

Presentation för energivärden tema vind

Andreas Johansson, Senior Director, Vestas Power Solutions

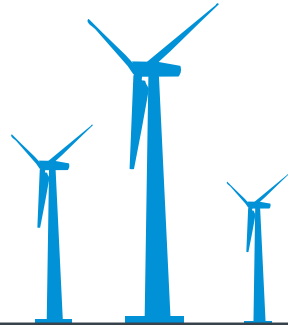
Vestas in brief

The only global wind energy company



+ 23,300

We employ more than 23,300 people worldwide and have more than 35 years of experience with wind energy



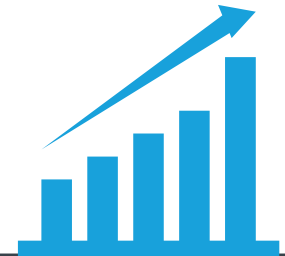
+38,892

We have a total of 38,892 turbines under service, or around 76 GW



+ 63,500

We have more than 63,500 turbines or 90 GW of installed wind power capacity in 77 countries worldwide spanning six continents



€ 10bn

Vestas' revenue for 2017 was EUR 10bn

Vestas' value chain

World leading wind energy solutions with a comprehensive range of capabilities



Research & Development

Vestas has a strong focus on continuously developing and optimising to lower the cost of energy thereby meeting customer needs and remaining the technology leader in the wind power industry

Project planning & design

Ensuring high quality project planning and design helps us to maximise total return on investment from project start up.

Procurement & manufacturing

Vestas' versatile and agile procurement and manufacturing concept provides competitive advantage.

Construction & installation

Vestas possesses construction and installation expertise to coordinate cooperative efforts or assumes full responsibility for wind power plant construction and commissioning.

Operation & maintenance

Vestas provides preventative and corrective service and maintenance for consistently optimised performance.

Vestas Services

Business areas



Parts & Repair

Benefit from a truly global supply chain and a strong local presence to decrease your Operations and Maintenance (O&M) cost.



Maintenance Partnering

Maximise the availability of your wind park with the most experienced maintenance partner in the industry.



Fleet Optimisation

Optimise your business with upgrades designed to improve the performance of your wind park.

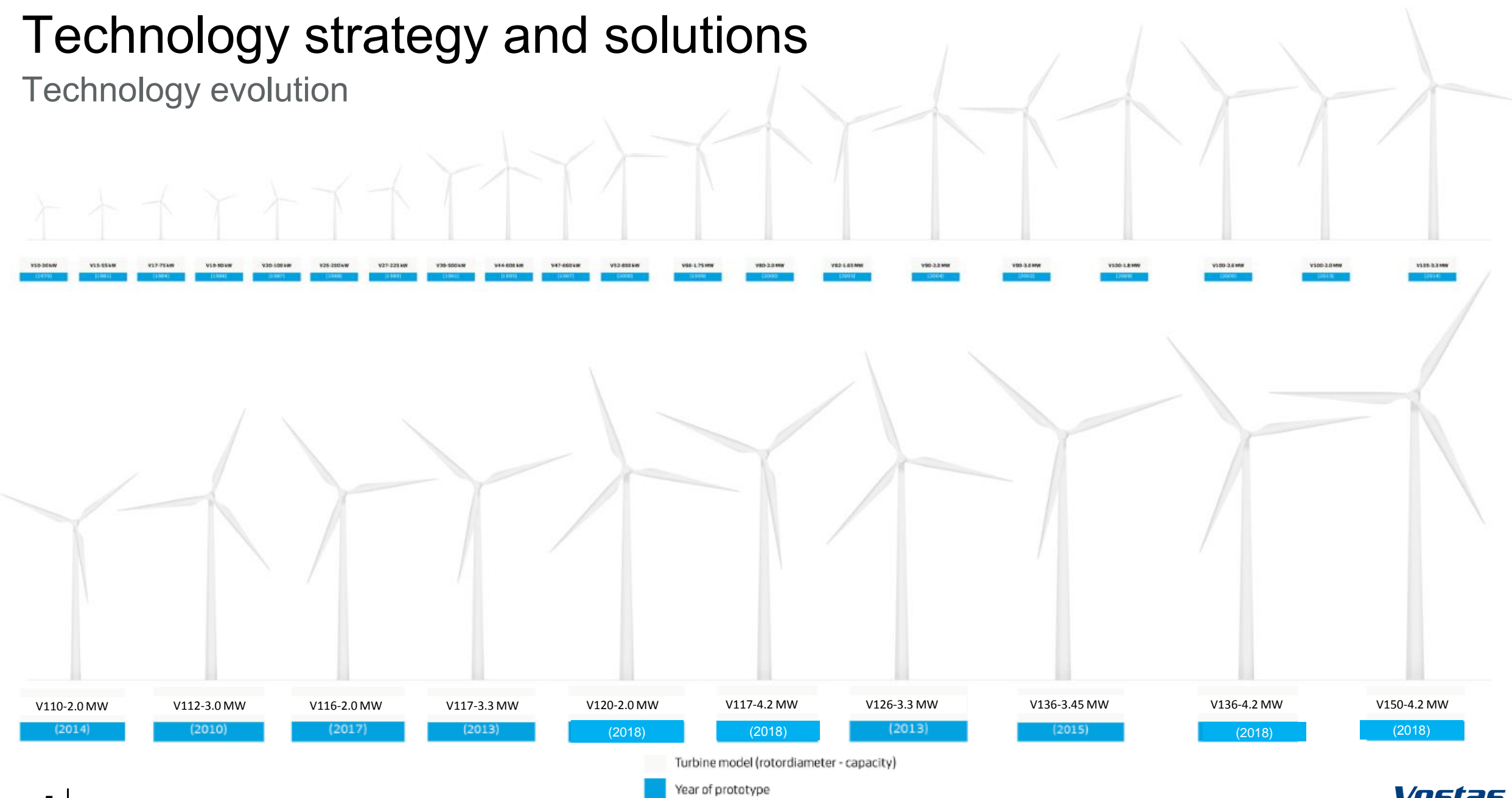


Smart Data

Benefit from our digital solutions, delivering greater predictability, increased renewable energy production, more efficient operations, and better integration with energy grids.

Technology strategy and solutions

Technology evolution



Versatile solutions for any wind energy project

Ongoing innovation from the undisputed global wind leader



2 MW PLATFORM

PRODUCT-
CAPACITY

YEAR OF
PROTOTYPE

V90-2.0 MW®	V100- 2.0 MW®	V110- 2.0 MW®	V116 2.0 MW™	V120 2.0 MW™
2004	2009	2014	2017	2018

Installed*
40 GW



4 MW PLATFORM

V105- 3.45 MW™	V112- 3.45 MW™**	V117- 3.45 MW™	V117- 4.2 MW™	V126- 3.45 MW™	V136- 3.45 MW™	V136- 4.2 MW™	V150- 4.2 MW™
2014	2013	2013	2018	2013	2016	2018	2018

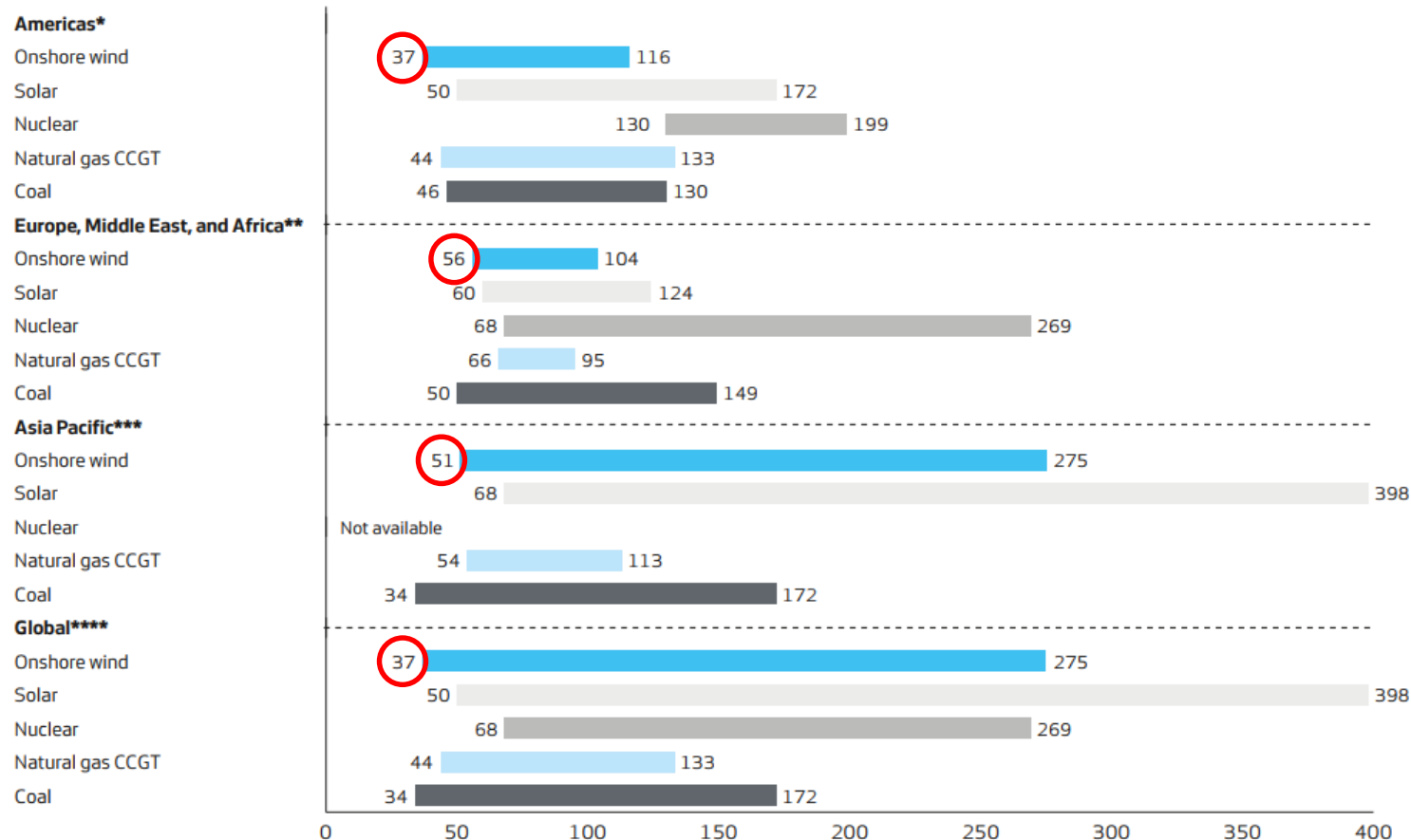
Installed**
17 GW

* As of 9 November 2017, including V80-1.8/2.0 MW™ and V90-1.8 MW™
** As of 9 November 2017, Including V112-3.0 MW™
Not shown: V90-3.0 MW®, constituting 9 GW
Not shown: ‘Other’ turbine models constituting 23 GW.

Wind is growing as costs are coming down

Wind energy continues to increase its competitiveness

Levelised cost of energy, USD/MWh



- Globally, costs have fallen 43% since 2009 and made wind an economically competitive power source
- Levelised cost of energy (LCOE) analysis for 2016 showing onshore wind energy to be fully competitive against new build gas and coal in many parts of the world.
- Equally, offshore wind is now showing its true potential with record low auction bids

Source: Bloomberg New Energy Finance 2018

Multinationals turning to wind

Technological advancements making wind ever-more competitive

Financial Services	Media and Software	Retailers and FMCG	Manufacturers	Primary Industry
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Selected commercial builders or buyers of renewable energy

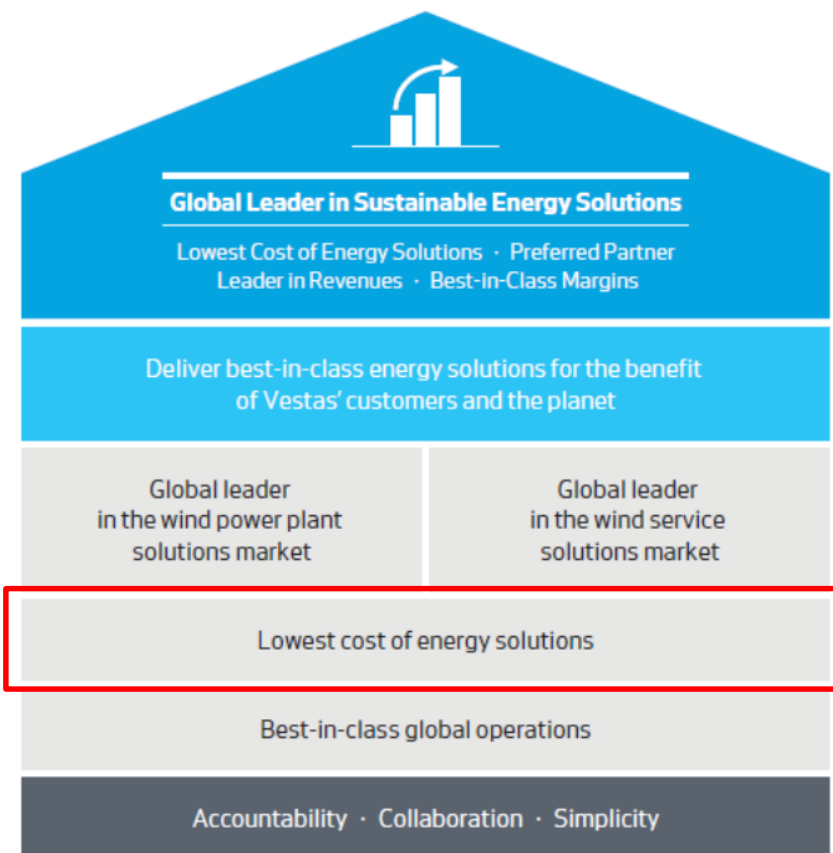


Source: Bloomberg New Energy Finance

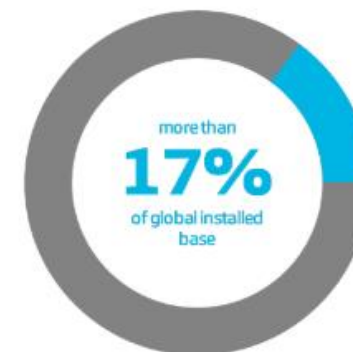
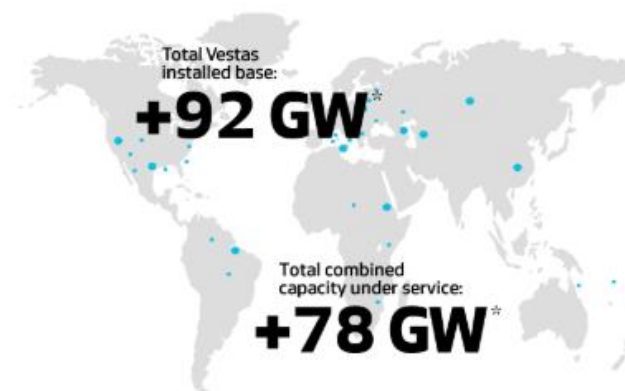
Reducing the cost of energy is at the core of our strategy

Lowering the levelised cost of energy (LCOE) faster than the market average

Vestas strategy



Vestas facts



Vestas installed base:
+92 GW

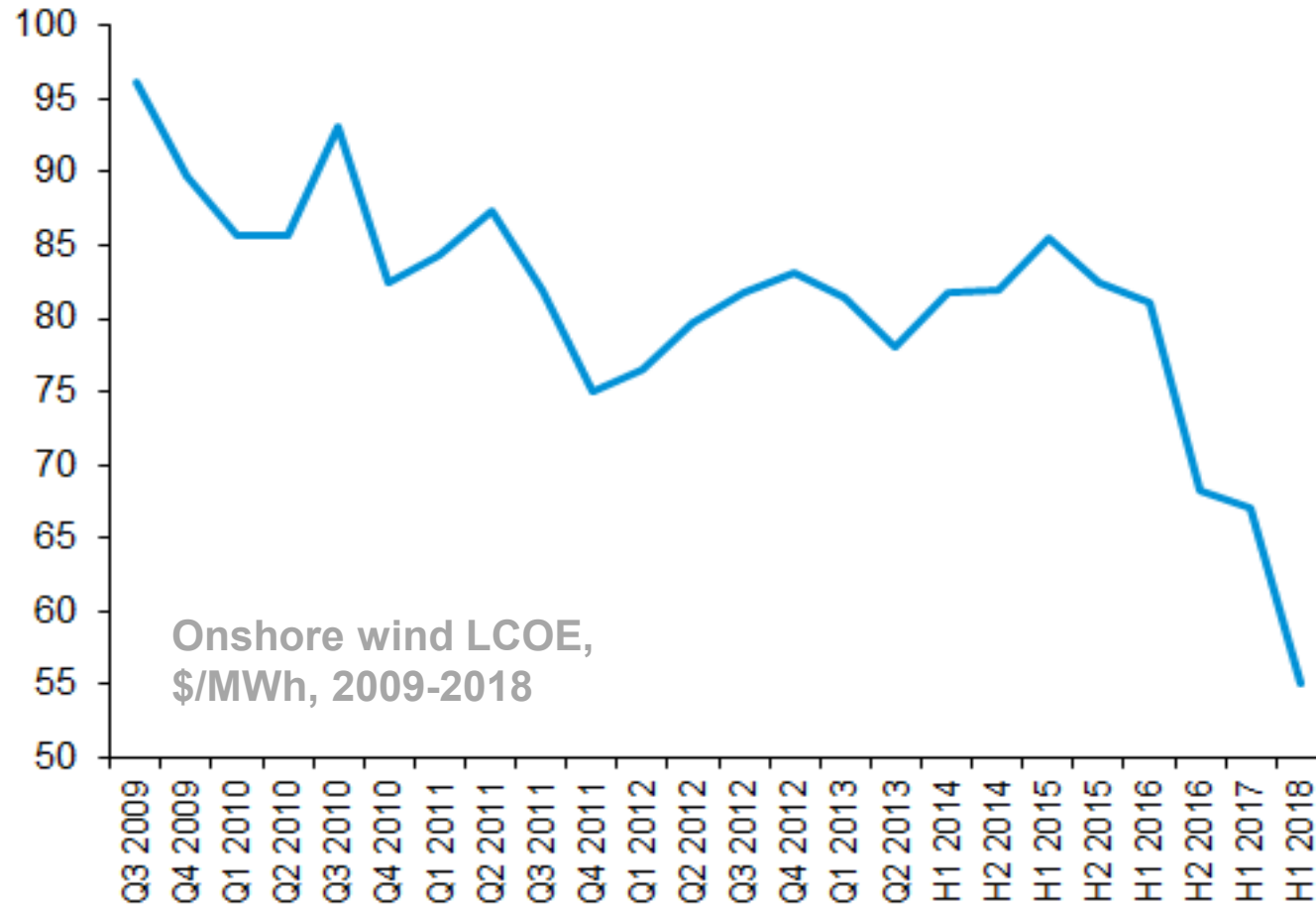
Worldwide installed wind capacity:
+539 GW

*Vestas Track Record as of 31 March 2018
**Global Wind Statistics 2017 (Year-end), GWEC



- At the core of our strategy is lowering the cost of energy. It is our ambition to lower it faster than the market average.
- It is our license to operate, as we always need to prove to customers, investors, policy makers and consumers that wind is the obvious choice.

Wind, from niche to mainstream



Onshore wind is today one of the most cost competitive energy sources

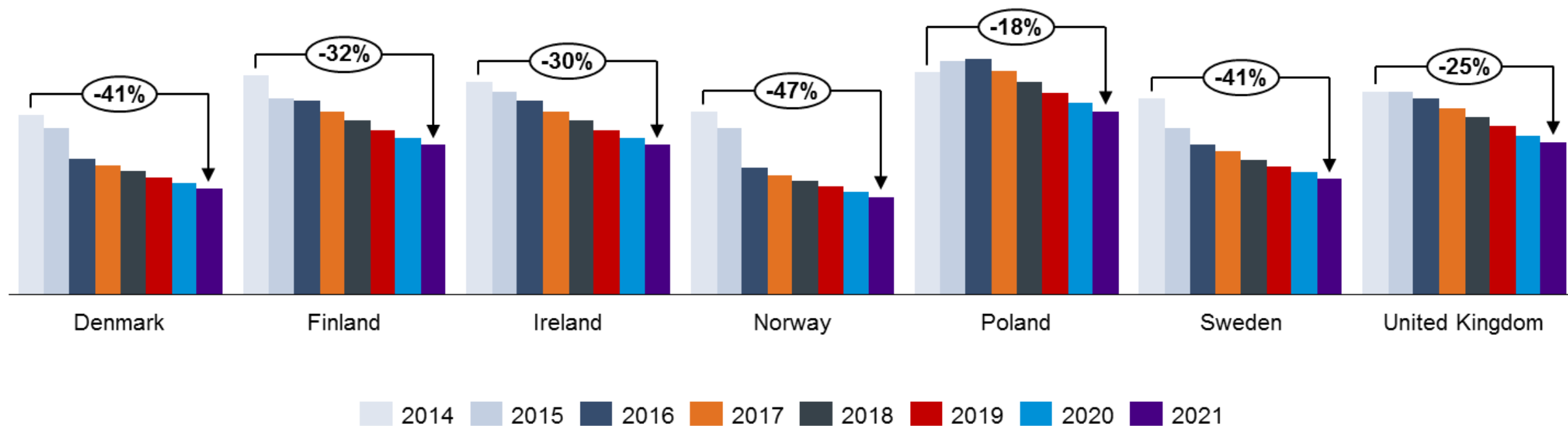
The global average LCOE for onshore wind has dropped from 96 \$/MWh in 2009 to 55 \$/MWh in 2018.

A reduction of 43%.

Vestas LCOE development 2014-2021e

Expected LCOE development, onshore wind, Northern Europe

EUR/MWh



Technology is constantly evolving

Wind turbines are now taller and more powerful than ever before

More output per turbine reduces the cost of each unit of electricity generated



- The reduction in cost of energy is driven by technological progress and scale
- Taller turbines with longer blades capture more wind and can support more powerful generators
- A 20% increase in tip height gives a 90% increase in output
- New turbines can generate 2x as much electricity per year compared to older models

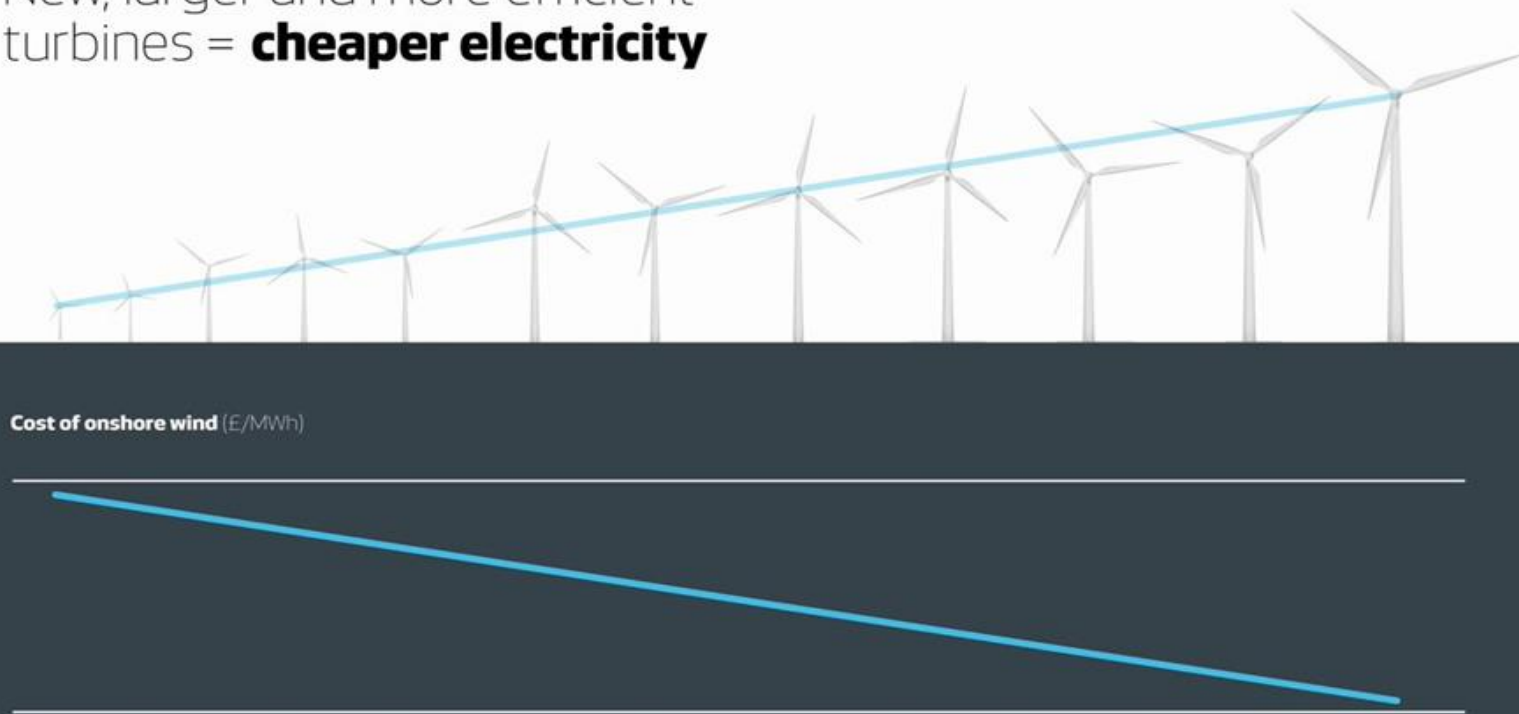
Source: Vestas 2017

The industry has to continue to develop better technology

Cost will have to continue to go down for the benefit of consumers

Technology and cost

New, larger and more efficient turbines = **cheaper electricity**



- In simple terms, the reduction in cost of energy will continue to be driven by technological progress and scale
- Rating and rotor size is expected to grow further enabling increased efficiency and lower cost of wind energy

The background of the slide features a grayscale image of several wind turbines. The most prominent turbine is in the center, with its three blades extending upwards. The blades are white, and the central hub is visible. The sky is filled with soft, white clouds. In the foreground, the lower parts of other turbines are visible, creating a sense of depth.

In conclusion...

- 1 Wind is today mainstream and cost competitive**
- 2 Technology developments and scale is driving down cost**
- 3 Long-term and predictable policy frameworks as well as system flexibility will be key to get the best out of wind**

A close-up, low-angle shot of a wind turbine's nacelle and hub, illuminated by bright blue light. The central hub and the base of the blades are visible, with the blades extending outwards. The lighting creates a high-contrast, futuristic aesthetic.

Vestas[®]

4 MW platform

Vestas 4 MW Platform Portfolio

One common platform, powering 8 turbine variants for broad wind spectrum coverage

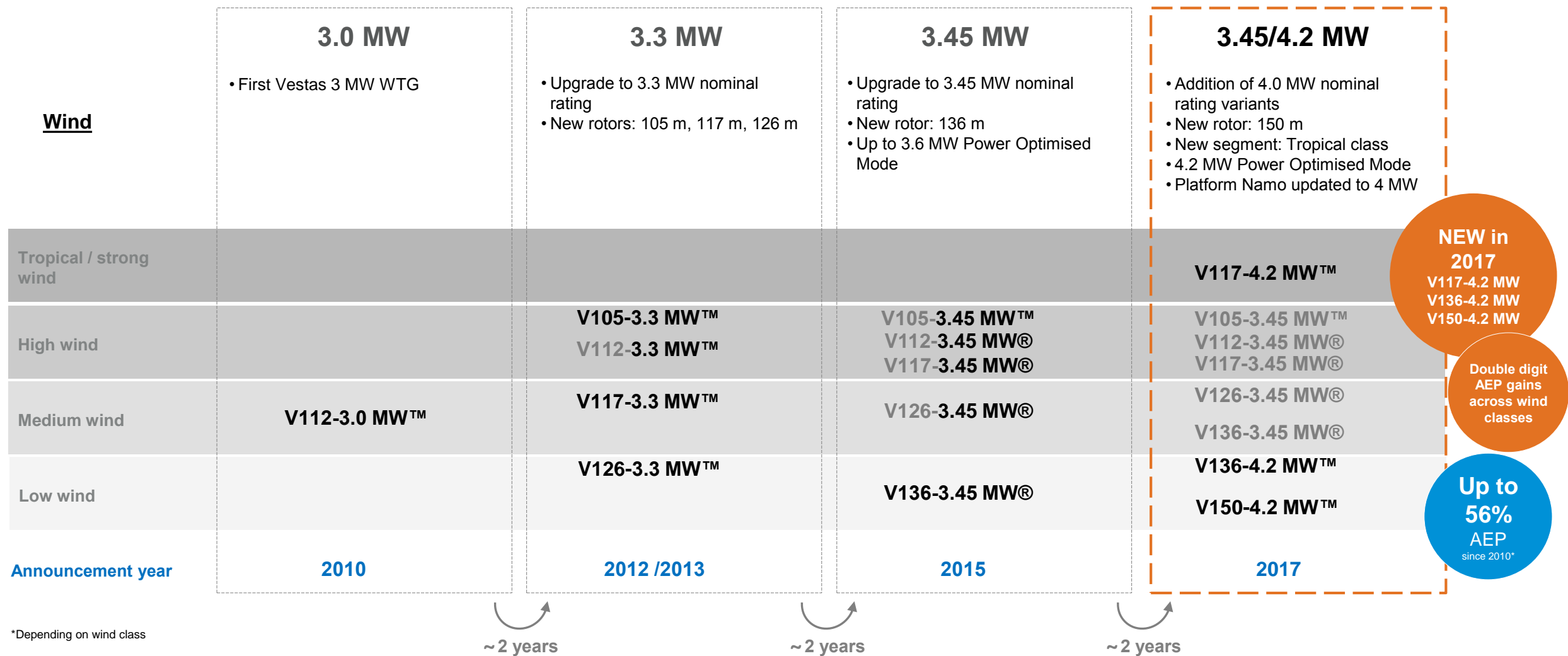
WINDCLASSES – IEC

■ Standard IEC conditions* ■ Site dependent*

TURBINE TYPE	IEC III (6.0 – 7.5 m/s)	IEC II (7.5 – 8.5 m/s)	IEC I (8.5 – 10.0 m/s)	Above 10.0 m/s
4 MW TURBINES				
V105-3.45 MW™ IEC IA Power Optimised Mode up to 3.6 MW			■	■
V112-3.45 MW® IEC IA Power Optimised Mode up to 3.6 MW			■	■
V117-3.45 MW® IEC IB/IEC IIA Power Optimised Mode up to 3.6 MW		■	■	■
V117-4.2 MW™ IEC IB/IEC IIA/IEC S/IEC T 4.2 MW Power Optimised Mode		■	■	■
V126-3.45 MW™ IEC IIB/IEC IIA Power Optimised Mode up to 3.6 MW		■	■	
V136-3.45 MW™ IEC IIB/IEC IIIA Power Optimised Mode up to 3.6 MW	■	■	■	
V136-4.2 MW™ IEC IIB/IEC S 4.2 MW Power Optimised Mode	■	■	■	
V150-4.2 MW™ IEC IIIB/IEC S 4.2 MW Power Optimised Mode	■	■		

Controlled Unfolding of Platform Potential

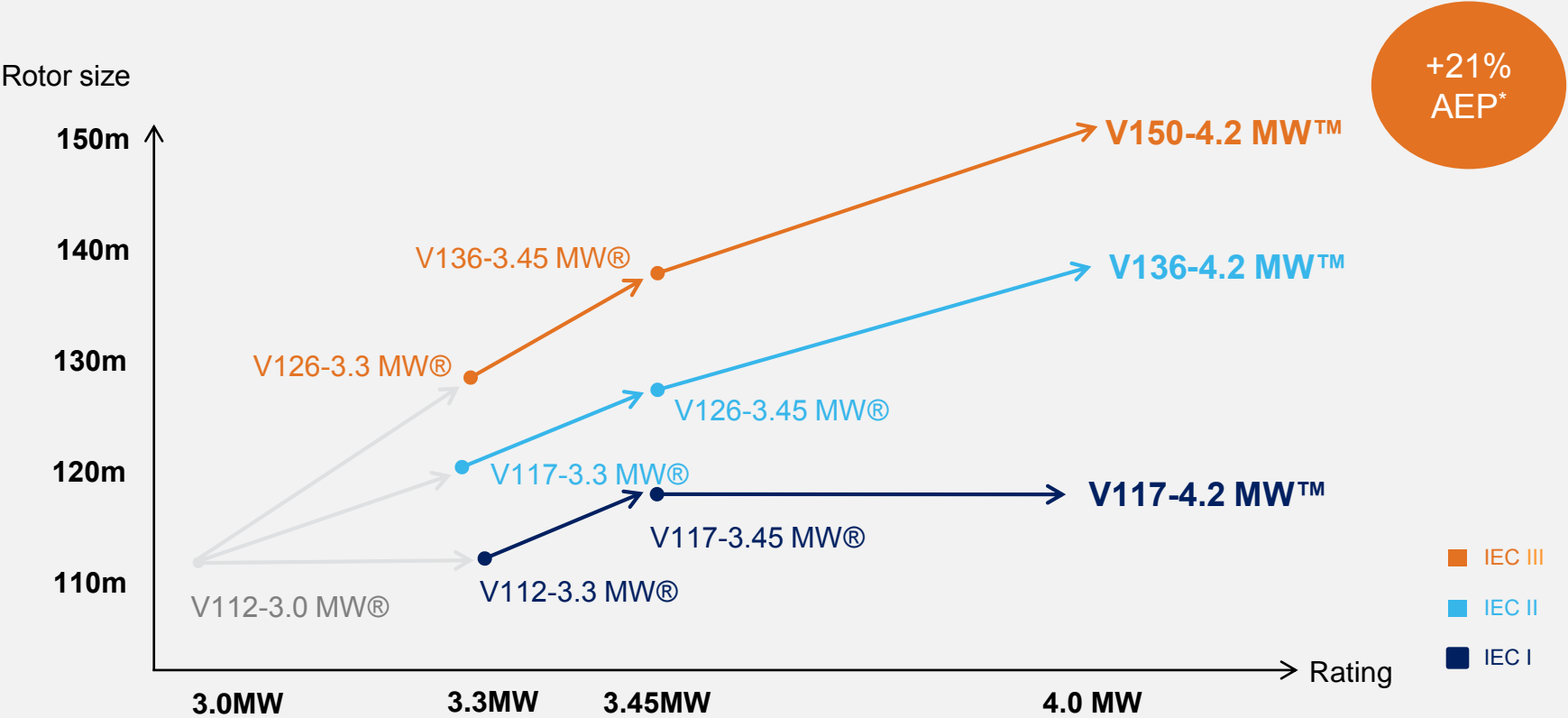
More Annual Energy production from same trusted platform



*Depending on wind class

Increased Annual Energy Production

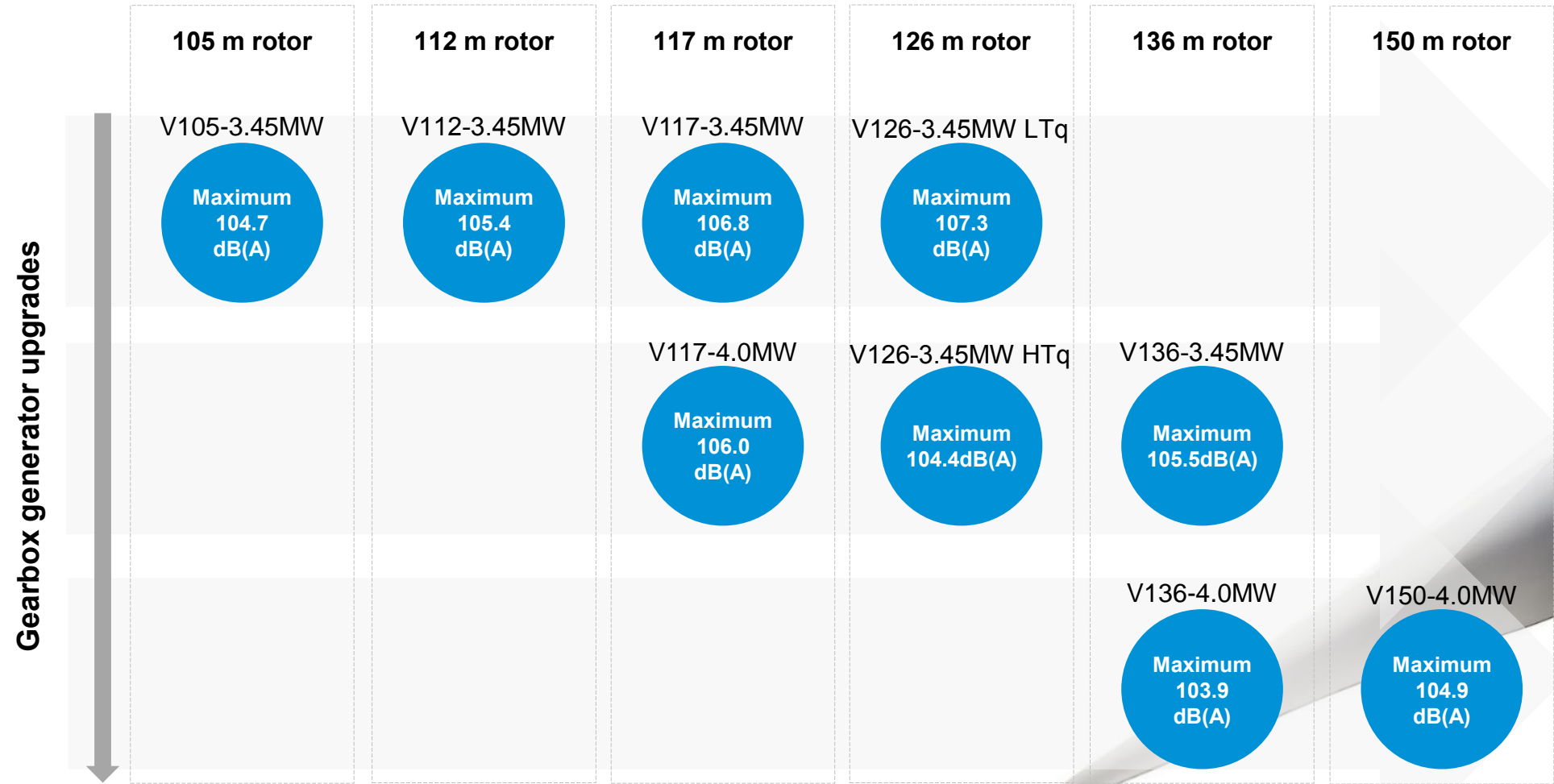
Latest upgrade enables double-digit AEP gains in all standard wind classes



*AEP=Annual Energy Production. V150-4.2 MW™ with 4.2 MW Power Optimised Mode in IEC III Compared to V136-3.45 MW™ Actual figures depend on site specific conditions.

Versatile modular approach to new developments

Continuous steps for improving sound and power performance



The V136-4.0MW has been developed using a higher torque gear box.

V136-4.2 MW™ Turbine Variant

High production at industry leading sound power levels

Strong siteability with
medium capabilities

Segment leading low
Sound Power Level

More Torque

Upgraded gearbox powering lower rotor rotational speed, enabling enhanced project specific siteability

More Power

Upgraded generator to 4.0 MW nominal rating with 4.2 MW Power Optimised Mode

Up to 11 %
AEP Increase*

Low Sound Power

Segment leading sound power level at 103.9 dB(A)

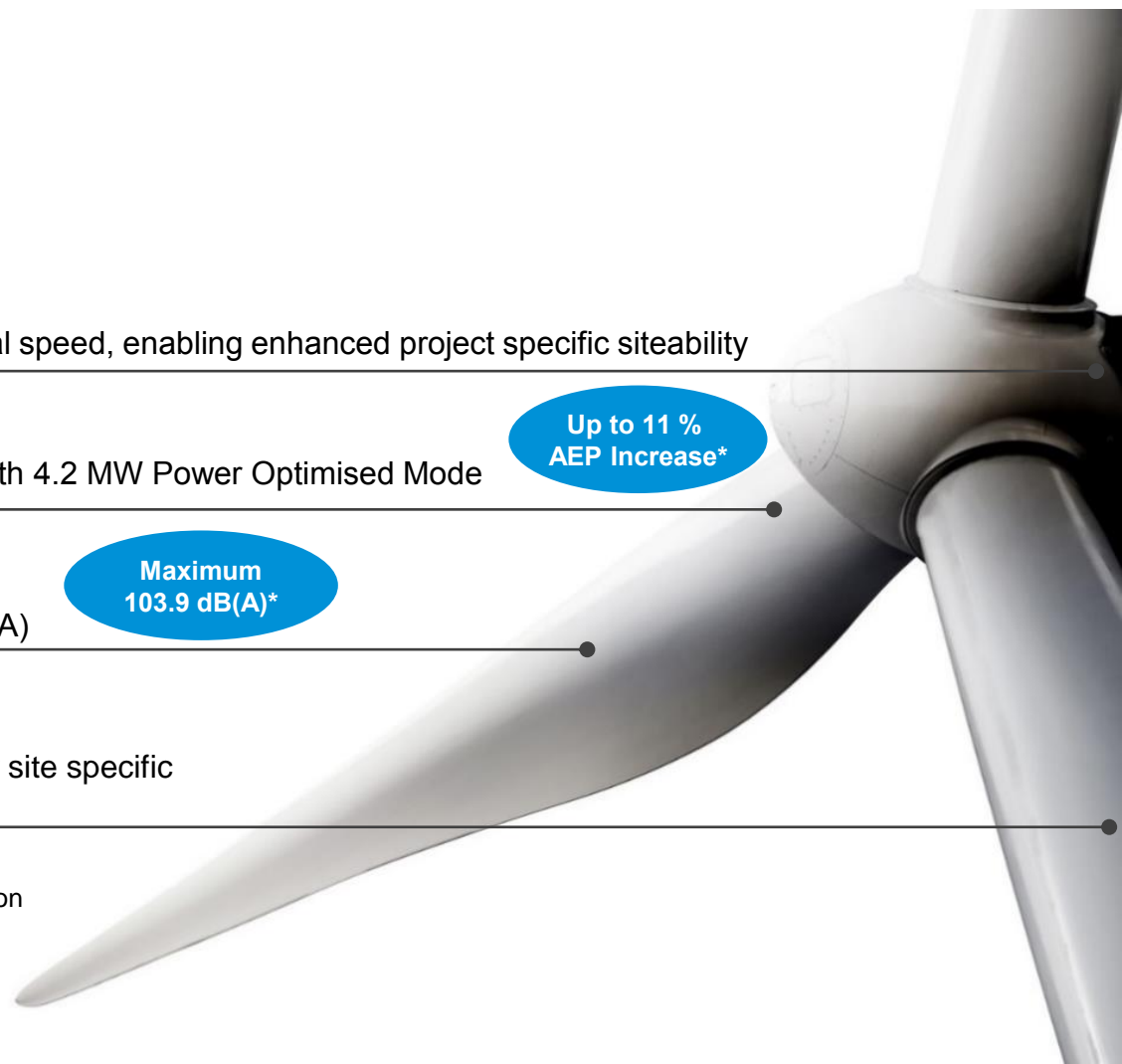
Maximum
103.9 dB(A)*

Tower Portfolio

Accommodating 150-230 m tip height. Option for site specific towers

*Compared to V136-3.45 MW. Depending on wind condition

**1.6 dB(A) compared to V136-3.45 MW



V150-4.2 MW™ Turbine Variant

Highest yielding onshore low wind turbine in the industry

Up to 241 m tip height

Segment leading **Energy Production**

Larger Swept Area

Blade length increased to 73.7 m using Vestas most advanced aerofoil design and materials

17,671 m²
swept area, +22%

Higher Energy Production

Combined with increase in capacity factor

Up to 21%
AEP Increase*

Reduced Sound Power Levels

Segment leading energy production combined with very low 104.9 dB(A)

Maximum
104.9 dB(A)

Tower Portfolio

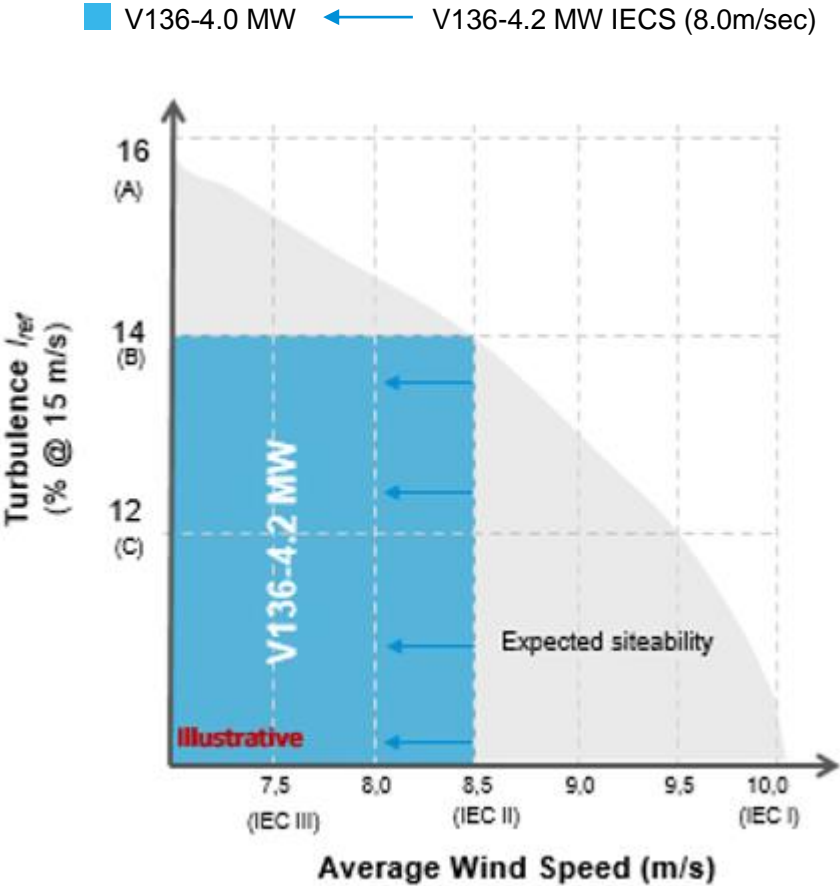
Site specific tower portfolio - tip heights ranging from 180-241 m, leveraging industry leading 166 m hub height

*Compared to V136-3.45 MW. Depending on wind condition

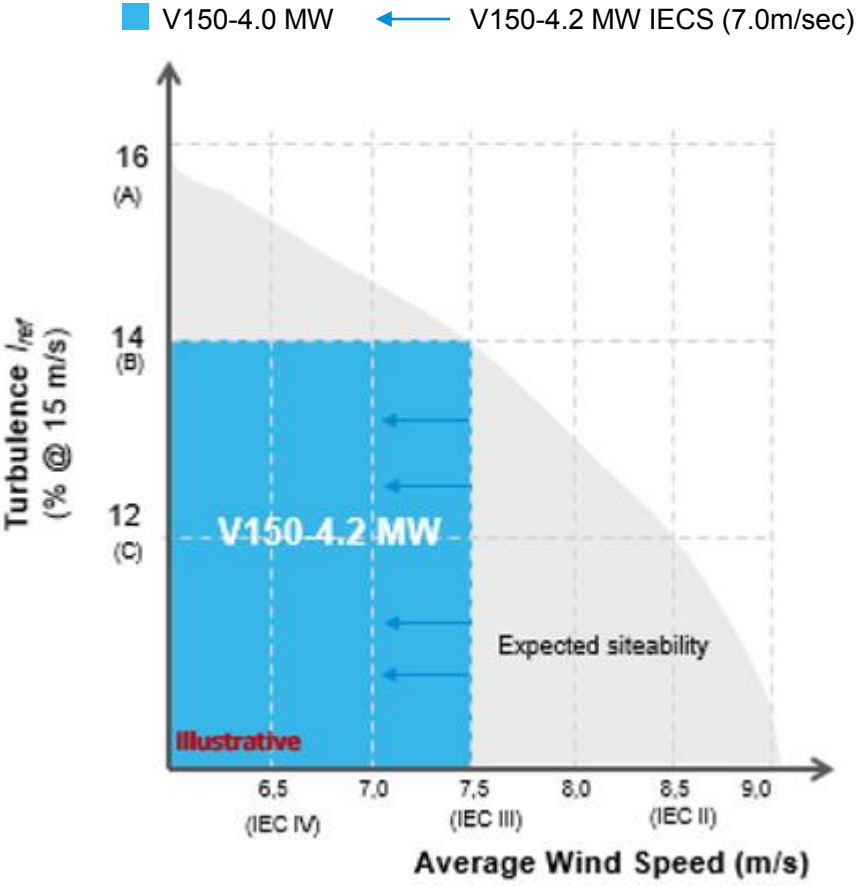
Siteability of the V136-4.2 MW and V150-4.2 MW

Operating strategy for maximizing siting and power performance

Application Space V136 4.0MW



Application Space V150 4.2MW



Main takeaways

- ✓ Proven platform & up to 21% AEP growth
- ✓ High selection of towers... 150m up to 230m tip height
- ✓ Covering low, medium & high winds
- ✓ Flexible siteability
- ✓ Ready for shipment in spring 2019