** over the past 12 months
We are now under 2%

Within Service, the Value Proposition is delivered through several capabilities

<p>Business Case Certainty</p> <p>Predict turbine performance</p> <p>Cost of Energy</p> <p>Improve the percentage of potential production lost due to turbine downtime (the inverse of yield), execute at lowest possible cost</p>	Intelligence and predictability	<ul style="list-style-type: none"> • Condition monitoring • Component statistics and analysis. • Performance and diagnostics centres • Weather and power forecasting
	O&M planning	<ul style="list-style-type: none"> • Documentation and task lists • Multi year plan: Site and turbines design drive plan • Medium term plan: Product upgrade, Predictive maintenance and workforce balancing • Short term plan: Weather condition, Corrective maintenance, Supplier coordination (grid etc)
	Maintenance organisation	<ul style="list-style-type: none"> • Qualified and skilled technicians. Internal technical hotline and surveillance • Knowledge management and sharing within service execution • Time reg. and back end confirmation
	Parts delivery	<ul style="list-style-type: none"> • Sourcing • Supply chain • Repair and Remanufacturing delivery (execution network) • Reconditioning delivery (execution network)
	Parts optimisation	<ul style="list-style-type: none"> • Maintenance concept and plan (preventive, predictive, hybrid, RCM) • Service Engineering (various system corrections, performance enhancements and upgrades) • Material Engineering • Rebuild and reconditioning engineering
<p>Partnership</p>	Transparency	<ul style="list-style-type: none"> • Ability to match expectations with our customers • Transparency in execution towards customers (performance, issue resolution, problem solving) • Proactive dialogue with customers around Vestas performance in relation to their business case and agreement on steps for improvement.
	Integration	<ul style="list-style-type: none"> • Shared workforce, shared planning • Operational information interchange, process and system integration • Interdependence, ongoing relationship with no sharp beginning and no clear endpoint
	Knowledge support	<ul style="list-style-type: none"> • Customer training • Customer focussed technical hotline
	Broadness in offerings	<ul style="list-style-type: none"> • Service other WTG brands • Service other energy sources • Providing services within asset management (administration, IT systems, processes, support) • Financial services
<p>Safety & Citizenship</p>	Safety	<ul style="list-style-type: none"> • Safety standards and safe behaviour • Safety regulations (including opportunities to set barriers in the market through safety standards)
	As green as it gets	<ul style="list-style-type: none"> • Ensuring our operations and the products we produce are as environmentally friendly as possible

Vestas Service Organisation in Numbers*

5500

are employed in Vestas' service organisation making us the world's largest wind turbine service provider.

50

countries across 5 continents are serviced by Vestas.

2100

employed in Vestas Technology provide a solid support for predictive maintenance.

33 GW

serviced by Vestas corresponding to more than half of the nuclear power capacity installed in France.

21500

turbines or 1 in every 12th turbine installed worldwide is monitored by Vestas.

27

turbine models across 5 platforms are serviced by our service technicians.

30 yrs

experience in operating and maintaining wind power plants.

15 yrs

experience in performance based servicing.

12 yrs

experience in 24/7/365 surveillance.

5 yrs

experience in performance diagnostics.

€450

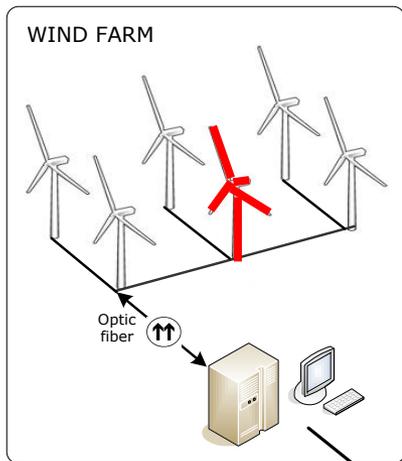
million of spare parts in stock enabling us to deliver main components/tools within 24/72 hours.



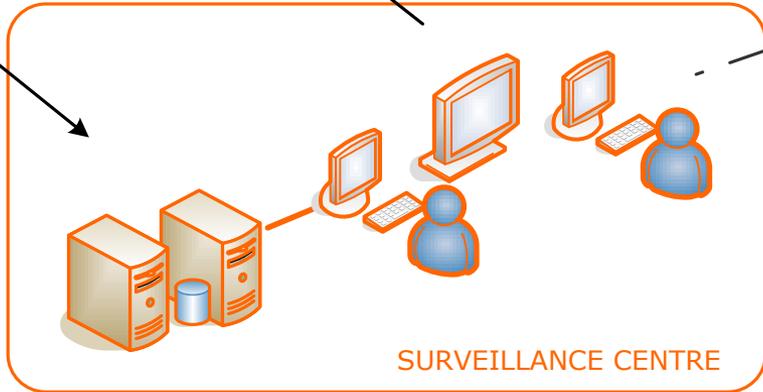
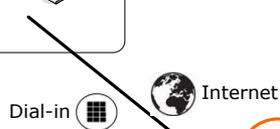
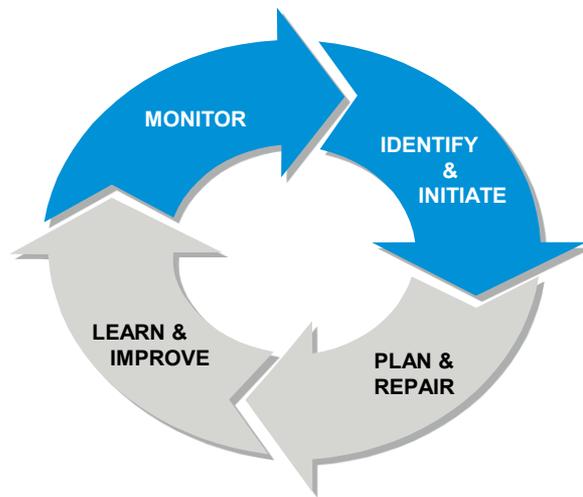
* As per H2 2011

Wind. It means the world to us.™

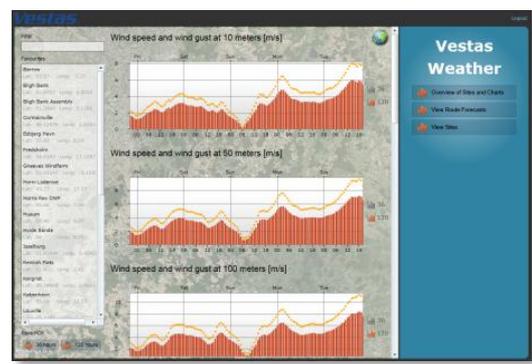
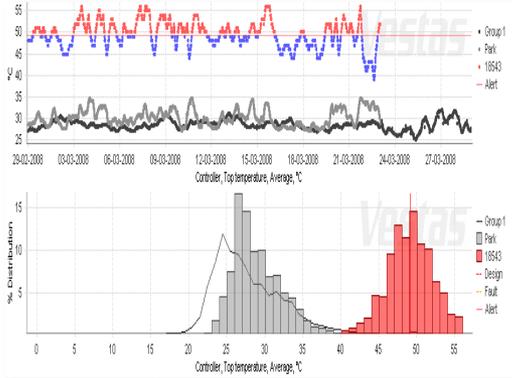
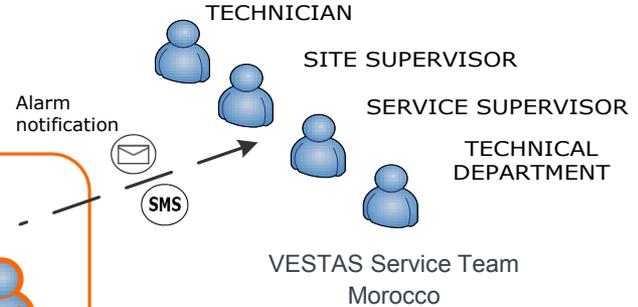
Turbine Performance Management Services



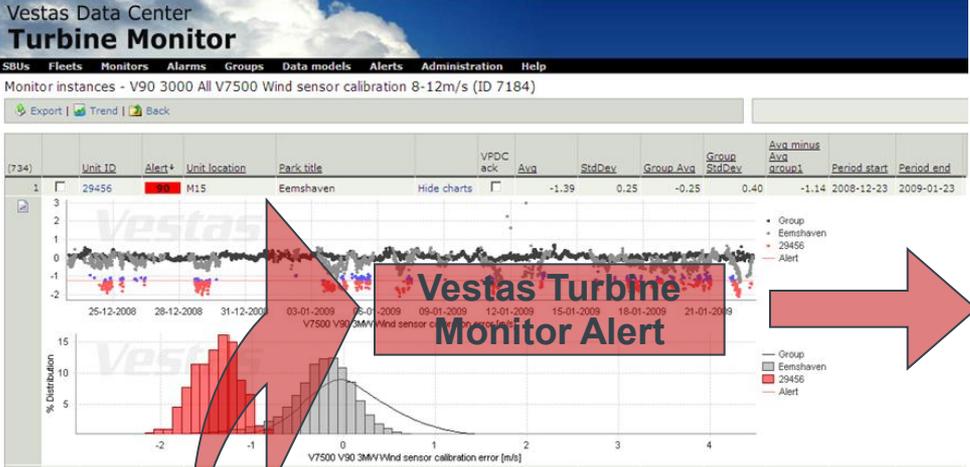
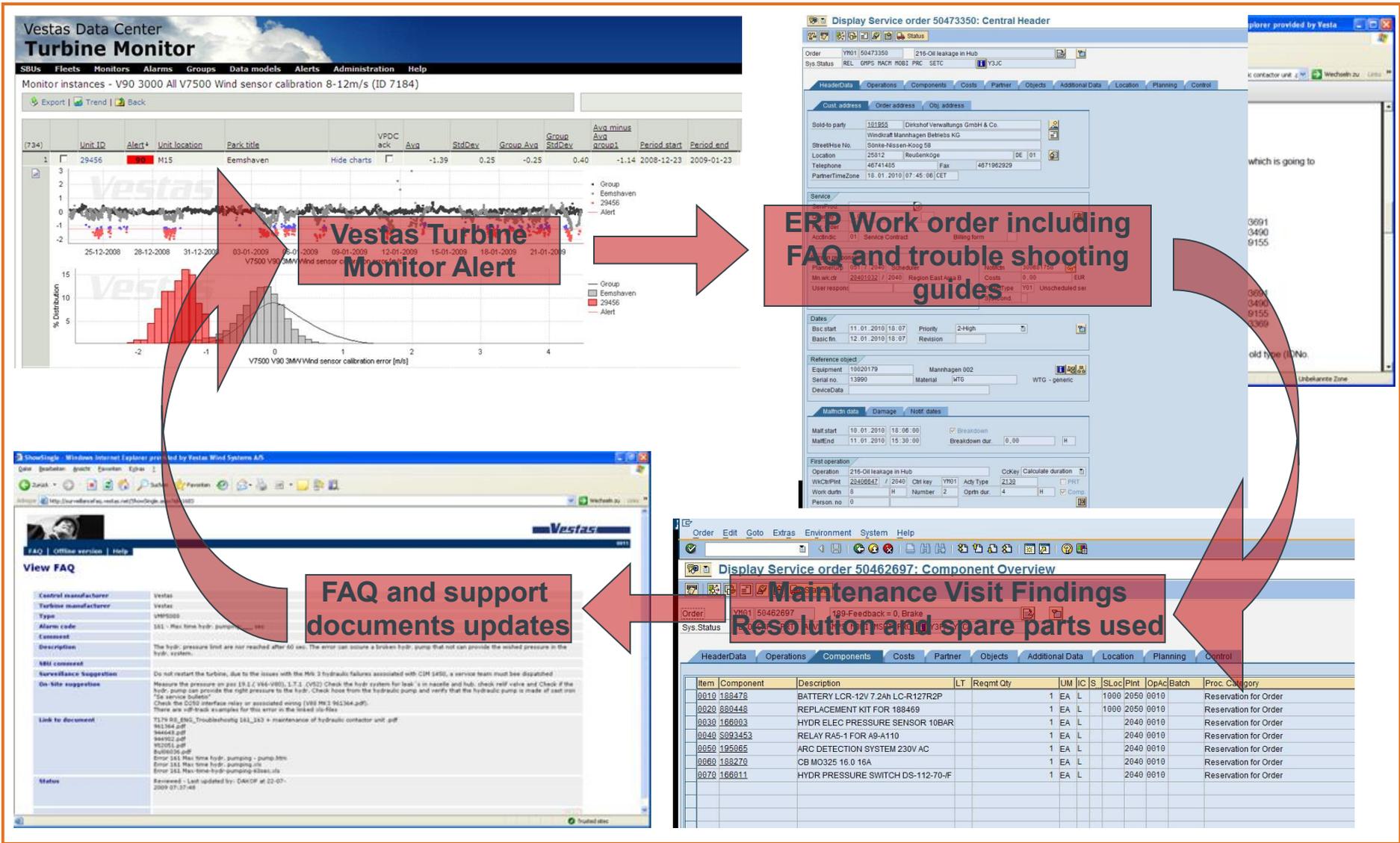
Supported by the 50th biggest computer in the world, Performance deviations in the fleet are identified to **INITIATE and OPTIMIZE OPERATIONS** activities for **MORE PRODUCTION** at the **RIGHT TIME** at the **RIGHT COST**



Vestas Mediterranean Control Centre



Continuous Turbine Performance improvement



Display Service order 50473350: Central Header

Order: Y901 50473350 216-Oil leakage in Hub
 Sys Status: REL - GPFS RACR MOB1 PRC - SETC Y9JC

ERP Work order including FAQ and trouble shooting guides

Customer: Ditsch/Verwaltungs GmbH & Co.
 Location: Reutenkøge, DE 01
 Dates: Basic start 11.01.2010 18:07, Priority 2-High
 Reference object: Equipment 10029179, Mannhagen 002
 First operation: Operation 216-Oil leakage in Hub, WkChnPnt 29456647 / 2940, Cnt key Y901, Acty Type 2138

View FAQ

FAQ and support documents updates

Control manufacturer: Vestas
 Turbine manufacturer: Vestas
 Type: VMP5000
 Alarm code: 181 - Max time hydr. pumping - V90
 Description: The hydr. pressure limit are not reached after 60 sec. The error can occur a broken hydr. pump that not can provide the wished pressure in the hydr. system.
 Surveillance Suggestion: Do not restart the turbine, due to the issues with the M15 3 hydraulic failures associated with CIM 3450, a service team must be dispatched.
 On-site suggestions: Measure the pressure on gas 18.1 / V90-V900, L7.1 (V92) Check the hydr system for leak -s in nacelle and hub, check relief valve and Check if the hydr. pump can provide the right pressure to the hydr. Check hose from the hydraulic pump, and verify that the hydraulic pump is made of cast iron. Check the G232 interface relay or associated wiring (V90 R9 3 943364-p09). There are v90-track examples for this error in the linked site files.
 Link to document: T179 00_090_Troubleshooting 181_183 + maintenance of hydraulic contractor unit.pdf
 Status: Reviewed - Last updated by: DAKOP at 22-07-2009 07:37:48

Display Service order 50462697: Component Overview

Order: Y901 50462697 189-Feedback = 0, Brake
 Sys Status: REL - GPFS RACR MOB1 PRC - SETC Y9JC

Item	Component	Description	LT	Reqmt Qty	UM	IC	S	ISLoc	Pnt	OpAc	Batch	Proc. Category
0010	188478	BATTERY LCR-12V 7.2Ah LC-R127R2P		1	EA	L		1000	2050	0010		Reservation for Order
0020	880448	REPLACEMENT KIT FOR 188469		1	EA	L		1000	2050	0010		Reservation for Order
0030	166803	HYDR ELEC PRESSURE SENSOR 10BAR		1	EA	L			2040	0010		Reservation for Order
0040	5093453	RELAY RA5-1 FOR A9-A110		1	EA	L			2040	0010		Reservation for Order
0050	195065	ARC DETECTION SYSTEM 230V AC		1	EA	L			2040	0010		Reservation for Order
0060	188270	CB M0325 16.0 16A		1	EA	L			2040	0010		Reservation for Order
0070	166011	HYDR PRESSURE SWITCH DS-112-70-F		1	EA	L			2040	0010		Reservation for Order

The Right PEOPLE

Advanced turbine technology and safe operations require competent personnel.

5500

employed worldwide to ensure superior turbine operation

VESTAS TECHNICIANS arrive well prepared, supported by a large team & knowledge base. You benefit from:

CERTIFIED TRAINING



SAFETY VALUES



FIELD EXPERIENCE



Training certified by:



- Certified technicians (4 levels) with the right knowledge and skills
- Industry leader in safety and training
- Mandatory “Safety Walks” by management
- Technicians empowered to stop work if something appears unsafe or someone is at risk
- “Safety First” is the primary value driver for Vestas service technicians
- Highest HSE standards, OHSAS 18001 certified
- R&D optimised diagnostics and maintenance strategy
- Support from technical help desk
- LEAN problem solving techniques

Wind. It means the world to us.™

The Right INTELLIGENCE

Vestas builds predictive intelligence through research, monitoring and field experience to maximize the output using different systems.

1/6

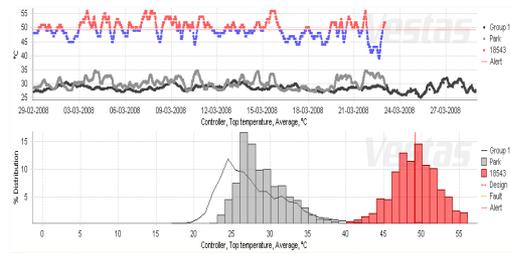
of the world's installed wind capacity is monitored by Vestas

VESTAS PERFORMANCE AND DIAGNOSTICS CENTRE (VDPC) monitors over 21 500 turbines amounting to almost 33 GW

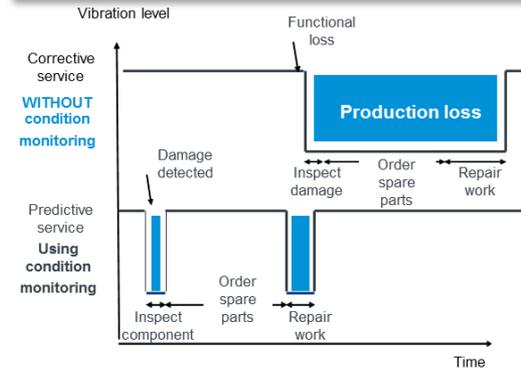
DATA ANALYSES



VTM – Vestas Turbine Monitoring CMS – Condition Monitoring System

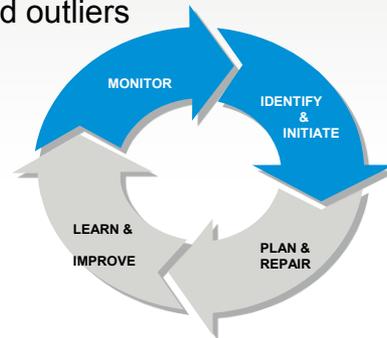


PREDICTIVE CONDITION BASED MAINTENANCE



- Assessing the "health" of a machine by analysing measured signals
- Assessments integrated into work planning

- Analysing more than 130 signals from heat sensors
- Detecting potential failures and outliers



- Estimating the time of failure, using the weather conditions and the best PPA → optimised planning of maintenance activities
- In-house ISO Certified Vibration Engineers
- Assessments integrated into work planning

Wind. It means the world to us.™

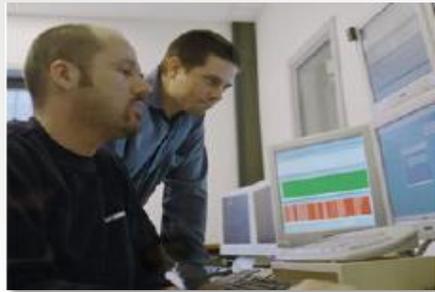
The Right OPERATIONS and MAINTENANCE PLAN

Maintenance operations and planning are executed synchronously by prevention through prediction.

12+

years of
expertise in
24/7/365
surveillance

Vestas Turbine Watch provides 12+ years
expertise in of **24/7/365 SURVEILLANCE**



MONITOR

**IDENTIFY
&
INITIATE**

**LEARN &
IMPROVE**

**PLAN &
REPAIR**

Maintenance strategy

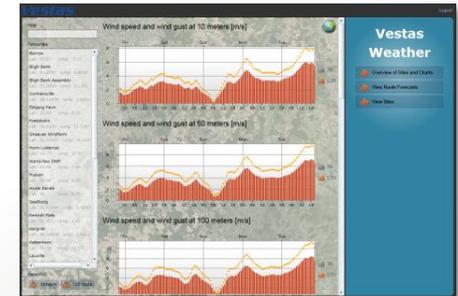
Preventive
Maintenance

Predictive
Maintenance

Corrective
Maintenance

Findings used to
provide **RELIABLE PERFORMANCE &
OUTPUT MANAGEMENT**

Performance deviations in the fleet are
identified to **INITIATE OPERATIONS**
activities at the **RIGHT TIME**



Planning of maintenance based on
Vestas weather forecast
to **MAXIMIZE PRODUCTION**

The Right INFRASTRUCTURE

Synchronized service support structure.

24/72
hours delivery
time worldwide of
spare parts /
main components

GLOBAL SPARE PARTS AND REPAIR



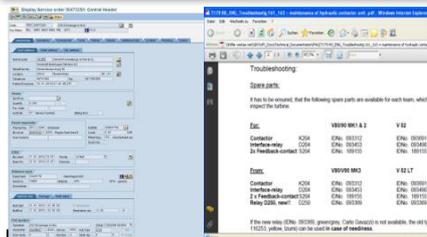
- ▶ Global delivery, logistics and sourcing network
- ▶ Certainty of quality, supply and control of cost
- ▶ Repair capabilities for generators, gearbox and other components

TECHNOLOGY HOTLINE AND PRODUCT UPGRADES



- 1st Level Support** ▶ 24/7 surveillance center/hotline accessible through email or phone
- 2nd Level Support** ▶ High expert knowledge available at country or region level
▶ Open normal business hours, accessible through 1st level support
- Technology R&D** ▶ Access to unique OEM technical expert knowledge
▶ Failure analysis & proactive engineering upgrades to enhance performance

CUSTOMISED ERP AND PROPRIETARY FAQ



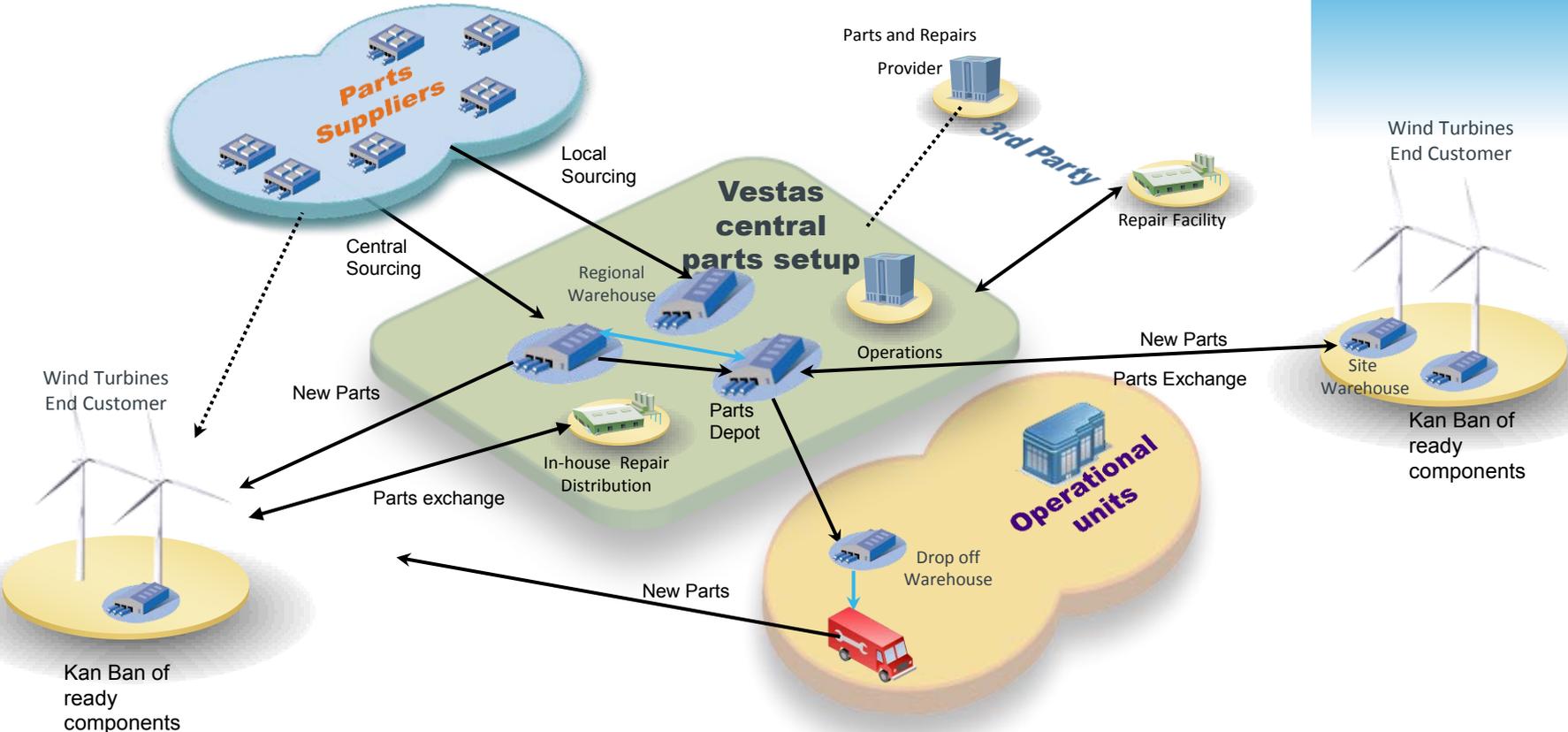
- ▶ ERP Work Order and Guides for fixing issues, list of necessary spare parts and list of other maintenance tasks
- ▶ Efficient service operations and strategic maintenance planning

The Right LOGISTIC

Vestas Spare Parts and Repair setup

€450

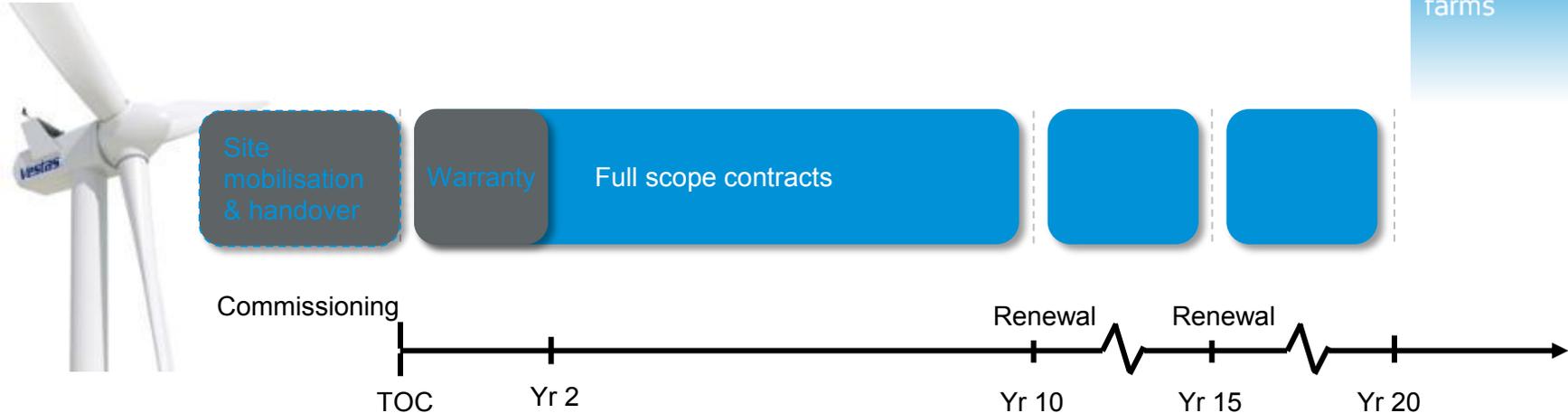
million of spare parts in stock enabling us to deliver main components/tools within 24/72 hours.



30 +

years of
experience in
operating wind
farms

Vestas' service contract guarantee levels fit with your life cycle needs.

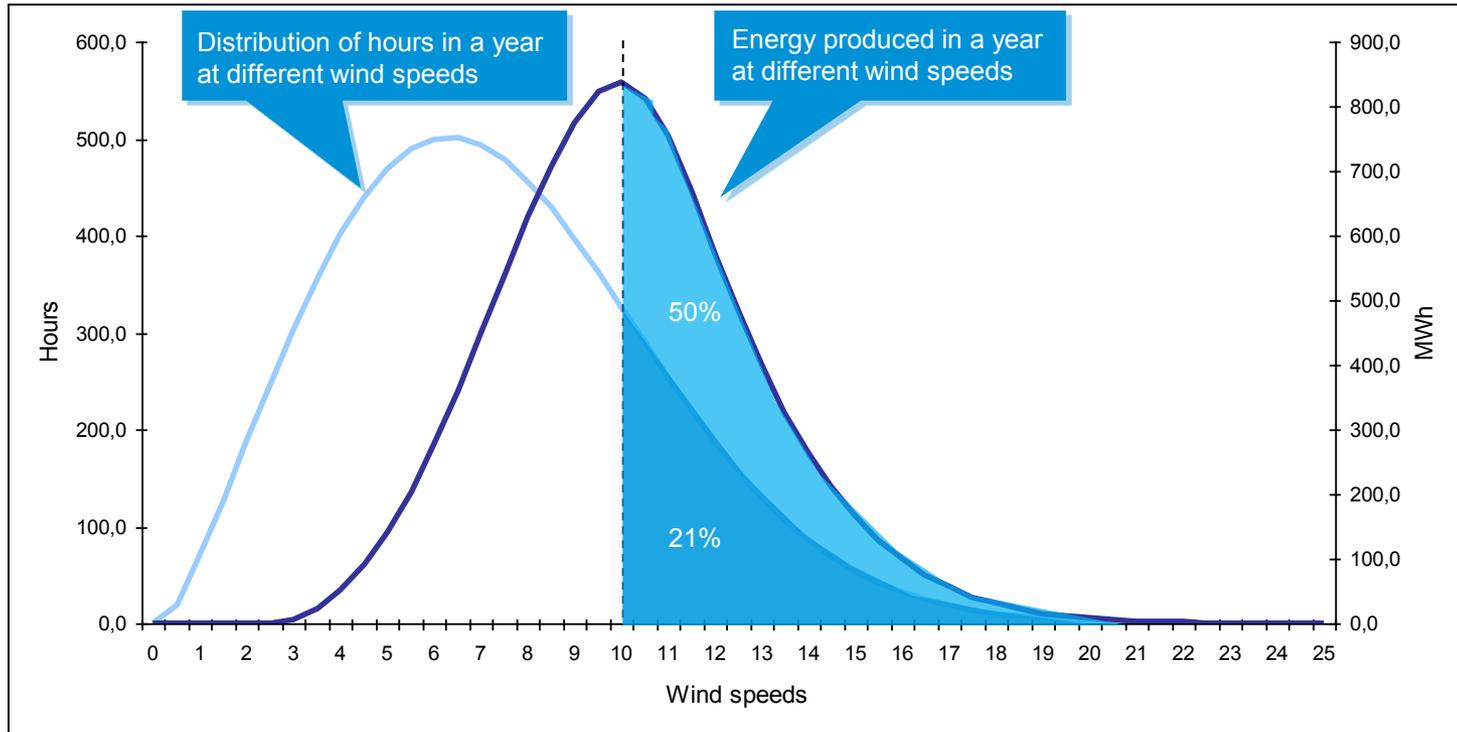


- A full scope contract means **no unforeseen and no unbudgeted maintenance costs**
- Contract **duration of up to 15 years** – warranty like coverage for the duration
- Aligned incentives through upside sharing with **industry leading performance guarantees** matched to your site needs
- Option of **All Risk Insurance** in selected markets. A unique option that can only be obtained through Vestas
- Access to **+30 years experience** of operating and maintaining wind farms
- Invoke a **long term relationship** with Vestas

Energy based availability incentivizes Vestas to ensure availability when the wind is there

50%
of the annual
wind energy is
typically captured
in **20%** of the
time

In a typical wind farm 50% of Annual Energy Production is obtained in 21% of available time

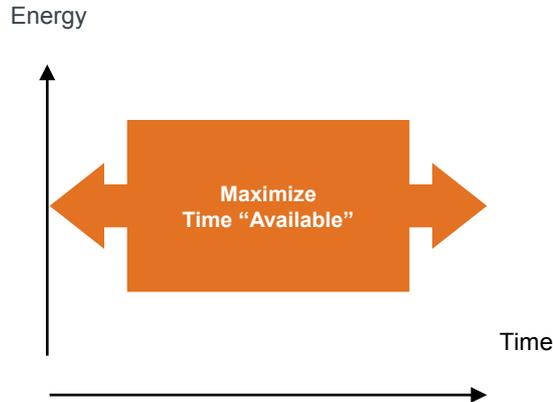


Source: V112 3MW turbine; noise mode 0; air density 1,225; Wind distribution estimated with a A = 8 and k 2,2

The Guarantees Side-by-Side

AOM 4000

100% Time based availability



Measures the TIME the turbine is available to make power

- Main Focus : Wind Farm Availability

Advantages:

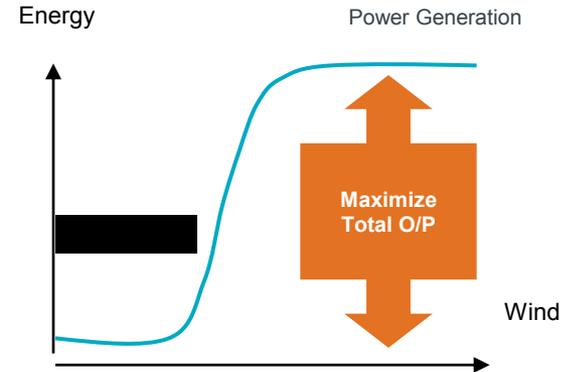
- Demonstrated bankability
- Almost a Standard? offer in the industry

Challenges

- Not aligned with customer revenue stream
 - Creeping expectations on guarantee

AOM 5000

100% Energy based availability



Measures the Production that is captured from the wind resources available at the site

- Main Focus : ↓ LPF (Lost Production Factor)

Advantages:

- Aligns Vestas to Customer's business
 - Optimizes the production output
 - Focus on running and non-running losses, on ROI
 - Demonstrated bankability

Challenges:

- Wind windows available for planned maintenance scheduling