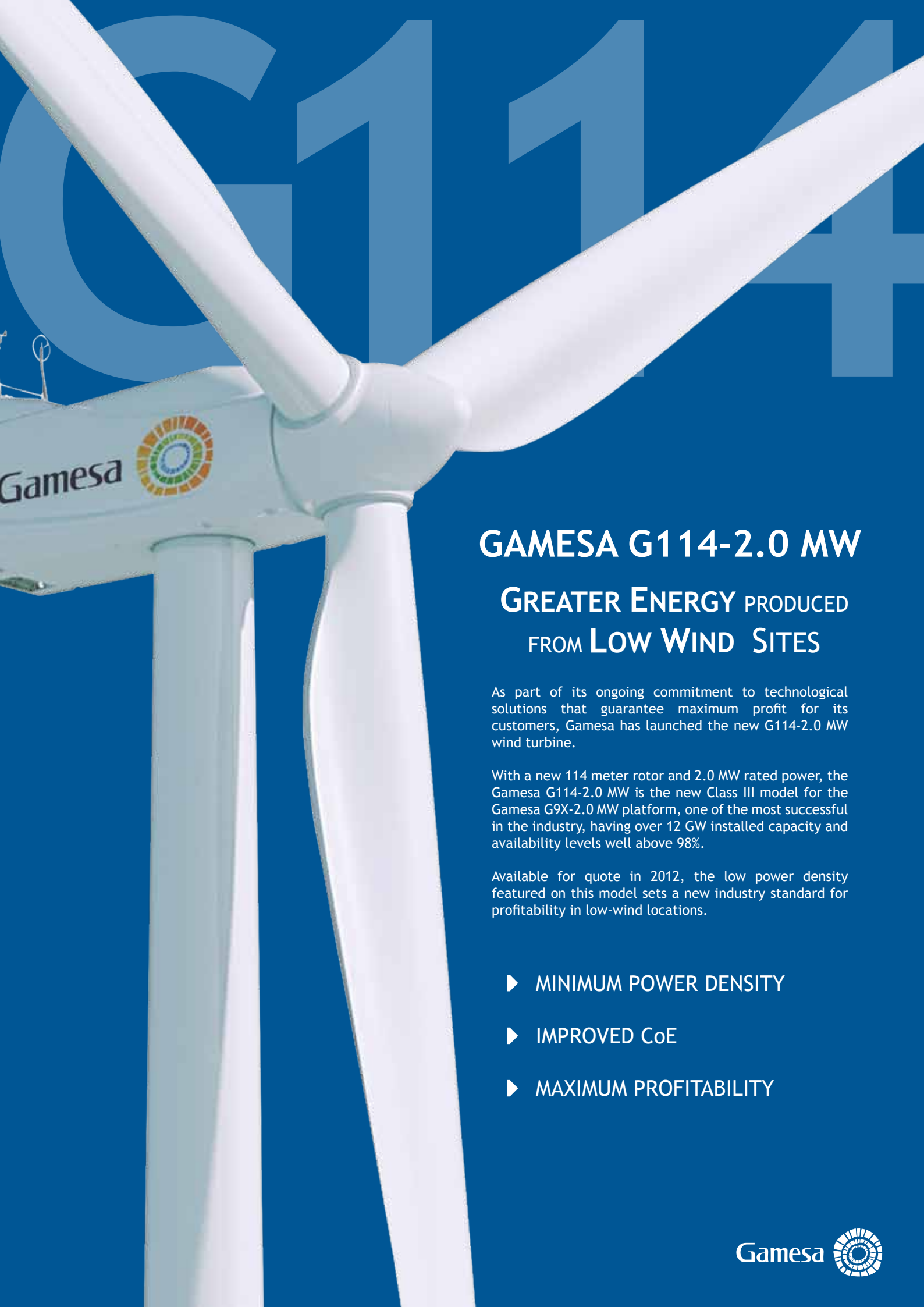


GAMESA G114-2.0 MW

GREATER ENERGY PRODUCED FROM LOW WIND SITES

As part of its ongoing commitment to technological solutions that guarantee maximum profit for its customers, Gamesa has launched the new G114-2.0 MW wind turbine.

With a new 114 meter rotor and 2.0 MW rated power, the Gamesa G114-2.0 MW is the new Class III model for the Gamesa G9X-2.0 MW platform, one of the most successful in the industry, having over 12 GW installed capacity and availability levels well above 98%.

Available for quote in 2012, the low power density featured on this model sets a new industry standard for profitability in low-wind locations.

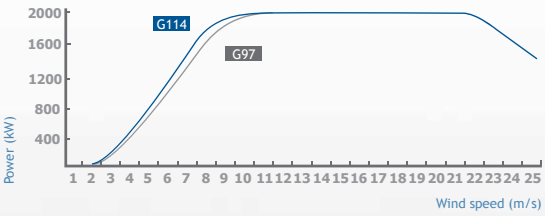
- MINIMUM POWER DENSITY
- IMPROVED CoE
- MAXIMUM PROFITABILITY

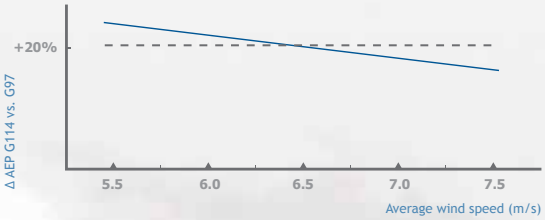
Gamesa

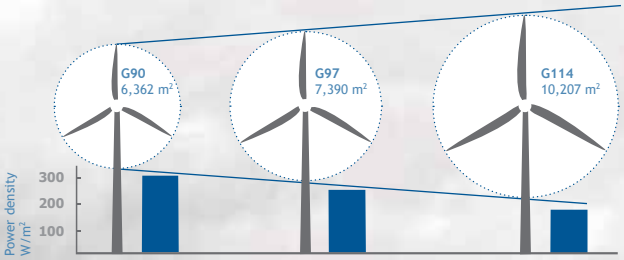
MORE ENERGY PRODUCTION IN LOW-WIND LOCATIONS

The Gamesa G114-2.0 MW wind turbine inherits many of the technologies developed over 10 years with the Gamesa G9X-2.0 MW platform.

Now, with a new 114 m rotor, the Gamesa G114-2.0 MW has a 38% larger swept area than the Gamesa G97-2.0 MW and produces over 20% more energy annually. The new 55.5 m blade with state-of-the-art airfoil design ensures maximum energy production, reduced noise levels and a significantly lower Cost of Energy for Gamesa's Class III products.







SPECIFICATIONS

General Details

Rated power	2.0 MW
Wind class	IIIA
Rotor diameter	114m
Swept area	10,207m²
Power density	195.94 W/m²
Control	Independent pitch and variable speed
Gearbox	3 stages
Generator	Doubly fed
Frequency	50 Hz / 60 Hz

Blades

Length	55.5 m
Airfoil	Gamesa

Towers

Height	93, 120, 140 m and site-specific

Gamesa

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Printed date: March 2012.

G126-2.5 MW

Benchmark in return for low-wind sites

Gamesa maintains its unwavering commitment to continue developing the best technological solutions for its clients while reducing as much as possible the cost of energy of its products. One example is Gamesa's latest technological design unveiled for its 2.0-2.5 MW product line, the new G126-2.5 MW IIIA wind turbine. Intended for low-wind sites, this new model will provide clients with the most competitive class III product on the market in the 2 to 3 MW power capacity segment.

The new G126-2.5 MW IIIA wind turbine, with a new 126-meter rotor linked to a 2.5 MW generator, is a benchmark for return in the main onshore wind power market segment, which is among the most competitive.

The knowledge acquired through the launching of Gamesa's latest products has been a key factor in the evolution of this new model. Product development optimization, new wind turbine testing and validation procedures have been incorporated and time to market has been reduced.

With an extremely low power density, excellent capacity factor and reduced cost of energy, the G126-2.5 MW wind turbine has been met with a remarkable welcome in the sector and is destined to take its place as an industry leader alongside Gamesa's G114-2.0 MW wind turbine, which was awarded Windpower Monthly's gold medal in the "*Best Onshore Wind Turbine up to 2.9 MW for 2014*" category.

- PROVEN TECHNOLOGY
- 20-25% MORE ENERGY PRODUCTION*
- EXCELLENT CAPACITY FACTOR AND REDUCED COST OF ENERGY
- OPTIMIZED FOR LOW-WIND SITES

** Compared with G114-2.0 MW.*

GLOBAL TECHNOLOGY
EVERLASTING ENERGY

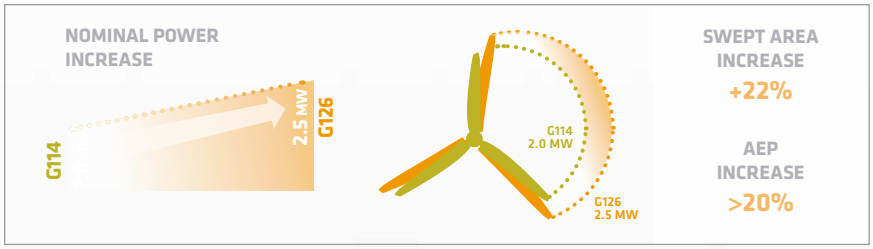
Gamesa

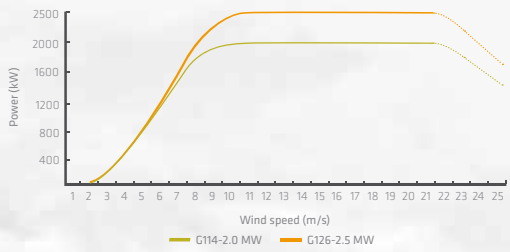
NEW MODEL G126-2.5 MW IIIA

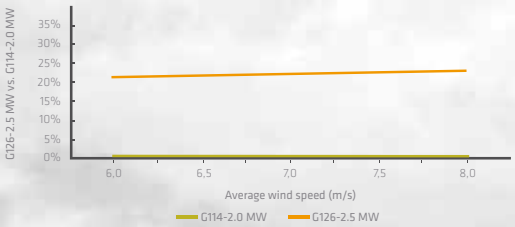
Gamesa harnessed the experience acquired through the design and installation of more than 18,000 MW from Gamesa's high performance 2.0-2.5 MW platform to develop this new model, capable of generating even more power at low-wind sites while remaining as competitive as existing, smaller-rotor models. The company's most recently developed turbines thus emerge through this approach: G114-2.0 MW IIA/IIIA, G114-2.5 MW IIA, and now G126-2.5 MW IIIA.

Following the evolutionary model of the 2.0-2.5 platform, and minimizing the risk associated with new technologies, the G126-2.5 MW is equipped with a 62 meter blade based on the 56-meter variant already delivering maximum production at lower noise and comprehensively validated for G114 turbines. Based on the same principle, the electrical system incorporated in the G126 is common for all 2.5 MW models across Gamesa's 2.0-2.5 MW platform.

Boasting a 20% increase in power production compared to the G114-2.0 MW model, the G126-2.5 MW wind turbine rounds off Gamesa's offering for Class III sites. With this new addition, this platform reaffirms itself as the market's most versatile, with seven different rotors, tower heights from 55 to 125 meters, and environmental options enabling installation at even the most complex sites.







SPECIFICATIONS

General Details

Rated power	2.5 MW	Control	Pitch and variable speed
Wind class	IIIA	Gearbox	3 stages
Rotor diameter	126 m	Generator	Doubly fed
Swept area	12,469 m²	Frequency	50Hz / 60 Hz
Power density	200.50 W/m²		

Blades

Length	62 m
Airfoil	Gamesa

Towers

Height	84, 102 m and site specific

Printed date: April 2015.

Gamesa

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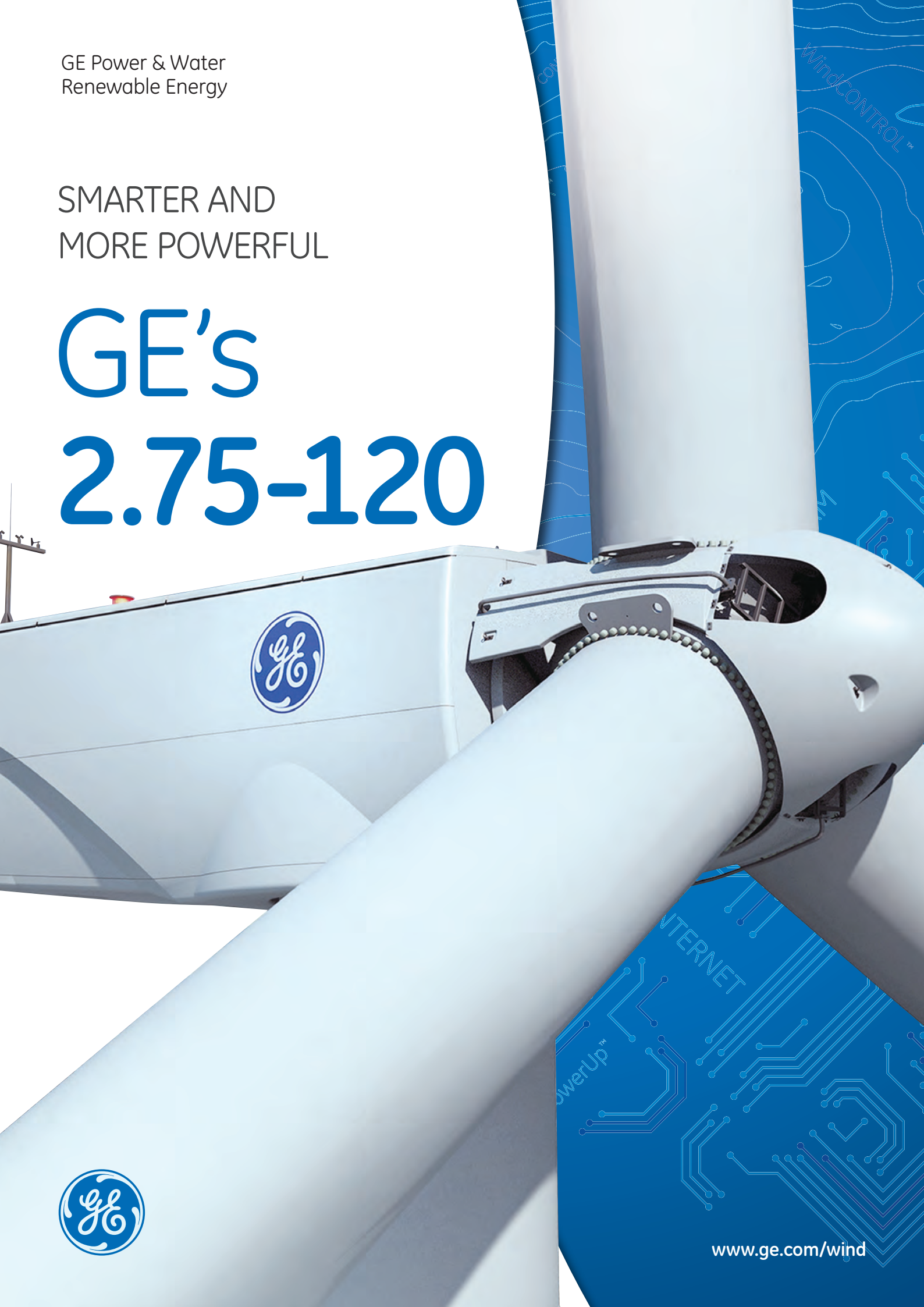
GE Power & Water
Renewable Energy

SMARTER AND
MORE POWERFUL

GE's 2.75-120



www.ge.com/wind

GE's **2.75-120**

Since entering the wind industry in 2002, GE Power & Water's Renewable Energy business has invested more than $2 billion in next generation wind turbines. Whether at the turbine, plant, or grid level, GE continues to focus on providing more value for our customers. Through the use of advanced analytics, GE's Renewable Energy business is redefining the future of wind power, delivering on proven performance, availability and reliability. With the integration of big data and the industrial internet, the company is helping to manage the variability of wind to provide smooth, predictable power. Our current product portfolio includes wind turbines with rated capacities ranging from 1.6 MW to 3.2 MW and support services ranging from development assistance to site planning, operation and maintenance.

For more information visit our website:
www.ge.com/wind

GE's 2.75-120 ... a Brilliant Machine

How do you define brilliance? GE is redefining the future of wind power by integrating the Industrial Internet with GE's industry leading power conversion technology, enabling "grid friendly" integration of wind farms around the globe. By helping to manage the variability of wind, GE is working to provide smooth, predictable wind power to the world regardless of what Mother Nature throws its way.

- **Increased output** – less downtime through turbine to turbine communication
- **Productivity**– enhanced diagnostics with Mark*VIe controller from GE
- **Smooth grid integration** – with wind farm to grid communication
- **Improved grid voltage support in the area** – with windfarm to windfarm coordination
- **Technical support around the world** – turbine to remote monitoring communication
- **New revenue streams** – advanced forecasting algorithms and storage ready

Tailor-Made Service Solutions

A flexible service agreement is offered on GE's 2.75-120. Turbine performance and life can be improved with power output software enhancements, predictive condition monitoring, and unplanned maintenance services. For customers that prefer to manage the O&M of their assets, flexible options are available:

- Service support
- 24/7 Remote control center
- Upgrades packages
- Performance improvements
- Spare part centers
- Lifetime extension

We have 1,000+ service professionals – available to you 24/7.

GE's 2.75-120 Wind Turbine

GE's 2.5 MW product platform is evolving towards a wider range of site applications by introducing the 2.75-120 wind turbine designed for IEC Wind Class III environments. This new turbine features a 120 meter rotor in combination with the proven single-blade pitch control that offers the latest enhancements in load management controls, low acoustic emissions, efficient electrical power conversion and robust performance.

As part of GE's brilliant wind platform, the 2.75-120 is a powerful turbine that generates 5 % more AEP than its predecessor the 2.5-120. The 2.75-120 is available on a steel or hybrid tower, ranging from 85–139 meters tall, helping to tailor the turbine for unique site conditions and bring wind power to new places across the continent. Short- or long-term energy storage is also available with the 2.75-120, making wind power more predictable, flexible and fast responding through battery software applications.

Building Upon Proven Performance

With an installed global fleet of more than 25,000 units, GE's proven platform runs at 98%+ availability, making it the world's best producing fleet. Together with GE's tailored customer service options, GE can enhance the value of your assets over their lifetime – generating high yields at low to medium wind speeds – and reduce the cost of electricity for our customers.

With over 1,500 units in operation, GE's 2.5 MW platform is the turbine of choice for two of the world's largest onshore wind farms in operation today:

- 845 MW Shepherds Flat wind farm, USA
- 600 MW Fantanele wind farm, Romania

As one of the world's leading wind turbine suppliers, GE provides evolutionary wind turbine designs and support services extending from development assistance to operation and maintenance for the successful implementation of projects. This creditable track record supports customers with the financeability of their wind projects.

Technical Description

GE's 2.75-120 is based on a proven platform design of over 1,500 operating 2.5 MW turbines. With the 120 meter rotor, the 2.75-120 wind turbine is designed to meet certification requirements for IEC Wind Class III and German DiBt WZ 2 environments. GE's patented loads control system proactively measures stress during operation. The individually adjustable blade pitch system from GE is used to operate the unit for high-energy generation. The GE partial power converter system efficiently converts the produced energy into the 50/60 Hz power network, maximizing the annual energy production. GE has a global reputation of meeting the strictest grid requirements and delivering reliable energy to the grid.

Focusing on performance, reliability and efficiency, GE's 2.75-120 wind turbine provides high customer value through evolutionary design.

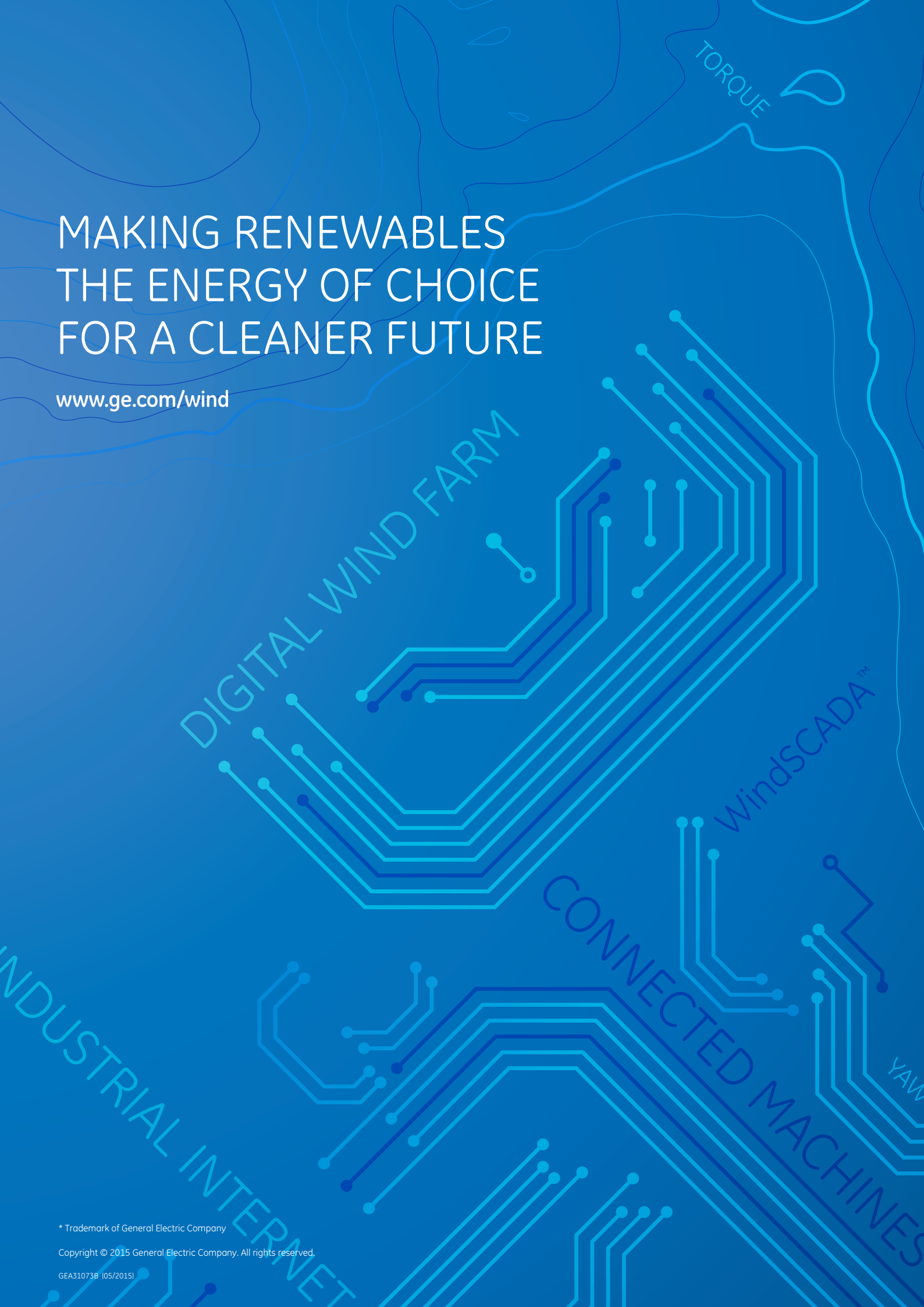
Features and Benefits

GE's 2.75-120 offers the following technical features:

- 120 meter rotor diameter
- 50/60 Hz
- 85 meter or 110 meter steel towers, up to 139 meter hybrid concrete
- 106 dB(A) standard sound power level
- Sound reduced operations and sound mitigation technology available
- Standard and cold weather extreme package

MAKING RENEWABLES THE ENERGY OF CHOICE FOR A CLEANER FUTURE

www.ge.com/wind



GEA31073B (05/2015)

GE Renewable Energy

GE's 3 MW Platform

POWERFUL AND EFFICIENT

www.ge.com/wind

GE'S **3 MW PLATFORM**

Since entering the wind industry in 2002, GE Renewable Energy has invested more than $2 billion in next-generation wind turbine technology to provide more value to customers—whether at the turbine, plant or grid level. Through the use of advanced analytics, GE Renewable Energy is redefining the future of wind power, delivering with proven performance, availability and reliability. With the integration of big data and the industrial internet, we can help customers manage the variability that comes with this resource for smooth, predictable power. Our onshore product portfolio includes wind turbines with rated capacities from 1.6-3.4 MW and flexible support services that range from basic operations and maintenance to farm- or fleet-level enhancements.

For more information visit our website:
www.ge.com/wind

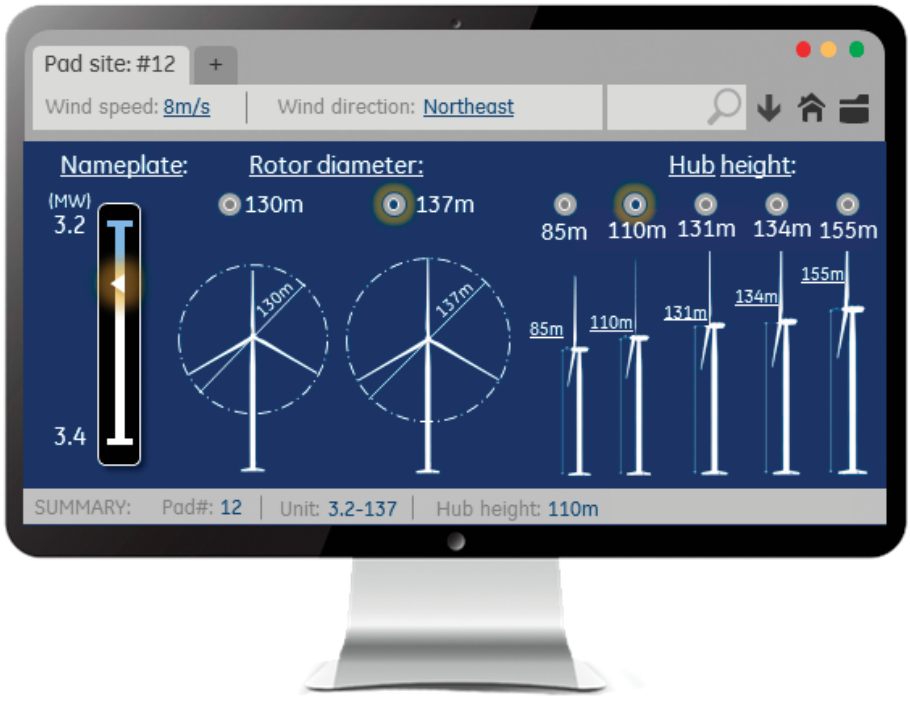
GE's 3 MW Platform

Extending the capability of the Digital Wind Farm to our 3 MW machines, GE's powerful and efficient 3.2–3.4 platform is adaptable to a full spectrum of wind regimes. The platform includes the 3.4-137, our highest performing turbine for Class III winds, providing up to a 24% higher output compared to the 2.75-120 turbine and improving project economics for our customers.

GE has employed selected legacy components with proven performance for the 3 MW platform, helping to ensure the consistent performance and reliability for which GE wind turbines are known. Turbine models within the 3 MW platform share drivetrain and electrical system architecture, with both systems scaled and upgraded for improved performance and greater energy production, as compared to previous models.

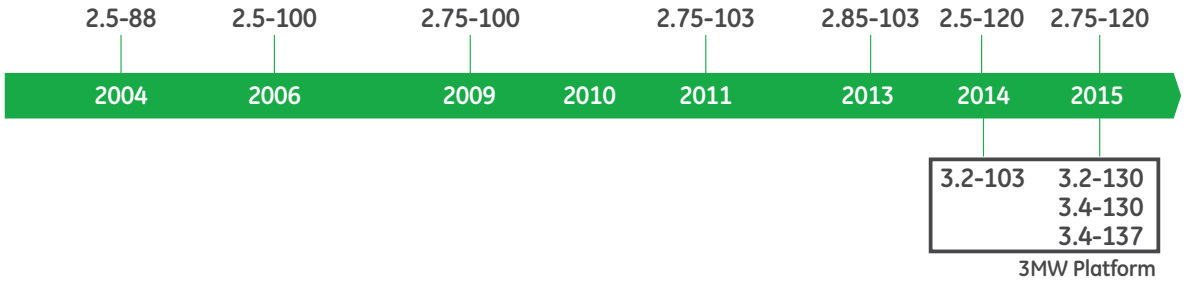
Parameters of the 3MW Platform

GE's 3MW platform can be customized based on nameplate, rotor diameter and hub height.



Building Upon Proven Technology

Model introduction
in Europe



Built from the maturity of its predecessors, the 3 MW platform increases the capacity factor, annual energy production (AEP) and application space. Component enhancements to the 2.5 MW models have resulted in a substantial performance increase, enabling the use of a 130- and 137- meter rotor on the 3 MW series and a nameplate ranging from 3.2–3.4 MW. These enhancements include gearbox and controls improvements, and a new aerodynamic structure enabling a greater blade length (130–137 meter rotor). Crafted for high reliability, GE's 3 MW platform offers excellent availability that is comparable to the 2.5 MW series units operating in the field today.

Technical Description

GE's 3 MW platform machines are three-blade, upwind, horizontal axis wind turbines with a rotor diameter ranging from 130 to 137 meters. The turbine rotor and nacelle are mounted on top of a tubular steel tower, with a range of hub height options that includes 85-, 110-, 131-, 134- and 155-meter variants. The turbines use active yaw control to keep the blades pointed into the wind. The 3 MW platform is engineered to operate at variable speeds and uses a doubly fed asynchronous generator with a partial power converter system.

Specifications

3 MW platform

- Standard and cold weather extreme options
- Standard tower corrosion protection: C2 internal and C3 external with internal and external C4/C5 options available
- Rotational direction: Clockwise viewed from an upwind location
- Speed regulation: Electric drive pitch control with battery backup
- Aerodynamic brake: Full feathering of blade pitch

GE's 3.2-130 IEC3A

- Up to 20% higher output than GE's 2.5-120
- Improved load management system and more efficient drive train technology
- Same electrical system as 3.2-103 turbine
- Sound power level of 106 db(A), reduced noise modes available
- Tip heights include 150 m, 175 m, 199 m, and 220 m rotor

GE's 3.4-130 IEC2B

- Up to 30% higher output than GE's 3.2-103
- Increased electrical rating of 3.4 MW combined with 130-meter rotor
- 107 dB(A) normal operation sound power level, reduced noise modes available
- Tip heights include 150 m, 175 m, and 199 m

GE's 3.4-137 IEC3B

- Up to 24% higher output than GE's 2.75-120
- New blade for more efficient production in low wind conditions
- Sound power level of 106 db(A), reduced noise modes available
- Tip heights include 180 m, 199 m, and 223.5 m

Features and Benefits

- Engineered to meet or exceed the 2.5 MW platform's historic high availability
- Available grid-friendly options:
  — Enhanced Reactive Power, Low & Zero Voltage Ride Thru, Power Factor Control, WindFreeReactive Power
- Wind Farm Control System; WindSCADA*
- Available in both 50 Hz and 60 Hz versions

Construction

Towers:

- Tubular steel sections provide a hub height of 85 and 110-meters
- Hybrid pre-cast concrete/tubular steel towers for 134-meter hub height
- Logistic friendly tower for a hub height of 131 m, 134 m, and 155 m

Blades:

- 63.7-meter blades (130-meter rotor); 67.2-meter blades (137-meter rotor)

Drivetrain components:

- GE's 3 MW platform uses an enhanced gearbox, main shaft with double bearings, and generator with appropriate improvements to enable the 130- and 137-meter diameter rotor in medium and lower wind speeds.

Enhanced Controls Technology

The 3 MW platform uses enhanced controls features:

- GE's patented Advanced Loads Control reduces loads on turbine components by measuring stresses and individually adjusting blade pitch.
- Controls were developed by GE Global Research to reduce extreme loads, including those near rated wind speeds, to improve annual energy production (AEP).

Condition Monitoring System

GE's Condition Monitoring System (CMS) and SCADA Anomaly Detection Services, a complementary suite of advanced condition monitoring solutions, proactively detects impending drive train and whole-turbine issues, enabling increased availability and decreased maintenance expenses. Built upon half a century of power generation drivetrain and data anomaly monitoring experience, this service solution is now standard on GE's 3 MW platform.

MAKING RENEWABLES THE ENERGY OF CHOICE FOR A CLEANER FUTURE

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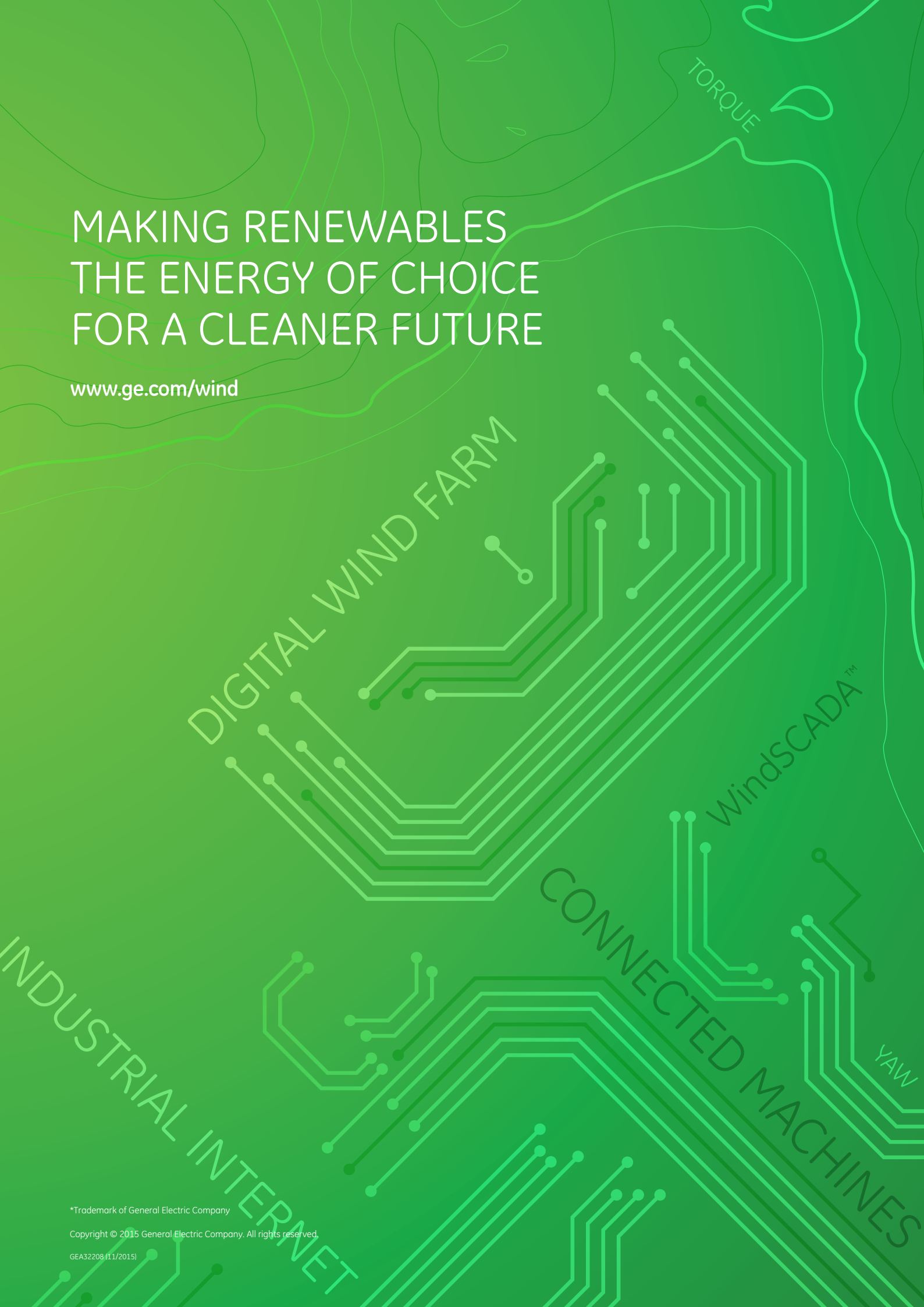

GEA32208 (11/2015)

DELTA GENERATION

PROVEN TECHNOLOGY – AT A NEW STAGE OF EVOLUTION

N100/3300
N117/3000
N131/3000

NORDEX
We've got the power.

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Economical at a wide range of sites

18 SOLUTION FOR LIGHT WIND
Maximum efficiency in the 3 MW segment

TECHNICAL DEVELOPMENT AT NORDEX
Experience keeps us one step ahead

As one of the pioneers in the modern use of wind energy, Nordex has been developing increasingly efficient wind turbines for use onshore since 1985. Since then, we have always remained true to proven principles, using tried-and-tested series engineering and giving top priority to the reliability of all system components.

In 2000, Nordex installed the first 2.5 megawatt series turbine in the world. Since then, the company has connected more than 4,000 machines from this platform to the grid at a wide range of locations around the world. We know what we're talking about when we claim that our wind turbine generators offer quality, mature technology and dependable performance, even in extreme locations.

With Delta Generation, we are now offering the fourth turbine generation of our proven multi-megawatt platform. Thanks to its larger rotors, greater nominal capacity and optimised technical systems, Delta Generation sets new standards for economic efficiency, reliability and service- and HSE-friendliness.

MATURE TECHNOLOGY
Proven concepts ensure a secure investment

With the new Delta Generation, Nordex customers benefit from the know-how we have gathered in the multi-megawatt range over many years. Mature technical solutions that have proven their worth thousands of times form a sound basis for the new generation.

Continuity: The electrical system

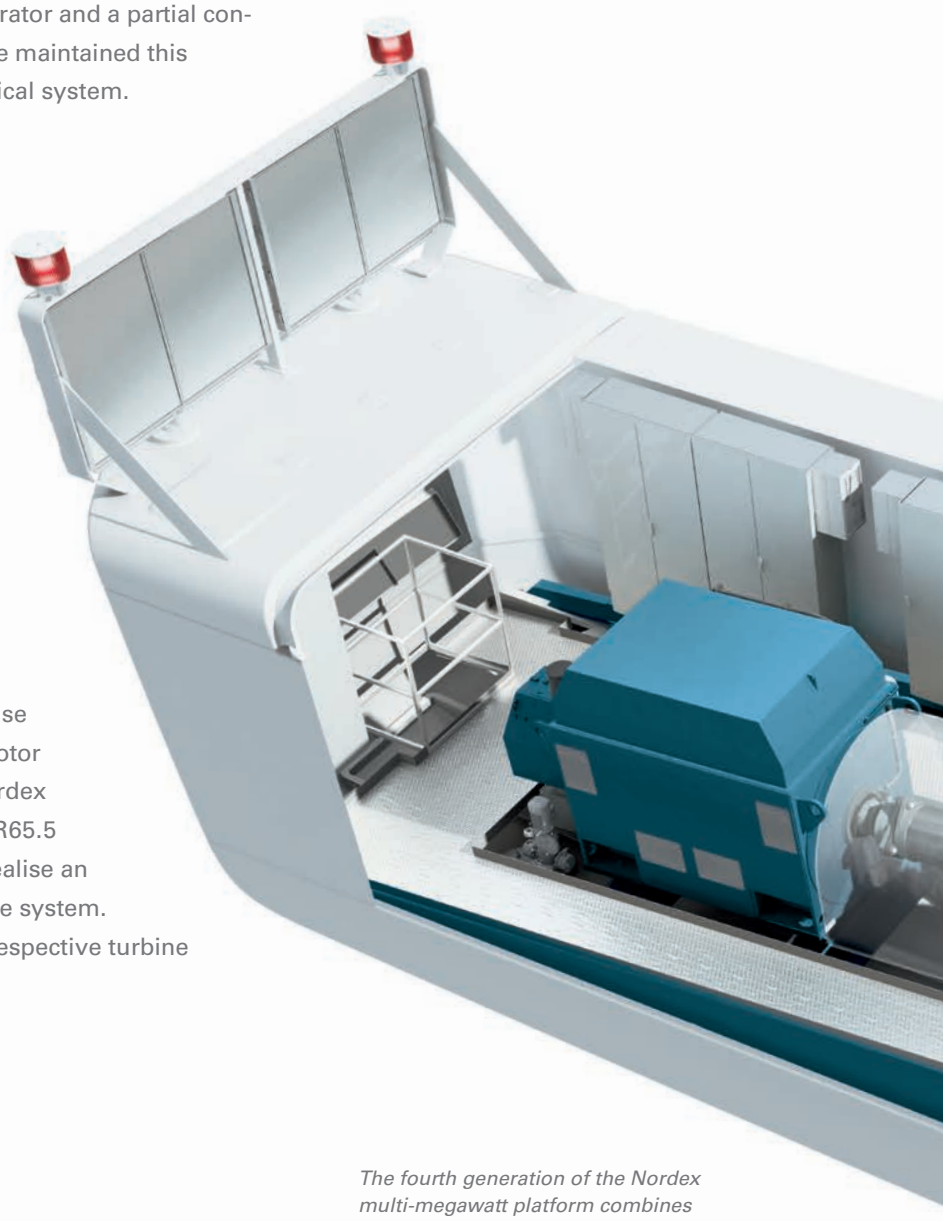
Even the first Nordex multi-megawatt turbine was equipped with a doubly fed asynchronous generator and a partial converter. With Delta Generation, we have maintained this proven and highly economical electrical system.

Tried-and-tested drive train concept

The drive train system is based on a modular drive train layout with a three-point suspension. We have used this system successfully from the outset. Together with our qualified suppliers, we work on continuously improving our drive train components. This delivers the output required while maintaining availability at a high level.

Proven rotor blade designs

The turbines of the new generation use proven aerodynamic designs for the rotor diameters of 100 and 117 metres. Nordex developed the NR50, NR58.5 and NR65.5 blades in-house. This allowed us to realise an optimal concept for the overall turbine system. The efficient rotor blades match the respective turbine technology perfectly.



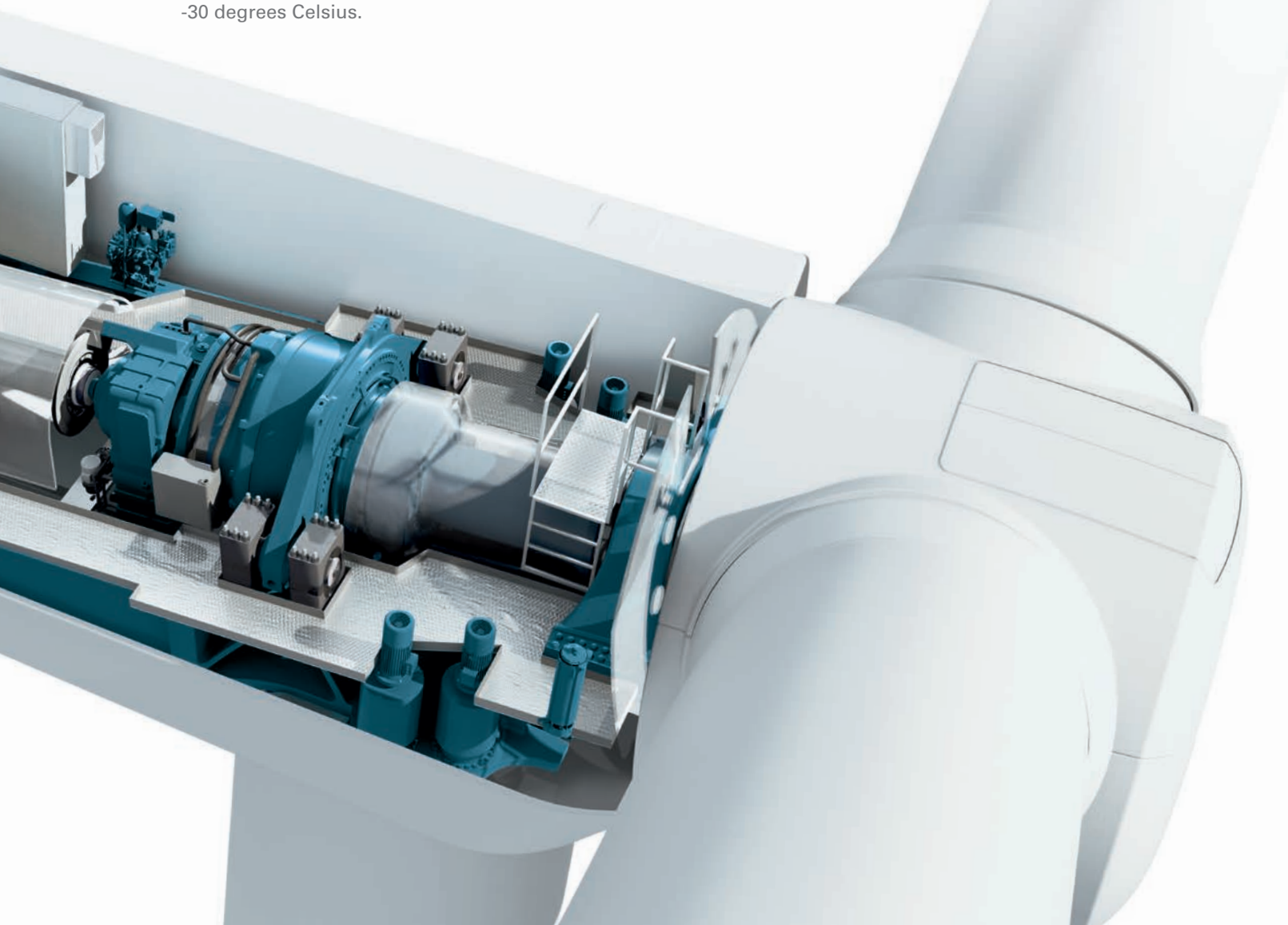
The fourth generation of the Nordex multi-megawatt platform combines proven, dependable technology with targeted improvements for enhanced performance.

Grid compatibility ensured

Like the previous generations, the turbines of Delta Generation meet the grid requirements of international markets. One of the most demanding grid connection directives in Europe is the German SDLWindV (Ordinance on System Services by Wind Energy Plants). Thanks to their fault-ride-through capability, our turbines are able to bridge voltage drops easily, thereby meeting all the requirements for the System Service Bonus (SDL Bonus). In addition, the Nordex Wind Farm Management System also allows the grid operator to directly control the active and reactive power of the wind farm in the grid.

Making the most of cold locations

During the winter, temperatures can be extreme at many sites offering a high wind yield. The tried-and-tested Nordex cold-climate package is designed to meet the challenges of these especially cold locations. Turbines in the cold-climate version (CCV) are able to operate down to an outside temperature of -30 degrees Celsius.



ECONOMIC EFFICIENCY
Higher yields reduce the cost of energy

In developing Delta Generation, we have met our main target – to cut the cost of energy. These Nordex multi-megawatt turbines deliver up to 31 per cent more yield from the sites, making Delta Generation turbines a particularly worthwhile investment.

Larger: Rotors

Nordex has designed the turbines to use a much larger rotor for each wind class. This produces higher yields. For example, the rotor diameter for machines for strong-wind locations was increased by ten metres compared to the previous model, resulting in a 23 per cent increase in swept area. The rotor for sites with moderate wind speeds is 17 metres larger: a 37 per cent increase in rotor sweep. With its 14 metre larger diameter, the rotor for light-wind sites offers a 25 per cent increase in swept area.

Stronger: Rated Output

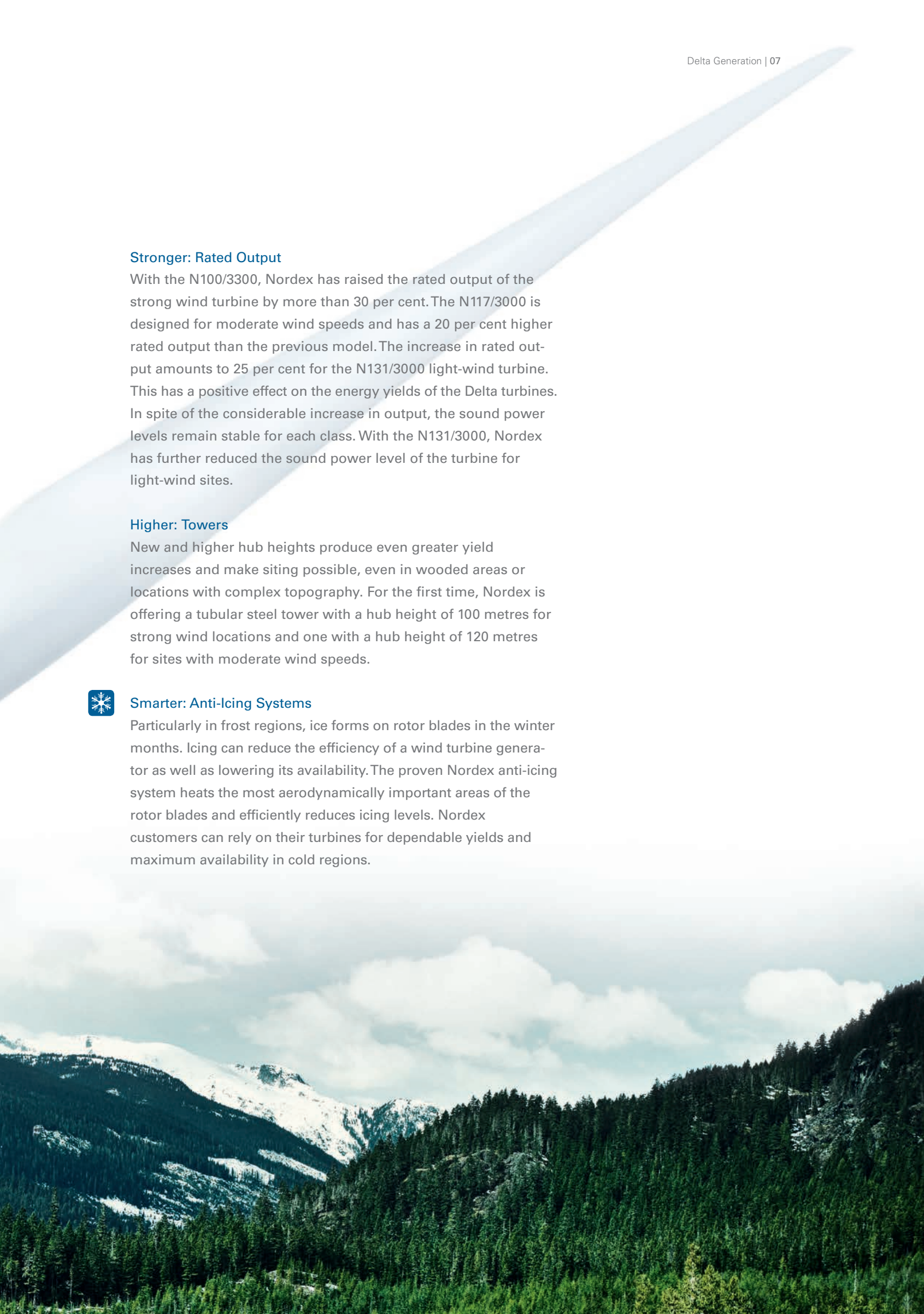
With the N100/3300, Nordex has raised the rated output of the strong wind turbine by more than 30 per cent. The N117/3000 is designed for moderate wind speeds and has a 20 per cent higher rated output than the previous model. The increase in rated output amounts to 25 per cent for the N131/3000 light-wind turbine. This has a positive effect on the energy yields of the Delta turbines. In spite of the considerable increase in output, the sound power levels remain stable for each class. With the N131/3000, Nordex has further reduced the sound power level of the turbine for light-wind sites.

Higher: Towers

New and higher hub heights produce even greater yield increases and make siting possible, even in wooded areas or locations with complex topography. For the first time, Nordex is offering a tubular steel tower with a hub height of 100 metres for strong wind locations and one with a hub height of 120 metres for sites with moderate wind speeds.

Smarter: Anti-Icing Systems

Particularly in frost regions, ice forms on rotor blades in the winter months. Icing can reduce the efficiency of a wind turbine generator as well as lowering its availability. The proven Nordex anti-icing system heats the most aerodynamically important areas of the rotor blades and efficiently reduces icing levels. Nordex customers can rely on their turbines for dependable yields and maximum availability in cold regions.



QUALITY AND RELIABILITY
A focus on high availability

To ensure that our turbines perform reliably, we conduct exhaustive tests. We certify the quality of all components and manufacture in a modern line production. The average availability of all turbines covered by Nordex Service stands at 98 per cent. We ensure this high level of availability by consistently further developing the vital important systems. This contributes to a further reduction in the cost of energy.

Extreme tests for hardware and software

In the Nordex Test Centre, engineers test the components and systems of the new turbine generation under simulated wind and weather conditions. By subjecting them to strains in excess of the usual specifications, Nordex ensures that the design meets all criteria, delivering a high-quality, mature product for serial production.

Highest industrial standards

Nordex continues to meet high industrial standards, manufacturing the nacelle and hub modules in a continuous flow process. Many of the steps needed for assembly and commissioning are performed in the protected factory hall before the equipment is shipped to the site.

In the Nordex Test Centre engineers ensure the quality of components.

Advanced control infrastructure

Nordex has equipped the new turbine generation with the Profinet communication system. Its ethernet-based fieldbus transfers turbine data rapidly, reliably and by priority. All actuators and sensors in the turbine control systems, as well as the different module options, are directly integrated into the network. This ensures improved diagnostics and the reliability of the system.

Optimised drive train

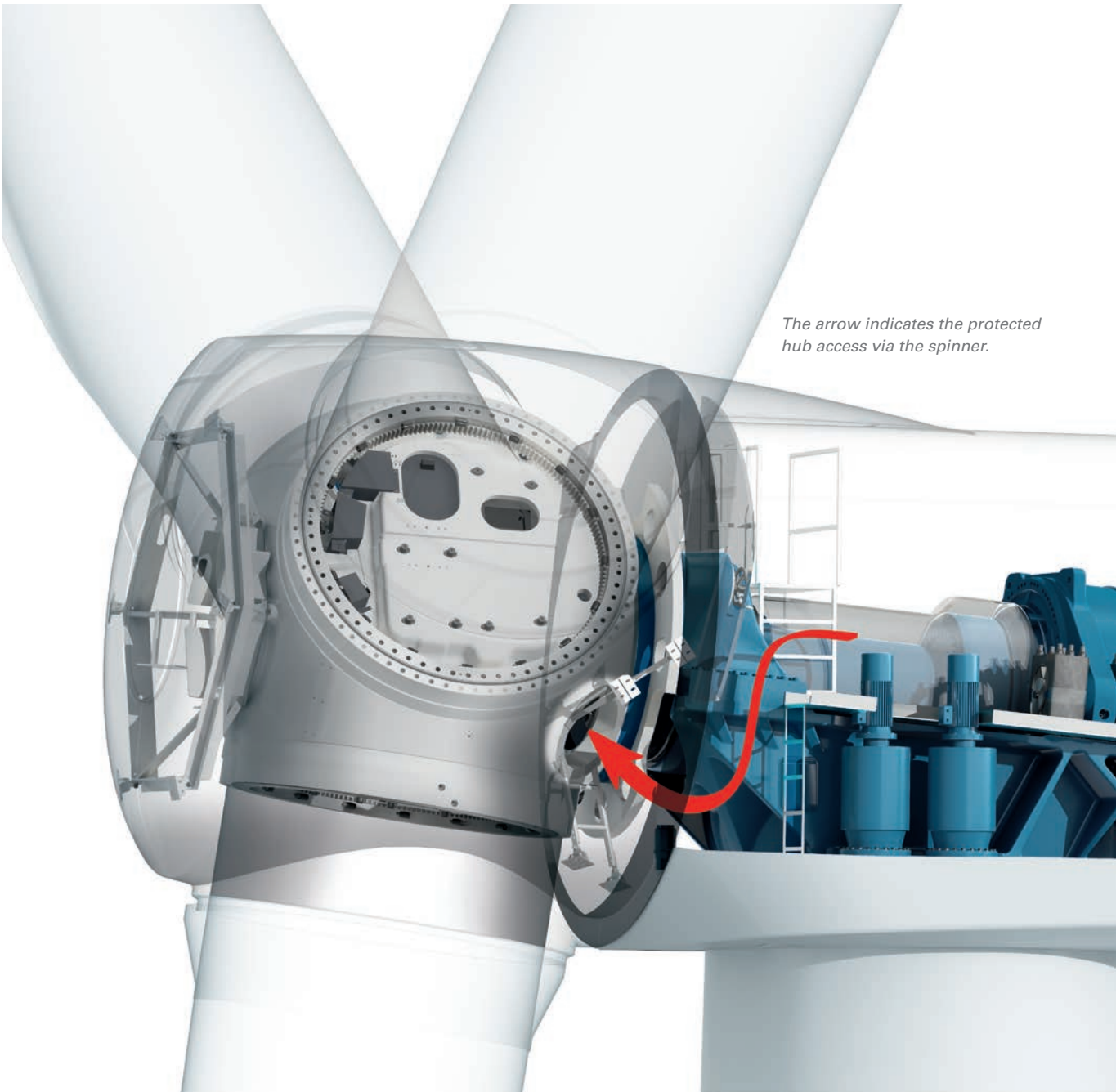
The drive train design of Delta Generation reduces the forces acting on the individual components, taking greater strain off the robust rotor bearing. Innovations in the cooling system of the drive train ensure constant temperatures over a wide operating range – with lower internal energy consumption.

SERVICE AND HSE
Fast and safe turbine O&M

Delta Generation is designed so that service operations can be conducted rapidly and safely. This reduces ongoing operational costs. We make no compromise when it comes to HSE – the turbines of the new generation meet the most stringent requirements.

Protected hub access

The new spinner, a complete housing for the rotor hub, provides rapid and protected access to the hub. This means that service work can be carried out in a wider range of wind and weather conditions. This is of particular advantage in cold regions – making it possible to reduce downtimes for service purposes.



The arrow indicates the protected hub access via the spinner.

Ergonomics and safety

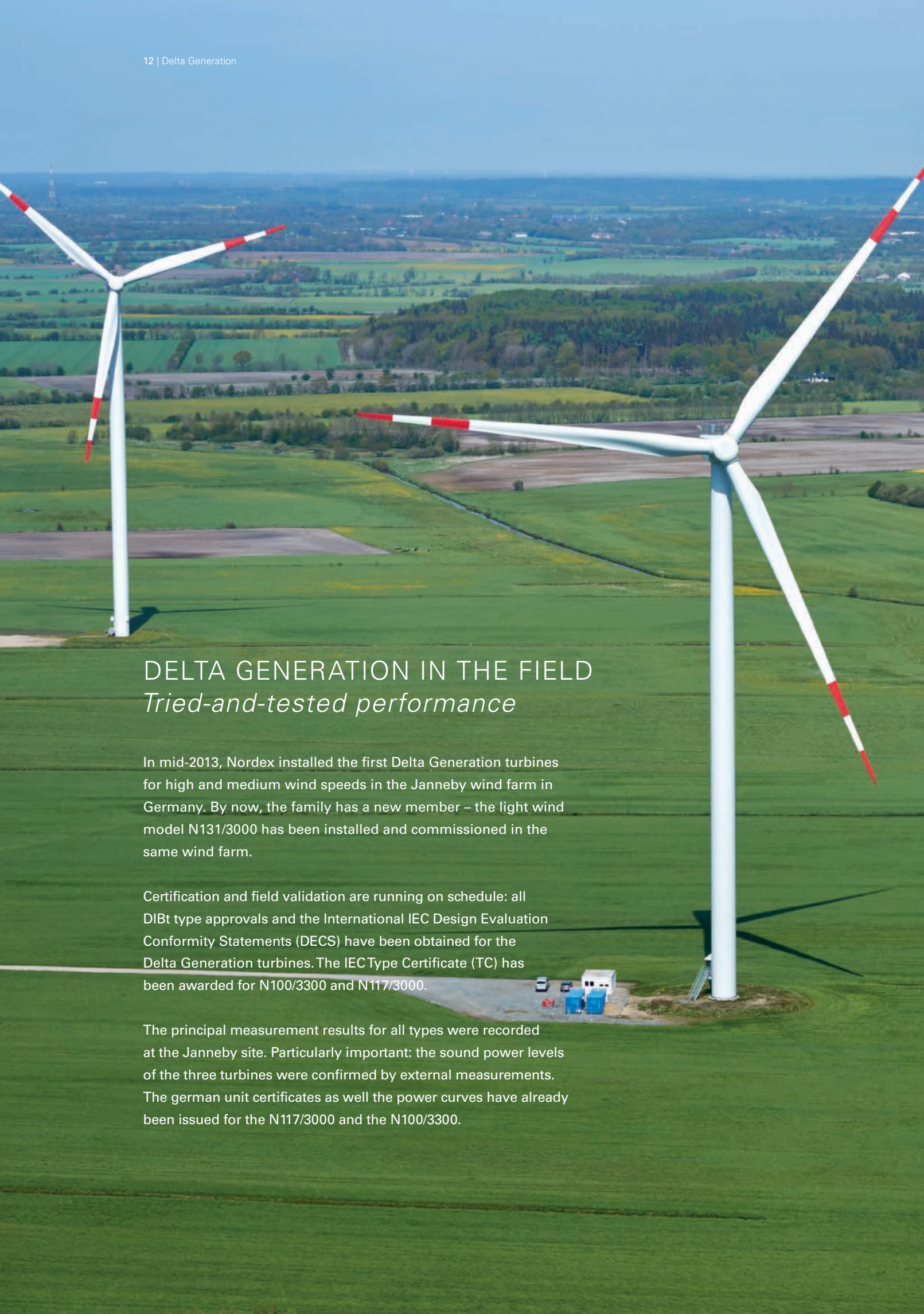
When we were developing the new multi-megawatt generation, we gave high priority to designing the turbines as a particularly safe and spacious workplace. In case of an emergency, the platform also offers extended escape and rescue routes. All systems are easily accessible for maintenance. Nacelle components weighing less than one tonne can be reached with the onboard crane and, if necessary, can be exchanged without additional equipment.

Annual service interval

The technical design of Delta Generation allows for an annual service interval. Automatic lubrication of the bearings in the pitch system replaces manual processes. These bearings, as well as the main bearing and the generator bearings, are supplied automatically with lubricant, making them less susceptible to wear. This minimises the service requirements and reduces the O&M expenses.

Yaw n-1 concept

The yaw system runs with four drives in standard operation. However, should one drive break down, the turbine can continue to run temporarily on three drives, making it possible to plan any needed service work. This concept increases turbine availability and reduces service costs.



DELTA GENERATION IN THE FIELD
Tried-and-tested performance

In mid-2013, Nordex installed the first Delta Generation turbines for high and medium wind speeds in the Janneby wind farm in Germany. By now, the family has a new member – the light wind model N131/3000 has been installed and commissioned in the same wind farm.

Certification and field validation are running on schedule: all DIBt type approvals and the International IEC Design Evaluation Conformity Statements (DECS) have been obtained for the Delta Generation turbines. The IEC Type Certificate (TC) has been awarded for N100/3300 and N117/3000.

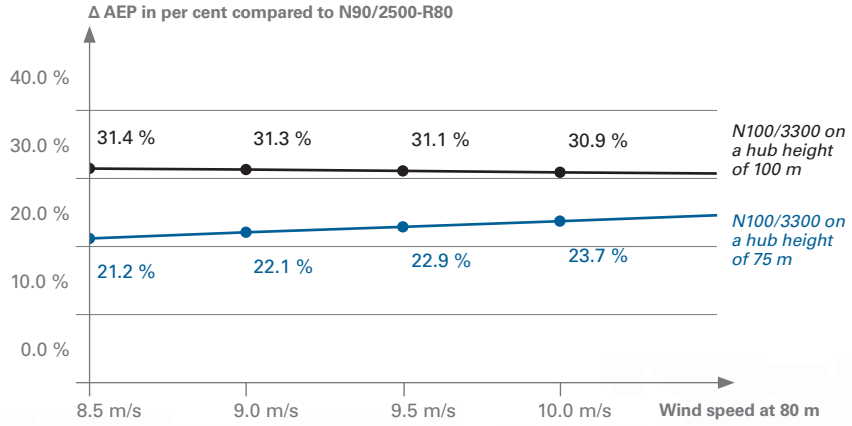
The principal measurement results for all types were recorded at the Janneby site. Particularly important: the sound power levels of the three turbines were confirmed by external measurements. The german unit certificates as well the power curves have already been issued for the N117/3000 and the N100/3300.


NORDEX

SOLUTION FOR STRONG WIND
High yields in rough climates

Wind sites with a rough environment call for mature, robust technology. With the turbines of Delta Generation, Nordex offers the proven 100-metre rotor, now also for IEC 1 locations. Thanks to the large rotor diameter and the higher rated output, the N100/3300 obtains much higher energy yields at sites with strong winds compared to the previous model. This turbine is available with hub heights of 75, 85 and 100 metres.

The N100/3300 generates between 21.2 and 31.4 per cent more AEP compared to the preceding IEC 1 model.

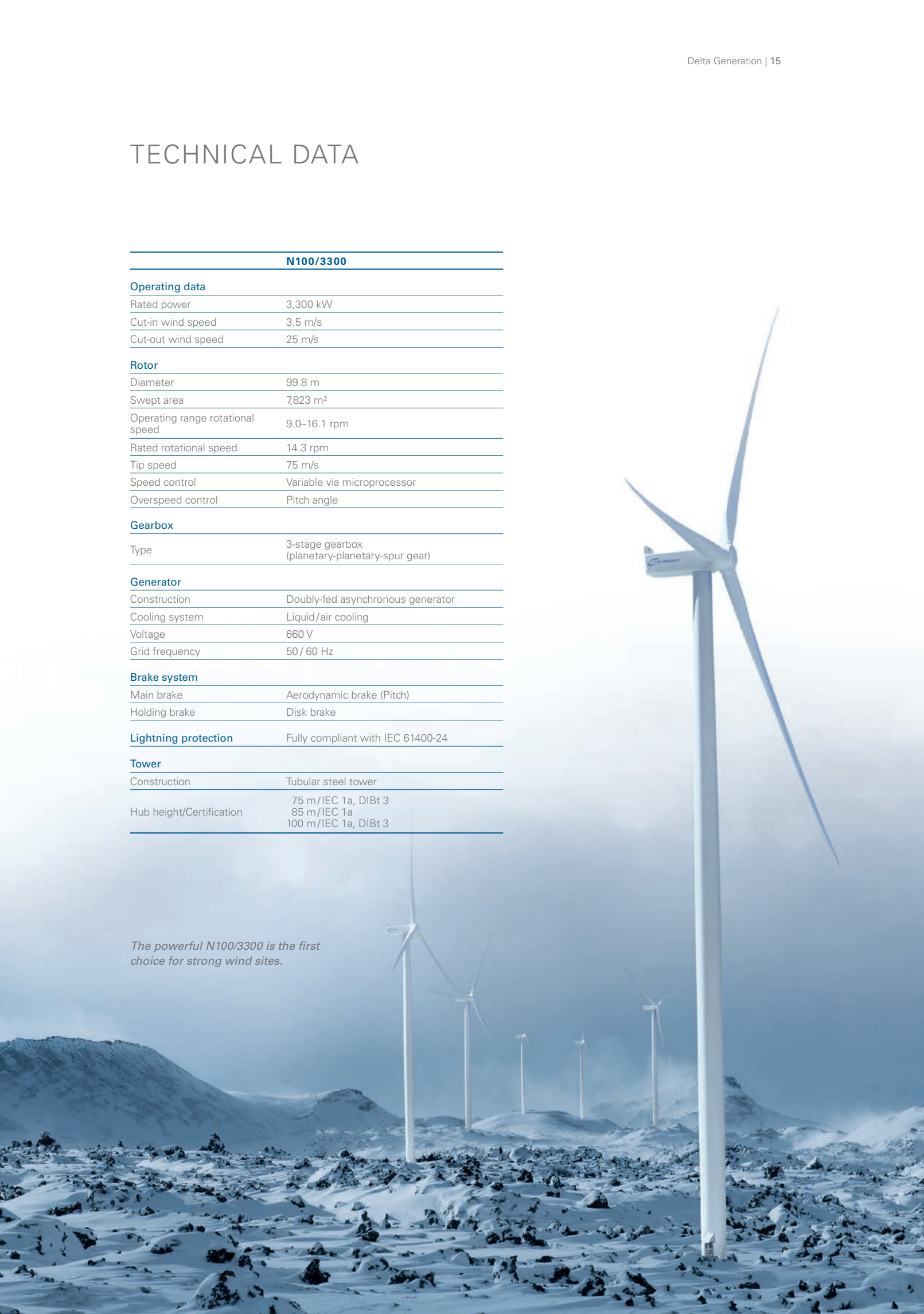


Calculation of AEP based on air density of 1.225 kg/m³, wind shear of 0.2 and Weibull shape parameter of k = 2.0

TECHNICAL DATA

	N100/3300
Operating data	
Rated power	3,300 kW
Cut-in wind speed	3.5 m/s
Cut-out wind speed	25 m/s
Rotor	
Diameter	99.8 m
Swept area	7,823 m²
Operating range rotational speed	9.0–16.1 rpm
Rated rotational speed	14.3 rpm
Tip speed	75 m/s
Speed control	Variable via microprocessor
Overspeed control	Pitch angle
Gearbox	
Type	3-stage gearbox (planetary-planetary-spur gear)
Generator	
Construction	Doubly-fed asynchronous generator
Cooling system	Liquid/air cooling
Voltage	660 V
Grid frequency	50 / 60 Hz
Brake system	
Main brake	Aerodynamic brake (Pitch)
Holding brake	Disk brake
Lightning protection	Fully compliant with IEC 61400-24
Tower	
Construction	Tubular steel tower
Hub height/Certification	75 m/IEC 1a, DIBt 3 85 m/IEC 1a 100 m/IEC 1a, DIBt 3

The powerful N100/3300 is the first choice for strong wind sites.

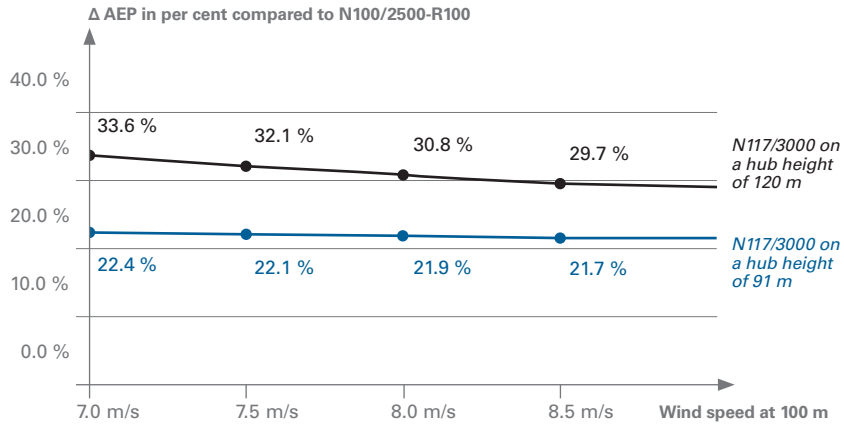


SOLUTION FOR MODERATE WIND
Economical at a wide range of sites

With the N117/3000, Nordex now offers an even more economical turbine for IEC 2 locations. The enlarged rotor sweep and higher rated output deliver much higher yields. The N117/3000 is available on tubular steel towers of 91 or 120 metres, as well as on a hybrid tower of 141 metres. Therefore, it is suitable for challenging sites as well.

To ensure high yields at sites in cold climates, Nordex equips the N117/3000 with the efficient anti-icing system as an option.

The N117/3000 generates between 21.7 and 33.6 per cent more AEP compared to the preceding IEC 2 model.

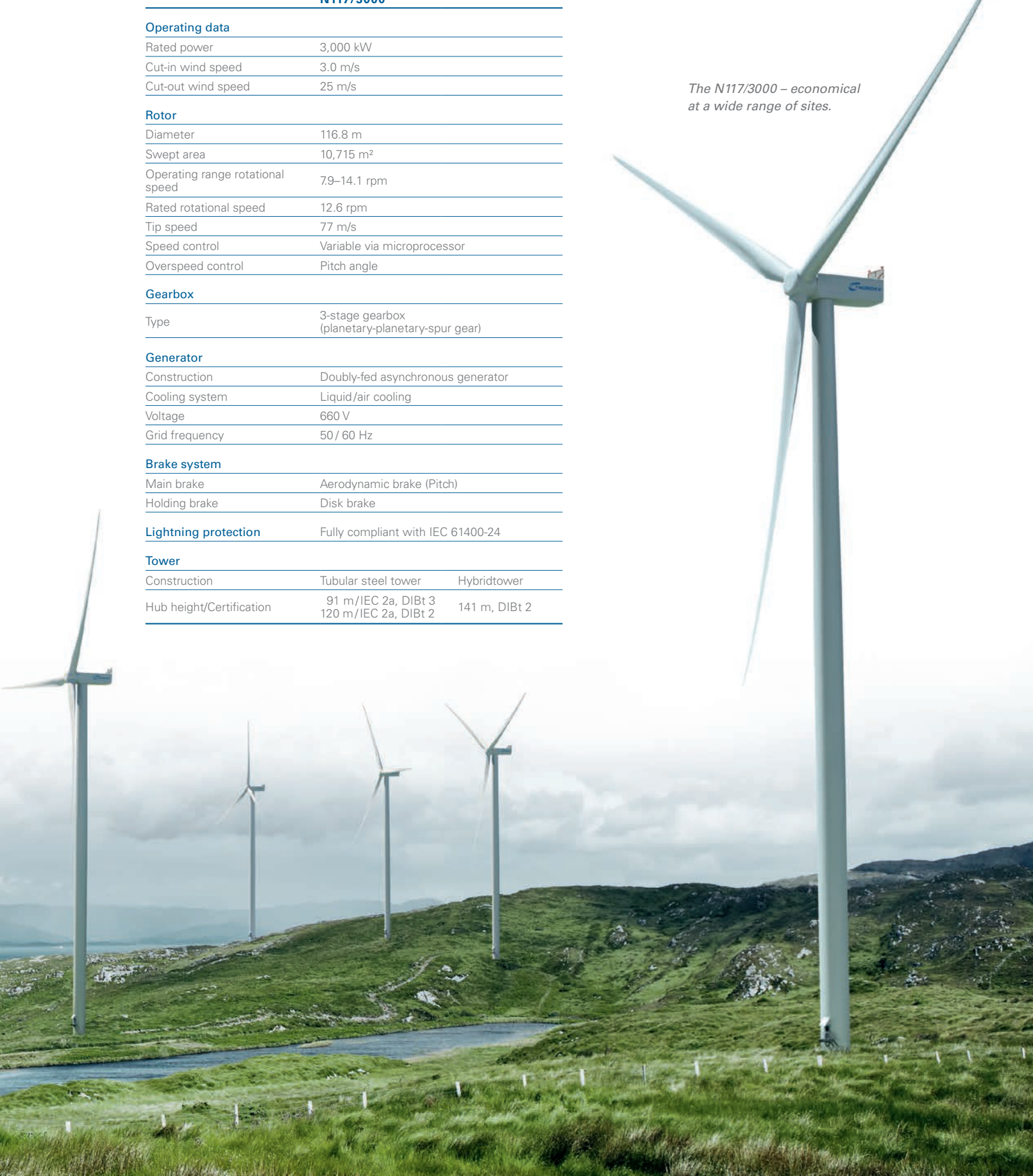


Calculation of AEP based on air density of 1.225 kg/m³, wind shear of 0.2 and Weibull shape parameter of k = 2.0

TECHNICAL DATA

	N117/3000	
Operating data		
Rated power	3,000 kW	
Cut-in wind speed	3.0 m/s	
Cut-out wind speed	25 m/s	
Rotor		
Diameter	116.8 m	
Swept area	10,715 m²	
Operating range rotational speed	7.9–14.1 rpm	
Rated rotational speed	12.6 rpm	
Tip speed	77 m/s	
Speed control	Variable via microprocessor	
Overspeed control	Pitch angle	
Gearbox		
Type	3-stage gearbox (planetary-planetary-spur gear)	
Generator		
Construction	Doubly-fed asynchronous generator	
Cooling system	Liquid/air cooling	
Voltage	660 V	
Grid frequency	50 / 60 Hz	
Brake system		
Main brake	Aerodynamic brake (Pitch)	
Holding brake	Disk brake	
Lightning protection	Fully compliant with IEC 61400-24	
Tower		
Construction	Tubular steel tower	Hybridtower
Hub height/Certification	91 m/IEC 2a, DIBt 3 120 m/IEC 2a, DIBt 2	141 m, DIBt 2

The N117/3000 – economical at a wide range of sites.



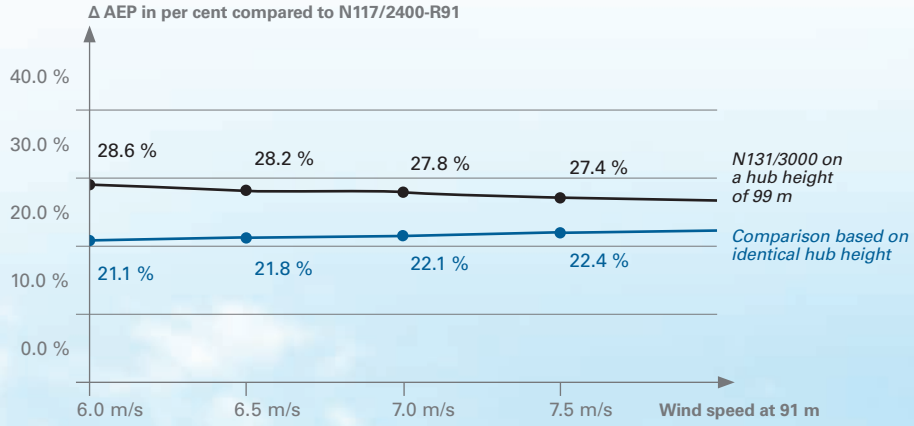
SOLUTION FOR LIGHT WIND
Maximum efficiency in the 3 MW segment

High yield even in regions with light wind: thanks to its enlarged rotor sweep and higher rated output, the N131/3000 generates a much higher yield at light-wind locations. The turbine is available on tubular steel towers with hub heights of 99 or 114 metres.

Nordex limits the sound power level of the light-wind turbine to max. 104.5 dB(A) – a crucial factor for optimising wind farms and facilitating permitting.

To ensure high yields at sites in cold climates, Nordex equips the N131/3000 with the efficient anti-icing system as an option.

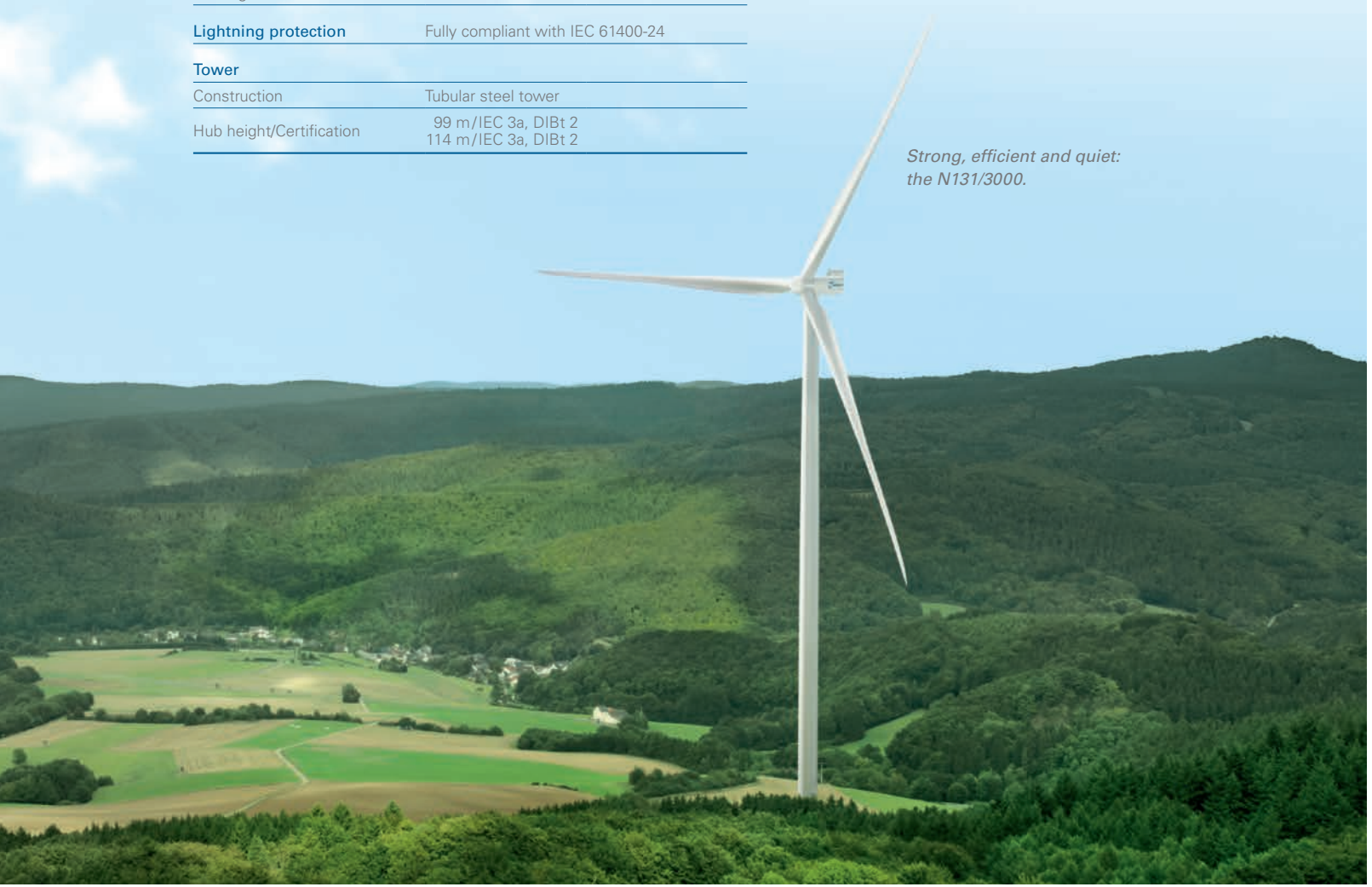
The N131/3000 generates between 27.4 and 28.6 per cent more AEP compared to the preceding IEC3 model.



Calculation of AEP based on air density of 1.225 kg/m³, wind shear of 0.2 and Weibull shape parameter of k = 2.0

TECHNICAL DATA

	N131/3000
Operating data	
Rated power	3,000 kW
Cut-in wind speed	3.0 m/s
Cut-out wind speed	20 m/s
Rotor	
Diameter	131.0 m
Swept area	13,478 m²
Operating range rotational speed	6.5–11.6 rpm
Rated rotational speed	10.3 rpm
Tip speed	70.5 m/s
Speed control	Variable via microprocessor
Overspeed control	Pitch angle
Gearbox	
Type	3-stage gearbox (planetary-planetary-spur gear)
Generator	
Construction	Doubly-fed asynchronous generator
Cooling system	Liquid/air cooling
Voltage	660 V
Grid frequency	50 / 60 Hz
Brake system	
Main brake	Aerodynamic brake (Pitch)
Holding brake	Disk brake
Lightning protection	Fully compliant with IEC 61400-24
Tower	
Construction	Tubular steel tower
Hub height/Certification	99 m/IEC 3a, DIBt 2 114 m/IEC 3a, DIBt 2



Strong, efficient and quiet: the N131/3000.

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As of: 09/2015

NORDEX
We've got the power.

SIEMENS

Introducing the SWT-2.3-120

Made for American needs.

siemens.com/wind

High capacity factor for higher returns

Witness the evolution of our robust G2 platform: designed with the high capacity factor needs of the U.S. market in mind, Siemens' powerful SWT-2.3-120 is tailored to optimize the output of medium to low wind sites.

The SWT-2.3-120 builds on the achievements of Siemens' proven G2 product platform, one of the most robust and successful turbine lines of all time with close to 8,000 units installed globally. Designed with the demands of the U.S. market in mind, the SWT-2.3-120 incorporates a variety of innovative features that have been scaled and streamlined to deliver an industry-leading capacity factor for sites with medium to low wind conditions.

In other words: a proven product tailored to local conditions that offers a safe investment with excellent returns for years to come.

With blades manufactured in Fort Madison, Iowa, and nacelles assembled in Hutchinson, Kansas, the SWT-2.3-120 helps provide domestic jobs while lowering the cost of energy.

Evolved technology with a proven track record

We drew on over 30 years of experience in the onshore wind industry in adapting the SWT-2.3-120. It was developed with an eye toward increasing energy production as well as increasing availability for the medium to low wind sites available for development in the U.S. market.

The SWT-2.3-120 wind turbine employs a high-performance 120-meter rotor, with 59-meter aeroelastically tailored blades. We are utilizing Siemens' IntegralBlade® technology to make intelligent use of the flexing capabilities of the blade structure. This allows for the SWT-2.3-120's larger rotor size, increased blade diameter, and 23 percent greater swept area without a proportional increase in structural loads.

The nacelle is ergonomically optimized for maintenance through increased accessibility of components, and enclosed by a square steel canopy designed for maximum protection of internals.

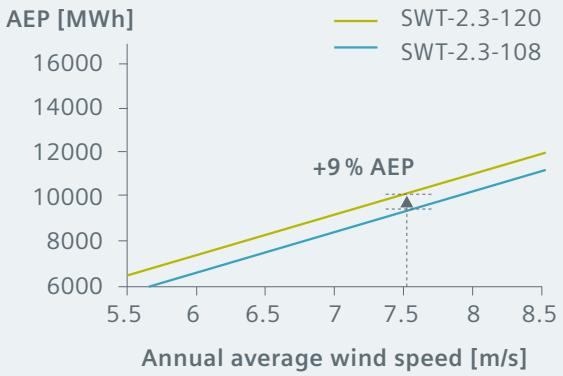
1. Square canopy made of steel for enhanced protection of internals
2. Efficient electric drive yaw motors
3. Gearbox with two planetary stages and one helical for increased capacity
4. Larger hatches for easier access and service of the generator and gearbox
5. Fully enclosed asynchronous generator with a simple squirrel cage without slip rings
6. Additional service space for easier access to main components

Features designed for enhanced capacity and simplified maintenance

The SWT-2.3-120 at a glance

To increase energy production and deliver an industry-leading capacity factor for medium to low wind sites, we have refined certain key features of our proven G2 product platform:

- 59-meter long aeroelastic tailored blades for reduced structural loading
- 120-meter rotor diameter with 23 percent increased swept area for high capacity factor and enhanced energy production
- Gearbox and yaw system designed for increased capacity
- Enhanced canopy design for easier access to main components

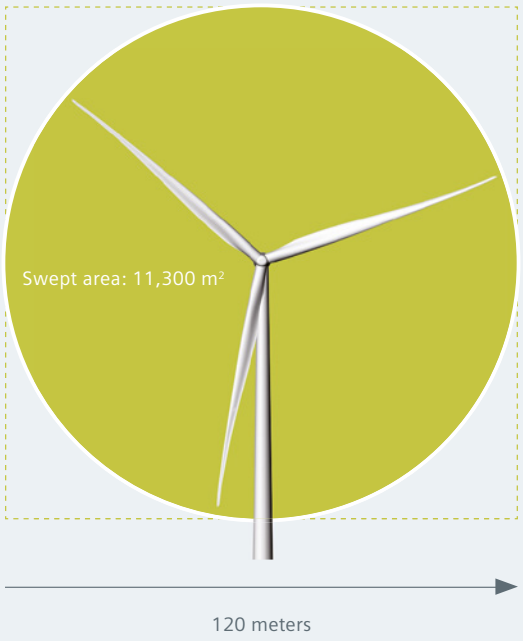


Higher AEP for medium to low wind sites

Tailoring service to your specific needs

To sustain your investment, our service team will fashion an intelligent service solution designed to deliver reliability and maximum output. The ultimate goal: optimizing your return on investment throughout the lifetime of your project.

Servicing your wind power plants requires dedication, and a long-term partnership with a commitment to care. By tailoring our flexible range of solutions to your specific needs, we can deliver 360° asset care for the lifetime of each turbine. When action is needed, we call on our unique diagnostic capabilities and experience to respond smarter and quicker. We're equally committed to safety. Continual training and a Zero Harm policy make health and safety paramount at all times.



SWT-2.3-120	
IEC Class	IIB / IIIA
Rotor diameter	120 m
Blade length	59 m
Swept area	11,300 m²
Hub height	80 or 92.4 m
Power regulation	Pitch regulated, variable speed
Annual output at 7.5 m/s	10,400 MW/h
Nacelle weight	88 tons
Rotor weight	70 tons

Published by
Siemens AG 2015

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SIEMENS

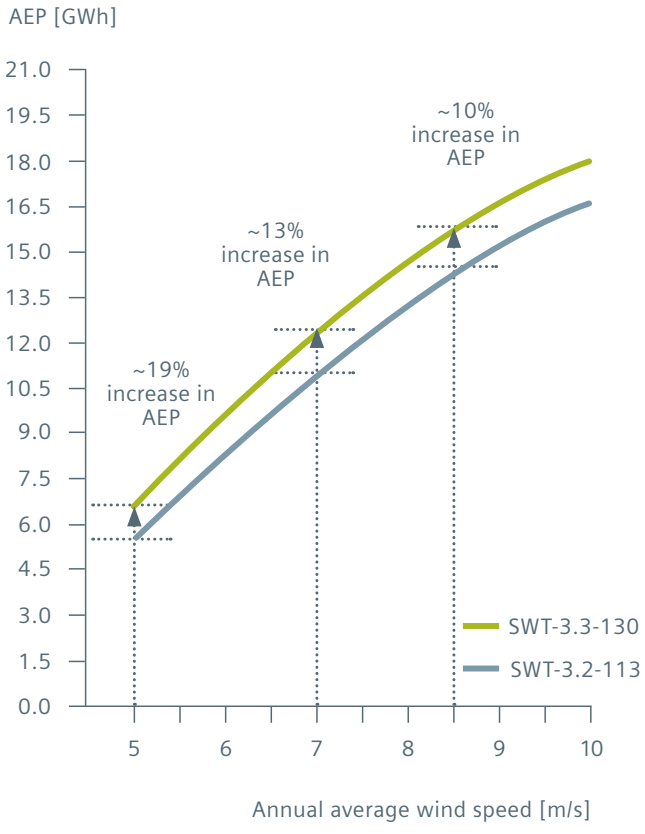
The new Siemens SWT-3.3-130

Low wind, high yield

siemens.com/wind

Combining innovation and proven technology to set new standards

Siemens has been a major driver of innovation in the wind power industry since 1980. Technology has changed with the times, but Siemens' commitment to providing its customers with proven wind turbine solutions has always remained the same.



The Siemens D3 platform's direct drive turbines offer innovation through the consistent implementation of a common, highly efficient generator concept. With fewer moving parts compared with a conventional geared turbine, the direct drive wind turbines deliver improved performance, reliability, and maintainability. After upgrading the platform from 3 MW to 3.2 MW of nominal power, we've now taken the next step: Introducing the new Siemens SWT-3.3-130, the ideal wind turbine for medium- to low-wind areas.

Higher annual energy output at medium to low wind conditions

Evolution is the key to successful, efficient wind power plants. The path we followed in developing the SWT-3.3-130 was to build on our proven, reliable technologies and extract the best from them. Its blades are evidence of the ongoing improvements that Siemens is aiming for. Thanks to their aeroelastic design, they are much lighter, helping to lower the cost of the energy they supply. In conjunction with the redesigned generator, the SWT-3.3-130 delivers up to 19 % more energy output compared with the predecessor model.

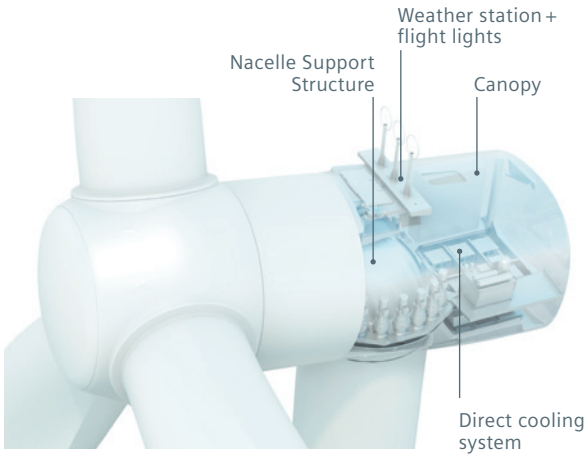
Energy production that always runs smoothly

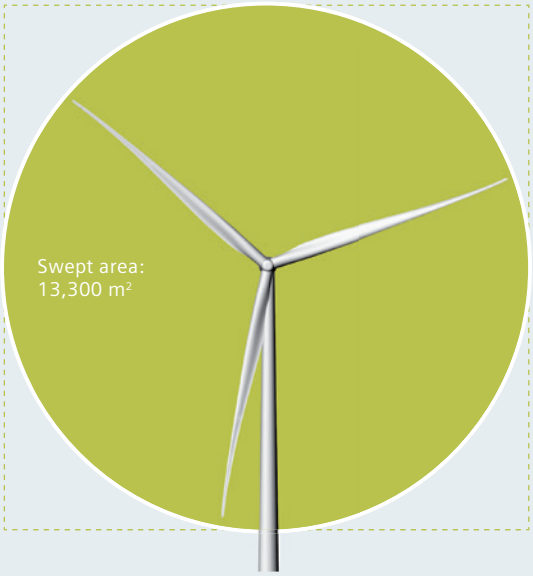
In addition to high yield at low wind conditions, we also focused on other important elements as well. Noise control keeps the plants' sound down to an acceptable level, and we also included features like "reactive power at no wind" and "inertia response" to help stabilize the grid. A variety of tower heights (85, 115 and 135 meters) enable tip heights up to 200 meters, making the SWT-3.3-130 the ideal choice for most onshore sites. And to safeguard your investment for many years to come, we offer long-term service and maintance solutions.

Optimization in every part

To make higher yields possible, we rethought every part of the wind turbine and are continually looking for more ways to improve performance. That's just what we did when we developed the new SWT-3.3-130.

- Improved generator design for increased performance
- Optimized bedframe and yaw system to accommodate the larger rotor
- Pitch-regulated rotor for optimized output under all conditions, designed to maximize aerodynamic efficiency while maintaining loads and noise level
- Upgraded hub to provide a simpler work environment
- Redesigned air cooling to enable increased performance





SWT-3.3-130	
IEC Class	Medium to low wind
Nominal power	3,300 kW
Rotor diameter	130 m
Blade length	63 m
Swept area	13,300 m²
Hub height	up to 135 m (Site specific)
Annual output at 8.5 m/s	16.0 GWh

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Vestas®

3 MW PLATFORM

Wind. It means the world to us.™

Are you looking for the maximum return on **your investment** in wind energy?

Wind energy means the world to us. And we want it to mean the world to our customers, too, by maximising your profits and strengthening the certainty of your investment in wind power.

That's why, together with our partners, we always strive to deliver cost-effective wind technologies, high quality products and first class services throughout the entire value chain. And it's why we put so much emphasis on the reliability, consistency and predictability of our technology.

These aren't idle words. We have over 30 years' experience in wind energy. During that time, we've delivered more than 55 GW of installed capacity and we currently monitor over 24,000 wind turbines across the globe. Tangible proof that Vestas is the right partner to help you realise the full potential of your wind site.

What is the 3 MW platform?
Our 3 MW platform has been optimised to 3.3 MW. The latest editions to the 3 MW platform are based on the proven and reliable technology of the V112-3.0 MW® turbine. After only three years on the market, the V112-3.0 MW® already has an installed base of more than 1.5 GW.

Ideal for all wind classes
Our 3 MW platform is designed for a range of wind conditions, onshore and offshore enabling you to mix turbines across your site or portfolio of sites, delivering industry-leading reliability, serviceability and exceptional energy capture wherever they are located. The combination of high returns and low risk has already made the 3 MW platform an industry favourite with more than 3 GW sold since 2010.

You can choose from four turbines on the 3MW platform:
- V112-3.3 MW™ - IEC IIA (Onshore)
- V112-3.3 MW™ - IEC IB (Onshore and offshore)
- V117-3.3 MW™ - IEC IIA (Onshore)
- V126-3.3 MW™ - IEC IIIA (Onshore)

Rotor diameters range from 112 to 126 metres and the rated output power is 3300 kW. Using a number of well proven technologies, among others a full-scale converter providing excellent energy yield in all wind and weather conditions.

By adding the V117-3.3 MW® to the platform and increasing the nominal power by 10% across the entire platform, it delivers even more energy production and a stronger business case.

The 3 MW platform combines Vestas' proven track record with our continuous efforts to improve and optimise our products, making it the obvious choice for customers looking to combine reliability with performance.

Main features of the 3 MW platform:
- Power system updated to 3.3 MW
- Standard operating temperature range from -20°C to +45°C with de-rating above 30°C
- Load carrying structure, drivetrain , pitch and yaw system optimised for higher loads

3.3 MW

Our engineers have increased the nominal power by 10% across the entire platform optimizing your energy production significantly.

How does our technology generate **more energy?**

More power for every wind site
All turbines of the 3 MW platform have an increased nominal power and are available with several noise modes to meet most site-specific sound level restrictions with an optimised production.

The power system enables superior grid support. What's more, it is capable of maintaining production across severe drops in grid voltage, while simultaneously minimising tower and foundation loads. It also allows rapid down-rating of production to 20 per cent.

With a full-scale converter, the 3 MW platform meets even the most challenging grid requirements, in almost any corner of the world.

Proven technologies - from the company that invented them
The 3MW platform is a low-risk choice. It is based on the proven technologies that underpin the +55,000 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, the platform's reliable design minimises downtime – helping to give you the best possible return on your investment.

With an operating range that covers all wind classes, our 3 MW platform delivers unrivalled energy production. The proven blade technology from the V112-3.0 MW® is used on the new V112-3.3 MW™ and on the V117-3.3 MW™. The industry known structural shell blades are used on the V126-3.3 MW™.

Reliable and robust
The Vestas Test Centre is unrivalled in the wind industry. We test most nacelle components using Highly Accelerated Life Testing (HALT) to ensure reliability. For critical components, 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 design specifications and performs at site. We systematically monitor measurement trends that are critical to quality, locating defects before they occur.

The 3 MW platform covers all wind segments enabling you to find the best turbine for your specific site.

WINDCLASSES - IEC

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)
3 MW TURBINES			
V112-3.3 MW™ IEC IB			
V112-3.3 MW™ IEC IIA			
V117-3.3 MW™ IEC IIA			
V126-3.3 MW™ IEC IIIA			

Turbulence level A Turbulence level B

Options available for the 3 MW platform

An option is an extra feature that can be added to the turbine to suit a project's specific needs. By adding options to the standard turbine, we can enhance the performance of the wind power project and facilitate a shorter permitting cycle at restricted sites. The options can even be a decisive factor in realizing your specific project, and the business case certainty of the investment.

Here is a list of the options available for the 3 MW platform:

- Condition Monitoring System
- Service personnel lift
- Aviation lights
- Aviation markings on the blades
- Low temperature operation to - 30°C
- Ice detection
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Obstacle Collision Avoidance System (OCAS™)

Life testing

The Vestas Test Centre has the unique ability to test complete nacelles using technologies like Highly Accelerated Life Testing (HALT). This rigorous testing of new components ensures the reliability of the 3 MW platform.

Would you **benefit** from uninterrupted control of wind energy production?

Knowledge about wind project planning is key
Getting your wind energy project up and operating as quickly as possible is fundamental to its long-term success. One of the first and most important steps is to identify the most suitable location for your wind power plant. Vestas' SiteHunt® is an advanced analytical tool that examines a broad spectrum of wind and weather data to evaluate potential sites and establish which of them can provide optimum conditions for your project.

In addition, SiteDesign® optimises the layout of your wind power plant. SiteDesign® runs Computational Fluid Dynamics (CFD) software on our powerful in-house supercomputer Firestorm to perform simulations of the conditions on site and analyse their effects over the whole operating life of the plant. Put simply, it finds the optimal balance between the estimated ratio of annual revenue to operating costs over the lifetime of your plant, to determine your project's true potential and provide a firm basis for your investment decision.

The complexity and specific requirements of grid connections vary considerably across the globe, making the optimal design of electrical components for your wind power plant essential. By identifying grid codes early in the project phase and simulating extreme operating conditions, Electrical PreDesign provides you with an ideal way to build a grid compliant, productive and highly profitable wind power plant. It allows customised collector network cabling, substation protection and reactive power compensation, which boost the cost efficiency of your business.

Advanced monitoring and real-time plant control
All our wind turbines can 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. VestasOnline® Business enables you to optimise production levels,

+24.000

The Vestas Performance and Diagnostics Centre monitors more than 24,000 turbines worldwide. We use this information to continually develop and improve our products and services.

monitor performance and produce detailed, tailored reports from anywhere in the world. The VestasOnline® Power Plant Controller offers scalability and fast, reliable real-time control and features customisable configuration, allowing you to implement any control concept needed to meet local grid requirements.

Surveillance, maintenance and service

Operating a large wind power plant calls for efficient management strategies to ensure uninterrupted power production and to control operational expenses. We offer 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine performance and availability. Predicting faults in advance is essential, helping to avoid costly emergency repairs and unscheduled interruptions to energy production.

Our Condition Monitoring System (CMS) assesses the status of the turbines by analysing vibration signals. For example, by measuring the vibration of the drive train, it can detect faults at an early stage and monitor any damage. This information allows pre-emptive maintenance to be carried out before the component fails, reducing repair costs and production loss.

Additionally, our Active Output Management® (AOM) concept provides detailed plans and long term agreements for service and maintenance, online monitoring, optimisation and troubleshooting. It is possible to get a full scope contract, combining your turbines' state-of-the-art technology with guaranteed time or energy-based availability performance targets, thereby creating a solid base for your power plant investment. The Active Output Management® agreement provides you with long term and financial operational peace of mind for your business case.

V112-3.3 MW™ IEC IB
Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,300 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IB

Standard operating temperature range from -20°C to +45°C with de-rating above 30°C*

*subject to different temperature options

SOUND POWER
(Noise modes dependent on site and country)

ROTOR

Rotor diameter	112 m
Swept area	9,852 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub height	site specific

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

BLADE DIMENSIONS

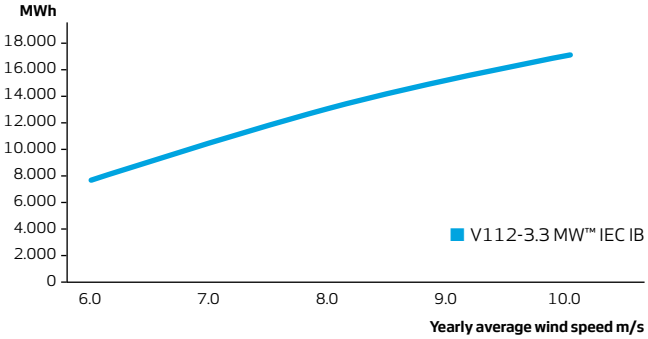
Length	54.65 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- Condition Monitoring System
- Service personnel lift
- Aviation lights
- Aviation markings on the blades
- Low temperature operation to - 30°C
- Ice detection
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Obstacle Collision Avoidance System (OCAS™)

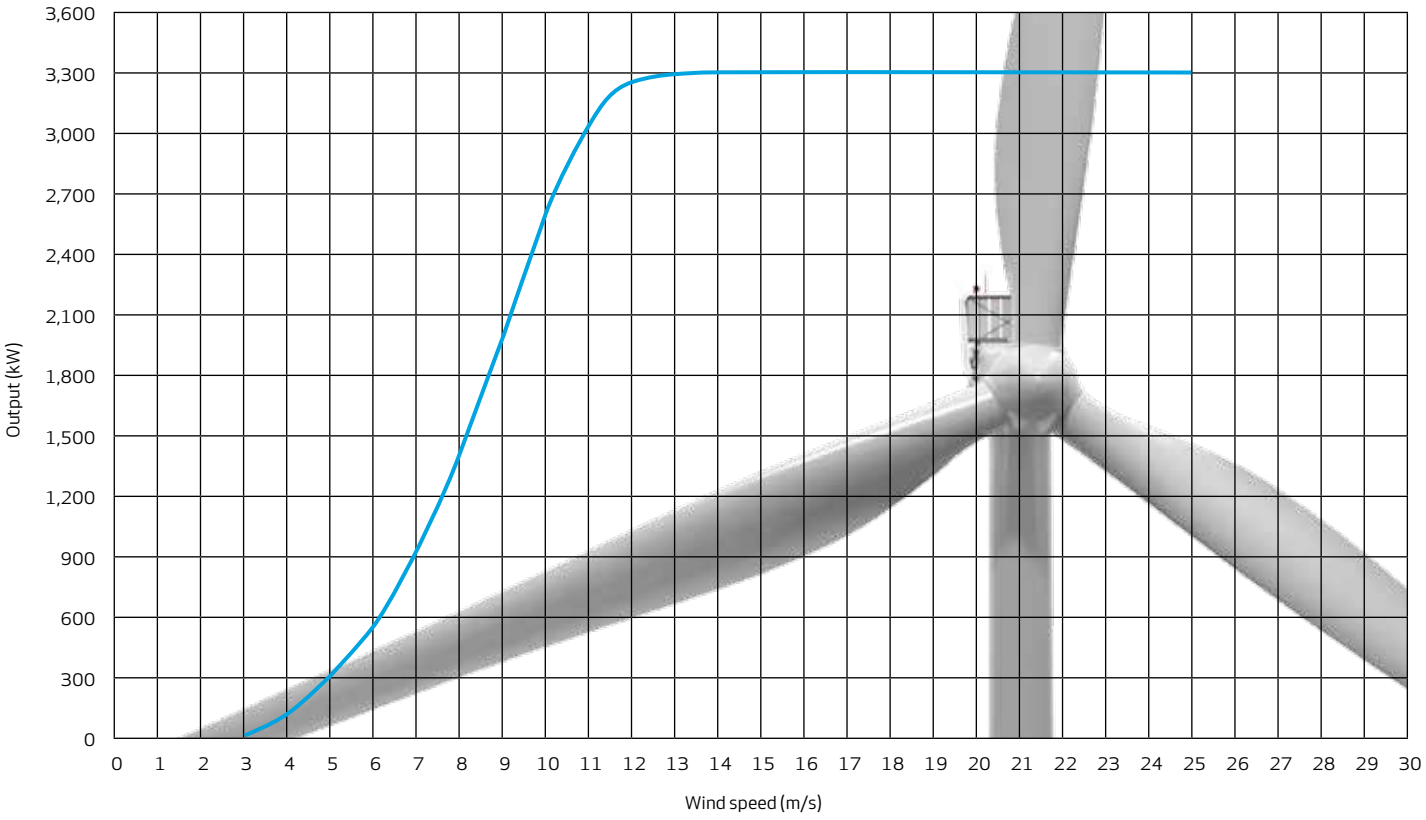
ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

POWER CURVE FOR V112-3.3 MW™ IEC IB

Noise reduced sound power modes are available



V112-3.3 MW™ IEC IIA
Facts & figures

POWER REGULATION — Pitch regulated with variable speed

OPERATING DATA

Rated power	3,300 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IIA/DIBt3

Standard operating temperature range from -20°C to +45°C with de-rating above 30°C*

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	112 m
Swept area	9,852 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	84 m (IEC IIA), 94 m (IEC IIA/DIBt3), 119 m (IEC IIIA og DIBt3) and 140 m (IEC IIIA /DIBt2)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

BLADE DIMENSIONS

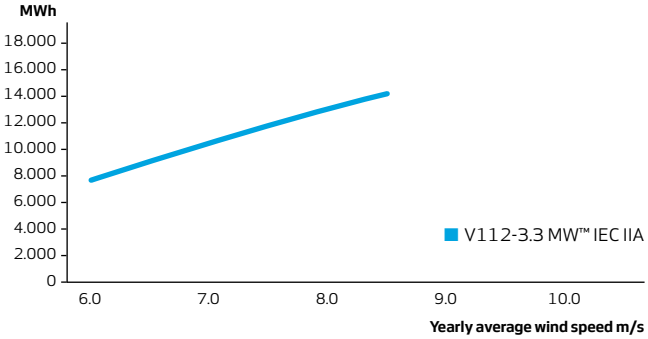
Length	54.65 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- Condition Monitoring System
- Service personnel lift
- Aviation lights
- Aviation markings on the blades
- Low temperature operation to - 30°C
- Ice detection
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Obstacle Collision Avoidance System (OCAS™)

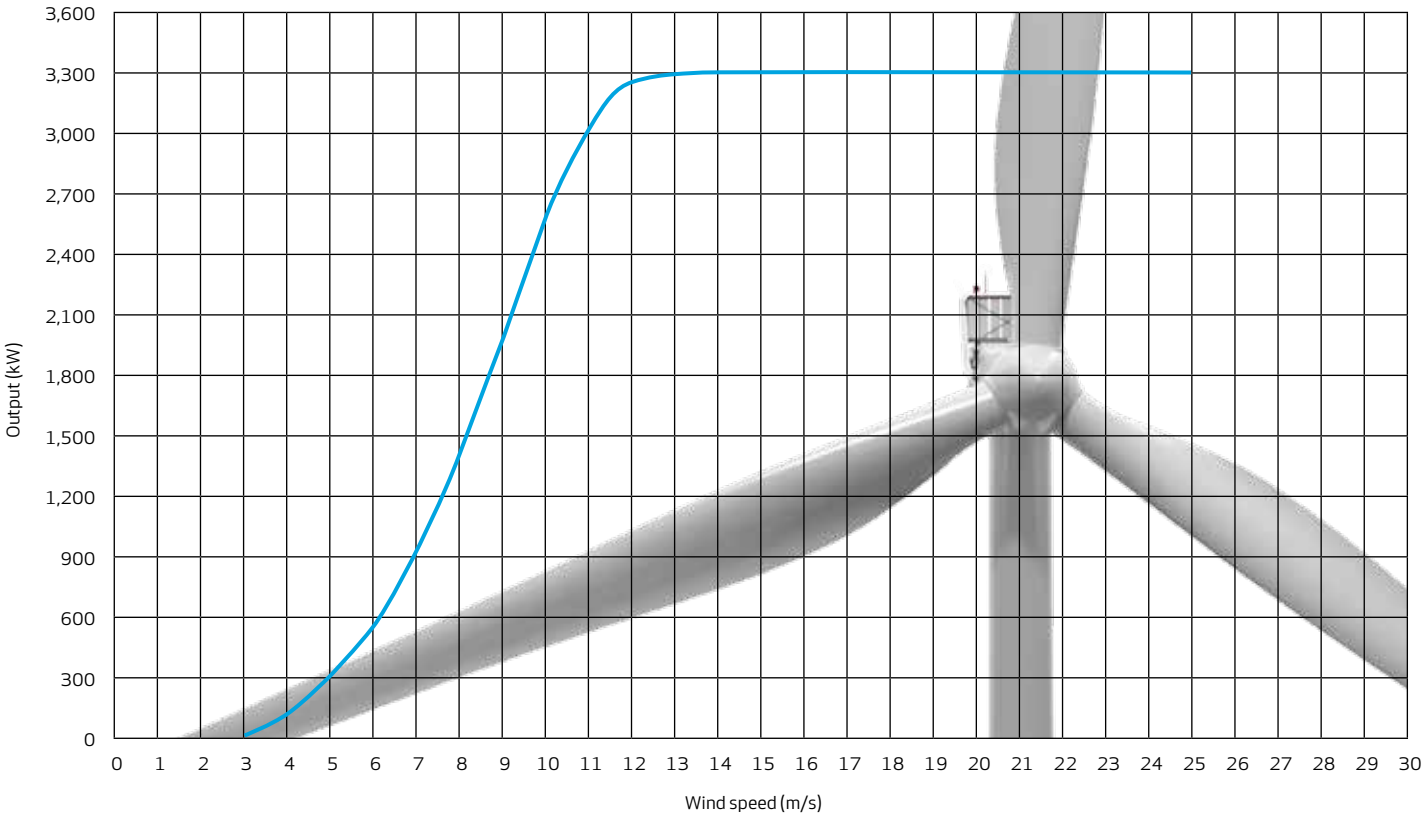
ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

POWER CURVE FOR V112-3.3 MW™ IEC IIA

Noise reduced sound power modes are available



V117-3.3 MW™ IEC IIA
Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,300 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IIA/DIBt2

Standard operating temperature range from -20°C to +45°C with de-rating above 30°C*

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	117 m
Swept area	10,751 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	91.5 m (IEC IIA/DIBt3) 116.5 m (IEC IIA/DIBt2)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

BLADE DIMENSIONS

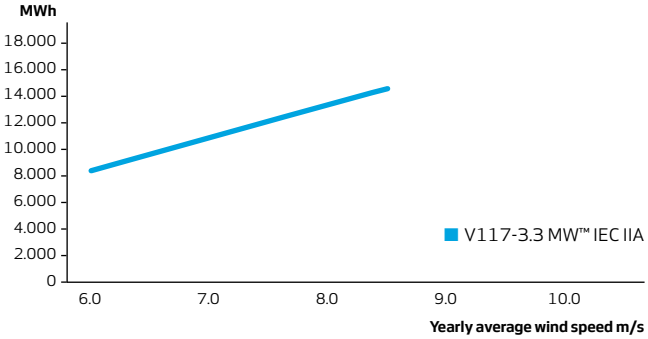
Length	57.15 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- Condition Monitoring System
- Service personnel lift
- Aviation lights
- Aviation markings on the blades
- Low temperature operation to - 30°C
- Ice detection
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Obstacle Collision Avoidance System (OCAS™)

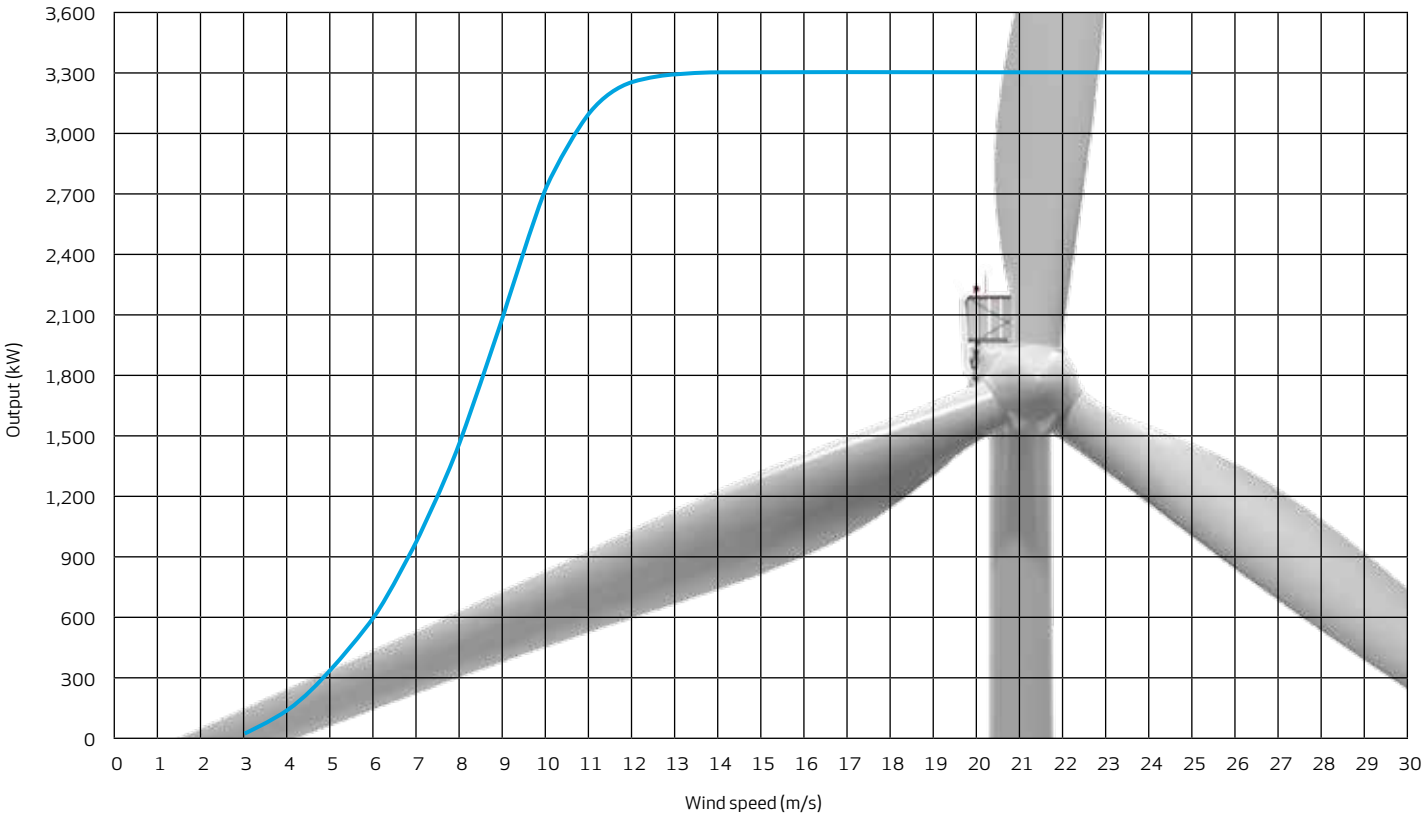
ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

POWER CURVE FOR V117-3.3 MW™ IEC IIA

Noise reduced sound power modes are available



V126-3.3 MW™ IEC IIIA
Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,300 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	22.5 m/s
Re cut-in wind speed	20 m/s
Wind class	IEC IIIA/DIBt2

Standard operating temperature range from -20°C to +45°C with de-rating above 30°C*

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	126 m
Swept area	12,469 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	117 m (IEC IIIB) 137 m (IEC IIIA/DIBt2)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

BLADE DIMENSIONS

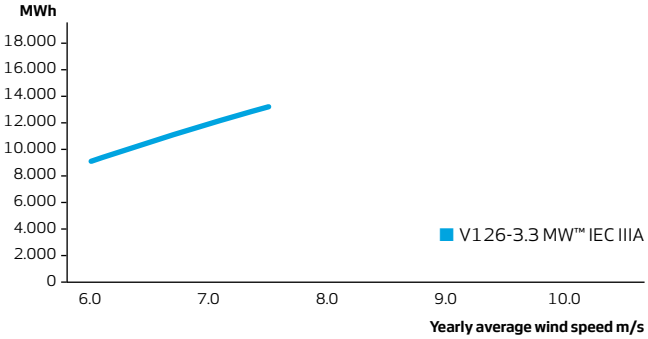
Length	62 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- Condition Monitoring System
- Service personnel lift
- Aviation lights
- Aviation markings on the blades
- Low temperature operation to - 30°C
- Ice detection
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION

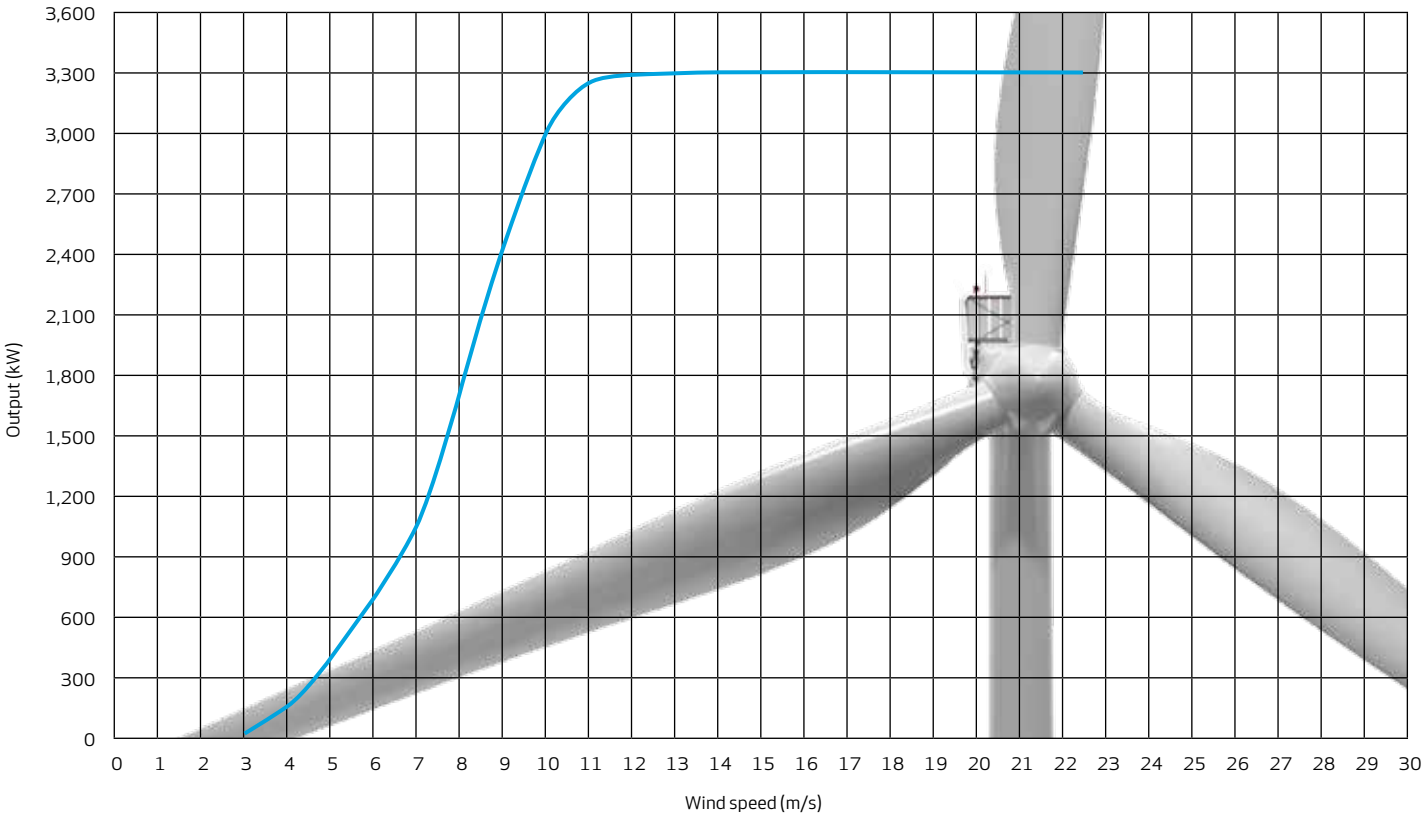


Assumptions

One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

POWER CURVE FOR V126-3.3 MW™ IEC IIIA

Noise reduced sound power modes are available



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06/2013-EN

Vestas®

V112-3.0 MW®
V126-3.0 MW™
ONSHORE

Wind. It means the world to us.™

3 MW Turbines
Higher profits across all wind classes

V112-3.0 MW®

The V112-3.0 MW® is an industry game-changer, with over 3 GW already sold in less than two years. Designed for onshore low-wind and medium-wind sites, anywhere in the world, it delivers industry-leading reliability, serviceability and exceptional energy capture.

The 54.65 m blades on the V112-3.0 MW®, together with its 3 MW generator, provide remarkable energy yield, boosting your economic returns and strengthening your investment for years to come.

Several innovative features, including a Vestas-designed permanent magnet generator and a full-scale converter for higher efficiency, better grid support and reduced drive train loads, make the V112-3.0 MW® capable of exceptional production in all wind and weather conditions, setting a new standard in turbine performance.

V112-3.0 MW® IEC S

Configured to the same specifications as our V112-3.0 MW® offshore model, the new IEC S simply extends the operation of V112-3.0 MW® onshore to high-wind sites. It is built to provide superior energy capture and profitability in high winds, year after year, ultimately ensuring that your return on investment is maximised.

An improved rotor-to-generator ratio for optimum energy capture, blades profiled for aerodynamic efficiency, as well as other innovative features, ensure prime performance.

The launch of the V112-3.0 MW® IEC S opens up many exciting new opportunities for reliable, high energy production in extreme wind and weather conditions. Combined with our 30 years of industry experience, it provides you with one of the most competitive investment opportunities in wind energy.

V126-3.0 MW™

Our best performer on low-wind sites, the V126-3.0 MW™ is built on the same proven technology as the V112-3.0 MW® models – with one crucial difference. The extended blades provide an immense 126 m rotor, enabling greater wind capture, which in turn produces more energy at a reduced cost. The result is exceptional profitability in areas with low wind, and new frontiers for wind energy investment.

With the launch of the V126-3.0 MW™, we now offer a range of 3 MW turbines covering all wind classes, increasing the range of opportunities available to wind energy investors. Vestas' unbeatable history of proven technology is combined with the most cutting-edge innovation, making the V126-3.0 MW™ the obvious choice for those looking to combine reliability with revolutionary performance.

3 GW

The combination of high returns and low risk have already made V112-3.0 MW® an industry favourite, with more than 3 GW already sold.

Powering
new opportunities

DESIGNED FOR ALL IEC SEGMENTS
The V112-3.0MW® covers all onshore and offshore IEC wind class segments
The V126-3.0 MW™ covers onshore IEC III wind class segments

TURBINE TYPE	WINDCLASSES		
	IEC III (6.0-7.5 m/s)	**IEC II** (7.5-8.5 m/s)	**IEC I** (8.5-10.0 m/s)
V164-7.0 MW™ offshore			
3 MW TURBINES			
V90-3.0 MW® onshore/offshore			
V100-2.6 MW™			
V112-3.0 MW® onshore/offshore			
V126-3.0 MW™			
2 MW TURBINES			
V80-2.0 MW®			
V80-2.0 MW® GridStreamer™			
V90-1.8/2.0 MW®			
V90-1.8/2.0 MW® GridStreamer™			
V100-1.8 MW®/V100-2.0 MW™			

Optimise energy production

- Designed for high productivity
- Reduced noise modes with minimal impact on power production
- Excellent grid support

Reduce energy costs

- Optimised Balance of Plant installation and transportation costs
- Designed for serviceability
- Innovative CoolerTop® uses the wind's own energy to cool the turbine

Secure your investment

- Proven technology
- Reliable and robust product
- Minimal downtime
- More than 30 years' track record

Above are some of the features and benefits that optimise your energy production, lower your operating costs and strengthen the business case for choosing the V112-3.0 MW® and the V126-3.0 MW™.

Industry-leading technology that generates more **energy**

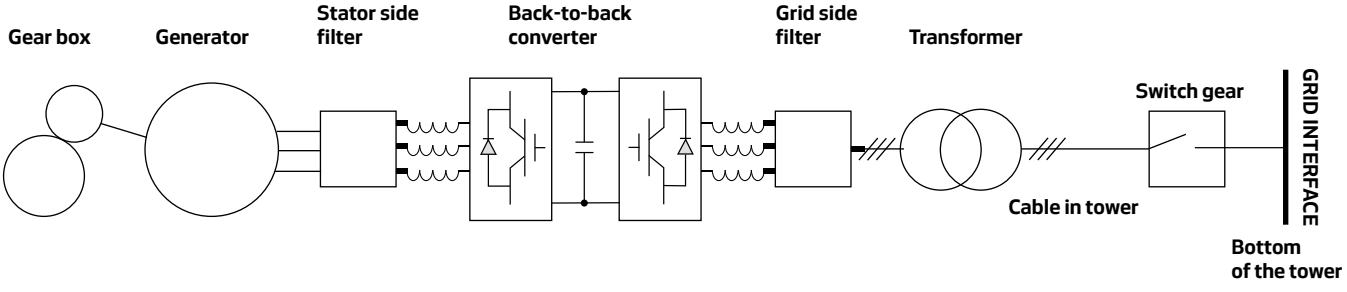
High productivity in all conditions

With the operating range now expanded to all wind classes, the V112-3.0 MW® and the V126-3.0 MW™ deliver unrivaled energy production. The turbine blades for the turbines incorporate robust structural design. Their geometric profile increases aerodynamic efficiency while reducing sensitivity to dirt and other airborne particles. This gives the turbine better in-service energy production.

Keeping noise down and power up

The V112-3.0 MW® and the V126-3.0 MW™ have several noise modes to meet most site-specific sound level restrictions - all without a significant reduction in productivity.

Excellent grid support

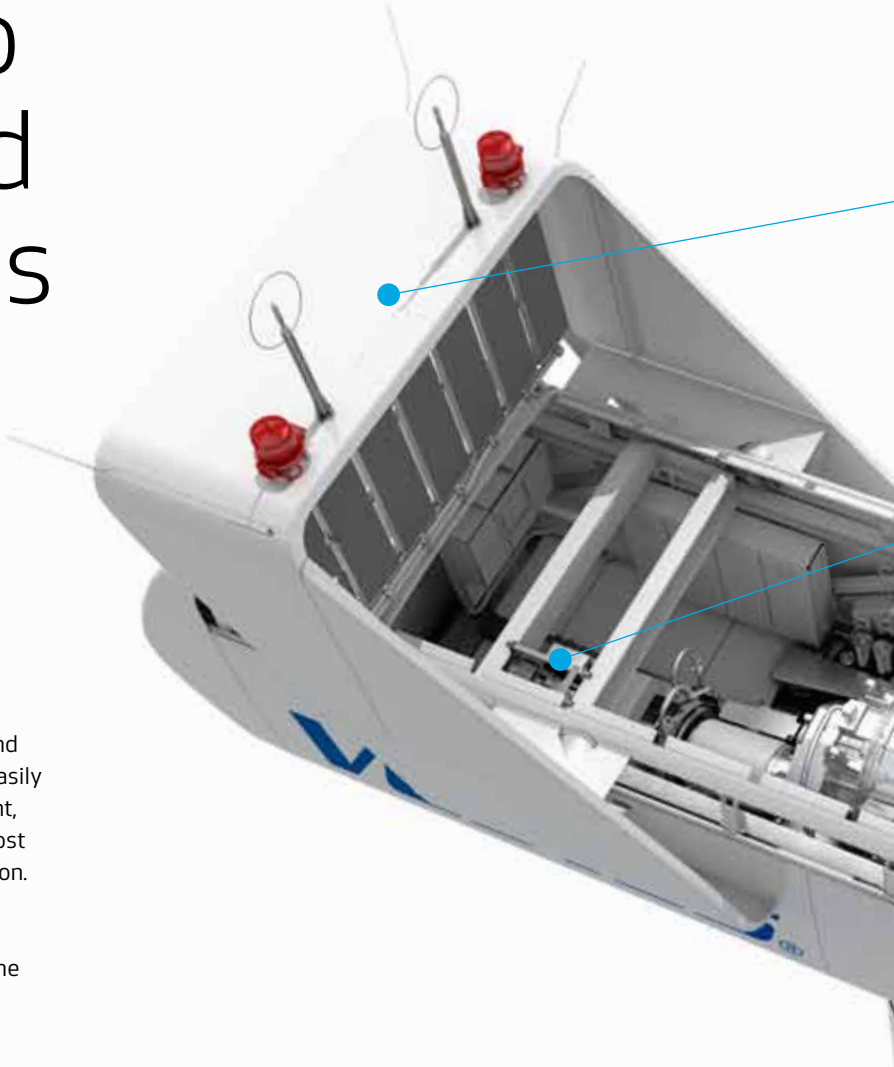


The new power system for the V112-3.0 MW® and the V126-3.0 MW™ enables superior grid support. The permanent magnet generator, coupled with a full-scale converter, meets most challenging grid requirements – in almost any corner of the world.

The new power system has the capability to maintain production across severe drops in grid voltage, while simultaneously minimising drive train loads. It also allows rapid down-rating of production to 20 per cent.

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.

Designed to **reduce** wind energy costs



Optimised Balance of Plant installation and transportation costs

Just like other Vestas turbines, the V112-3.0 MW® and the V126-3.0 MW™ are designed to be transported easily to virtually any site around the world. In terms of weight, height and width, all of its components comply with most local and international limits for standard transportation.

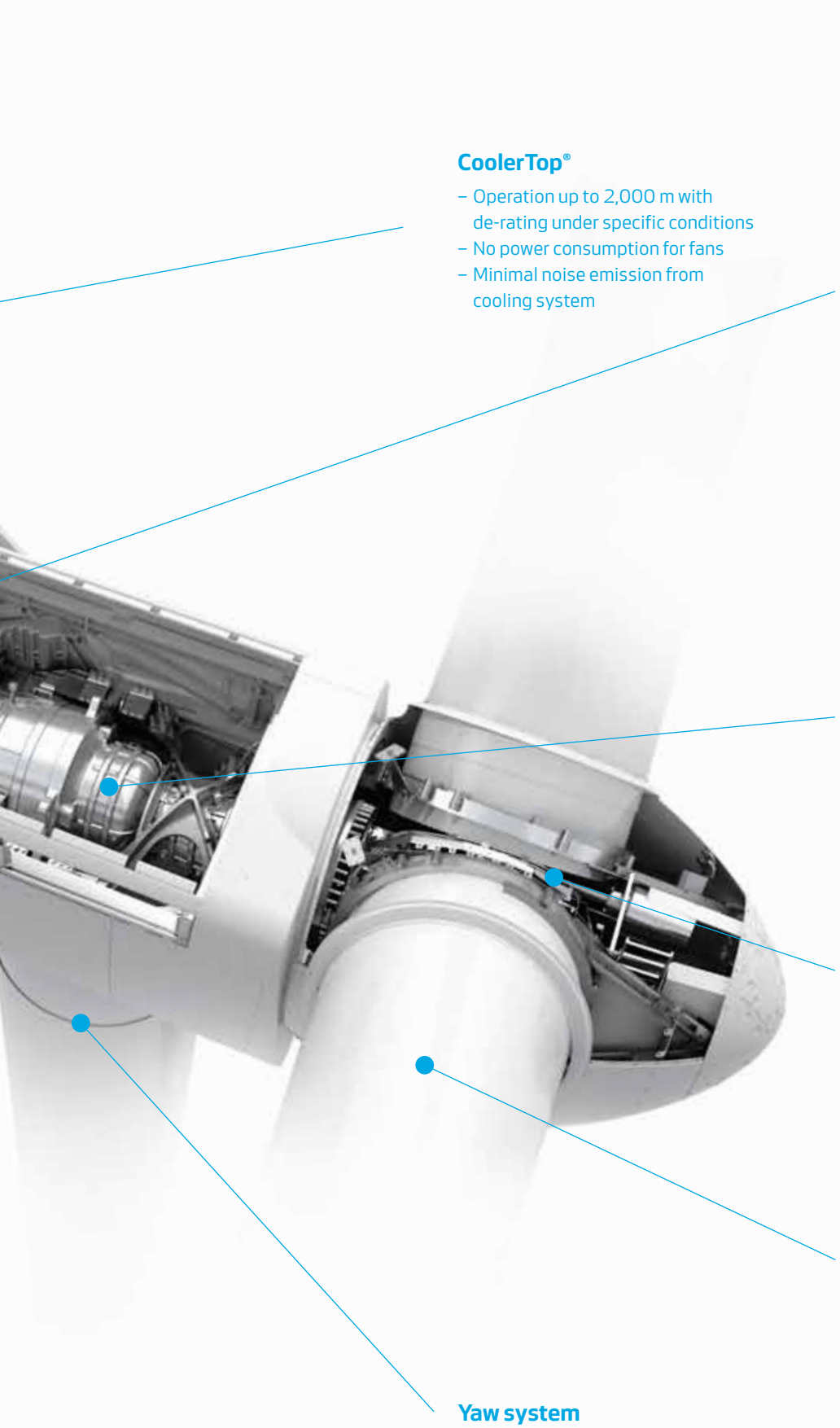
Each transportable component weighs less than 70 tonnes. Your foundation costs are also lowered with the V112-3.0 MW® and the V126-3.0 MW™ due to its improved load control. Additionally, the grid support capabilities of the new power system help minimise substation cost and provide greater flexibility to meet future requirements.

Easy serviceability

The nacelle of the V112-3.0 MW® and the V126-3.0 MW™ is ergonomically designed. It maximises the available internal space by integrating the power converter into the nacelle floor. This extra space makes it easier for maintenance crews to gain access – reducing the time spent on service and, therefore, maximising uptime. The automatic lubrication of the yaw system, main bearing and generator bearings delivers the triple benefit of increased reliability, reduced maintenance time and less frequent servicing. Combined, these factors save you money and maximise your returns on the wind energy produced on all onshore sites. The turbines can be put into place and maintained using standard installation and servicing tools and equipment – minimising ongoing maintenance costs.

Innovative CoolerTop®

The CoolerTop® installed on the the V112-3.0 MW® and the V126-3.0 MW™ uses the wind's own energy to generate the cooling required, rather than consuming energy generated elsewhere. The fact that the CoolerTop® has no moving parts means it requires little maintenance, reducing costs once more. In addition, the absence of any fans ensures that the cooling system makes minimal noise while simultaneously reducing the turbine's own energy consumption. Finally, the CoolerTop® provides sufficient cooling at altitudes of up to 2,000 m. This makes the turbines an ideal choice for locations high above sea level that were once deemed unsuitable.



CoolerTop®

- Operation up to 2,000 m with de-rating under specific conditions
- No power consumption for fans
- Minimal noise emission from cooling system

Permanent magnet generator and full scale converter

- Simple and effective power system with high efficiency and excellent fault ride-through capabilities
- Permanent magnet generator designed by Vestas
- Reduced maintenance cost
- Highly adaptable for future requirements
- HCCBA bearings (High Capacity Bearing)

Drive train

- Based on proven geared technology
- Integrated rotor lock system to improve maintenance

Pitch system

- Design based on V90-3.0 MW®
- Double feeding pump system ensuring redundancy and reliability
- Solutions for safe work in hub integrated in design

Blade

- Large root diameter (Φ2.6 m) ensures blade bearing longevity
- Lightning receptors and internal grounding cable integrated
- Robust aerodynamic profile less sensitive to airborne contamination

Yaw system

- Design based on V90-3.0 MW® and V90-2.0 MW®
- Robust plain bearing with built-in friction (grease lubricated)

The passion and experience to secure your wind energy **investment**

47,000+

The V112-3.0® MW and the V126-3.0 MW™ advance the already proven technology powering over 47,000+ installed Vestas turbines worldwide – more than any other supplier.

Life testing

The Vestas Test Centre has the unique ability to test complete nacelles using technologies like Highly Accelerated Life Testing (HALT). This rigorous testing of new components ensures the reliability of the V112-3.0 MW® and the V126-3.0 MW™.

Proven technologies - from the company that invented them

Since 1999, Vestas has installed over 2,600 V90-3.0 MW® turbines and more than 9,700 2 MW turbines globally. These workhorses form the basis of the mighty V112-3.0 MW® and V126-3.0 MW™, which incorporates their thoroughly tested technologies – including the pitch, yaw and control systems, and the drive train concepts. This heritage makes the turbines your low-risk choice.

The V112-3.0 MW® and V126-3.0 MW™ are based upon the proven technologies that underpin the 47,000+ 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, the turbines' reliable design minimises downtime – helping to give you the best possible return on your investment.

In Vestas Performance and Diagnostics Centre, we monitor more than 22,000 turbines worldwide. The information we obtain is then used in developing new turbines, including the V112-3.0 MW® and V126-3.0 MW™.

Reliable and robust product

The Vestas Test Centre is unrivalled in the wind industry. We test most of the nacelle components using Highly Accelerated Life Testing (HALT) to ensure reliability. For critical components, 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 design specifications and performs at site. We also employ a Six Sigma philosophy and have identified critical manufacturing processes (both in-house and for suppliers). We systematically monitor measurement trends that are critical to quality, locating defects before they occur.

Uninterrupted **control** of wind energy production

Knowledge about wind project planning is key

Getting your wind energy project up and operating as quickly as possible is fundamental to its long-term success. One of the first and most important steps is to identify the most suitable location for your wind power plant. Vestas' SiteHunt® is an advanced analytical tool that examines a broad spectrum of wind and weather data to evaluate potential sites and establish which of them can provide optimum conditions for your project.

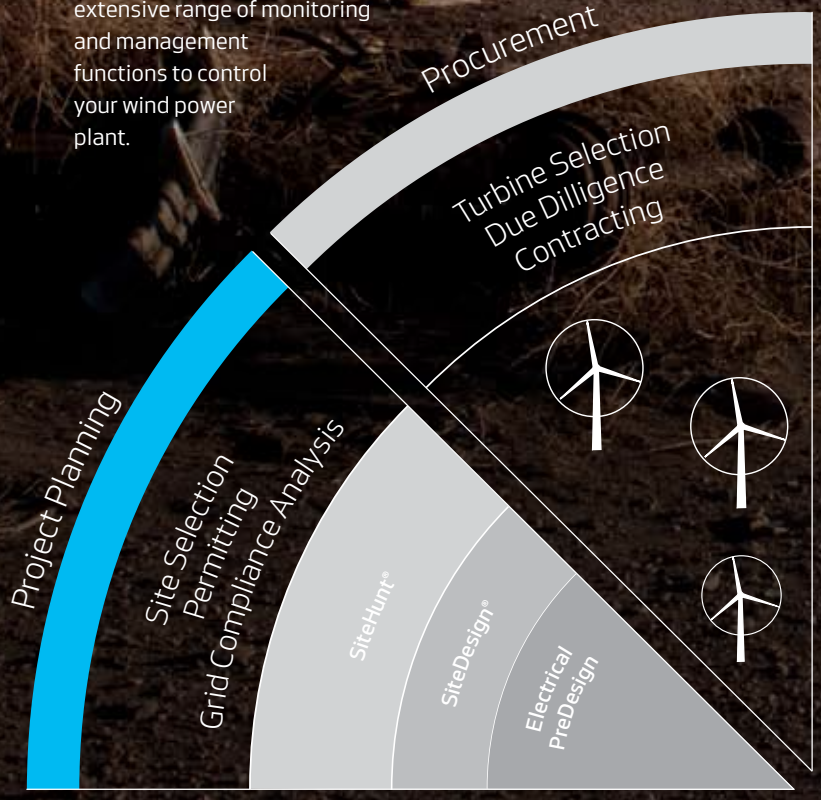
In addition, SiteDesign® optimises the layout of your wind power plant, through a sophisticated analysis of lifetime energy costs for each turbine. Put simply, it finds the optimal balance between the estimated ratio of annual revenue to operating costs over the lifetime of your plant, to determine your project's true potential and provide a firm basis for your investment decision.

The complexity and specific requirements of grid connections vary considerably across the globe, making the optimal design of electrical components for your wind power plant essential. By identifying grid codes early in the project phase and simulating extreme operating conditions, Electrical PreDesign provides you with an ideal way to build a grid compliant, productive and highly profitable wind power plant. It allows you customized collector network cabling, substation protection and reactive power compensation, which boost the cost efficiency of your business.

Advanced monitoring and real-time plant control

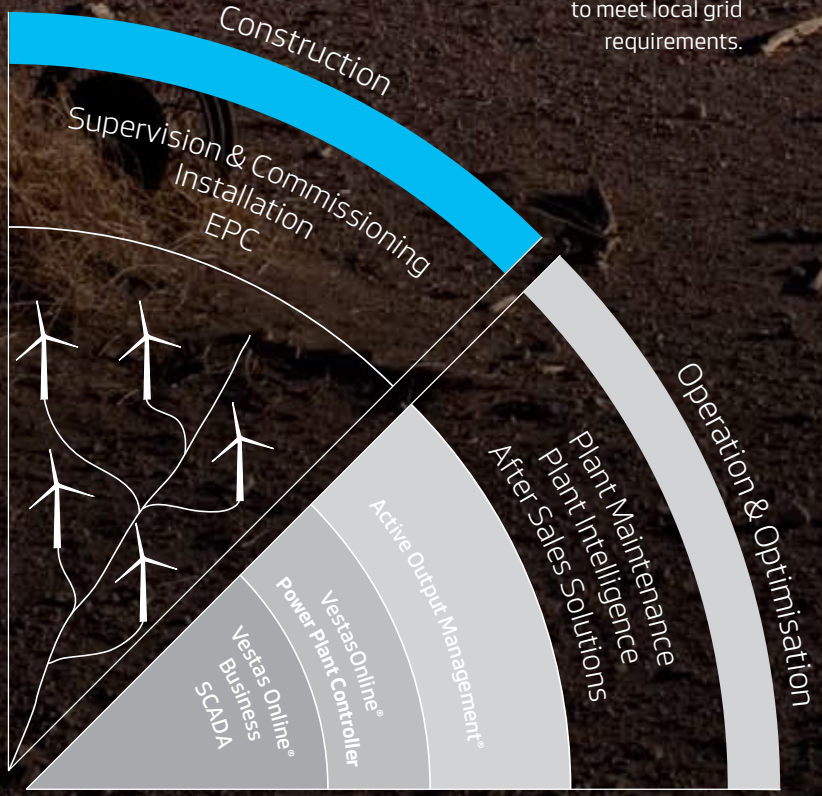
All our wind turbines can benefit from VestasOnline® Business, the latest Supervisory Control and Data Acquisition (SCADA) system for modern wind power plants.

This flexible system includes an extensive range of monitoring and management functions to control your wind power plant.



Vestas works with you across the full project life cycle

VestasOnline® Business enables you to optimise production levels, monitor performance, and produce detailed, tailored reports from anywhere in the world. The VestasOnline® Power Plant Controller offers scalability and fast, reliable real-time control and features customisable configuration, allowing you to implement any control concept needed to meet local grid requirements.



Surveillance, maintenance and service

Operating a large wind power plant calls for efficient management strategies to ensure uninterrupted power production and to control operational expenses. We offer 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine performance and availability. Predicting faults in advance is essential, helping to avoid costly emergency repairs and unscheduled interruptions to energy production.

Our Condition Monitoring System (CMS) assesses the status of the turbines by analysing vibration signals. For example, by measuring the vibration of the drive train, it can detect faults at an early stage and monitor any damage. This information allows pre-emptive maintenance to be carried out before the component fails, reducing repair costs and production loss.

Additionally, our Active Output Management® (AOM) concept provides detailed plans and long term agreements for service and maintenance, online monitoring, optimisation and troubleshooting. It is possible to get a full scope contract, combining the V126-3.0 MW™'s state-of-the-art technology and guaranteed time or energy-based availability performance targets, thereby creating a solid base for your power plant investment. The Active Output Management® agreement provides you with long term and financial operational peace of mind for your business case.

V112-3.0 MW®
Facts & figures

WIND CLASS	IEC IIA/IIIA	IEC S
POWER REGULATION	pitch regulated with variable speed	
OPERATING DATA		
Rated power	3,075 kW	3,000 kW
Cut-in wind speed	3 m/s	3 m/s
Rated wind speed	13 m/s	13 m/s
Cut-out wind speed	25 m/s	25 m/s
Re cut-in wind speed	23 m/s	23 m/s
Operating temperature range:	-30°up to +40°*	

*subject to different temperature options

SOUND POWER*		
(Mode 0, 10 m above ground, hub height 84 m, air density 1,225 kg/m³)		
3 m/s	94.5 dB	96.0 dB
4 m/s	97.3 dB	97.5 dB
5 m/s	100.9 dB	100.9 dB
6 m/s	104.3 dB	104.4 dB
7 m/s	106.5 dB	107.5 dB
8 m/s	106.5 dB	107.5 dB

*other sound reduced modes available

ROTOR		
Rotor diameter	112 m	112 m
Swept area	9,852 m²	9,852 m²
Air brake	full blade feathering with 3 pitch cylinders	
ELECTRICAL		
Frequency	50/60 Hz	50/60 Hz
Generator type	permanent magnet	permanent magnet
Converter	full scale	full scale

WIND CLASS	IEC IIA/IIIA	IEC S
GEARBOX		
Type	Multi stage (planetary + helical)	
TOWER		
Type	tubular steel tower	
Hub heights		
50hz:	84 m/94 m IEC IIA & 119 m/140 m IEC IIIA	84 m
	94 m/119/140 m DIBt II & 94 m/119 m DIBt III	
60 hz:	84 m/96 m IEC IIA & IIIA	84 m
BLADE DIMENSIONS		
Length	54.65 m	54.65 m
Max. chord	4 m	4 m
NACELLE DIMENSIONS		
Height for transport	3.4 m	3.4 m
Height installed (incl. CoolerTop®)	6.8 m	6.8 m
Length	12.8 m	12.8 m
Width	4.0 m	4.0 m
TOWER DIMENSIONS		
Max. section length	30 m	30 m
Max. diameter	4.5 m	4.2 m
HUB DIMENSIONS		
Max. transport height	3.74 m	3.74 m
Max. transport width	3.75 m	3.75 m
Max. transport length	5.42 m	5.42 m
Max. weight per unit for transportation	70 metric tonnes	70 metric tonnes

TURBINE OPTIONS

OCAS®, smoke & heat detection, shadow detection, increased cut-in wind speed & aviation light.

V126-3.0 MW™
Facts & figures

WIND CLASS	IEC IIIB
POWER REGULATION	pitch regulated with variable speed

OPERATING DATA

Rated power	3,000 kW
Cut-in wind speed	3 m/s
Rated wind speed	12 m/s
Cut-out wind speed	22.5 m/s
Re cut-in wind speed	20 m/s
Operating temperature range:	-30˚up to +40˚*

*subject to different temperature options

SOUND POWER*

(Mode 0, 10 m above ground, hub height 119 m, air density 1,225 kg/m³)

Max sound power	107.5 dB

*other sound reduced modes available

ROTOR

Rotor diameter	126 m
Swept area	12,469 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50 Hz
Generator type	permanent magnet generator
Converter	full scale

WIND CLASS	IEC IIIB

GEARBOX

Type	Multi stage (planetary + helical)

TOWER

Type	tubular steel tower
Hub heights	
50hz:	119 m*

*or site specific

BLADE DIMENSIONS

Length	62 m
Max. chord	4 m

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

Max. weight per unit for transportation	70 metric tonnes

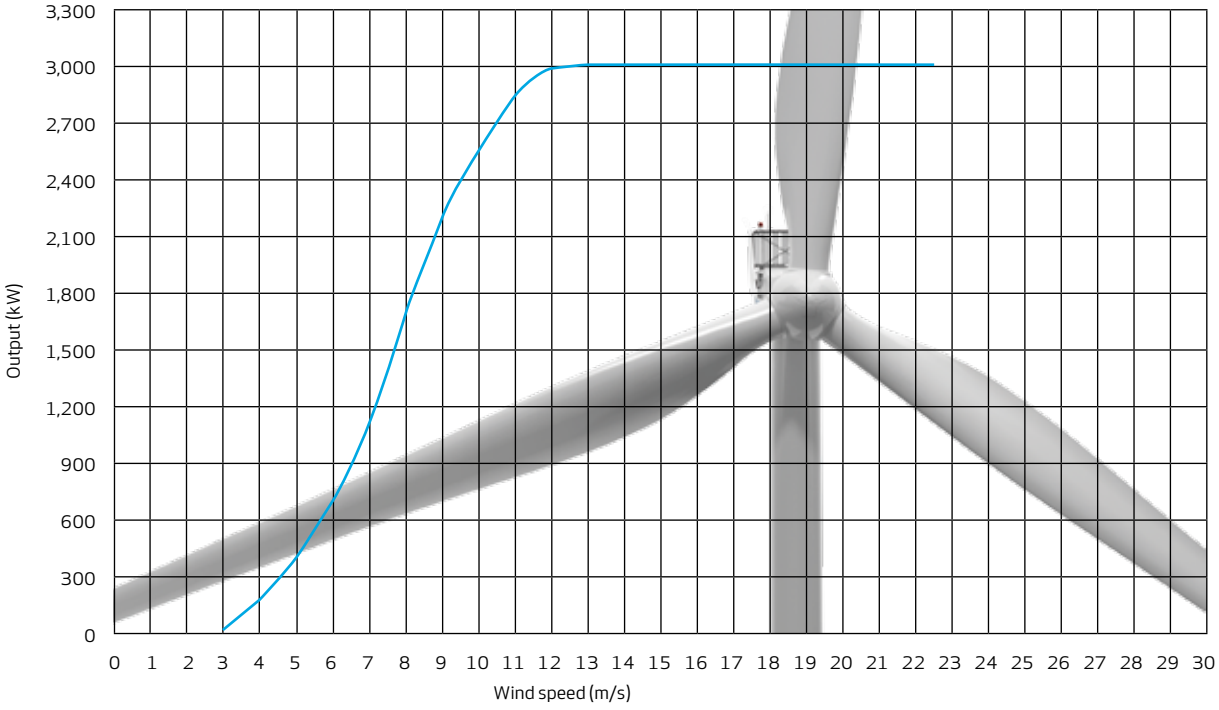
TURBINE OPTIONS

OCAS®, smoke & heat detection, shadow detection, increased cut-in wind speed & aviation light.

POWER CURVE FOR V126-3.0 MW™

Noise reduced sound power modes are available

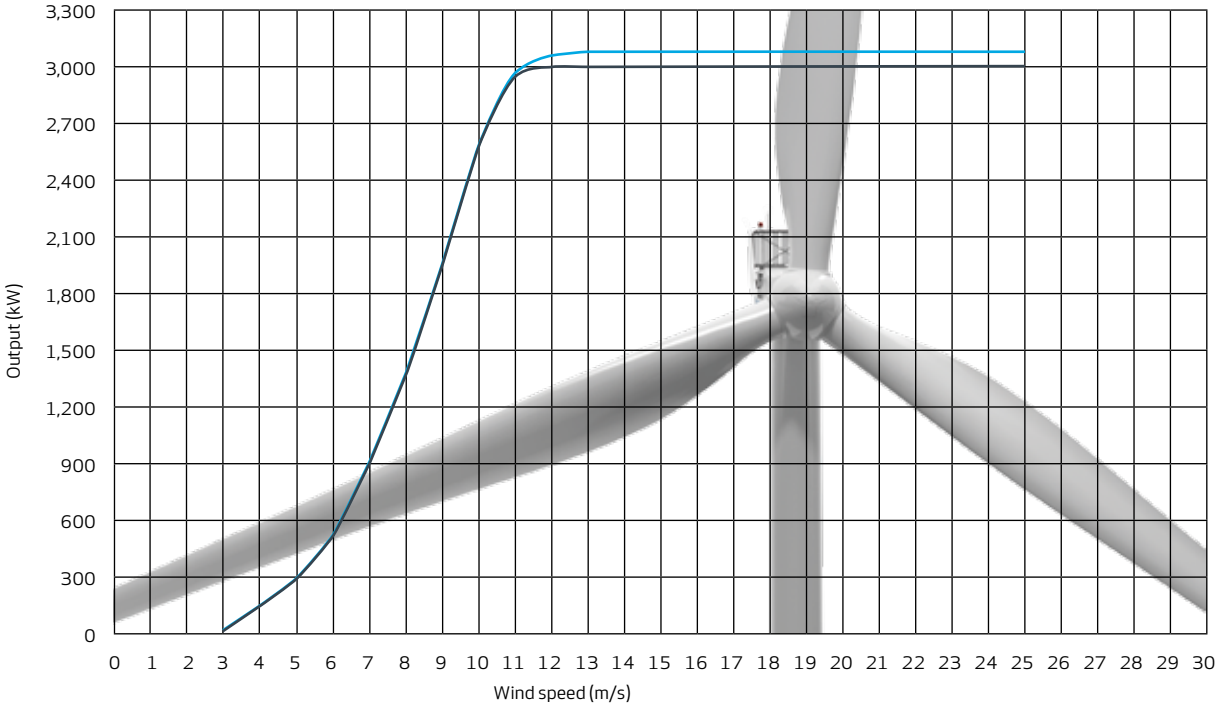
IEC IIIB



POWER CURVE FOR V112-3.0 MW®

Noise reduced sound power modes are available

IEC IIA/IIIA
IEC S



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08/2012-EN