

A guyed tower is used to further reduce weight and to allow the whole machine to be lowered to the ground for maintenance. The gearbox is a specially designed, two stages, planetary design to maximize the power to weight ratio. The generator is integrated with the gearbox so that space and weight are saved.

The blades are mounted on a specially designed, filament wound, flexible beam that allows the blades to cone in high winds. The beam is torsion ally flexible so that the blades can be pitched to stop the machine in high winds or in an emergency.

A failsafe electromagnet holds the blades in their normal operating position but is released on receiving a fault signal or when power is lost. A mechanical disk brake acts as a back up to the blade pitching and also holds the rotor steady during maintenance.

Each Model 300 wind turbine has an Enerpro SCR (silicon controller rectifier) controller which can turn the generator on and off 120 times per second and can in effect vary the generator voltage like a light dimmer switch. This controller constantly monitors the generator rpm and, when the generator reaches precisely 1800 rpm, directs the SCR controller to tie the generator into the utility grid.

A variable voltage system is used to run the generator at the most efficient voltage corresponding to the generator's kW output. This feature can significantly improve the wind generator's yearly kWh production, providing the most improvement when the generator is producing less than 50kW. For example, at a 5kW output the generator efficiency is 83% when using the variable voltage controller but is less than 30% when run at 480 volts (no variable voltage control). Even though the generator's voltage is effectively varied, the voltage output to the utility grid is held constant.

Yaw or wind tracking is provided by an active/passive yaw drive system. A weather vane mounted on the nose of the pod provides a signal that tells the controller how much the pod heading differs from the wind direction. If the pod is not lined up with the wind within a certain angle, typically 15 degrees, and within a certain period of time, the controller signals the yaw motor to operate until the pod are again aligned with the wind.

In light winds (< 15 mph) the turbine will not normally accurately track the wind without this active yaw drive; however, in higher winds there is enough yaw stability in the blades to cause the turbine to accurately track the wind. This natural yaw tracking force back drives the yaw motor without having to wait for the controller to sense a wind direction change. In this situation the yaw motor acts as an inertia damper. Because of high loads than can be induced into the yaw drive, a slip clutch is incorporated into the yaw drive gearbox to limit the loads imposed on the yaw drive. This slip clutch is a multiple disk design using hardened steel disks running in oil so that wear is virtually non-existent.

System Specifications (Summary)

TOWER

Tubular, tilt-up with gin pole
160 ft high
12 sided, galvanized steel
Four guys, connecting 125' above base

OPERATIONAL DATA

Cut-in wind-speed: 8.9 mph
Cut-off wind-speed: 60 mph
Survival wind-speed: 125 mph

ROTOR

67 or 78 ft diameter
Downwind orientation

MISCELLANEOUS

Entire Assembly (Turbine, rotor, tower, turnbuckles, guy cables, winch, controller) weighs approx. 27,000 lbs.
Tilt-up or down accomplished by winch in about 20 minutes (depending upon conditions)

GENERATORS

Induction generator
Maximum rated output: 400 kW
480 VAC; 3-phase; 60 Hz

COMPONENT WEIGHT

Hub and rotor:	1,920 lbs.
Tower and gin pole:	17,650 lbs.
Nacelle:	4,250 lbs.

BLADES

Fiberglas composite
3580 sq ft swept area

Requirement to be connected to Utility Grid

These turbines must be connected to an electric utility grid. A significant advantage of this connection can be a special metering and billing arrangement called net metering with your Electric Service Provider (ESP).

If your ESP approves this, net metering is the way in which you sell your extra power to the ESP. When your turbine produces more electricity than you need, the excess flows to the grid and turns your meter backwards. This net (subtracting from you usage) metering allows you to get retail value for some, if not all, of the electricity your turbine produces. Most ESPs will buy your excess power, but the rates vary by location.

You need to contact your ESP to find out their requirements for a parallel generator (this is when you are both a producer and a consumer of electricity). For everyone's protection some grid inter tie control will be required. You may be required to install a locking disconnect switch for the wind turbine next to your kilowatt- hour meter. We will supply a block diagram of the major system components. An electrical schematic showing how your turbine is connected, depending on local condition can be added by you or your contractor. Also, the ESP may ask you to carry liability insurance. This can be added to your homeowners policy.

Wind Speed and Performance Estimates

We suggest the turbines be operated in an area with at least 12 mph (near the ground, 15 mph at turbine height) annual average wind speed. You may be able to obtain wind speed information from a local airport or weather bureau. Keep in mind that if the local airport monitors the wind speed at 20 to 30 feet above ground, the actual wind speed at 160 ft. elevations may be 3 to 4 mph higher. Normally the wind speed increases as we move away from the surface of the earth.

The calculation of the estimated energy production of the turbines depends on the power output of the turbines at various wind speeds, or the "Power Curve", the expected wind conditions at the operating site, and the estimated turbine availability rate and power transfer line losses.

PERFORMANCE ESTIMATES

Wind Speed (mph at rotor height)	Power Output (kW) 67' Rotor	Power Output (kW) 78' Rotor
10	3	20
15	35	55
20	90	105
25	152	166
30	206	220
35	255	275
40	275	305
45	286	325
50	295	337
55	305	346
60	320	349

Actual output varies with air density and turbulence. Carter makes no representations or warranties express or implied regarding the power curve or power output of these turbines.

Installation and Servicing

The Carter 300 wind turbine requires minimal site preparation since the low weight of the system means that heavy lifting equipment is not essential for installation. The tilt down tower offers further advantages since all assembly is done within 15 feet of the ground.

The heaviest component that must be handled on your site is the complete nacelle assembly. This assembly weighs just 3.5 tons and needs to be lifted to a height of just over 12 feet.

Foundation requirements vary depending on your soil conditions, but typically use 40 cubic yards of concrete in five separate pads. You will be provided sample foundation drawings at the time of purchase.

Servicing the turbines is rather simple. All maintenance work can be done at ground level using light equipment. We will provide manuals and blueprints at the time of sale. For future needs, technical phone support or on-site training can be purchased for a reasonable fee.

The turbines are not offered with any warranty (express or implied) but my distributor does stock a supply of replacement parts.

TO ORDER A TURBINE OR FOR FURTHER INFORMATION, PLEASE CONTACT:

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