

2 MW

V80-2.0 MW

V90-1.8/2.0 MW

V100-1.8 MW

2 MW platform.

A stable return on your investment

Reliable technology proven over generations

The 2 MW turbines build on technology proven over several generations, ensuring industry-leading reliability, serviceability and availability. Durable and dependable, they have been designed to reduce the risk of downtime and safeguard the stability of your investment.

Meeting your investment forecasts

With an average contractual availability above 98% in 2010, this turbine reduces costs and business risk to an unparalleled level. The predictable performance of the 2 MW platform's V80-2.0 MW, V90-1.8/2.0 MW and V100-1.8 MW turbines allows you to forecast confidently, strengthening the business case for investment. Its design and performance ensure you can produce energy from low- to medium to high-wind onshore sites at the lowest possible cost.

The latest generation of the V90-1.8/2.0 and V100-1.8 MW turbines incorporates Load and Power Modes, an improved yaw system and a redesigned bed frame and main bearing housing – lowering your operating costs by simplifying turbine serviceability.

+8,500

2 MW turbines installed worldwide
+11 GW installed



Maximum availability. **Strong** business case

Wind. It means the world to us.™
Wind is all we do. We are relentlessly committed to the success of wind as a source of energy for the world, providing everything you need to succeed in your wind power ambitions.

Unprecedented.

Productivity, reliability and performance

The 2 MW turbine range maximises productivity thanks to its high-productivity design, noise reduction technology, Load and Power Modes and enhanced grid support. Low installation costs, remote monitoring, automatic cooling and easy servicing all keep costs as low as possible. And business case certainty is increased by the use of proven technology, robust components and redesigned systems to enhance reliability.

Fig 1: The 2 MW turbines operate with outstanding efficiency and high productivity across low, medium and high wind classes.

Fig 2: The V80-2.0, V90-1.8/2.0 and V100-1.8 MW turbines have been designed for exceptionally high annual energy output across different wind speeds.

Optimise energy production

- Designed for high productivity
- Noise modes that reduce noise and have minimal impact on power production
- Load and Power Modes for V90-1.8/2.0 MW and V100-1.8 MW
- Enhanced grid support

Reduce energy cost

- Low Balance of Plant (BOP), installation and transportation costs
- 24/7 remote control with VMP Global®
- Innovative CoolerTop® technology
- Designed for serviceability

Secure your investment

- Proven technology
- Reliable and robust product
- Redesigned bed frame and main bearing housing
- Improved yaw system

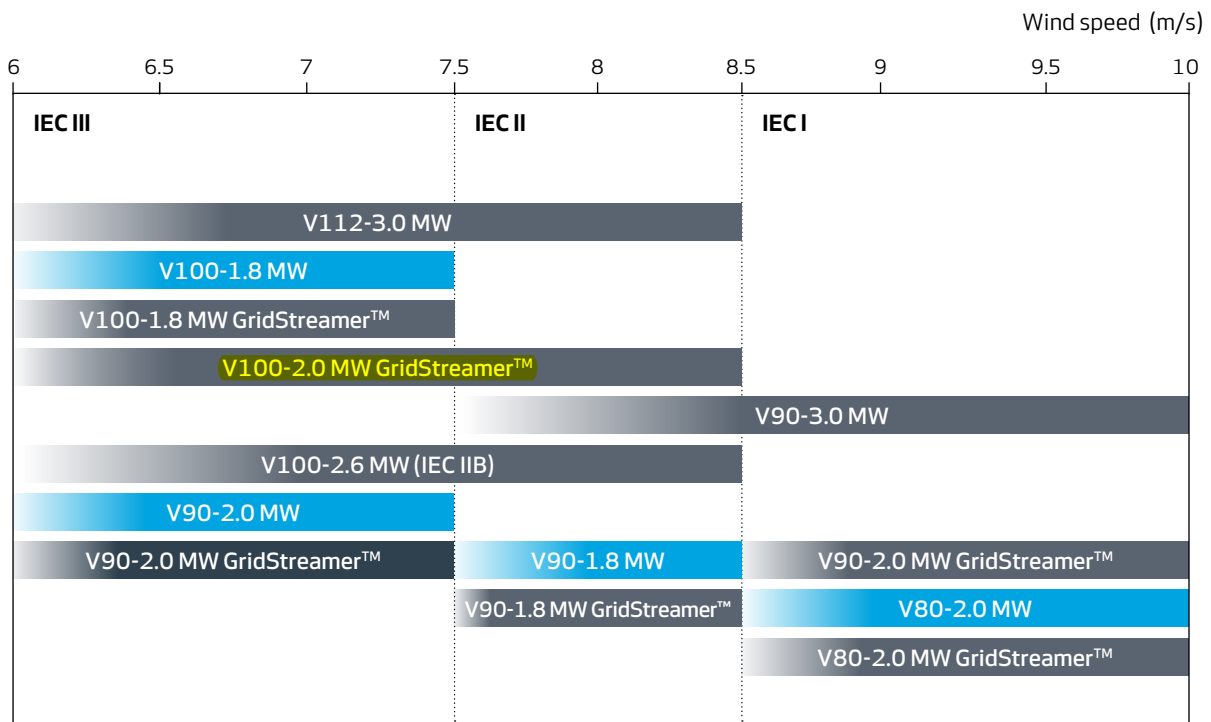


Fig 1: Overview of Vestas wind turbines operating in the various wind classes

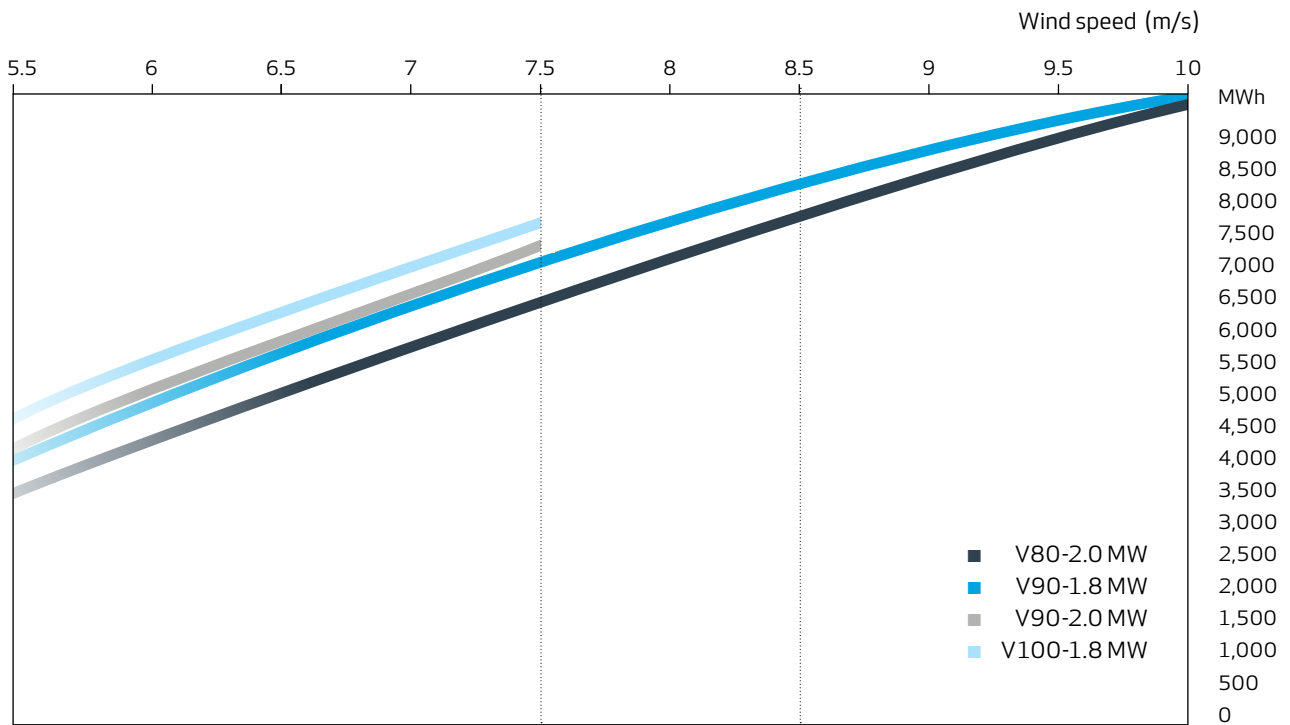


Fig 2: Annual Energy Production (AEP) for the V80-2.0 MW, V90-1.8/2.0 MW and V100-1.8 MW turbines.

Industry-leading technology generates **more energy**

Blades designed for high productivity

We use a combination of proven technology and new processes to create the innovative blades of the 2 MW turbines. Made of glass fibre and carbon fibre in an epoxy resin, the blades include lightning receptors and an internal grounding cable for added safety. As a result of these blade innovations, the 2 MW turbines produce an improved performance with increased output while reducing the loads transferred to the nacelle.

Noise modes maintain high power production

The 2 MW turbines have various noise modes to meet sound-level restrictions at any site.

The Vestas Converter System (VCS) is able to reduce the rotor speed and therefore the noise of the turbine – a significant factor when considering the suitability of the V100-1.8 MW for an onshore site with low winds.

In fact, the turbine can operate in site-specific configurable modes, staying within defined decibel ranges without significantly reducing productivity. Even in areas where sound-level restrictions are in place, these turbines are the versatile solution.

Load and Power Modes increase energy output

The V90-1.8/2.0 MW and V100-1.8 MW turbines support Load and Power Modes, used to maximise energy production under certain wind and site conditions.

Based on a site analysis, the turbines can be configured to run de-rated instead of shutting down under complex weather conditions such as extreme turbulence. Conversely, under benign wind conditions the turbine can be up-rated – maximising annual energy production.

Enhanced grid support

The VCS inside the V80-2.0 MW, V90-1.8/2.0 MW and V100-1.8 MW turbines delivers a constant and consistent output to the grid. The system maintains grid stability by rapidly regulating the turbine's power provision when needed, swiftly responding to faults and other grid disturbances. The VCS also lessens the load on the gearbox and other key components, reducing wear and tear.





Reduce wind energy cost by design

Low Balance of Plant, installation and transportation costs

At Vestas, we use technology tailored to control loads on specific tower heights. We have applied this principle to the V90-1.8/2.0 MW and the V100-1.8 MW by reducing both the weight of the turbine and the loads on the tower and foundation. This impacts on foundation costs, saving you unnecessary expense.

Manufacturing the tower from steel creates multiple advantages. It avoids having to dispose of tonnes of concrete when dismantling the turbine. Instead, you can gain from its scrap metal price. Steel towers also benefit the environment because they can be recycled.

All 2 MW turbines are easy to transport (by rail, truck or barge) to virtually any site around the world. In terms of weight, height and width, all components comply with local and international standard transportation limits, ensuring you incur no unforeseen costs.

In addition, 2 MW turbines can be built and maintained using tools and equipment that are standard within the installation and servicing industries – minimising ongoing maintenance costs.

24/7 remote control with VMP Global®

To reduce the cost of energy, our 2 MW turbines are equipped with VMP Global®, our latest turbine control and operation software.

Developed to run this latest generation of turbines, VMP Global® automatically manages the turbine 24/7 and ensures maximum power generation. The application also monitors and troubleshoots the turbines – both onsite and remotely – saving further expense on servicing.

Generator

- A reliable slip ring system
- Hybrid bearings with ceramic balls prevent bearing current for improved durability
- Improved generator cooling unit makes cooling effective

Transformer room

- More space available
- Optional 35 kV transformer allowing installation up to 2,000 m above sea level in USA/Canada/China

Innovative CoolerTop®

Our exclusive CoolerTop® technology uses the wind's own energy to generate the cooling required, rather than consuming energy generated elsewhere. CoolerTop® has no moving parts so requires little maintenance. Furthermore, the absence of any electrical components ensures that the cooling system makes no noise and adds nothing to the nacelle's energy consumption.

CoolerTop® allows for a temperature range of up to 40° centigrade without de-rating, and without needing a high temperature option that would reduce the amount of space available within the nacelle.

Designed for serviceability

Service crews are helped by the overall design of the 2 MW turbines which, like all other Vestas turbines, shields every rotating part and positions components for easy access.

CoolerTop®

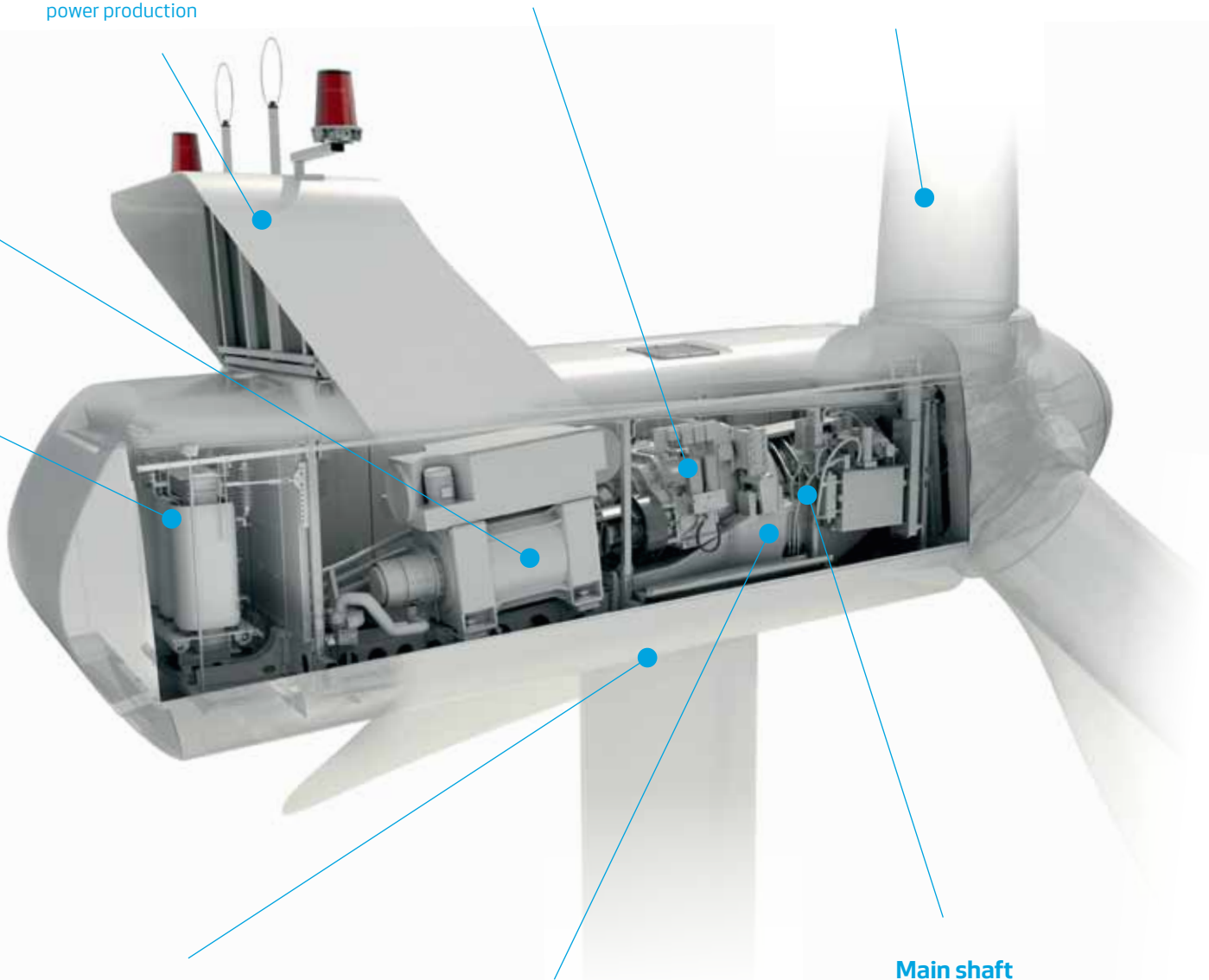
- New feature designed for efficient cooling to maximise power production

Gearbox

- Planetary gearbox with combined two-stage parallel gearbox

Blade

- Market-leading aerodynamic design
- Glass fibre and carbon fibre combination
- Single point greasing system, reducing service time



Yaw system

- 6 yaw gears
- Automatic lubrication greasing
- Less downtime and higher energy production

Main-bearing housing

- One piece
- Stronger construction to absorb higher loads from rotor

Main shaft

- Forged
- All rotating parts shielded for ease of servicing

A nighttime photograph of a city skyline with several tall, modern skyscrapers. The buildings are illuminated from within, with many windows glowing with light. The sky is dark, and the overall scene is a vibrant urban night scene.

Our passion and
commitment are
your guarantee
for safer business
investments

+ 98%

availability and lost production
factor below 1.7%

Proven technology from the company that proved it

Since 1995, we have installed over 8,500 of our 2 MW turbines around the world. This includes more than 4,000 V80-2.0 MW turbines, more than 4,200 V90-1.8/2.0 MW turbines and almost 200 of the newest V100-1.8 MW turbines. They are designed to maximise the commercial viability of low, medium and high-wind onshore sites, even under extreme weather conditions. Being based on such a mature and well-established platform, the 2 MW turbine is a sound, low-risk choice.

Using the best features from across the range, as well as some of the industry's most stringently tested components and systems, the 2 MW's reliable design minimises downtime – giving you the best possible return on your investment.

Reliable and robust product

The Vestas Test Centre is unrivalled in the wind industry. Uniquely, we test complete nacelles for reliability using Highly Accelerated Life Testing (HALT) to ensure reliability. At the critical component level, HALT identifies potential failure modes and mechanisms. Specialised test rigs ensure strength and robustness for the gearbox, generator, yaw and pitch system, lubrication system and accumulators.

Our quality-control system ensures that each component is produced to validated design specifications, and performs to peak potential at site. We also employ a Six Sigma philosophy and aim to perform at Six Sigma levels during 2011. We have identified critical manufacturing processes (both in-house and for sub-suppliers), and we systematically monitor measurement trends that are critical to quality, locating defects before they have chance to occur.

Redesigned bed frame and main bearing housing

Created with future generations of turbines in mind, the new single bed frame and stronger main bearing housing of the 2 MW turbines provide a better foundation for loads.

The toughened frame and housing – each made from single-piece castings – work in conjunction to absorb higher loads from the rotor. Additionally, the housing ensures correct alignment during bearing assembly, making the process more accurate and efficient and distributing loads evenly.

These improvements combine to increase the production capabilities of the turbine and reduce downtime.

Improved yaw system

Previous generations of turbines in the 2 MW class included a four-gear yaw system. But the Vestas commitment to continuous improvement means the 2 MW version is even better. It features a six-gear yaw system and 110 mm yaw rim which has been induction hardened, making it more robust and reliable than ever before.

The maintenance savings associated with this improvement are boosted further by the semi-automatic yaw lubrication system, fitted as standard on all 2 MW turbines. This greasing mechanism delivers tangible service savings and raises revenues by increasing turbine uptime.



Full control through service experts and our surveillance system

Surveillance, maintenance and service

Operating a large wind power plant calls for efficient management strategies to ensure power production is uninterrupted and operational expenses are controlled. Vestas provides 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine performance and availability. Predicting if any critical components are likely to break down is essential to this effort, helping to avoid costly emergency repairs and unscheduled interruptions to energy production.

The Vestas Condition Monitoring System (CMS) assesses the status of the 2 MW turbines by analysing signals such as vibrations and temperatures. For example, by measuring the vibration of the drive train, it can detect faults at an early stage and monitor the progress of any damage. This information allows the service organisation to perform the required maintenance work before the component fails, reducing repair costs and production loss.

What's more, our Active Output Management® (AOM) concept provides detailed plans for service and maintenance, online monitoring, optimisation and troubleshooting, and includes a competitive insurance scheme. It is even possible to get a full availability guarantee, under which we compensate you if the turbine fails to meet agreed availability targets.

Vestasonline® Business

All Vestas wind turbines benefit from VestasOnline® Business, the latest Supervisory Control and Data Acquisition (SCADA) system for modern wind power plants.

This flexible system includes an extensive range of monitoring and management functions to control your wind power plant in the same way as a conventional power plant. VestasOnline® Business enables you to optimise production levels, monitor performance, and produce detailed, tailored reports from anywhere in the world. The system's power plant controller provides active and reactive power regulation, power ramping and voltage control.



Vestas turbines include a range of additional features that give you the control you need to maximise your production and ensure a high return on your investment. Thanks to our superior operations and maintenance capabilities, we also provide a level of service unparalleled in the industry.

V80-2.0 MW

Facts and figures

POWER REGULATION pitch regulated with variable speed

OPERATING DATA

Rated power	2,000 kW
Cut-in wind speed	4.0 m/s
Rated wind speed	16 m/s
Cut-out wind speed	25 m/s
Wind class	IEC IA and IEC IIA
Operating temperature range	-20°C to 40°C
	low temperature turbine: -30°C to 40°C

ROTOR

Rotor diameter	80 m
Swept area	5,027 m ²
Nominal revolutions	16.7 rpm
Operational interval	10.8 - 19.1 rpm
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Generator type	4-pole doubly fed generator, slip rings

GEARBOX

Type	two planetary stages and one helical stage
------	--

TOWER

Type	tubular steel tower
Hub heights	60 m, 67 m and 78 m (IEC IA) 60 m, 67 m, 80 m and 100 m (IEC IIA) 100 m (DIBt)

BLADE DIMENSIONS

Length	39 m
Max. chord	3.5 m

NACELLE DIMENSIONS

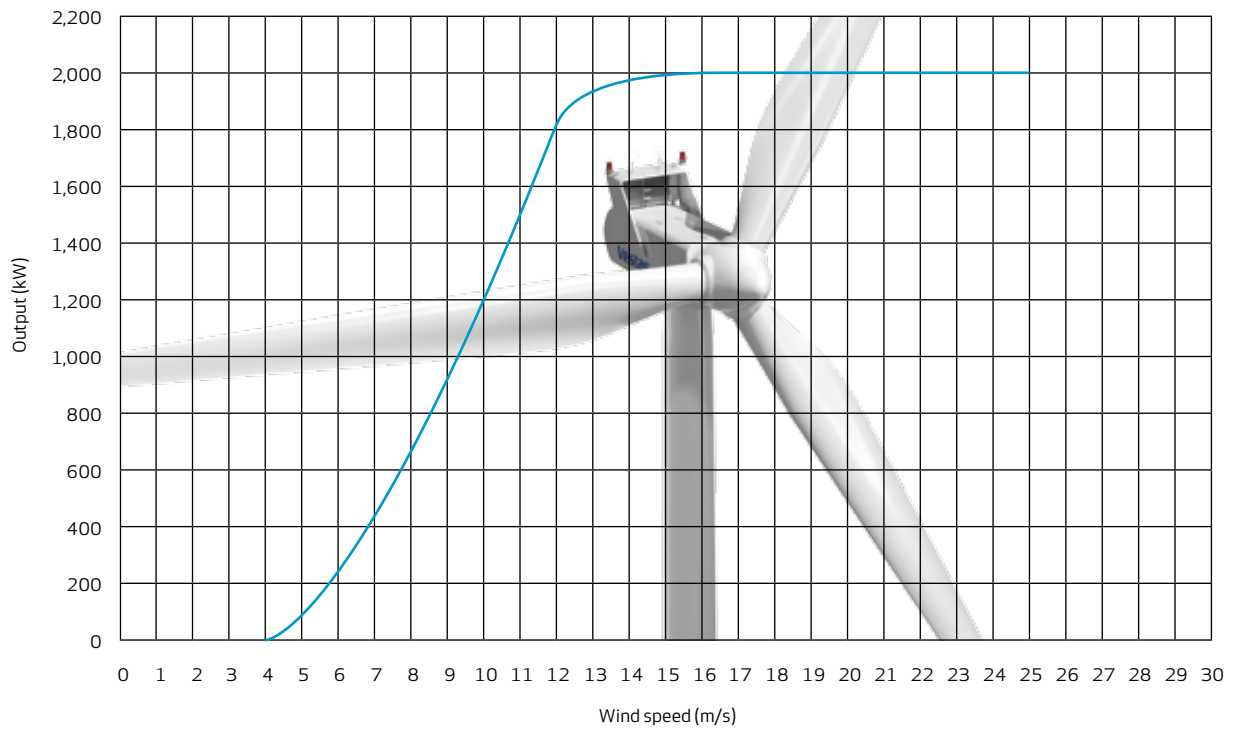
Height for transport	4 m
Height installed (incl. CoolerTop®)	5.4 m
Length	10.4 m
Width	3.4 m

HUB DIMENSIONS

Max. diameter	3.3 m
Max. width	4 m
Length	4.2 m

Max. weight per unit for transportation 70 metric tonnes

POWER CURVE FOR V80-2.0 MW Noise reduced sound power modes are available



V90-1.8/2.0 MW

Facts and figures

POWER REGULATION

pitch regulated with variable speed

OPERATING DATA

Rated power	IEC IIA - 50 Hz: 1,800 kW
	IEC IIA - 60 Hz: 1,815 kW
	IEC IIIA - 50 Hz: 2,000 kW
Cut-in wind speed	4.0 m/s
Rated wind speed	12 m/s
Cut-out wind speed	25 m/s
Wind class	IEC IIA (V90-1.8 MW)
	IEC IIIA (V90-2.0 MW)
Operating temperature range	standard turbine: -20°C to 40°C
	low temperature turbine: -30°C to 40°C

SOUND POWER MODES

Mode 0: Max sound power level:	104 dB(A)
Mode 1: Max sound power level:	103 dB(A)
Mode 2: Max sound power level:	101 dB(A)
Mode 3: Max sound power level:	104 dB(A)*

*) low noise at low wind

ROTOR

Rotor diameter	90 m
Swept area	6,362 m ²
Nominal revolution	14.5 rpm
Operational interval	9.3 – 16.6 rpm
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Generator type	4-pole (50 Hz)/6-pole (60 Hz) doubly fed generator, slip rings
Nominal output	50 Hz: 1,800 kW / 2,000 kW
	60 Hz: 1,815 kW

GEARBOX

Type two planetary stages and one helical stage

TOWER

Type	tubular steel tower
Hub heights	
V90-1.8 MW - 50 Hz	80 m, 95 m and 105 m (IEC IIA)
V90-1.8 MW - 60 Hz	80 m and 95 m (IEC IIA)
V90-2.0 MW	80 m, 95 m, 105 m and 125 m (IEC IIIA)
V90-2.0 MW	95 m, 105 m and 125 m (DIBt II)

BLADE DIMENSIONS

Length	44 m
Max. chord	3.5 m

NACELLE DIMENSIONS

Height for transport	4 m
Height installed (incl. CoolerTop®)	5.4 m
Length	10.4 m
Width	3.4 m

HUB DIMENSIONS

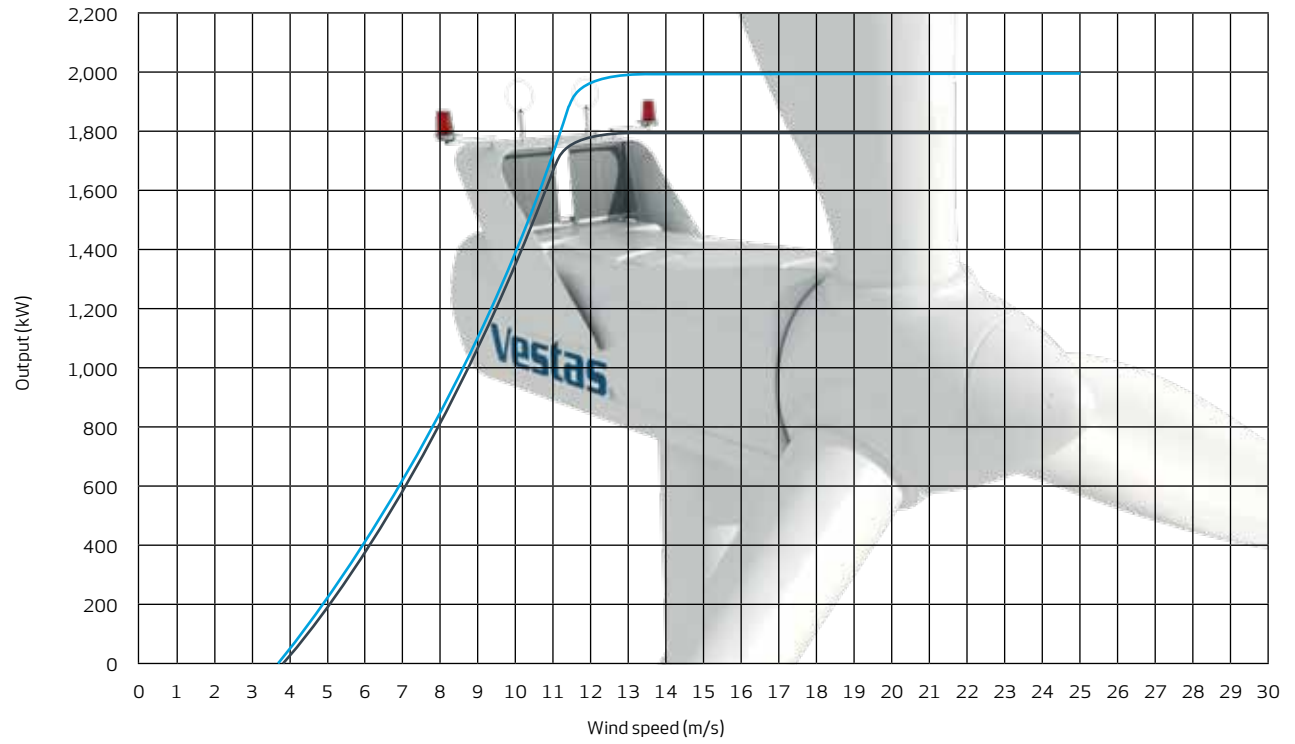
Max. diameter	3.3 m
Max. width	4 m
Length	4.2 m

Max. weight per unit for transportation 70 metric tonnes

POWER CURVE V90-1.8/2.0 MW (50 Hz)

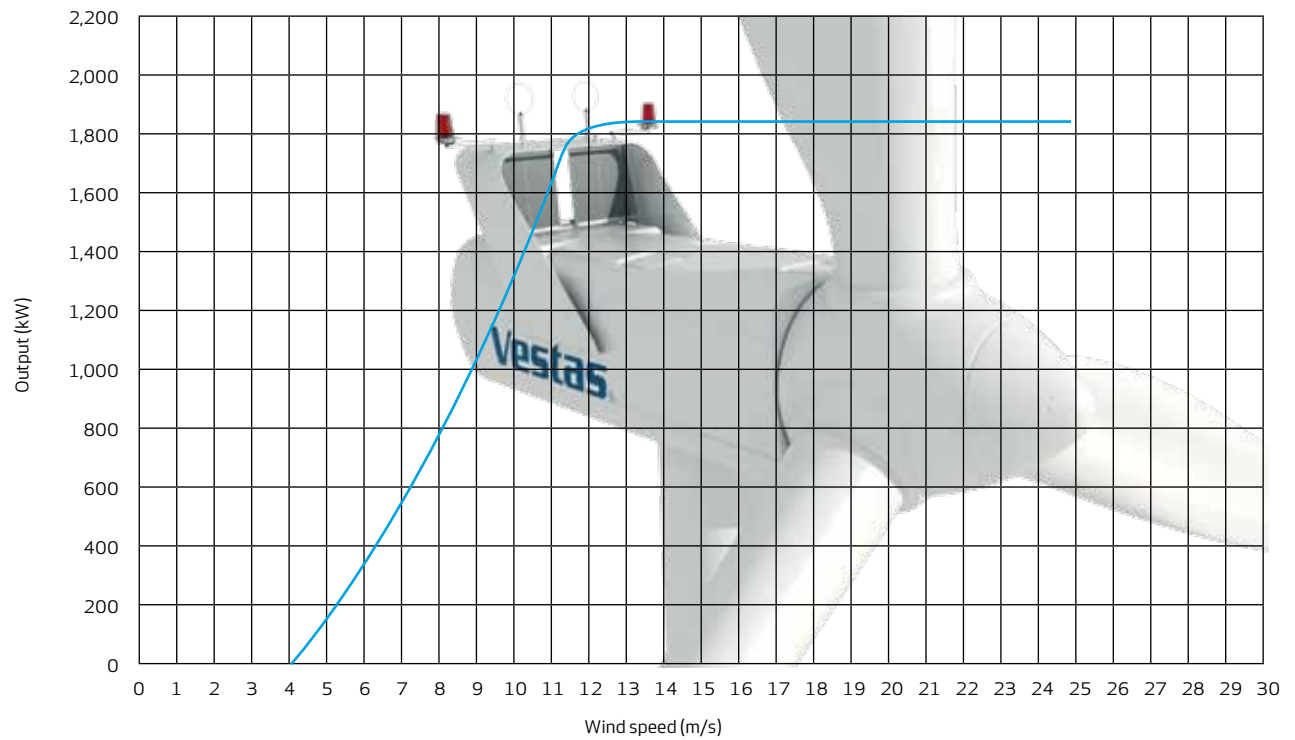
Noise reduced sound power modes are available

2,000 kW 
1,800 kW 



POWER CURVE V90-1.8 MW (60 Hz)

Noise reduced sound power modes are available



V100-1.8 MW

Facts and figures

POWER REGULATION pitch regulated with variable speed

OPERATING DATA

Rated power	1,800 kW (50 Hz)
	1,815 kW (60 Hz)
Cut-in wind speed	3 m/s
Rated wind speed	12 m/s
Cut-out wind speed	20 m/s
Wind class	IEC S (IEC IIIA average wind/ IEC IIA extreme wind)
Operating temperature range	standard turbine: -20 °C to 40 °C low temperature turbine: -30 °C to 40 °C

SOUND POWER MODES

Mode 0: Max sound power level:	105.0 dB (A)
Mode 1: Max sound power level:	105.0 dB (A)*
Mode 2: Max sound power level:	103.0 dB (A)

*) low noise at low wind

ROTOR

Rotor diameter	100 m
Swept area	7,850 m ²
Nominal revolutions	14.5 rpm
Operational interval	9.3 – 16.6 rpm
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Generator type	4-pole (50 Hz)/6-pole (60 Hz) doubly fed generator, slip rings

GEARBOX

Type one planetary stage and two helical stages

TOWER

Type tubular steel tower
Hub heights 80 m and 95 m

BLADE DIMENSIONS

Length 49 m
Max. chord 3.9 m

NACELLE DIMENSIONS

Height for transport 4 m
Height installed (incl. CoolerTop®) 5.4 m
Length 10.4 m
Width 3.4 m

HUB DIMENSIONS

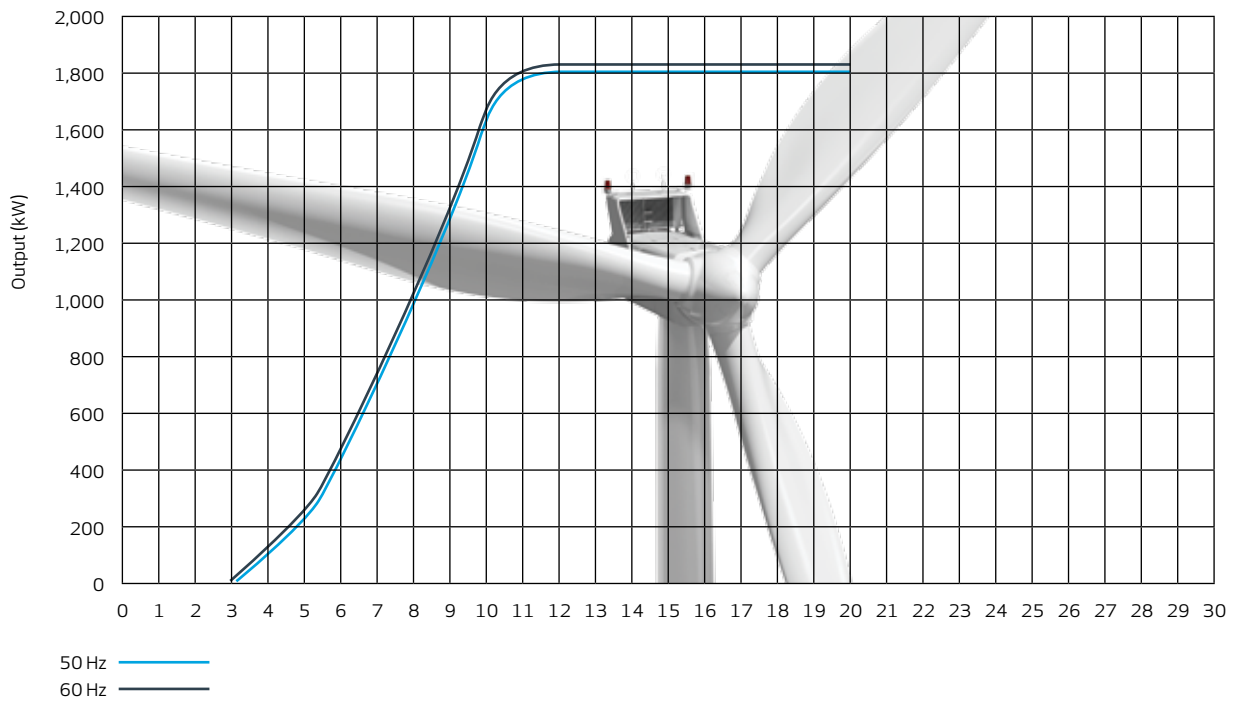
Max. diameter 3.3 m
Max. width 4 m
Length 4.2 m

Max. weight per unit for transportation 70 metric tonnes

+21,000

committed, highly-trained employees around the globe are always ready to help in any aspect of wind power production.

POWER CURVE FOR V100-1.8 MW Noise reduced sound power modes are available



Vestas Wind Systems A/S
Alsvej 21 . 8940 Randers SV . Denmark
Tel: +45 9730 0000 . Fax: +45 9730 0001
vestas@vestas.com . vestas.com

©Vestas 2011

This document was created by Vestas Wind Systems A/S and contains copyrighted material, trademarks and other proprietary information. All rights reserved. No part of the document may be reproduced or copied in any form or by any means such as graphic, electronic or mechanical, including photocopying, taping or information storage and retrieval systems, without the prior written permission of Vestas Wind Systems A/S. All specifications are for information only and are subject to change without notice. Vestas does not make any representations or extend any warranties, expressed or implied, as to the adequacy or accuracy of this information.
VCS turbines are not available in the USA or Canada.