

Small Wind System Requirements

Developed by



v. 4

Revision History

Revision	Date	Author	Change
0.0	7/9/07	E. Johnston	Prelim Internal Review Draft
0.1	9/26/07	T. Olsen	Add general, materials, and equipment and installation requirements
0.2	10/01/07	A. Cowan	Review Draft
0.3	10/11/07	A. Cowan	Add lightning protection and surge suppression requirement
1	10/11/07	E. Johnston	Revised per Staff
2	10/19/07	E. Johnston	Reduced minimum tower height to 60 feet
3	1/08/08	E. Johnston	Added Endurance Wind Power S-250 5kW wind turbine to list of eligible turbines
4	7/14/08	E. Johnston	Corrected PGE's interconnection process

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I Purpose

This System Requirements document details the requirements and minimum criteria for small wind systems installed by a Small Wind Trade Ally Contractor ("Contractor") under Energy Trust's Small Wind Program (the "Program").

The purpose of the system requirements is to help ensure that all small wind systems installed as a part of the Program are designed to be long-lasting and will meet or exceed their expected performance. Any variations from the Program's system requirements are subject to prior approval by Energy Trust.

2 System Requirements

The following minimum criteria will be used to determine if a proposed small wind system is eligible under the Program.

2.1 General

- 2.1.1 The system must be grid-connected and installed on buildings or properties that receive electrical service directly from Portland General Electric ("PGE") or Pacific Power in the State of Oregon.
- 2.1.2 The system must meet local utility interconnection and net metering requirements.
- 2.1.3 Systems must be installed upon real property owned by the Program participant.
- 2.1.4 The installation must be of industry standard and workmanlike quality.
- 2.1.5 The system should be designed for optimal annual performance. See **Section 2.5** through **Section 2.7**.
- 2.1.6 The system design must be documented with as-built drawings that accurately describe the components installed and the wiring design, including wire sizes and estimated length of wire runs. This and a parts list must be included in the Customer Manual. See **Section 4**.
- 2.1.7 The system must be properly permitted, inspected, and in compliance with all applicable building and electrical codes.
- 2.1.8 The system equipment must be installed by a licensed installer according to the National Electrical Code.

2.2 Materials

- 2.2.1 Materials used outdoors should be sunlight/UV-resistant, NEMA (National Electrical Manufacturers Association) approved and rated for outdoor locations.
- 2.2.2 Materials used must be designed to withstand the temperatures to which they are exposed.

- 2.2.3 Dissimilar metals that have galvanic action (such as aluminum and steel) must be isolated from one another using industry standard practices (such as non-conductive shims, washers, or other methods).
- 2.2.4 Aluminum must not be placed in direct contact with concrete materials.
- 2.2.5 Only high-quality fasteners will be used.
- 2.2.6 Structural members shall be either:
- Corrosion-resistant aluminum, 6061 or 6063.
 - Hot-dip galvanized steel per ASTM A123.
 - Coated or painted steel (not allowed in marine environments).
 - Stainless steel (recommended for marine environments).

2.3 Equipment and Installation

- 2.3.1 All system components must be new or approved refurbished.
- 2.3.2 Wind turbine must be on the list of Energy Trust Qualified Wind Turbines. See **Section 2.4.**
- 2.3.3 Tower must be designed to accommodate the proposed wind turbine
- 2.3.4 Foundations must be designed to accommodate the proposed wind turbine, tower, and soils conditions, and must be certified by a licensed professional.
- 2.3.5 Tower must be at least 60 feet tall.
- 2.3.6 Wind turbine may not be mounted on any pre-existing structures.
- 2.3.7 All components must be mounted securely.
- 2.3.8 All electrical equipment must meet appropriate current electrical standards and be approved by a nationally recognized testing laboratory (e.g. UL, ETL).
- Inverters must meet IEEE 929, 1374 and 1547 (listed to UL 1741), or their successor standards.
- 2.3.9 Manufacturer warranties must cover:
- Inverter and controller for a minimum of 5 years against manufacturer's defects
 - Wind turbine for a minimum of 5 years against manufacturer's defects
- 2.3.10 Installer's warranty must cover workmanship for a minimum of 2 years.

- 2.3.11 All electrical equipment must be listed for the voltage and current ratings necessary for the application.
- 2.3.12 Equipment that is modified such that it voids the UL listing or manufacturer warranty is not allowed.
- 2.3.13 All required over-current protection must be included in the system and accessible for maintenance.
- 2.3.14 A means of disconnection from all sources of power (both AC and DC) must be provided such that the inverter can be safely isolated and removed for service.
- 2.3.15 All electrical terminations must be torqued to specifications, secured, and strain-relieved as appropriate.
- 2.3.16 All cables, conduit, exposed conductors, and electrical boxes must be secured and supported according to code requirements and in accordance with their performance ratings (i.e. NEMA).
- 2.3.17 Twist-on wire connectors shall not be used on DC conductors or ground wire. Instead, these wire connections will be made using terminal strips in combiner boxes, split bolt connectors or other mechanical wire splicing devices.
- 2.3.18 Permanent labels must be applied to system components as required by NEC, including the wind turbine disconnect.
- 2.3.19 Disconnect switch coverplates (not switch handles) shall be secured closed for safety (e.g. padlock, zip tie, etc.).
- 2.3.20 The equipment shall include lightning protection and surge suppression.
- 2.3.21 All components must be installed per manufacturer specifications.
- 2.3.22 Energy Trust may, at times, require systems receiving an Energy Trust incentive to include the installation of an anemometer. If, upon its review of the Incentive Application, Energy Trust determines that an anemometer is necessary, Energy Trust will notify both the Contractor and the Program participant and additional Incentive paperwork will be required before the Application can be approved. If Contractor installs an anemometer, the anemometer documentation must be included in the Customer Manual.

2.4 Qualified Wind Turbines

Turbines must be on the Energy Trust qualified turbine list in order to be eligible for an incentive. To qualify for the list, the following criteria shall be used by Energy Trust, (1) certification by a nationally recognized testing laboratory or organization as meeting the safety and performance requirements of a nationally or internationally recognized testing institution, or (2) providing technical information and specifications of the wind generator for Energy Trust review and providing acceptable evidence demonstrating one

year of reliable operation of that model of equipment at a site with average annual wind speeds of at least 12 mph.

Energy Trust may add also wind turbines that have been approved by other jurisdictions with similar eligibility criteria to the list of Qualified Wind Turbines.

Energy Trust is currently participating in the Small Wind Certification Corporation's efforts to create a national certification program and will become the preferred method for qualifying wind turbines and estimating annual energy output.

The Energy Trust Qualified Wind Turbines are as follows:

- Abundant Renewable Energy – ARE 110 – 2.5kW
- Abundant Renewable Energy – ARE 442 – 10kW
- Bergey Windpower - BWC XL.1 - 1kW
- Bergey Windpower - EXCEL - 10kW
- Endurance Wind Power – S-250 – 5kW
- Entegry Wind Systems – EW15 – 50kW
- Fuhrlander – FL 30 – 30kW
- Southwest Windpower – Skystream 3.7 – 1.8kW
- Wind Turbine Industries – Jacobs 23-10 – 10kW
- Wind Turbine Industries – Jacobs 31-20 – 20kW

2.5 Wind Resource and Turbine Siting

- 2.5.1 The average annual wind speed at the hub height at the proposed site of the turbine must be equal to or greater than 10 mph, as determined by 3Tier Group's online wind speed map, Firstlook, or other nationally recognized wind resource map, and verified by Energy Trust's in-house wind speed data. See **Section 5.1.1** for more on wind resource assessment.
- 2.5.2 Participant's lot size must be at least one acre.
- 2.5.3 Wind turbine must be placed 30 feet above any physical wind barrier (e.g. trees or buildings) within a 300 foot radius.
- 2.5.4 Minimum set-back between the tower base and property lines and power lines must be equal to or greater than the height of the wind system, including the blades. Participants may apply for exemptions from the minimum distance to a property line with written permission, in the form of a completed **Form 765: Turbine Location Consent and Release**, from the affected neighbor.

2.6 Output Meter

- 2.6.1 A "revenue quality" electric meter which meets the following specifications must be installed on the AC output of the wind system, which measures **ONLY** the AC output of the wind turbine. Refurbished meters may be used with the Program's pre-approval.
- ANSI certified revenue meter

- 0.5 or better accuracy class
 - Digital display or cyclometer display for easy reading by system owner
 - One of the following configurations
 - Single-phase 120 volt – Form 1S – Class 100
 - Single-phase 240 volt – Form 2S – Class 200
 - Three-phase 120-480 volt – Form 14-16S – Class 200
 - Meter warranty of not less than 1 year
- 2.6.2 Multiple-inverter systems may either combine output through a dedicated sub-panel from which the output is metered or use one electric meter for each inverter.
- 2.6.3 The wind system meter must have a UV-resistant label identifying it as the **Wind Turbine Output**.
- 2.6.4 All meters must be set at 000000 at time of shipment to the Contractor to ensure accurate and consistent “start” readings for every system.
- ## 2.7 Battery-based Systems
- 2.7.1 Batteries must be located in a secure enclosure that meets seismic requirements and is weatherproof as needed.
- 2.7.2 Access to live battery terminals must be limited per code.
- 2.7.3 Flooded lead acid batteries must be housed in an enclosure with adequate spill containment and vented to the outdoors, with a nearby clearly marked safety kit.
- 2.7.4 Battery interconnect and inverter cables must be properly sized, with UL-certified or equivalent cables and lugs, with the lugs properly double-crimped.
- 2.7.5 Charge controller and inverter settings must be appropriate for the installation’s batteries, and set for grid-tied optimum performance.
- 2.7.6 Temperature compensation probes for inverter and/or charge controller must be installed to control battery charge properly.
- 2.7.7 Wind turbine must operate within current and voltage limits of charge controller.
- 2.7.8 Battery overcharge protection using turbine regulation and/or diversion controller and diversion load must be installed.
- 2.7.9 Customer Manual must include instructions for operation, maintenance and safety procedures for batteries, charge controller and inverter.

2.7.10 AC output meter is of the 5-jaw type, and is correctly wired to meter power flows to both utility and AC loads.

2.8 Utility Net Metering Requirements

Prior to final inspection, Contractor must provide the Inspector with either a copy of the signed interconnection agreement between the participant and the utility or proof that an agreement is pending. Contractor will include a copy of the agreement in the Customer Manual.

The processes set forth below represent Energy Trust’s understanding of the net-metering equipment and processes required by each utility. However, this information is subject to change and the information provided by Energy Trust in this section may or may not be the most current. Contractor is responsible for obtaining and verifying the relevant utility’s current net metering requirements.

PACIFIC POWER
 Customer Service: (888) 221-7070
<http://www.pacificpower.net>
 Schedule 135 – Net Metering Service
 Net Metering Coordinator:
 Frank Vanderpool
 (800) 831-3125

PORTLAND GENERAL ELECTRIC
 Customer Service: (800) 542-8818
<http://www.portlandgeneral.com>
 Schedule 203 – Net Metering Service
 Net Metering Coordinator:
 Bruce Barney
 (503) 464-7812

PACIFIC POWER Interconnection Process:

1	Contractor installs small wind system at customer site.
2	Contractor obtains an electrical code inspection.
3	Customer or contractor calls Pacific Power at (800) 469-0614 to schedule net meter installation. Caller should request a work order number from Pacific Power (Energy Trust will ask for this work order number as verification that the utility has been notified of the wind system installation.)
4	Pacific Power visits site to verify code inspection has been passed and interconnection requirements are met. Pacific Power replaces existing meter with new net meter. Pacific Power provides two copies of Net Metering Agreement to customer.
5	Customer signs both copies of Net Metering Agreement and gives them to Pacific Power at the time of the net meter installation or by mail.
6	Utility mails fully executed Net Metering Agreement to customer if not provided at net meter installation.

PGE Interconnection Process:

1	Customer completes and signs <u>two</u> copies PGE’s Net Metering Application Level 1 (<25 kW) or Level 2 (>25 kW), keeps one
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	copy to show Energy Trust inspector, and mails one original to: <i>Net Metering Coordinator, Portland General Electric, 121 SW Salmon Street M/S WTC 0407, Portland, OR 97204</i>
2	Customer signs <u>two</u> copies of PGE's Net Metering Agreement (available on PGE's website), keeps one copy to show Energy Trust inspector, and mails one original to above address. The Net Metering Application and Agreement can be submitted together.
3	Contractor installs small wind system.
4	Contractor obtains an electrical code inspection.
5	Contractor calls Bruce Barney at PGE, at 503-464-7812 to schedule a utility inspection.
6	PGE inspector visits site to verify equipment UL listed, code inspection passed and interconnection requirements met.
7	PGE installs new net meter.
8	Utility mails fully executed net metering agreement to customer and arranges to begin Net Metering billing on their account.

3 Customer Information

Contractor must explain the following information before seeking a Program participant's signature on the Incentive Application Form.

3.1 Incentive Application

- **Wind resource information:** Document that the participant's wind resource meets Energy Trust's minimum 10 mph wind speed based on wind maps. See Section 5.1 for more on wind resource assessment.
- **Performance estimate:** Educate customer about the amount of energy he/she should expect to generate annually. This gives the participant a baseline to which the system's actual performance can be compared.
- **Incentive:** Explain Energy Trust's incentive rates, and how the incentive payment will be made (directly to the participant or to the Contractor in exchange for a lower price).
- **Terms and conditions:** Give the participant time to read through all terms and conditions, and to contact the Program with any questions.

3.2 Contractor Warranty

Contractor must provide the Program participant with a written warranty providing the following minimum guarantees: Equipment shall be free from all defects in workmanship and materials for at least 2 years from the date of final approved building inspection. The warranty shall cover all labor for any repairs resulting from equipment defects or Contractor's workmanship.

4 Customer Manual

Upon completion of installation, Contractor must provide the Program participant with a system owner's manual (the "Customer Manual") and instruct the Program participant on proper system operation and maintenance.

The Customer Manual provides accurate system documentation for the current system owner, as well as future owners and potential service staff. The Customer Manual must be bound in a durable and professional-looking binder, and must contain, at minimum, three sections: 1) System Design and Operation, 2) Warranties and Installation Documentation, 3) Manuals and Data Sheets.

Section 1 — System Design and Operation

- System Overview Page
Form 721: Small Wind System Overview summarizes the system's operating conditions and provides emergency information. It's available at <http://energytrust.org/TA/smallwind/forms.html>.
- Operation & Maintenance Instructions
Contractor's written instructions for system start-up and shutdown procedure, troubleshooting guidelines and recommended routine maintenance schedule.
- Electrical As-built Diagram
Schematic diagram that accurately depicts all electrical components installed, plus main service panel and utility connection. Must depict system wiring including wire sizes, wire types and wire run lengths.
- Mechanical Design
Description of wind turbine and tower, including engineering specifications of structural elements and manufacturer installation instructions. Provide drawings describing type of tower.

Section 2 — Warranties and Installation Documentation

- Contractor Warranty
Contractor 2-year full system warranty for materials and workmanship.
- Manufacturers' Warranties
Written warranties and product registration instructions for wind turbine and inverters.
- Incentive Application Form
Final version of the signed form showing incentive and configuration approved by Energy Trust.
- Permit(s)
Copy of approved electrical and, where applicable, building permit for the system installation.

- Utility Interconnection / Net Metering Agreement
Copy of the agreement between the Program participant and the utility.

Section 3 — Manuals and Data Sheets

- Parts and Source List
Bill of material listing all system components including part numbers.
- Wind Turbine Owner's Manual
Documentation from turbine manufacturer.
- Inverter Owner's Manual
Documentation from inverter manufacturer.
- Manufacturer Data Sheets for Major Components
Including but not limited to: wind turbine, inverters, tower, charge controller, batteries, disconnect switches, ground fault protection equipment, lightning arrestors, combiner boxes.
- Anemometer documentation, when applicable (see **Section 2.3.22**)

5 Estimating System Output

On the Incentive Application form, the Contractor will provide the Program participant with an estimate of the wind system output. This estimate includes the following elements.

5.1 Wind Resource Information

Wind resource information includes a proposed site's annual average wind speed, as given by the 3Tier Group's web-based wind map, AWS Truewind data, or other national recognized software based wind energy map or site collect data. Data will be verified by Energy Trust's in-house wind map data, and additional evaluation of site characteristics such as physical obstructions to the wind.

5.1.1 Wind Resource

The 3Tier Firstlook interactive web-based wind map gives the annual average wind speed for the site of your small wind system at a 5 km resolution at heights of 20, 50 and 80 meters. Energy Trust's in-house wind maps give the annual average wind speed and site characteristics including elevation and surface roughness at a 200m resolution at heights of 30, 50 and 70 meters. Additional wind resource maps are available from AWS Truewind and the National Renewable Energy Laboratory.

5.1.2 Site Characteristics

Characteristics at the site of the wind turbine can affect the wind resource. These characteristics must be noted on **Form 720: Small Wind Incentive Application**. Obstacles in the upwind and downwind directions can have adverse affects on the performance and reliability of a small wind system. A site visit by an Energy Trust Inspector or the installation of an anemometer may be necessary to verify that the wind resource meets Program requirements.

5.2 Performance Estimate

5.2.1 Annual Delivered Energy

Annual delivered energy is the estimated annual kilowatt-hours (kWh) output of the system, based on the sites wind speed and turbine manufacturer data.

Annual energy estimates may be based on manufactures estimates for the annual average wind speed at the site or on the manufactures power curve and the sites annual wind speed distribution.

The method and assumptions used to estimate the production shall be included on **Form 720: Small Wind Incentive Application**.

5.2.2 Total Installed Capacity

Total installed capacity is the nameplate rating of the proposed turbine, in kW, multiplied by the number of turbines to be installed.

6 System Inspection

An Energy Trust Inspector will review the system to determine whether it meets the Program's requirements. The Energy Trust inspection is not a code inspection. It determines whether a system meets Energy Trust's requirements and is therefore eligible to receive our incentive funding. The Inspector will use the **Form 731: Small Wind Systems Installation Checklist**, available on the Energy Trust website at www.energytrust.org, during the systems review. See the Small Wind Program Guide for additional information about the inspection.