

WIND

S Y S T E M S

2014

TURBINE DIRECTORY

Wind turbines are the one component that wind farms simply cannot do without. More than 100 wind turbine manufacturers exist globally, offering as many 1,000 turbine models. No single turbine is the right fit for every application.

In the following pages, *Wind Systems* has compiled news, turbine models, and general specifications from common utility-scale wind turbine manufacturers, in its inaugural Turbine Directory.

Ten turbine manufacturers were selected for this directory, based on U.S. wind energy capacity installed during 2012* (Source: AWEA U.S. Wind Industry Annual Market Report Year End 2012). Technical specifications were taken from manufacturers' literature or otherwise provided by the manufacturers. Readers should contact the turbine manufacturer directly for complete specifications.

* Companies with top-ten 2012 market share that have ceased manufacture of new wind turbines were not included in this directory.

GE ENERGY

General Electric's onshore wind turbine portfolio consists of five models ranging from 1.7 to 3.2 MW, with various configurations to meet project requirements. GE is the top wind turbine manufacturer in the U.S., with 3,003 turbines (5,014 MW) installed during 2012, accounting for a 38.2 percent market share. GE turbines account for more than 24 GW of installed wind power capacity in the U.S.

GE'S 2.5-120 TURBINE NOW OPERATING COMMERCIALY AT GERMAN SITE

Two months after the completion of installation, the first GE 2.5-120 wind turbine has been put into

commercial operation in Schnaittenbach, a town in Bavaria, Germany. The 2.5-120 produces approximately

8,000-megawatt hours a year, which is equivalent to the required average energy needs of about 2,000 German households. The investor and operator of this project is Max Bögl Wiesner GmbH.

By choosing GE's new 2.5-120 turbine, Max Bögl Wiesner GmbH made a decision for today's most efficient inland wind turbine worldwide. GE's goal was to facilitate the generation of wind energy in densely wooded regions with low wind intensity such as the Oberpfalz (Upper Palatinate area). The 2.5-120 meets these requirements and additionally contributes to the successful implementation

of the "Energiewende" on a regional level.

The turbine's advanced controls, paired with the 120-meter rotor and a specially engineered hybrid tower with a hub height of 139 meters, allow for a more efficient energy output. The 2.5-120 is GE's first brilliant wind turbine to utilize the power of the Industrial Internet. The Industrial Internet uses data analysis to connect machines and equip them with intelligence, helping to position each one for enhanced performance. The 2.5-120 analyzes tens of thousands of data points every second to drive higher output and improve services productivity, ultimately helping to manage wind's variability.



GE WIND TURBINES					
	1.7-100	1.85-82.5	1.85-87	2.5-120	3.2-103
Rated Power (kW)	1700	1850	1850	2500	3200
Wind Class (IEC)	S (~IIIB)	S (~IIB)	S	III/DIBt Type Class S	IIB
Cut-in Wind Speed (m/s)	3				
Rated Wind Speed (m/s)	10.5	12.5	13	11.5	15.5
Cut-out Wind Speed (m/s)	23	25		20	25
Rotor Diameter (m)	100	82.5	87	120	103
Hub Height (m)	80, 96	80, 65 (50Hz)	80	85, 110, 120, 139	70, 75, 85, 98.3
Swept Area (m ²)	7,854	5,346	5,945	11,310	8,332
Generator Type	DFIG				
Rated Voltage (V)	50/60				50
Drivetrain	Geared				

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SUZLON

The Suzlon Group (India) is among the largest wind turbine suppliers in the world. The company has installed more than 22 GW of wind energy globally. In 2012, Suzlon installed 187 MW in the U.S., accounting for a 1.4 percent market share. The company's cumulative installation in the U.S. at the end of 2012 was 2,685 MW. Suzlon also owns turbine manufacturer Repower (see page 30).

SUZLON TURBINE MODELS						
	S52	S66 MARK II	S82	S88	S95	S97
Rated Power (kW)	600	1,250	1,500	2,100		
Wind Class (IEC)	IIa	IIIa	IIIa	IIa	IIa	IIIa
Cut-in Wind Speed (m/s)	4				3.5	
Cut-out Wind Speed (m/s)	25	20		25		20
Rotor Diameter (m)	52	66	82	88	95	97
Hub Height (m)	75	74.5	76.8	80,100	80, 90, 100	
Swept Area (m ²)	2,124	3,421	5,281	6,082	7,085	7,386
Generator Type	Single speed induction generator (asynchronous)	Dual speed induction generator (asynchronous)	Induction generator with slip rings, variable rotor resistances		Asynchronous 3 phase induction generator with slip rings operated with rotor circuit inverter system (DFIG)	
Rated Voltage (V)	690					
Drivetrain	Gearbox, one planetary stage and two helical stages					

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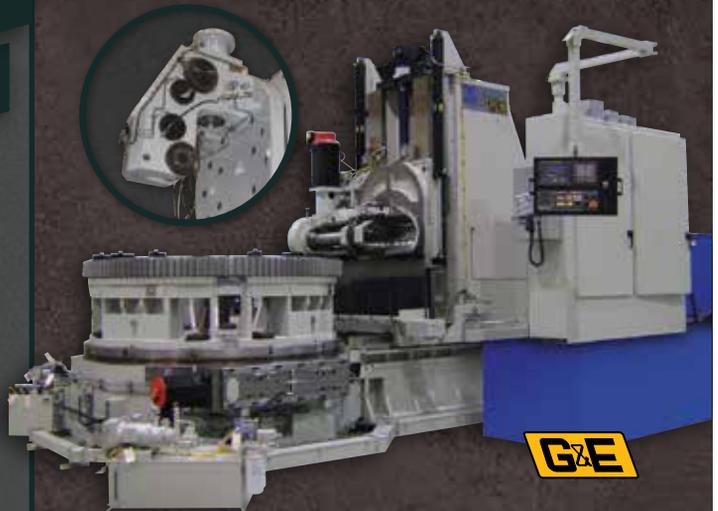
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SIEMENS

Siemens ranked second among turbine manufacturers in 2012 U.S. installed capacity (2,638 MW, 20.1 percent share), and cumulatively had installed more than 8.5 GW in the U.S. as of 2012. The company is also a leader among manufacturers in the European offshore market. Recently, Siemens landed the largest single turbine order in history (1,050 MW) from MidAmerican Energy (see page 9).

SIEMENS, DONG ENERGY REACH DEAL ON 582 MW GERMAN NORTH SEA OFFSHORE PROJECTS

Siemens recently announced it will supply 97 wind turbines, each with a rating of six megawatts and a rotor diameter of 154 meters, to the Danish energy provider DONG Energy. The total capacity for the Gode Wind 1 and Gode Wind 2 projects is 582 MW, enough to supply around 600,000 German households with eco-friendly power.

The Gode Wind 1 (252 MW) and Gode Wind 2 (330 MW) wind power plants will be erected off the North Sea island of Juist, around 45 kilometers from the German coast in water depth of up to 34 meters. This will mark the first time that Siemens will be supplying its new 6 MW wind turbines for offshore in Germany. Siemens will also service the wind turbines for a period of five years. Construction is planned to begin in the first half of 2015, with commissioning scheduled for the second half of 2016.

“Offshore wind energy is a vital contributing factor to the success of the energy transition in Germany,” stated Markus Tacke, Siemens wind power division CEO. “Only at sea can wind projects of a performance category equivalent to major power plants be erected in Germany. Offshore wind energy will also act as a stabilization factor in the German energy mix. Offshore wind power plants produce electricity on more than 340 days per year, thanks to stable wind conditions at sea.”

Siemens is at the front of the market for offshore wind power plants, for grid connection and for offshore wind service. To date, the company has installed wind turbines with a total capacity of 3.9 gigawatts (GW) at sea worldwide. Siemens currently has orders for offshore projects with a capacity of around 5 GW in the books.

“Despite the fact that offshore wind energy is quite a new technology, we are making great advances. In the coming ten years we intend to reduce costs by up to 40 percent,” declared Mr. Tacke. “To accomplish this, it is essential that we have clearly defined and reliable framework conditions for the expansion of offshore wind power in Germany.”

SIEMENS D6 PLATFORM	
	SWT-6.0-154
Rated Power (kW)	6,000
Wind Class (IEC)	
Cut-in Wind Speed (m/s)	3-5
Cut-out Wind Speed (m/s)	25
Rotor Diameter (m)	154
Hub Height (m)	Site-specific
Swept Area (m²)	18,600
Generator Type	Synchronous permanent magnet
Rated Voltage (V)	690
Drivetrain	Direct drive



SIEMENS D3 PLATFORM				
	SWT-2.3-113	SWT-3.0-101	SWT-3.0-108	SWT-3.0-113
Rated Power (kW)	2,300	3,000		
Wind Class (IEC)				
Cut-in Wind Speed (m/s)	3		3-5	
Cut-out Wind Speed (m/s)	25			
Rotor Diameter (m)	113	101	108	113
Hub Height (m)	99.5 or site specific	47.5, 79.5, 89.5, 94, 99.5	79.5	79.5, 92.5, 99.5, 122, 142
Swept Area (m ²)	10,000	8,000	9,144	10,000
Generator Type	Synchronous, permanent magnet			
Rated Voltage (V)	690			
Drivetrain	Direct drive			

SIEMENS G2 PLATFORM				
	SWT-2.3-82	SWT-2.3-93	SWT-2.3-101	SWT-2.3-108
Rated Power (kW)	2,300			
Wind Class (IEC)				
Cut-in Wind Speed (m/s)	3-5	4		3-5
Cut-out Wind Speed (m/s)	25			
Rotor Diameter (m)	82.4	93	101	108
Hub Height (m)	80 or site-specific			
Swept Area (m ²)	5,300	6,800	8,000	9,144
Generator Type	Asynchronous			
Rated Voltage (V)	690			
Drivetrain	3-stage planetary/helical gearbox			

SIEMENS G4 PLATFORM			
	SWT-3.6-120	SWT-4.0-120	SWT-4.0-130
Rated Power (kW)	3,600	4,000	
Wind Class (IEC)			
Cut-in Wind Speed (m/s)	3-5		
Cut-out Wind Speed (m/s)	25	32	
Rotor Diameter (m)	120		130
Hub Height (m)	90 or site-specific		Site-specific
Swept Area (m ²)	11,300		13,300
Generator Type	Asynchronous		
Rated Voltage (V)			
Drivetrain	3-stage planetary/helical gearbox		

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inFOCUS: Turbine Directory

VESTAS

Vestas ranks second in the United States in terms of cumulative installed capacity (11.3 GW as of 2012), and accounted for more than 1.8 GW of U.S. installations in 2012.

VESTAS AND ENEL GREEN POWER INK DEAL FOR 350 MW, PLAN FOR ORDER OF ADDITIONAL 636 MW

Vestas will supply 75 V100-2.0 MW turbines for the 150 MW Origin wind power plant in Oklahoma. Vestas and EGP-NA also have signed an agreement for up to an additional 836 MW worth of 2 MW turbines of which 200 MW is firm. Deliveries for Origin are expected to occur midyear, followed by commissioning by the end of December.

“We’re thankful to work again with a major global company like Enel which has a proven track record of building successful wind-energy

projects in this country,” said Chris Brown, President of Vestas’ sales and service division in the United States and Canada.

Vestas’ factories in Colorado will be involved in manufacturing blades, nacelles and towers for the 350 MW order. To meet customer demand, Vestas is adding more workers at three of its Colorado factories—the blade factory in Windsor as well as the blade and nacelle factories in Brighton. Vestas is recruiting now and expects to add hundreds of production workers in the first half of 2014 in Windsor and Brighton, primarily at the two blade factories. Interested candidates can apply at ElwoodWindJobs.com.



VESTAS V90 and V100		
	V90-3.0 MW	V100-2.6 MW
Rated Power (kW)	3,000	2,600
Wind Class (IEC)	Ia, IIa	IIb
Cut-in Wind Speed (m/s)	3.5, 20 (re-cut in)	3, 20 (re-cut in)
Cut-out Wind Speed (m/s)	25	23
Rotor Diameter (m)	90	100
Hub Height (m)	65, 80 (Ia); 105 (IIa)	
Swept Area (m ²)	6,362	7,854
Generator Type	4-pole doubly fed generator	
Rated Voltage (V)		
Drivetrain	gearbox, two planetary stages and one helical stage	

VESTAS V164-8.0 MW	
Rated Power (kW)	8,000
Wind Class (IEC)	S
Cut-in Wind Speed (m/s)	4
Cut-out Wind Speed (m/s)	
Rotor Diameter (m)	164
Hub Height (m)	
Swept Area (m ²)	site specific
Generator Type	permanent magnet
Rated Voltage (kV)	33-35 or 66
Drivetrain	

The Origin project will include a three-year Active Output Management (AOM) 5000 service agreement. AOM 5000 is an energy-based availability guarantee that ensures the turbines are operational when the wind is blowing. This service option includes the VestasOnline surveillance system that remotely controls and monitors the turbines and predicts potential wear-and-tear issues. This allows Vestas to plan maintenance so the turbines operate with the minimum amount of lost production.

Vestas has previously supplied wind turbines to Enel for three U.S. projects, most recently the 200 MW Caney River wind power plant in Kansas that was commissioned in 2011.

EGP-NA, part of Enel Green Power, is a leading owner and operator of renewable energy plants in North America with projects operating or under development in 21 U.S. states and two Canadian provinces.

VESTAS 2MW PLATFORM						
	V80-2.0 MW	V90-1.8/2.0 MW		V100-1.8/2.0 MW		V110-2.0MW
Variant/application		1.8 MW	2.0 MW	1.8 MW	2.0 MW	
Rated Power (kW)	2,000	1,800 (50 Hz); 1,815 (60 Hz)	2,000 (50 Hz)	1,800 (50 Hz)	2,000 (60 Hz)	2,000
Wind Class (IEC)	Ia	IIa	IIIa	S (IIIa average wind/IIa extreme wind); IIb		IIIa
Cut-in Wind Speed (m/s)	4			3		
Cut-out Wind Speed (m/s)	25			20		
Rotor Diameter (m)	80	90		100		110
Hub Height (m)	80	80, 95, 105 (50 Hz)	80, 95, 105, 125	80, 95, 120 (IIIa)		80, 95 (60 Hz); 95, 125 (50Hz)
Swept Area (m ²)	5,027	6,362		7,854		9,503
Generator Type	4-pole (50Hz)/6-pole (60Hz) doubly fed generator, slip rings					
Rated Voltage (V)						
Drivetrain	gearbox; 2 helical stages and one planetary stage					

VESTAS 3MW PLATFORM						
	V105-3.3 MW	V112-3.3 MW		V117-3.3 MW	V126-3.3MW	
Variant/application		IIa	IIb			
Rated Power (kW)	3,300					
Wind Class (IEC)	Ia	IIa	IIb	IIa		
Cut-in Wind Speed (m/s)	3, 23 (re-cut in)					3, 20 (re-cut in)
Cut-out Wind Speed (m/s)	25					22.5
Rotor Diameter (m)	105	112		117		126
Hub Height (m)	site specific	84, 94 (IEC IIa); 119, 140 (IIIa)	site specific	91.5, 116.5		117 (IIIb); 137 (IIIa)
Swept Area (m ²)	8,659	9,852		10,751		12,469
Generator Type						
Rated Voltage (V)						
Drivetrain	gearbox, two planetary stages and one helical stage					

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GAMESA

Spanish turbine manufacturer Gamesa—celebrating 20 years in the wind energy industry this year—ranks fourth among total installed U.S. wind energy capacity (3.9 GW, 2012).

GAMESA TO SUPPLY GESTAMP WIND 128 MW FOR FIVE WIND PROJECTS IN BRAZIL

Gamesa has signed a supply agreement under which it will supply 128 MW of its turbines to a Brazilian wind farm complex being developed by Gestamp Wind, the wind energy subsidiary of Gestamp Renewables, in Lagoa Nova in the state of Rio Grande do Norte. The development encompasses five wind farms: Santana I (20 MW), Santana II and III (30 MW each), Lanchinha (28 MW) and Pelado (20 MW).

The scope of the agreement includes the manufacture, supply, transport, installation and commissioning of 64 G97 wind turbines, each with unit capacity of 2.0 MW, as well as the complex's foundations civil works. The wind turbines are scheduled for delivery throughout the year, and the facility is expected to be commissioned at the end of this year. Gamesa will also maintain the facility's services for 10 years.

Gamesa has secured supply contract for over 1,000 MW in Brazil, in less than two years. As of last September, Gamesa had already installed 394 MW of capacity in Brazil, one of the company's priority markets in the short and medium term.

SUPPLY AGREEMENT IN TURKEY

Gamesa and Gestamp Wind have also entered into another agreement under which the former will supply the latter 10 MW of wind turbines for a

GAMESA 850 kW CLASS		
	G52	G58
Rated Power (kW)	850	
Wind Class (IEC)	Ia	IIa / IIIb
Cut-in Wind Speed (m/s)		
Cut-out Wind Speed (m/s)		
Rotor Diameter (m)	52	58
Hub Height (m)	44, 55, 65	44, 49, 55, 65, 74
Swept Area (m ²)	2,214	2,642
Generator Type	Dual power fed	
Generator Output (V)	690	
Drivetrain	3 stage gearbox: 1 planetary, 2 parallel	

GAMESA 5.0 MW CLASS			
	G128		G132
	ONSHORE		OFFSHORE
Rated Power (kW)	4,500	5,000	5,000
Wind Class (IEC)	IIa	Ia / IIa	B
Cut-in Wind Speed (m/s)			
Cut-out Wind Speed (m/s)			
Rotor Diameter (m)	62.5		64.5
Hub Height (m)	81, 95, 120, 140	80-94; also project-specific	95, 120, 140
Swept Area (m ²)	12,868		13,685
Generator Type	Permanent magnet synchronous generator with independent modules in parallel		
Generator Output (V)	690		
Drivetrain	Gearbox; 2 planetary stages		

project in Turkey. The company will install and commission five G90-2.0 MW turbines at the Adares wind farm, which Gestamp is developing in a joint venture with Faik Celik

in Selçuk, in the province of Izmir. Gamesa will maintain these turbines for 10 years. This facility is slated for completion during the second half of this year.

GAMESA 2.0-2.5 MW CLASS						
	G80	G87	G90	G97	G114	
Rated Power (kW)	2,000				2,000	2,500
Wind Class (IEC)	Ia	Ia, IIa	Ia, IIa	IIa, IIIa	IIa, IIIa	IIa
Cut-in Wind Speed (m/s)						
Cut-out Wind Speed (m/s)						
Rotor Diameter (m)	80	87	90	97	114	
Hub Height (m)	60, 67, 78, 100	67, 78, 90, 100	67, 78, 90, 100	78, 90, 100, 120	80, 93, 125, site-specific	93, 120, 140, site-specific
Swept Area (m ²)	5,027	5,945	6,362	7,390	10,207	
Generator Type	Doubly-fed machine					
Generator Output (V)	690					
Drivetrain	3 stage gearbox: 1 planetary, 2 parallel					

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REPOWER

REpower, a subsidiary of Suzlon, accounted for 595 MW of installations in the U.S. during 2012. The company is undergoing rebranding efforts this year, and will then be known as Senvion. (Editor's note: Rebranding efforts had not been completed at press time. All references to REpower apply to the wind turbine manufacturer.)



REPOWER RECEIVES TURBINE ORDERS TOTALING 266 MW FOR 24 GERMAN COMMUNITY WIND FARMS

REpower Systems SE, a wholly owned subsidiary of the Suzlon Group, has signed contracts to deliver 103 wind turbines with a total capacity of over 266 MW for 24 community wind farm projects in the Schleswig-Holstein region of Germany. The contracts were concluded with different contractors who were previously represented by a purchasing association.

REpower signed a primary memorandum with the purchasing association, "Schleswig-Holstein GmbH Wind," in December 2012. This memorandum assured the participants from 52 projects

in Schleswig-Holstein binding conditions in a model contract. The participants could choose the appropriate offer from the final negotiated contracts of four different manufacturers for their own location. REpower has won 55 percent of all potential wind turbines for itself in this process.

The projects will employ various types of turbines from the MM82 with a 59 meter hub height, to the 3.2M114 with a hub height of 93 meters. Eleven wind turbines of the signed projects are already in the implementation phase and are to be

commissioned quickly. The other projects will be completed by 2015.

"With these contracts, we are significantly expanding our position in Northern Germany," said Andreas Nauen, CEO of REpower Systems SE. "This is only possible because we have a suitable turbine for each individual site in our product portfolio, from Lübke-Koog in the far north, to near Fehmarn in the east of Schleswig-Holstein, and also because we have the ability to implement the interests of customers optimally with our staff on site."

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REPOWER MM PLATFORM			
	MM82	MM92	MM100
Rated Power (kW)	2,050		1,800 / 2,000 (50Hz)
Wind Class (IEC)	up to Ia	up to Ib	S (IIIa annual; IIa extreme)
Cut-in Wind Speed (m/s)	3.5	3	
Cut-out Wind Speed (m/s)	25	24	22
Rotor Diameter (m)	82	92.5	100
Hub Height (m)	59, 69, 80, 100	68.5, 80, 100	80, 100
Swept Area (m ²)	5,281	6,720	7,854
Generator Type	Double-fed asynchronous; 4-pole (50 Hz), 6-pole (60 Hz)		
Rated Voltage (V)	690 (50 Hz); 575 (60 Hz)		
Drivetrain	Combined planetary/spur wheel gearbox		

REPOWER 3.XM PLATFORM			
	3.0M122	3.2M114	3.4M104
Rated Power (kW)	2,970 (MV-side, 3,000 (LV-side))	3,170 (MV-side, 3,200 (LV-side))	3,370 (MV-side, 3,400 (LV-side))
Wind Class (IEC)	IIIa	up to IIIa	up to Ib / IIa
Cut-in Wind Speed (m/s)	3		3.5
Cut-out Wind Speed (m/s)	22		25
Rotor Diameter (m)	122	114	104
Hub Height (m)	139	90-93; 120-123; 140-143	78-80; 93; 96.5-100; 125-128
Swept Area (m ²)	11,690	10,207	8,495
Generator Type	Asynchronous doubly-fed generator		
Rated Voltage	10/20/30 kV		
Drivetrain	Three stage planetary/spur-gear system		

REPOWER 6.XM PLATFORM		
	6.2M126	6.2M152
Rated Power (kW)	6,150	
Wind Class (IEC)	Ib (offshore); Ib, IIa (onshore)	S (offshore); Ib (onshore)
Cut-in Wind Speed (m/s)	3.5	
Cut-out Wind Speed (m/s)	25 (onshore); 30 (offshore)	
Rotor Diameter (m)	126	152
Hub Height (m)	100-117 onshore; approx. 85-95 offshore (location-dependent)	121, 124 onshore; approx. 95-110 offshore (location dependent)
Swept Area (m ²)	12,469	18,146
Generator Type	Double-fed induction	
Rated Voltage (kV)	20, 30, 33	20, 30, 33, 66 (upon request)
Drivetrain	Three-stage planetary/spur gearbox	

ACCIONA

Acciona Energy has the unique business model of not only being a wind turbine manufacturer, but also a wind farm developer. The company has developed more than 8 GW of wind globally. Acciona turbines accounted for 195 MW of capacity in 2012. Cumulatively, the company has 908 MW of installations in the U.S. (2012).

ACCIONA'S 3MW PLATFORM ISSUED SEVEN GL DESIGN/TYPE CERTIFICATES

GL Renewables Certification, issued seven new certificates for different models of ACCIONA Windpower's 3 MW AW 3000 turbine.

With these new certificates, Acciona Windpower now has 15 awarded for its 3 MW platform, a range of turbines for which the company has supplied or has orders for over 1,300 MW.

Specifically, GL Renewables Certification issued the Design Certificate for the AW 125/3000 IEC IIIa wind turbine, with a 125 meter rotor, 120 meter concrete tower and

61.2 meter blade, for grids of 50 and 60 Hz. This model is specially adapted for sites with low wind speeds.

GL has also given the Type Certificate for another six models of the AW 116/3000 turbine with a 116 meter rotor. Apart from validating the design, this certificate indicates that AWP has a quality management system according to the ISO 9001 standard, that the manufacture of the main components of the turbine is done in line with the highest quality standards, and that the turbine is capable of passing

the prototype tests defined in current standards.

The Type Certificate has been awarded to the models of the AW 116/3000 for 120 meter (hub height) concrete tower and for 92 meter tubular steel tower. Acciona Windpower also holds Type Certificates for three other turbine models offered on its 3MW platform: the AW 100/3000 IEC Ia (100-meter rotor), the AW 109/3000 IEC IIa (109-meter rotor), and the AW 116/3000 IEC IIa (116-meter rotor)— all mounted on 100-meter concrete towers.

AW1500			
	AW 70	AW 77	AW 82
Rated Power (kW)	1,500		
Wind Class (IEC)	Ia	IIa+	IIa
Cut-in Wind Speed (m/s)	4	3.5	3
Cut-out Wind Speed (m/s)	25		
Rotor Diameter (m)	70	77	82
Hub Height (m)	60, 80 (steel)	60, 71.5, 80 (steel); 100 (concrete)	80 (steel); 100 (concrete)
Swept Area (m ²)	3,848	4,657	5,289
Generator Type	6 poles, double feeding		
Generator Output (V)	12,000		
Drivetrain	3-stage gearbox: 1 planetary, 2 parallel (helical)		

AW3000				
	AW 100	AW 109	AW 116	AW 125
Rated Power (kW)	3,000			
Wind Class (IEC)	Ia	IIa+	IIa	IIIa
Cut-in Wind Speed (m/s)	4	3.5	3	3.5
Cut-out Wind Speed (m/s)	25			
Rotor Diameter (m)	100	109	116	125
Hub Height (m)	100 (concrete)	95.5 (steel); 100 (concrete)	92 (steel); 100, 120 (concrete)	Site specific (steel); 120 (concrete)
Swept Area (m ²)	7,864	9,360	10,568	12,305
Generator Type	6 poles, double feeding			
Generator Output (V)	12,000			
Drivetrain	3-stage gearbox: 2 planetary, 1 parallel (helical)			

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MITSUBISHI

Mitsubishi Power Systems, a division of Mitsubishi Heavy Industries Ltd. has been involved in the development and manufacture of wind turbines since 1980. At the end of 2012, the company's turbines account for nearly 3.9 GW of total U.S. installed capacity.

MITSUBISHI WIND TURBINE MODELS						
	MWT62/1.0	MWT92/2.4	MWT95/2.4	MWT92/2.3	MWT100/2.4	MWT102/2.4
Rated Power (kW)	1,000	2,400		2,300	2,400	
Wind Class (IEC)	IIa	IIa	IIa	Ia	IIa	
Cut-in Wind Speed (m/s)	3					
Cut-out Wind Speed (m/s)	25					
Rotor Diameter (m)	61.4	92	95	92	100	102
Hub Height (m)	50, 60, 69	80				
Swept Area (m ²)	2,960	6,648	7,088	6,648	7,854	8,171
Generator Type	Induction generator (4-pole)	Doubly fed asynchronous generator + IGBT converter				
Rated Voltage (V)	690 (50Hz), 600 (60Hz)			690		
Drivetrain						

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NORDEX

German turbine manufacturer Nordex has nearly three decades of experience in wind industry, amassing a global installed capacity of more than 9 GW. In 2012, U.S. developers installed 111 Nordex turbines, accounting for 274 MW of installed capacity.



NORDEX EXTENDS “GENERATION DELTA” WITH THE ADDITION OF THE N131/3000 FOR LIGHT-WIND SITES

Nordex SE is extending the “Generation Delta” turbine platform launched in spring 2013 with the addition of a turbine for light-wind locations. With the N131/3000, customers will not only be able to choose from strong and moderate-wind turbines but now also from a highly efficient system specially designed for IEC-3 locations. The N131/3000 combines the proven advantages of the high efficiency and low sound power levels of the Gen-

eration Gamma’s N117/2400 turbine with the benefits of a high nominal output and the technical advances of the Delta platform.

A special feature of the N131/3000 is the substantially larger rotor. With rotor blades measuring 64.4 metres in length, the rotor diameter is 14 metres larger, thus producing a close to 26 percent increase in rotor sweep. This sweep plays a key role for energy yield. For this reason, the N131/3000 will achieve substan-

tially improved project economics compared with existing turbines particularly at light-wind locations. The N131/3000 can derive up to 28.6 percent more yield from sites characterized by lighter winds. The reason for this is that Nordex also has raised the nominal output of this product for locations with wind speeds of less than 7.5 m/s by 25 percent to 3.0 MW.

Nordex is offering the N131/3000 on tubular steel towers with a hub

height of 99 and 114 metres for international markets. The target markets for the N131/3000 are Central Europe, Scandinavia and Turkey, as well as selected regions in Africa and the Americas.

One particular advantage of the turbine is the low operating sound power level. At nominal power, it achieves a sound power level of only 104.5 dB (A) – an advantage in densely populated regions or at noise-critical locations. A range of noise-optimised operating modes make it possible to run the turbine specifically meeting the requirements of those locations and so to reduce emissions even further.

The N131/3000 is based on the technical platform used in Generation Delta. All relevant certificates and documents required to apply for building permits have been available for the moderate-wind turbine N117/3000 and the strong-wind version N100/3300 since summer 2013. The first three Generation Delta turbines are in operation in Germany and Denmark. In Finland, two further cold-climate turbines were recently installed.

The first light-wind N131/3000 turbine is to be installed in the fourth quarter of 2014. Series production of the turbine is scheduled for 2015.

NORDEX GENERATION GAMMA			
	N90/2500	N100/2500	N117/2400
Rated Power (kW)	2,500		2,400
Wind Class (IEC)	Ia	IIa	IIIa
Cut-in Wind Speed (m/s)	3		
Cut-out Wind Speed (m/s)	25		20
Rotor Diameter (m)	90	99.8	116.8
Hub Height (m)	65, 70, 80	75, 80, 100	91, 120, 141
Swept Area (m ²)	6,362	7,823	10,715
Generator Type	Double-fed asynchronous		
Generator Output (V)	660		
Drivetrain	Combined spur/planetary gear or differential gearbox		

NORDEX GENERATION DELTA			
	N100/3300	N117/3000	N131/3000
Rated Power (kW)	3,300	3,000	
Wind Class (IEC)	Ia	IIa / IIIa (141m)	IIIa
Cut-in Wind Speed (m/s)	3.5	3	
Cut-out Wind Speed (m/s)	25		20
Rotor Diameter (m)	99.8	116.8	131
Hub Height (m)	75, 100	91, 120, 141	99, 114
Swept Area (m ²)	7,823	10,715	13,478
Generator Type	Doubly-fed asynchronous		
Generator Output (V)	660		
Drivetrain	Combined spur/planetary gear		

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GOLDWIND

Headquartered in China, Goldwind's entire wind turbine portfolio takes advantage of permanent magnet direct drive technology. Globally, the company has an installed capacity of more than 15 GW. In 2012, the U.S. market installed 155 MW of the company's turbines.

GOLDWIND BREAKS INTO ROMANIAN, EASTERN EUROPEAN MARKETS

Goldwind recently announced the first successful installation of its 2.5 MW PMDD wind turbine, as part of a 50 MW turbine supply contract with the Romanian company Mireasa Energies S.R.L. The installation also

marks the first Chinese wind turbine in Romania as well as Eastern European Market.

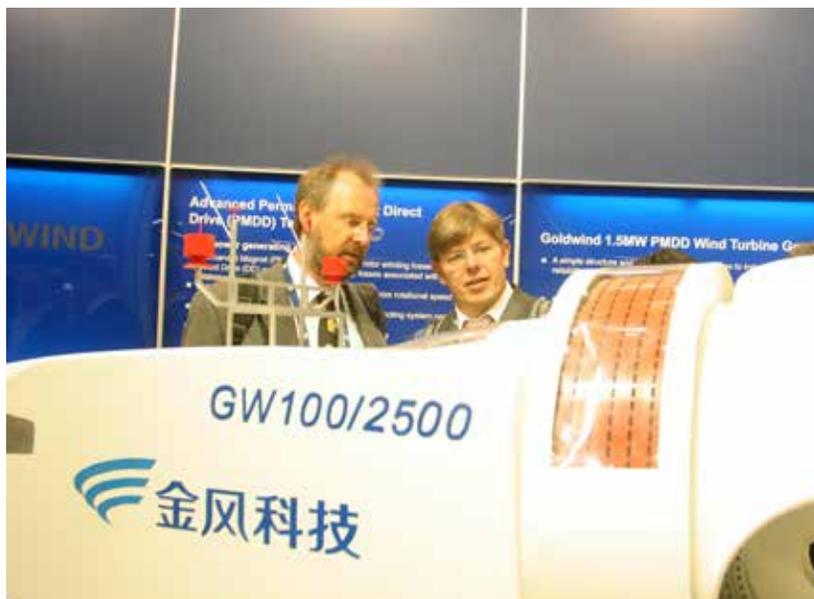
The Mireasa project is located in Constanta, Romania's second largest harbor city. The city is on the west

coast of the Black Sea—170 kilometers east of the capital city of Bucharest. The Constanta region is one of the country's most prosperous areas.

Constanta has several benefits, including a temperate climate with an average annual temperature of about 10 degrees Celsius, annual rainfall of 600 to 800 millimeters, and the main attraction for electric generation is its abundant wind.

Goldwind customized its permanent-magnet direct-drive wind turbine to optimize its operating performance for local conditions in Constanta—a standard practice for the company's installations. The objectives are to make the best use of the wind resources and to provide the most durable long-life performance for each installation, given the location's environment.

Twenty Goldwind 2.5 MW wind turbines were expected to be shipped to Romania by the end of 2013. The turbine installations and connections to the local electric grid are to be completed in June. Monsson Alma, a local wind power developer in Romania, will operate the wind farm.



Goldwind recently announced the installation of its 2.5MW PMDD turbine, a scale model of which is seen here, in Romania, marking the first Chinese wind turbine installation in Eastern Europe.

GW 2.5MW			
	GW 90	GW 100	GW109
Rated Power (kW)	2500		
Wind Class (IEC)	IIa	IIIa	IIa / IIIa
Cut-in Wind Speed (m/s)	3		
Cut-out Wind Speed (m/s)	25		
Rotor Diameter (m)	90	100	109
Hub Height (m)	Site specific		
Swept Area (m ²)	6,316.7*	7,854*	9,331.3*
Generator Type	Multi-pole synchronous, permanent magnet excitation		
Generator Output (V)	690		
Drivetrain	Direct Drive		

GW 1.5MW				
	GW 70	GW 77	GW 82	GW 87
Rated Power (kW)	1,500			
Wind Class (IEC)	Ia	IIa	IIIa	IIIb
Cut-in Wind Speed (m/s)	3			
Cut-out Wind Speed (m/s)	25	22		
Rotor Diameter (m)	70	77	82	87
Hub Height (m)	Site specific			
Swept Area (m ²)	3,848.5*	4,656.6*	5,281*	5,944.7*
Generator Type	Multi-pole synchronous, permanent magnet excitation			
Generator Output (V)	620 (air-cooled) or 690 (water-cooled)			
Drivetrain	Direct drive			

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