Net Metering & Small Electrical Generators

Background

The following material provides reference and resource information about small generators. Small generating systems include fuel cells, solar photovoltaic panels and wind turbine generators.

In Oregon, Washington, Wyoming and California, new regulations have established formal rules for connections and sales between customer-owned generators that are 25 kw or less and electric utility providers. Under these new rules, or "tariffs," customers can sell energy to their local utility provider. They will be charged for the amount of energy they purchase from the utility company minus the cost of the energy they provide to the utility company. The tariffs clarify that the customer is responsible for all costs associated with any modification to the generating facility that may be required to connect it to the larger utility system.

With the adoption of new tariffs, Pacific Power recognizes that customers may have renewed interest in purchasing and operating small generating systems. For that reason, we have compiled an overview of small generators for customer use.

The following illustration shows a small electrical generation system's major components and its connections to Pacific Power's system.

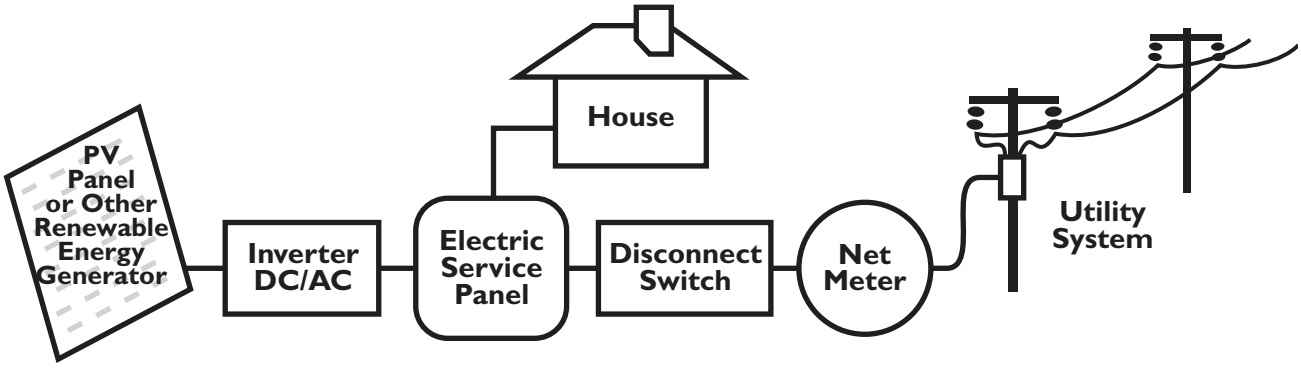

Diagram A

What is Net Metering?

Net metering measures the difference between the electricity you buy from your utility and the electricity you generate using your own solar or wind or other acceptable renewable generating equipment. Your meter keeps track of this difference as you generate electricity and take electricity from the electricity transmission grid. When you generate more than you use, your electric meter spins backward.

Normally your electric meter spins forward as it measures how many kilowatt-hours or electricity you buy, and is read by your utility once a month. A Net Meter allows you to use the electricity you

generate first, reducing what you would normally buy from your utility. If you generate more electricity than you use, the excess goes through you electric meter and into the grid, spinning your meter backward. Your meter shows the net amount, measured as the difference between the electricity you generate and the electricity you purchase from your utility.

What are the benefits of Net Metering?

Net Metering is a simple way to get the full value of the electricity you generate. For example, if you are a residential customer, you may not be home during the day when your system generates electricity. Net Metering allows you to "store" this excess electricity on the grid, reducing or offsetting the electricity you would otherwise have to purchase.

Generator Technology

Many small generating systems are easily available and environmentally sound. The following paragraphs describe a variety of generators, including general costs, performance, and sizing recommendations.

When considering the purchase of energy generation equipment, ask the dealer what agencies have tested, qualified, or otherwise approved a unit. Underwriters Laboratories (UL), Factory Mutual Research (FM) organizations and the Institute of Electrical and Electronic Engineers (IEEE) certify the safety and performance of renewable products.

Wind

The wind turns a propeller connected to a generator in this renewable technology system. A direct current wind generator will provide its energy to direct current loads. Alternating current for refrigerators, computers, TV, etc. would have to be provided by an inverter. If the wind turbine generator produces 60 cycle alternating current, the generator could serve AC loads directly.

Wind energy experts recommend placing an 80 to 120 foot high residential wind turbine on no less than one acre of land. Smaller lots generally are not acceptable for safety and noise reasons.

The economics of a 5 to 10 kw residential system are sensitive to the average wind speed and the cost of electricity. As a general rule, an economical system requires an average wind speed of at least 10 MPH at the turbine's location.

Solar Photovoltaic Panels

Solar photovoltaic panels (PV) generate direct current electricity. These solar cells consist of positive and negative layers on a silicon wafer. Sunlight striking the panels is absorbed, freeing electrons in the silicon crystal. Electrons activated by the sunlight move through the crystal and out to the load or

battery. This type of electric generation is typically 10 to 15 percent efficient; meaning 10 to 15 percent of the energy striking the panels is converted to electricity. Research continues to increase this efficiency.

Cost of a PV system depends largely on the application. Systems containing 100 watts or more generally cost between $10 and $30 per watt. Smaller systems are more expensive on a per watt basis. The cost of the panels is usually one-third to one-half of the total system cost. Each watt of panel typically produces between two and six watt-hours of energy a day depending on the season and location. Solar panels can generate electricity in cloudy weather, although their output is diminished. Energy produced on an overcast day might be as little as five to ten percent of the amount generated on a bright, sunny day.

Fuel Cell

Fuel cells are similar to batteries in that they produce electricity using an electrochemical reaction. Unlike a battery, which must be recharged, a fuel cell produces electricity continuously when supplied by a fossil fuel–usually natural gas, propane, methane, or bio-mass. These units are available commercially in 200 kw sizes. Smaller residential units are being produced and field-tested at this time. Fuel cells less than or equal to 25 kw are applicable for Pacific Power's Oregon net metering tariff.

The National Aeronautics and Space Administration (NASA) first used fuel cells to provide electricity on space missions. Current 200 kw applications are found in hospitals, computer facilities and industrial firms.

A fuel cell has two major sections: the reformer and the stack. Hydrogen is stripped from the fossil fuel in the reformer. In the stack section, electricity is produced from the hydrogen. The type of reformer determines the type of fossil fuel that can be used.

While the 200 kw fuel cell can use natural gas, propane or bio-mass, optimum electrical performance is obtained with natural gas. Using propane or bio-mass will reduce the kw output of the nominally rated 200 kw unit. Others use methane as its energy source. Fuel cell size, equipment costs and maintenance requirements, as well as fuel quantity needed, are a few of the factors that determine the best fossil fuel to use in the fuel cell.

This equipment produces clean and quiet energy. This cogenerator is so clean that it enjoys a blanket exemption from air quality standards in Southern California, which has the strictest air quality standards in the country.

Micro-turbines (not included in the net metering tariff)

Micro-turbines – like their larger counterparts, the combustion turbines – use jet engine technology to produce electricity. The simplest combustion turbine consists of three components: a compressor, a combustion chamber and a turbine.

Air is compressed in the compressor. This high temperature and high pressure air moves to the combustion chamber where fuel is injected and the mixture is ignited. In the turbine section, this very hot mixture expands, turning the turbine shaft that is connected to the generator.

This equipment is designed and operated to produce 60-cycle alternating current and can operate on multiple fuel sources, including natural gas propane and diesel. Micro-turbines can produce electricity efficiently and cost-effectively, while emitting very low levels of pollutants. The hot exhaust can be used for space and water heating.

Summary

The following table summarizes the size and cost of various electric generators. Information on our net metering tariffs can be found on our Web site, www.pacificpower.net.

	Small Wind	Photovoltaic	Fuel Cell	Micro-Turbines
Commercial Availability	Well Established	Well Established	Well Established	New Industry
Size	600 watts-40 kw	0.30 kw-2 MW	1 kw-200 kw	25 kw-75 kw
Installed Cost ($/kw)	$1,000-$1,500	$6,000-$10,000	$3000	$500-$1300
O&M Costs (cents/kWh)	Varies	Minimal	0.3-1.5	0.2-1.0
Fuel Type	Wind	Solar	Hydrogen biogas, propane & methane	Propane, NG, distillate oil & biogas

Other online resources follow:

- American Wind Energy Association, www.awea.org
- Energy Efficiency and Renewable Energy, www.eren.doe.gov
- Fuel Cells, www.fuelcells.org
- Micro-turbines, www.eren.doe.gov/disributedpower
- Solar Energy Industries Association, www.seia.org

Renewable energy without the equipment

Pacific Power offers a new renewable resource program called Blue Sky. Our Blue Sky program uses the clean, renewable power of wind to generate electricity.

Buying one 100-kwh block of Blue Sky each month for a year has the same environmental benefits as not driving a car for 2,500 miles or planting one-half acre of trees.*

Blue Sky is easy – all you have to do is sign up, and the charge shows up on your monthly statement. Then, each month, each Blue Sky block you've bought will help increase the portion of electricity coming from clean wind power.

For more information contact your account manager, call us at 1-800-842-8458, e-mail us at bluesky@pacificorp.com or visit us on the Web at www.pacificpower.net.

**These figures use an average of PacifiCorp's system generation resources (current as of July 31, 2003) and EPA data. This average may change as PacifiCorp acquires or changes system generation resources.*

For more information

Contact your account manager or call 1-888-221-7070. You can find the tariff for your state on our Web site, www.pacificpower.net, click on News then Rates & Regulation.

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