Vestas®

V90
3.0 MW

Wind. It means the world to us.™

V90-3.0 MW
A better wind business by design

Reliable turbines through proven technology

Vestas has installed more than 1,300 V90-3.0 MW turbines on- and offshore – the equivalent of more than 4 GW – around the world.

The V90-3.0 MW builds on proven technology ensuring reliability, serviceability and yield. It is a uniquely tested platform that provides the safest way to a better wind business and a higher return on investment.

Innovative low-weight design drives down the cost of energy

Through Vestas' unique, innovative nacelle design and integrated drive train, the V90-3.0 MW minimises weight and loads.

The result is a turbine that can generate more power without an appreciable increase in size, weight and tower loads. In this way the innovative design optimises energy production and drive down the overall cost of energy.

+1,300

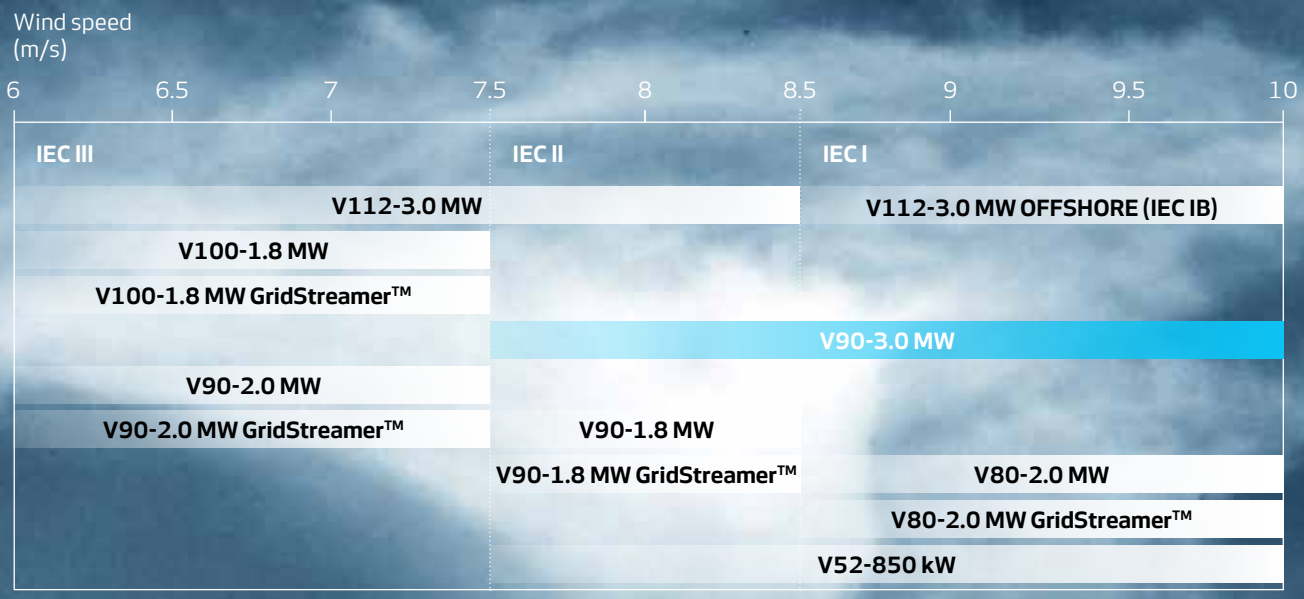
turbines installed, equivalent of more than 4 GW around the world.

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.

Low weight High **return**

Setting the standard for low-weight, **high-performance turbines**

If you want to ensure the yield of your high-wind (IEC IA) and medium-wind locations (IEC IIA), the low-weight V90-3.0 MW is an excellent choice.



- – 90 meter rotor diameter
- – 3.0 MW rated power

Our passion and commitment are **your guarantee** for safer business investments

Proven technologies

The V90-3.0 MW is based upon the proven technologies that underpin the +40,000 Vestas turbines installed around the world. Using the best features from across the range, as well as some of the industry's most stringently tested components and systems, this turbine's reliable design minimises your downtime – helping to give you the best possible return on your investment.

Reliable and robust product

The Vestas Test Centre is unrivalled in the wind industry and has the unique ability to test complete nacelles using a.o. the Highly Accelerated Life Testing (HALT) to ensure reliability. At the critical component level, potential failure modes and mechanisms are identified and specialised test rigs are used to ensure strength and robustness for the gearbox, generator, yaw system, pitch system and lubrication system. We have quality controls in place to manage variations in the manufacturing process and to ensure that each component is delivered to design specifications and performs at site. Vestas employs a Six Sigma philosophy – and aims to perform at Six Sigma levels during 2011 – and our standards mean that we reproduce each component to validated design specifications. We have identified critical manufacturing processes (both in-house and for sub-suppliers) and we systematically monitor measurement trends that are critical to quality to identify variation and make changes before any defects occur.

Optimise energy production and **reduce** the operational costs

Designed to let you take advantage of high and medium wind speed sites, the V90-3.0 MW allows you to increase productivity by extracting more power from the available wind while minimising your downtime and maintenance costs. Here's an overview of selected features that optimise your energy production, reduce operational costs and strengthen the business case for choosing the high-performing V90-3.0 MW.

Innovative drive train

The V90-3.0 MW minimises weight and loads through its innovative nacelle design and high-efficiency integrated drive train. The result is a turbine that can generate more power without an appreciable increase in size, weight, or tower load.

Groundbreaking blade design

Blades are made out of a glass fibre/carbon spar with glass fibre airfoil shells creating one of the lightest 44 m blade on the market. As a result the V90-3.0 MW blades maximise production while reducing the loads transferred to the nacelle.

Advanced grid support

The turbine features advanced control of reactive power capability which stabilises the frequency and the voltage of the grid. The V90-3.0MW is also able to support the grid according to various applicable grid requirements.

Designed for easy service

The V90-3.0 MW is designed for a 12 month service interval instead of usual 6 months. This means that you can plan your maintenance for the season avoiding the windiest months and minimising lost production.

Designed for uncomplicated transport and reduced installation costs

The V90-3.0 MW is designed to be transported easily to virtually any site around the world. All of its components comply with local and international limits for standard transportation. The nacelle does not require on-site assembly – lowering your installation costs, as less activity is needed. We also use anchor bolts in our foundation design, which allows faster erection on-site and simpler tower realignment.

Control system

- Synchronisation of generator to the grid
- Operation of turbines during various fault situations
- Effective load distribution

Generator

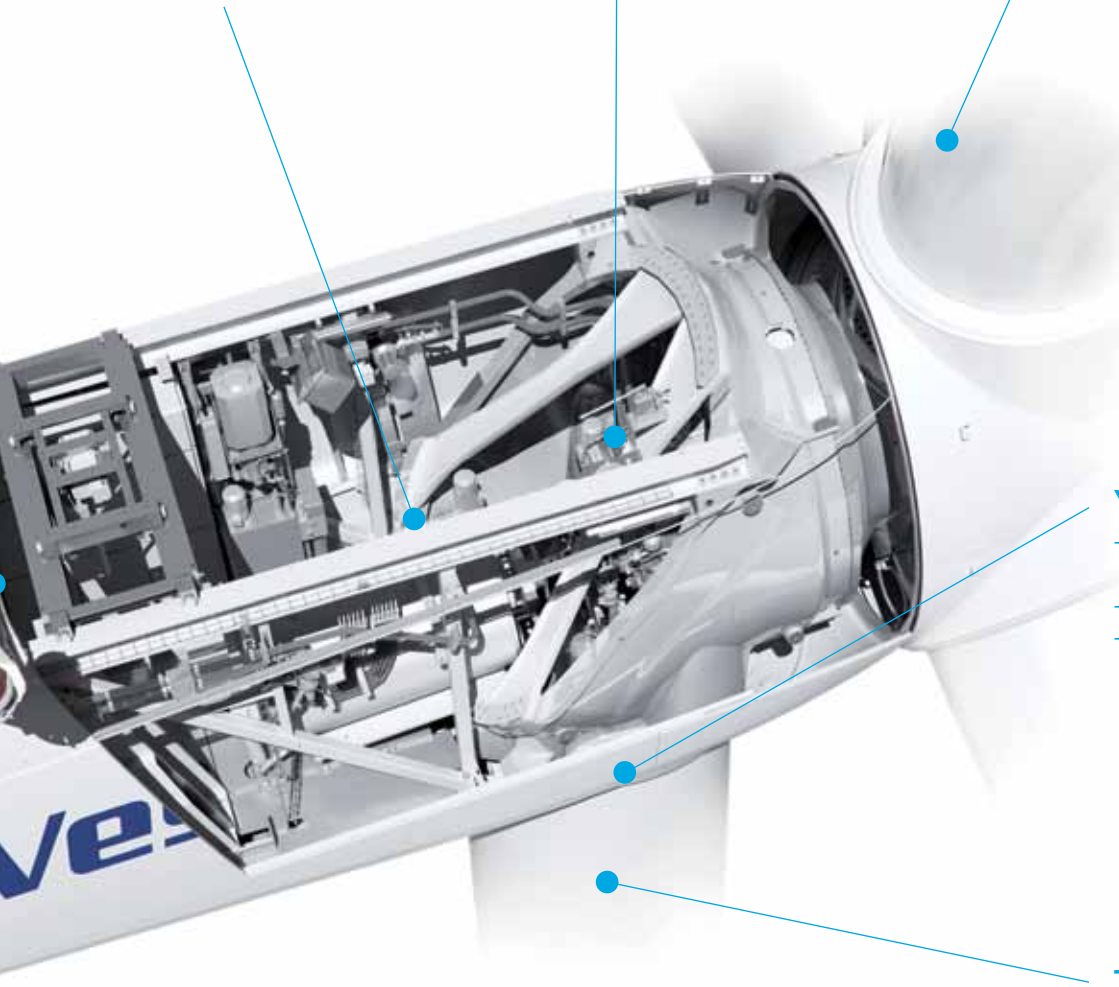
- Doubly fed generator
- Equipped with wound rotor and slip rings
- Connected to Vestas converter system
- Liquid cooled

Drive train

- Compact design without main shaft
- Main bearing is integrated into the gearbox
- 2 planetary stages + 1 helical stage gearbox
- Forced oil lubrication

Blade

- Glass fibre/carbon spar with glass fibre airfoil shells
- Slim blades with efficient wind utilisation



Yaw system

- 4-step planetary gear with motor brake and torque limiter
- 6 yaw gears
- Automatic lubrication, designed to reduce number of scheduled maintenance visits to once a year

Tower

- Weight reduction through use of magnets instead of welding tower internals to the tower wall

Full control through service experts and a global surveillance system

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.

+16,000

turbines worldwide giving us real-time performance data.

VestasOnline® Business

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

This flexible system includes an extensive range of monitoring and management functions that allow you 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 while the system's power plant controller provides active and reactive power regulation, power ramping and voltage control.

Surveillance, maintenance and service

Vestas provides 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine uptime, production and availability. Operating a large wind power plant today calls for highly efficient management strategies, to ensure that power production is uninterrupted and that operational and maintenance expenses are controlled. The ability to predict when critical components are most likely to break down is essential to this effort, as it helps to avoid costly emergency repairs and unscheduled interruptions to energy production.

The Vestas Condition Monitoring System performs this predictive maintenance function, assessing the status of the turbine by analysing measured signals such as vibrations and temperatures (e.g. in gearbox bearings and the main bearings).

For example, by measuring the vibration of the drive train, the system can detect faults at an early stage and monitor the progress of the damage. This information allows the service organisation to plan and execute the required maintenance work before the component fails, reducing repair costs and production loss.

What's more, our Active Output Management® 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 Vestas pays compensation if the turbine fails to meet the agreed availability targets.

V90-3.0 MW
Facts and figures

POWER REGULATION pitch regulated with variable speed

OPERATING DATA

Rated power	3.0 MW
Cut-in wind speed	3.5 m/s
Rated wind speed	15 m/s
Cut-out wind speed	25 m/s
Re-cut in wind speed	20 m/s
Wind class	IEC IA and IEC IIA
Operating temperature range	standard range: -20 °C to 40 °C low temperature option: -30 °C to 40 °C

SOUND POWER

(Mode 0, 10 m above ground, hub height 80 m, air density 1,225 kg/m³)

4 m/s	97.9 dB (A)
5 m/s	100.9 dB (A)
6 m/s	104.2 dB (A)
7 m/s	106.1 dB (A)
8 m/s	107.0 dB (A)
9 m/s	106.9 dB (A)

ROTOR

Rotor diameter	90 m
Swept area	6,362 m²
Nominal revolutions	16.1 rpm
Operational interval	8.6 - 18.4 rpm
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

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

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Type	tubular steel tower
Hub heights	65 m and 80 m (IEC IA) 105 m (IEC IIA)

BLADE DIMENSIONS

Length	44 m
Max. chord	3.5 m

NACELLE DIMENSIONS

Height for transport	4 m
Length	9.65 m
Width	3.65 m (3.85 m installed)

HUB DIMENSIONS

Max. diameter	3.6 m
Max. width	4.2 m
Length	4.4 m

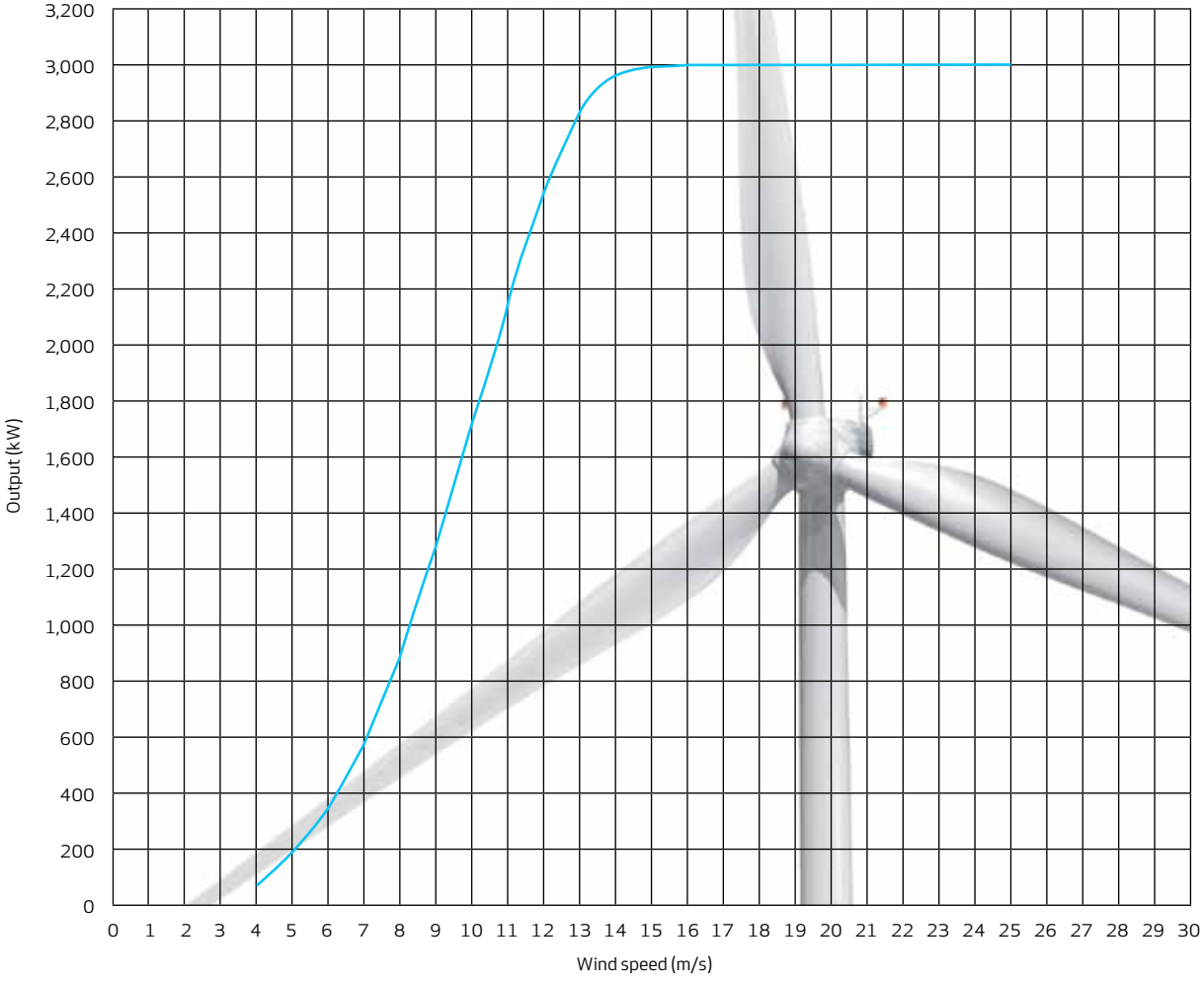
Max. weight per unit for transportation	70 metric tonnes

+20,000

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

POWER CURVE FOR V90-3.0 MW

Noise reduced sound power modes are available



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03/2011-EN