

Gamesa G9X

Technological Evolution



Gamesa 

2.0 MW



Gamesa G9X



P.4 Economic progress and sustainable development.

P.5 Innovative evolution.

P.6 Global capacity for production, installation and operation and maintenance.

P.8 Discovering the Gamesa G9X:

Maximum productivity.
Advantages of the Gamesa G9X platform.
Technical characteristics.

Economic
progress

Sustainable
development

These are the great challenges facing today's society. Gamesa is tackling this challenge in the area of energy management and generation by developing technologies that contribute to sustainable energy in a clean, efficient and profitable manner.

By harnessing the best and most modern technologies in junction with its high industrial potential, Gamesa continues to improve the efficiency and capacity of its products and services by designing and manufacturing of ever more advanced wind turbines.

The purpose of this activity is to guarantee full customer satisfaction, to develop more efficient technologies, products and services and to ensure that Gamesa's range of products is the most competitive on the market.



G9X

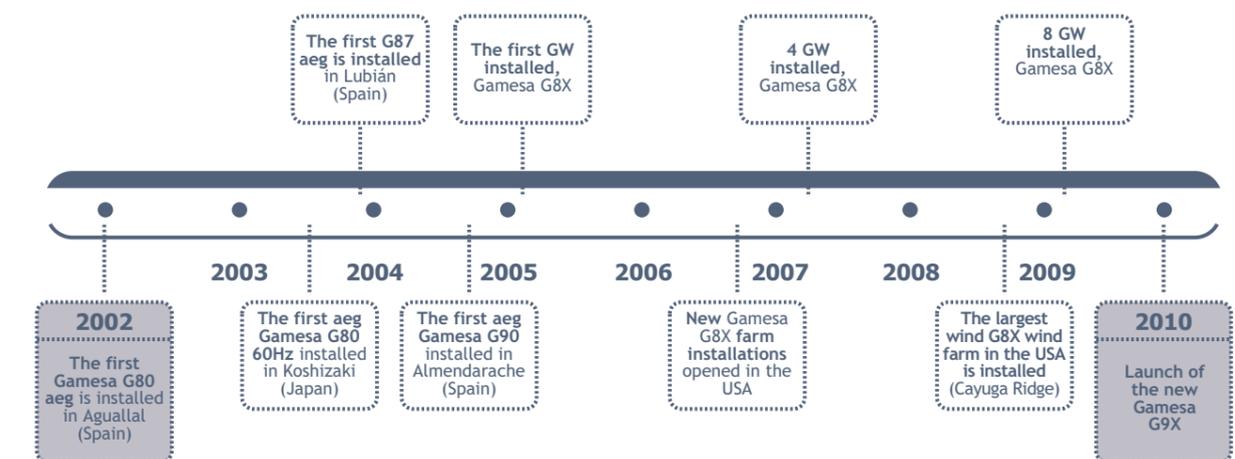
Innovative
Evolution

Gamesa knows that technology is the fundamental focal point of its activities. One example of this is the substantial R&D efforts the Spanish company has made to introduce improvements to its Gamesa G8X platform.

Technology characterized by **robustness, reliability and adaptability to all types of sites and wind conditions**, from the toughest, most demanding locations to situations with medium to light winds. This is a technology that has been very well received for which a growing demand has been felt right from the beginning, backed by a very

high adaptation capacity proven by the more than 8,400 MW of power installed in 15 countries.

The company's significant **experience base and its in-depth knowledge of market needs and demands** have enabled it to develop technological improvements in this platform. The evolution and incorporation of substantial **innovations in design, products and features** have put the new Gamesa G9X platform on the path to leadership in the multi-megawatt segment.



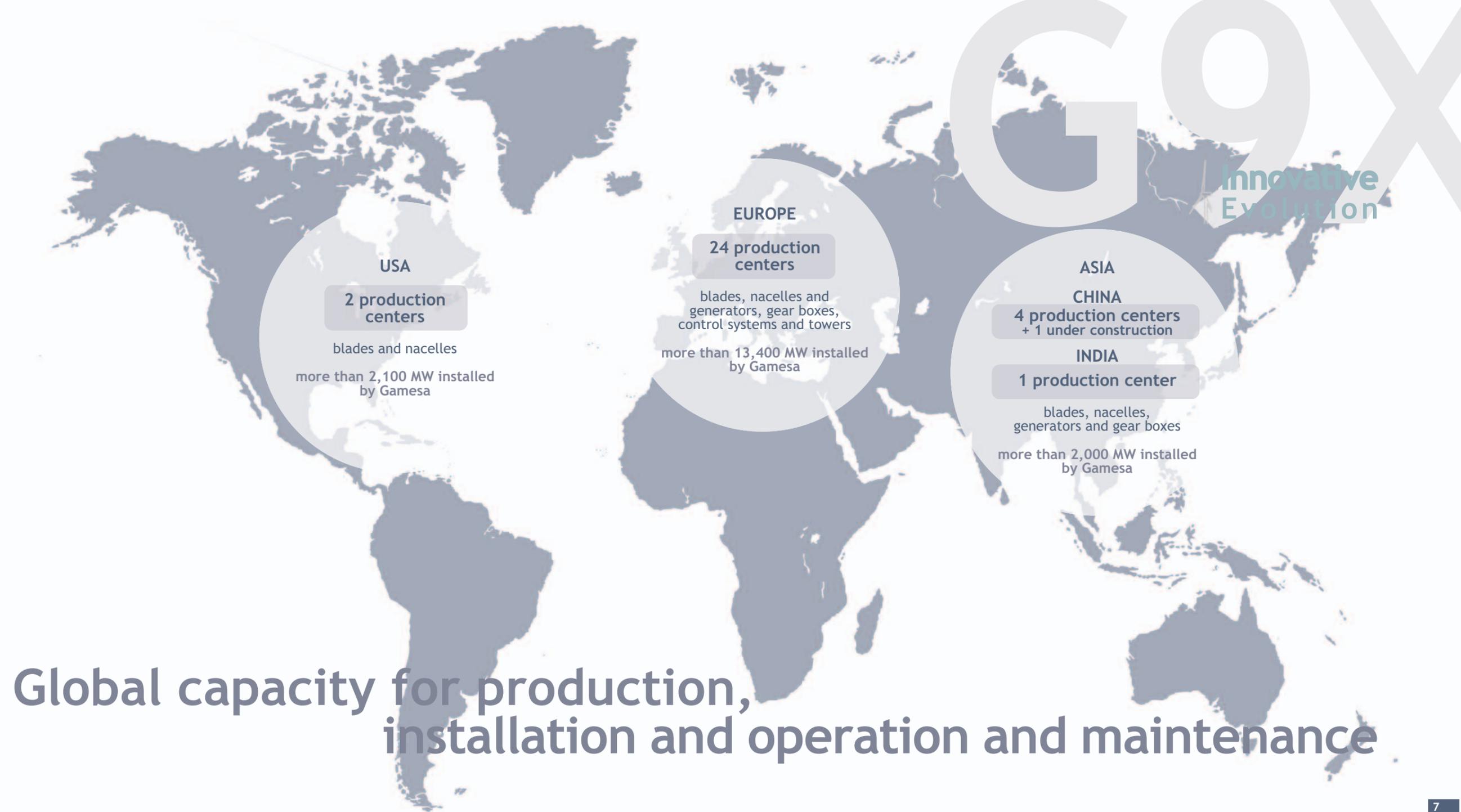


Gamesa is a company specialized in sustainable energy technologies, primarily wind power. With more than 15 years of experience, Gamesa is one of the world's leading designers, manufacturers, installers and maintainers of wind turbines, with more than 18,000 MW installed in twenty countries on four continents.

Within this sector, Gamesa manages the entire process from design, manufacture and installation of wind turbines, through and including their operation and maintenance.

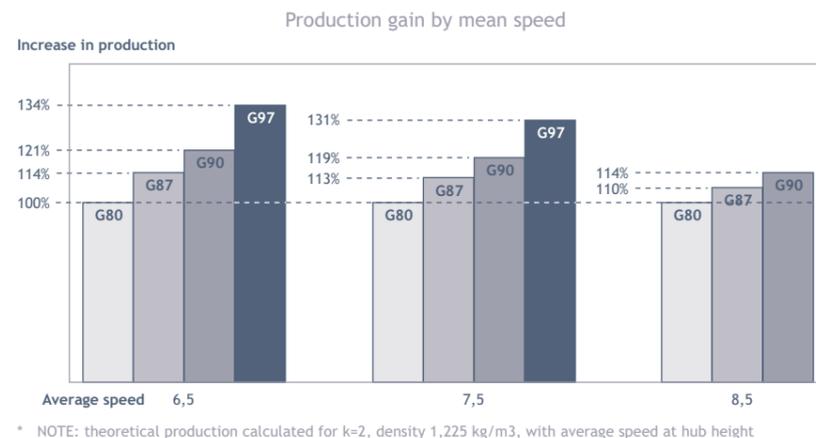
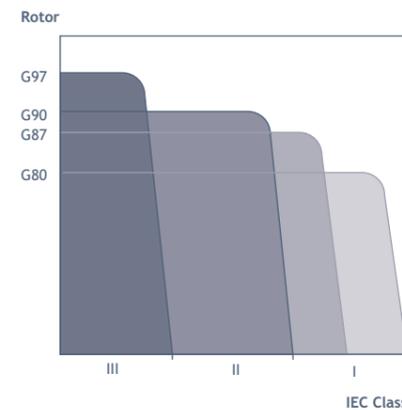
Gamesa designs and manufactures its own blades, blade roots and moulds for blade and tower manufacture as well as the assembly of its wind turbines. Gamesa also works with other companies that manufacture other components that are particularly important in a wind turbine, such as the gear boxes, generators and converters.

Its industrial capacity allows it to fully control the production process, from design to manufacture of the various critical wind-turbine components, offering its customers the highest quality standards and shortest customer response times. With 30 production centers in Europe, the United States, China and India and an annual production capacity of 4,400 MW, the company has an international workforce of more than 6,300 members.



Versatility

Multi-megawatt wind turbines from the **Gamesa G9X** platform improve competitive investment ratios per MW installed and Cost of Energy produced due to their versatile combination of a 2.0 MW unit power wind turbine and 4 different sized rotors: 80, 87, 90 and 97 m diameter⁵, to achieve maximum output in all types of settings and wind conditions.



Platform Versatility: site-specific offerings optimizing energy capture & maximizing production

This is what Gamesa G9X wind turbines can promise



The **Gamesa G9X** bases its technology on speed control and variable pitch, while incorporating the latest technologies to extract the maximum amount of energy from the wind and to do it as efficiently as possible.

- ☞ Composite materials reinforced with glass and carbon fiber for lighter blades without sacrificing rigidity and strength.
- ☞ The **Gamesa WindNet**[®] remote control system.
- ☞ **Gamesa SMP** predictive maintenance.
- ☞ **Gamesa NRS**[®] noise control.
- ☞ Solutions for optimum grid connection.

Model	IEC	Rated Power	Grid Code	Tower Heights	Env / Opt*	50 Hz	60 Hz
G80	IA	2.000 kW	✓	60, 67, 78, 100**	✓	✓	✓
G87	IIA	2.000 kW	✓	67, 78, 100	✓	✓	✓
G90	IIA /IIIA	2.000 kW	✓	67***, 78, 100	✓	✓	✓
G97	IIIA	2.000 kW	✓	78, 90,****	✓	✓	✓

* Different versions and optional kits are available to adapt machinery to high or low temperatures and saline or dusty environments.
 ** 100 meter IEC IIA tower.
 *** Availability subject to site location.
 **** New developments underway with heights over 115 meters.

Advantages

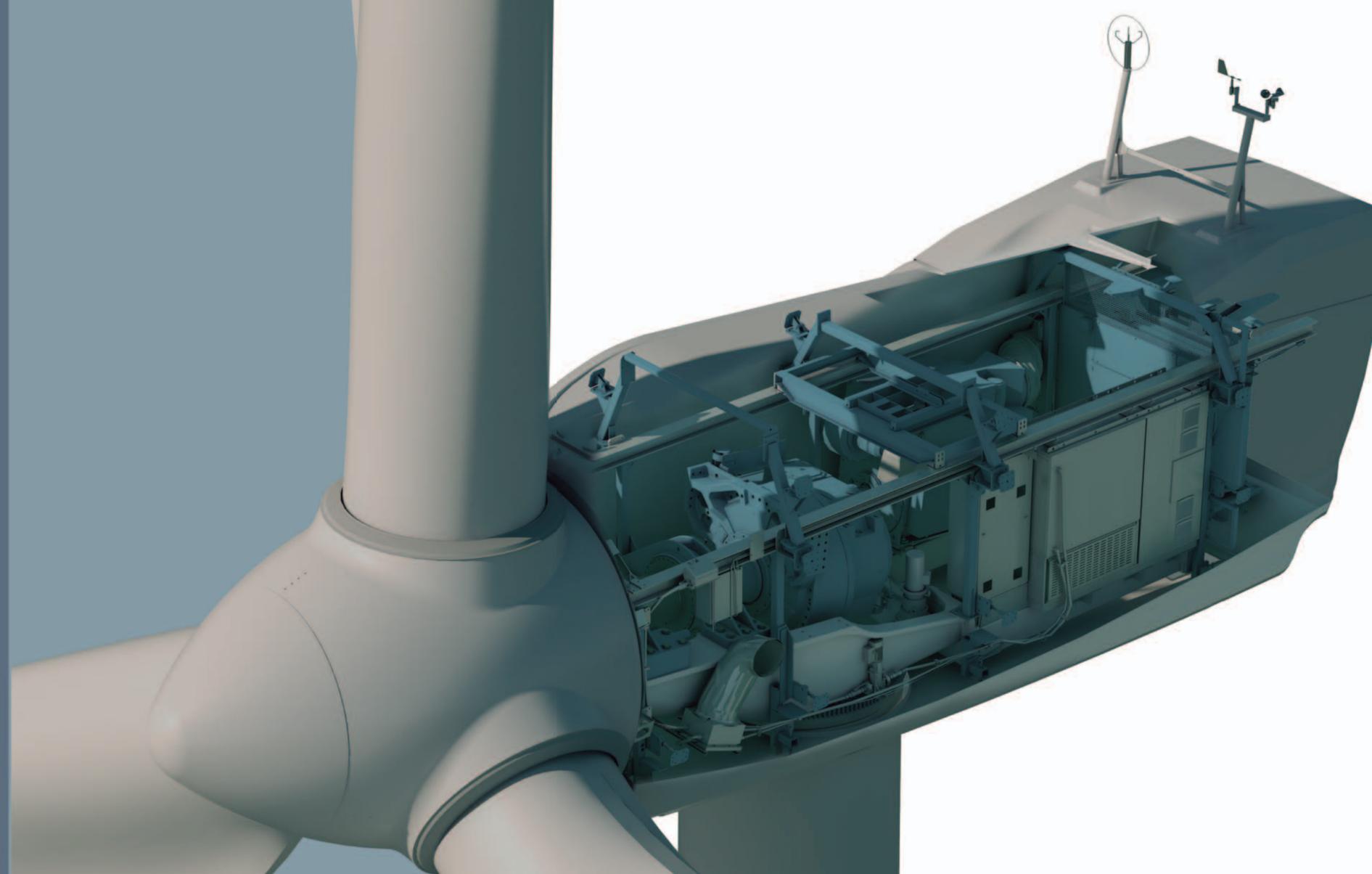
of the new
Gamesa G9X
platform

- ▣ Platform Versatility: site-specific offerings optimizing energy capture & maximizing production.
- ▣ New, latest generation 97-meter rotor for light winds which, together with the 80-, 87- and 90-meter rotors make this the most versatile platform on the market.
- ▣ Variable pitch and speed technology maximize energy production.
- ▣ State-of-the-art blade manufacturing technology. New optimized blade profiles guarantee maximum production and low noise.
- ▣ Technological solutions guarantee compliance with main international grid connection requirements.
- ▣ Gamesa active yaw system ensures optimum adaptation to complex terrain.
- ▣ Aerodynamic design and the Gamesa NRS® control system minimize noise emissions.
- ▣ Gamesa WindNet®: remote control and monitoring system with web access.
- ▣ Gamesa's own Gamesa SMP system for scheduled preventive maintenance.



Advantages of the new Gamesa G9X platform

- Platform Versatility: site-specific offerings optimizing energy capture & maximizing production.
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The reliability of the Gamesa G8X, backed by broad experience and proven capacity to adapt,

More than 8.400 MW installed

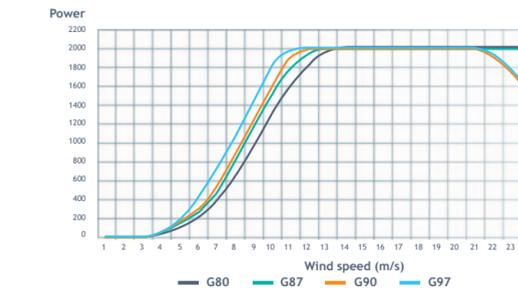
Present in 15 countries

Established & vertically integrated manufacturing capabilities in the three main wind markets: Europe, China & the USA

are joined with the Gamesa G9X technological advances providing notable improvements in performance, optimized models, a new tower portfolio and an upgraded image.

New features and improvements

- Maximum output under any wind condition.
- Enhanced power curves.



Optimized models

- The new Gamesa G97-2.0 MW/IIIA model.
- The Gamesa G90-2.0 MW/IIA model.

New tower portfolio

- Optimization of the 78-meter tower (from 4 to 3 sections).
- The new 90 meter tower.
- New developments underway with heights over 115 meters.

Upgraded image

- Newer, more attractive nacelle design.
- Improved cooling of nacelle interior.

- Reduced noise levels: Aerodynamic design. Gamesa NRS® control system.
- Compliance with the main international grid connection requirements. Gamesa WindNet®: remote control and monitoring system with web access.

- New optimized blade profile for the new Gamesa G97-2.0 MW: Optimized blade root with high thickness blade profiles. Lighter blades through the use of fiber glass, carbon fiber and preimpregnation methods.



Maximum energy production and reduced noise emissions

G9X

Discovering Gamesa G9X



Innovative Evolution
Gamesa G9X

One step forward

Gamesa G9X

Technical specifications and services

Mechanical design: Optimum reliability and performance

The Gamesa G9X incorporates improved and increased mechanical capacity in key wind-turbine components such as the yaw system, the framework, main axis and blade bearings. These improvements guarantee maximum reliability of the equipment and allow larger rotors to be used to increase the power generated in medium and light winds.

Drive train

The main axis is supported on two spherical bearings that provide significant advantages since lateral loads are transmitted directly to the framework through a rack. This prevents the gear box from receiving additional, unwanted loads, thus reducing the possibilities of breakdown as well as providing a longer service life.

Controlled brake system

The joint action of the primary aerodynamic brakes and mechanical emergency brake (located at the output of the high speed axis of the gear box) with a hydraulic control system, allows controlled braking that prevents damage due to excessive load transmission.

Total lightning protection

The Gamesa G9X platform uses the "total lightning protection" system, according to the IEC 61024-1 standard. This system conducts the lightning from both sides of the tip of the blade to the root, and from there, through the nacelle and the tower structure, to the foundation grounding system. This protects the blade and prevents the lightning from going through the blade bearings and main axis, protecting sensitive electrical elements from becoming damaged.



Gamesa WindNet® (SCADA) system with real-time web-access capability

New generation SCADA wind farm system, entirely developed by Gamesa, which allows remote operation and the monitoring of wind turbines in real time, meteorological mast and electrical substation.

An innovative, modular design based on TCP/IP architecture with active and reactive power, voltage and frequency, regulation tools, and environmental options to optimize production while complying with the current regulations.

Accessible anywhere through a web browser, simple and intuitive. It features the Report Generator and Information Manager decision-taking analytical tools as well as TrendViewer, an advanced tool to visualize trends.

Designed for simple maintenance

Gamesa's global response also offers a wide range of operational and maintenance options. Equipment supplied by the company comes with a two-year warranty on components, availability and power curves as well as a maintenance service, all standard.

But Gamesa's commitment to its customers does not end there. The company has developed an Integral Management Service comprising a long-term operation and maintenance contract (up to 12 years, renewable) with wider coverage to guarantee maximum availability and to help smooth out the road to funding.

Through detailed analysis of its extensive operational experience, Gamesa also continuously adapts its equipment to the most demanding connection grids and environmental surroundings.



Control system: Maximum output under any wind condition

Dual powered generator, speed and power controlled by IGBT converters and electronic PWM control (Pulse Width Modulation).

Advantages:

- ☞ Active and reactive power control.
- ☞ Low harmonic content and minimum losses.
- ☞ Increased efficiency and production.
- ☞ Improved useful life of the machine.

Maintenance System Predictive SMP

Predictive maintenance system for premature detection of potential deterioration or faults in the main wind-turbine components.

Advantages:

- ☞ Fewer large corrections.
- ☞ Improved availability and useful life of the machine.
- ☞ Preferential conditions in negotiations with insurance providers.
- ☞ Integration with the control system.

Minimum noise emission Maximum production

New aerodynamic design of the blade tip and design of mechanical components minimize noise emissions.

In addition, Gamesa has developed the Gamesa NRS® noise control system, which makes it possible to program noise emissions according to such criteria as the date, time or wind direction.

This achieves compliance with local regulations to achieve maximum production.



Optimum electrical grid connection and stable production

Gamesa's dual power wind turbines and Active Crowbar technologies and oversized converters guarantee compliance with the most demanding requirements for connection to current grids and future electric grid and wind farm configurations. Support for voltage-drop and dynamic active and reactive power regulation.

	Gamesa 80 Gamesa G80-2.0 MW	Gamesa 87 Gamesa G87-2.0 MW	Gamesa 90 Gamesa G90-2.0 MW	Gamesa 97 Gamesa G97-2.0 MW
ROTOR				
Diameter	80 m	87 m	90 m	97 m
Swept area	5,027 m ²	5,945 m ²	6,362 m ²	7,390 m ²
Rotational speed	9,0 - 19,0 rpm	9,0 - 19,0 rpm	9,0 - 19,0 rpm	9,6 - 17,8 rpm
BLADES				
Number of blades	3	3	3	3
Length	39 m	42.5 m	44 m	47.5 m
Airfoils	NACA 63.XXX + FFA-W3	DU + FFA-W3	DU + FFA-W3	Gamesa
Material	Pre-impregnated epoxy glass fiber	Pre-impregnated epoxy glass fiber	Pre-impregnated epoxy glass fiber + carbon fiber	Pre-impregnated epoxy glass fiber + carbon fiber
TOWER				
Type	Modular	Modular	Modular	Modular
Height	60, 67, 78 y 100 m	67, 78 y 100 m	67, 78 y 100 m	78, 90 m (New developments underway with heights over 115 meters)
GEARBOX				
Type	1 planetary stage 2 parallel stages			
Ratio	1:100.5 (50 Hz) 1:120.5 (60 Hz)	1:100.5 (50 Hz) 1:120.5 (60 Hz)	1:100.5 (50 Hz) 1:120.5 (60 Hz)	1:106.8 (50 Hz) 1:127.1 (60 Hz)
GENERATOR 2.0 MW				
Type	Doubly-fed machine	Doubly-fed machine	Doubly-fed machine	Doubly-fed machine
Rated power	2.0 MW	2.0 MW	2.0 MW	2.0 MW
Voltage	690 V ac	690 V ac	690 V ac	690 V ac
Frequency	50 Hz / 60 Hz			
Protection class	IP 54	IP 54	IP 54	IP 54
Rotational speed	900:1,900 rpm (rated 1,680 rpm) (50Hz) 1,080:2,280 rpm (rated 2,016 rpm) (60Hz)	900:1,900 rpm (rated 1,680 rpm) (50Hz) 1,080:2,280 rpm (rated 2,016 rpm) (60Hz)	900:1,900 rpm (rated 1,680 rpm) (50Hz) 1,080:2,280 rpm (rated 2,016 rpm) (60Hz)	900:1,900 rpm (rated 1,680 rpm) (50Hz) 1,080:2,280 rpm (rated 2,016 rpm) (60Hz)
Power factor	0.95 CAP - 0.95 IND throughout the power range*	0.95 CAP - 0.95 IND throughout the power range*	0.95 CAP - 0.95 IND throughout the power range*	0.95 CAP - 0.95 IND throughout the power range*

* Power factor at generator output terminals, on low voltage side before transformer input terminals





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