

# RENEWABLE ENERGY OPTIONS

## INTRODUCTION

With the increase in energy costs, customers are looking for ways to reduce or offset the operational costs of households and businesses through energy-efficiency improvements, technology and renewable energy.

Energy-efficiency improvements and technology may reduce energy consumption by reducing the energy requirements of the home, business and equipment.

Renewable energy offsets energy usage by the production of electricity or heat.

PPL Electric Utilities customers have a renewed interest in energy alternatives. In this document, we will discuss:

1. Solar energy for domestic hot water heating and space conditioning.
2. Solar (photovoltaic) energy for the production of electricity.
3. Wind energy for the production of electricity.

Potential benefits related to installing these options include:

- Saving on household operational costs.
- Reducing your electric bill.
- Selling power back to the utility.
- Helping to protect the environment.



## DISCLAIMER:

This information is being provided to PPL Electric Utilities customers for informational purposes only. PPL Electric Utilities does not warrant or endorse the energy system or equipment of any particular manufacturer. PPL Electric Utilities does not guarantee that a particular third party system will in fact save energy.

# SOLAR HOT WATER SYSTEMS

Solar hot water systems use the sun's energy to heat water for domestic hot water use.



## Installation Cost

Average installed cost ranges from \$3,500 to \$7,000 for a system capable of providing ample hot water for a small family.\*

\* The average cost of the renewable energy systems in this document is based on customer and contractor feedback (2004 through 2008). System size, type and cost, mounting hardware, equipment location, and site conditions govern the actual cost of the installation.

## Installation Requirements

- Look for systems that have SRCC (Certified Collector & Water Heating Ratings) & Warranties.
- A minimum 10'x15' of roof area is needed for mounting solar water heating collectors.
- Solar water heating collectors should be mounted on a roof. Ground mounting is an option.
- The roof should be structurally sound and have no more than one layer of shingles.
- The proposed area where the collector is to be located should face due south and receive the maximum amount of sunshine on a daily basis for both the winter and summer season.
- The area where the collectors are mounted should not be shaded by trees, building or other objects.

### Pros

**Low Cost Installation.**

**Short Investment Payback.**

### Cons

**Operation.** The system will operate only when sufficient sunlight is available.

**Seasonal Output.** Production of hot water is highest during summer, spring and fall.

## Things to Consider

- Check with the local zoning office in your area for rules, regulations and possible permits that may be needed.
- The value and addition of solar panels may increase insurance costs.
- PPL Electric Utilities has to approve renewable electric generation systems and equipment that will be connected to the grid. Applications are available at:  
<http://www.pplelectric.com/Business+Partners/Tools+and+Reference+Center/Customer-Owned+Generation/>
- Prior to making major equipment investments, you should have a qualified professional perform a site study, specific to the proposed mounting location for the system and identify and evaluate any conditions that may affect the system's ability to produce energy.

# SOLAR (PHOTOVOLTAIC) GENERATION SYSTEMS



Solar (photovoltaic) energy systems use the sun's energy to produce electricity.

## Installation Cost

The installed cost for the first kilowatt of generation ranges from \$7,000 to \$10,000.\*

\* The average cost of the renewable energy systems in this document is based on customer and contractor feedback (2004 through 2008). System size, type and cost, mounting hardware, equipment location, and site conditions govern the actual cost of the installation.

## Installation Requirements

- A minimum 10'x15' of roof area is needed for mounting photovoltaic panels.
- Photovoltaic panels should be mounted on a roof. Ground mounting is an option.
- The roof should be structurally sound and have no more than one layer of shingles.
- The proposed area where the photovoltaic panels are to be located should face due south and receive the maximum amount of sunshine on a daily basis for both the winter and summer season.
- The area where the photovoltaic panels are mounted should not be shaded by trees, buildings, or other objects.

### Pros

**Systems Connect to the Power Grid.** If the system is equipped with the proper inverter, surplus generation could be sold back to the utility. (PPL Electric Utilities has to approve the system.)

**Stand-alone Systems.** Ideal for providing power applications such as area lighting or power for use at remote locations. These systems have battery back-up and charging systems. (The power supplied by the system is the sole source of power to the device it powers.)

### Cons

**Operation.** The system will operate only when sufficient sunlight is available.

**System Output.** The electrical output of the system is limited to the space available for the photovoltaic panels. The systems are usually roof-mounted but could also be ground-mounted if a suitable location is available. The amount of direct sunlight that is available on a daily basis (southern exposure) is most important. Photovoltaic roof shingles are a new technology that can be used in place of panels.

**Power During Electrical Outages.** Systems that are grid-connected will **NOT** supply power to the household if an electrical outage occurs. Non-supply of power during outages is incorporated as a safety feature to protect your equipment from overloading and protect the safety of electric service personnel.

## Things to Consider

- Check with the local zoning office in your area for rules, regulations and possible permits that may be needed.
- The value and addition of solar panels may increase insurance costs.
- PPL Electric Utilities has to approve renewable electric generation systems and equipment that will be connected to the grid. Applications are available at:  
<http://www.pplelectric.com/Business+Partners/Tools+and+Reference+Center/Customer-Owned+Generation/>
- The rated outputs of solar and wind energy systems are supplied by equipment manufacturers. Although the ratings are supplied, the output of any system is specific to your location and conditions.

# WIND GENERATION SYSTEMS

Wind generation uses wind power to generate electricity.



## Installation Cost

The installed cost for one kilowatt of generation is approximately \$4,000 to \$6,000.\*

\* The average cost of the renewable energy systems in this document is based on customer and contractor feedback (2004 through 2008). System size, type and cost, mounting hardware, equipment location, and site conditions govern the actual cost of the installation.

## Installation Requirements

- Systems producing greater than 1 kilowatt of electricity should not be mounted on residential structures. Systems greater than 1 kilowatt may require a pole or tower mounts, which would be an added expense. Guy wires are often required for additional support.

### Pros

**Systems Connect to the Power Grid.** If the system is equipped with the proper inverter, surplus generation could be sold back to the utility. (PPL Electric Utilities has to approve the system.)

**Stand-alone Systems.** Ideal for providing power applications such as area lighting or power for use at remote locations. These systems have battery back-up and charging systems.

### Cons

**System Output.** The electrical output of the system varies by wind speed.

**Large Systems.** Require special pole mounts or towers that add to installation costs.

**Power During Electrical Outages.** Systems that are connected to the grid will **NOT** supply power to the household if an electrical outage occurs.

## Things to Consider

- Check with the local zoning office in your area for rules, regulations and possible permits that may be needed.
- The value and addition of wind generation systems may increase insurance costs.
- PPL Electric Utilities has to approve renewable electric generation systems and equipment that will be connected to the power grid. Applications are available at:  
<http://www.pplelectric.com/Business+Partners/Tools+and+Reference+Center/Customer-Owned+Generation/>
- The rated output of solar and wind energy systems are supplied by equipment manufacturers. Although the ratings are supplied, the system's output is specific to your site location and conditions.

# CALCULATING INVESTMENT PAYBACK

## Questions to Ask Before Making an Investment

- Will the energy production or energy savings the system provides pay for the investment in equipment, installation, and maintenance?
- Will lesser investments in energy conservation yield higher energy savings?
- What is the interest on the money you would use for the cost of the equipment or what is the interest rate you would have to pay if you financed the system?
- Will state, federal or other grants lower the installed cost of the equipment?

Investment payback results will vary based on the following factors:

- Sun's angle
- Atmospheric conditions
- Collector or photovoltaic panel tilt angle, orientation, and efficiency
- Shading
- Outside temperature
- For solar generation systems, power conversion losses (inverter and wiring loss)
- For solar water heating systems, pipe heat loss, collector supply/return piping, amount of thermal storage, and time and volume of usage
- For wind generation systems, the average wind speed at site location

## Calculating the Electrical Output of Solar (Photovoltaic) Generation Systems

The potential kilowatt-hour output can be found by multiplying the number of sun hours per day in your geographic area (average of 5.5 per day in Northeastern Pennsylvania) by the kilowatt (or watt) output of the system. This number represents the system's maximum potential of a properly installed system in a location that has ideal solar conditions.

$$\text{(Number of Sun Hours)} \times \text{(System Output in kWh)} = \text{Total kWh}$$

To properly evaluate the kilowatt-hour output of a solar (photovoltaic) generation system, the proposed location of the photovoltaic panels needs to be evaluated using a Solar Pathfinder. A pathfinder evaluation takes into consideration the site's geographic location, collector orientation and shading potential. The evaluation gives the number of sun hours available on a monthly basis for the entire year.

## Calculating the Electrical Output of Wind Generation Systems

The electrical rating of a wind generation system is rated at the maximum kilowatt-hour the unit is capable of producing. To give an indication of the unit's potential for production of electricity the manufacturer provides the kilowatt-hours the unit produces using an average wind speed.

$$\text{(Wind Speed)} \times \text{(kWh Output at Speed)} \times \text{(Hours of Operation)} = \text{Total kWh}$$

Wind studies using a wind speed recorder should be made at site location.

## Calculating Savings Using Solar Hot Water Systems

Solar water heating collectors are rated in thousands of British Thermal Units, or BTUs, per panel per day, application, and climate. Consult the system manufacturers or distributors for system capacity.

**Step 1:** Calculate the change in temperature needed to heat the water.

$$\text{Desired Temperature of Water} - \text{Current Temperature of Water} = \text{Change in Temperature}$$

**Step 2:** Convert the volume and temperature of the water heated by the system to BTUs

$$(\text{Gallons of Water to be Heated} \times 8.33) \times \text{Change in Temperature} = \text{BTUs}$$

**Step 3:** Convert BTUs to the equivalent quantity of fuel or electricity that would have been needed to heat the water.

$$\text{BTUs} \div (\text{Usable BTUs Per Unit of Fuel}) = \text{Amount of Fuel}$$

(See Table Below)

Usable BTUs Per Unit of Fuel at 100% Efficiency	
Electricity	3,413 BTUs Per kWh
Fuel Oil	138,000 BTUs Per Gallon
Propane	91,000 BTUs Per Gallon 21,500 BTUs Per Pound
Natural Gas	1,028 BTUs Per CCF
Coal Anthracite	27,000,000 BTUs Per Ton

The usable heat output of fossil fueled heating and hot water heating systems has to be adjusted for the efficiency of the furnace or hot water heating system being used.

**Space Conditioning (Heating):** Usable heat for space conditioning should be factored by the burn efficiency of the heating unit. Electricity's burn efficiency is always rated at 100%. If unknown, a burn efficiency of 80% could be used. Older and unmaintained heating systems will have a lower efficiency.

**Domestic Water Heating:** Some furnaces provide domestic hot water by use of a heating coil within the boiler. When the furnace is used for hot water needs during summer months, water heating efficiency may be lower than 80%.

For all systems, stand-by heat loss and piping heat losses should be considered. The percentage of heat loss depends on distance from the heater to point of use, temperature of the area that the pipes pass through and amount of pipe insulation.

### Example

A domestic solar water heating system heats an average of 80 gallons of hot water per day from 45 degrees to 120 degrees.

How many dollars per day would be saved on your electric bill?

**Step 1: Calculate the Change in Temperature.**

$$120 \text{ Degrees} - 45 \text{ Degrees} = 75$$

**Step 2: Calculate the**

$$(\text{Gallons of Water to be Heated} \times 8.33) \times \text{Change in Temperature} = \text{BTUs}$$

$$80 \times 8.33 \times 75 = 49,980 \text{ BTU}$$

$$\text{BTUs} \div 3,413 \text{ (Electric Water Heater)} = \text{kWh}$$

$$49,980 \div 3,413 = 14.64 \text{ KWH}$$

$$(\text{kWh}) \times (\text{Cost Per kWh}) = \text{Savings}$$

$$14.64 \times \$0.10 = \$ 1.46$$

\$1.46 per day would be saved on the cost to heat domestic hot water.

## FAQ's for PPL Electric Utilities

### Customer-owned Renewable Generation Projects

#### 1. What is Pennsylvania Act 213?

Pennsylvania Act 213 requires electric utilities and generation suppliers to ensure that a certain percentage of the generation sold to Pennsylvania customers comes from alternative energy sources.

For example, PPL Electric Utilities purchases electricity supply for customers who don't choose a supplier. In 2010, more than 8 percent of that power must come from alternative energy sources; include hydropower, wind power, solar power and other sources. That requirement gradually climbs to 18 percent in 2020.

The regulations also establish the net metering and compensation provisions that allow utilities to reimburse customer-generators for surplus energy supplied to the electric grid. Additionally, the act establishes regulations governing interconnection for customers that generate power. This includes rules regarding the application and evaluation process and interconnection standards. Please visit <http://paaeps.com/credit> for more information.

#### 2. Can I connect a small renewable generation system to PPL Electric Utilities' delivery system?

Yes, with PPL EU's permission. You must first submit an application for interconnection and meet certain requirements before you can connect to our delivery system. These requirements ensure that your system is compatible with ours, meets our safety standards and will not jeopardize delivery system reliability. For more information, visit [Customer Owned Generation Website](#).

#### 3. How do I apply for interconnection?

We can guide you through the interconnection process. If you're considering a generation project, call us at 1-800-342-5775. To access our interconnection applications online, use one of the following links: [Inverter-based 10 kW or smaller](#) or [Generation is 10 kW to 10,000 kW](#) .

For the quickest response, please e-mail your completed application and all appropriate information to the appropriate e-mail address below:

- [renewableenergyapplications@pplweb.com](mailto:renewableenergyapplications@pplweb.com)  
For systems 25 kW or smaller and being installed at a location with single-phase service.

- *businessaccounts@pplweb.com*  
For any system larger than 25 kW and systems of any size being installed at a location with three-phase service.

#### **4. Is there an application fee?**

There is no application fee.

#### **5. Are there any costs to connect?**

If the interconnection requires changes to our equipment or facilities, you may be responsible for our costs to design the changes and buy and install the necessary equipment.

#### **6. Must I sign a contract?**

Yes, you must sign an interconnection agreement with PPL Electric Utilities. Additional service and construction agreements may be required for larger projects under the jurisdiction of PJM Interconnection.

#### **7. Will I be paid if I generate more power than I use?**

You may be compensated for excess power that you produce if you qualify as an alternative energy generator under Pennsylvania Act 213. Here's how it works:

- Your meter will spin backwards at times when you're producing more electricity than you're using, and forwards when the opposite is true.
- At the end of the monthly billing period, when we read the meter, we'll measure the net result. This is called "net metering."
- If you generate more than you use during a particular month, your electricity bill will show zero kilowatt-hours used. You will only pay the monthly minimum distribution charge. For residential customers, this is simply the customer charge. Demand charges still apply for business customers.
- If, at the end of the year, the net result is that you've generated more electricity than you've used, you will be paid a lump-sum payment for that electricity. Prices and payments are made per our [tariff](#). Essentially, we'll pay you the same amount for your excess power that you would pay us.

**8. Will I still get a bill if I generate more power than I use?**

Yes. If you are a residential customer, you will still receive a bill for the monthly minimum distribution charge for your rate schedule. This is simply the customer charge. No usage charges would apply.

If you are a business customer, you would still receive the customer charge, if applicable for your rate schedule, and demand charges.

**9. Will PPL Electric Utilities meter how much power I produce?**

Our meters will track the excess power that you produce – electricity that flows into our delivery system for use by others. They do not track the total electricity generated by your system. To record your system's total output, you will need to have a qualified professional supply and install an additional meter.

**10. Will my generating system provide emergency power during a power outage?**

Not if it is connected to our delivery system. For safety reasons, renewable generation systems that are interconnected to the power grid will not supply power to your home or business if an outage occurs. This protects your equipment from overloading and protects personnel who may be working on electrical equipment in your area to restore power.

**11. Could generation systems be modified to supply power during a power outage?**

Yes. Your system must be set up so that it can be isolated from our distribution system. This protects our linemen and work crews by ensuring that no electricity is delivered to our power lines during the outage. If you would like your system to be set up this way, you must notify PPL EU of your intention and consult with your contractor.

**12. Can I shop for electricity supply if I also generate my own power?**

Yes. All customers (regardless of rate) have the right to choose a generation supplier. If you are a shopping customer, PPL EU will net your usage on a monthly billing cycle basis. If you are a shopping customer that has generated more than you have used on an annual basis, you will need to contact your chosen supplier to determine if they will pay you their supply price for your excess power.

**13. Will the system become outdated?**

Consult your contractor as new technologies are always emerging.

**14. Are grants available from PPL Electric Utilities or for renewable generation?**

For latest information, please visit [www.pplelectric.com/e-power](http://www.pplelectric.com/e-power). For an overview of state, local, utility, and federal incentives, check the Database of State Incentives for Renewables & Efficiency (DSIRE) at [www.dsireusa.org](http://www.dsireusa.org).

**15. What are alternative energy credits?**

Alternative energy credits are tradable commodities that can be sold separately from the power produced by qualifying alternative energy facilities. A credit is produced when a megawatt of electricity has been generated from a qualifying facility.

Credits are issued through a program administered by the Pennsylvania Public Utility Commission. For more information, visit <http://paaeps.com/credit>.

**16. Will my project produce alternative energy credits that I can sell separately?**

Energy credits are based on energy produced by the generator. To get one credit, your generator must produce at least 1,000 kWh.

**17. Are RTS customers eligible for net metering?**

RTS customers are not eligible for net metering, meaning they are not paid for excess power generated and supplied to our delivery system. These customers can switch to our RSO Rate Schedule and receive compensation for excess power that's produced.

**18. May I sell power to my neighbor?**

No. Only licensed electric generation suppliers subject to PJM and Pennsylvania Public Utility Commission regulations may sell power to customers through agreements with PPL Electric Utilities, PJM or a third-party.

**19. What is virtual meter aggregation?**

Virtual meter aggregation is the combination of readings and billing for multiple meters, regardless of rate class. The meters to be combined must be on properties owned or leased and operated by a customer-generator. In addition, the meters must be located within two miles of the boundaries of the customer-generator's property and within a single electric distribution company's service territory.

## 20. When is my generation system under PJM jurisdiction?

A project is under PJM jurisdiction if the generator's capacity is greater than 2,000 kilowatts or if it is strictly a merchant generator built to sell generation supply to others.

PJM, the regional transmission organization, ensures the reliability of the electric power supply system in 13 states and the District of Columbia. It reserves the right to review projects with generating capacities less than 2,000 kilowatts if there is already another interconnected generator on the same electrical distribution line that feeds into our main delivery system.

## 21. Where can I learn more about renewable energy?

The following Web resources may be helpful in finding additional information on renewable energy technologies and equipment suppliers. PPL Electric Utilities cannot endorse or validate the accuracy of the information on these sites.

American Wind Energy Association	<a href="http://www.awea.org">www.awea.org</a>
Build It Solar	<a href="http://www.builditsolar.com">www.builditsolar.com</a>
PA AEPS Alternative Energy Credit Program	<a href="http://www.paaeps.com">www.paaeps.com</a>
PA Department of Environmental Protection	<a href="http://www.depweb.state.pa.us">www.depweb.state.pa.us</a>
PA Department of Environmental Protection – Energy Independence Strategy	<a href="http://www.depweb.state.pa.us/energyindependent">www.depweb.state.pa.us/energyindependent</a>
Database of State Incentives for Renewables & Efficiency	<a href="http://www.dsireusa.org">www.dsireusa.org</a>
Find Solar	<a href="http://www.findsolar.com">www.findsolar.com</a>
Home Power Magazine	<a href="http://www.homepower.com">www.homepower.com</a>
Solar Energy in Pennsylvania	<a href="http://www.pasolar.org">www.pasolar.org</a>
Renewable Energy Installation Businesses in Pennsylvania	<a href="http://www.energy.sourceguides.com">www.energy.sourceguides.com</a>
U.S. Department of Energy – Energy Efficiency and Renewable Energy	<a href="http://www.eere.energy.gov">www.eere.energy.gov</a>
National Renewable Energy Laboratory	<a href="http://rredc.nrel.gov/solar/old_data/nsrdb">http://rredc.nrel.gov/solar/old_data/nsrdb</a>

## GLOSSARY OF TERMS AND ADDITIONAL RESOURCES

Term	Definition
<b>Watt</b>	A standard rating of electrical energy: 1,000 watts are in 1 kW. 1,000 watts used within 1 hour equals 1 kWh.
<b>Inverter</b>	A piece of equipment that converts the low-voltage direct current (DC) electricity produced by the system into 120 or 240 volts of alternating current (AC) electricity.
<b>kWh (Kilowatt Hour)</b>	Designates the amount of electrical energy used by an appliance or produced by a generation system within 1 hour. kWh is the standard unit of energy used for electric bill calculations.
<b>kW (Kilowatt)</b>	The flow rate of electrical energy measured in 1,000 watts (1 kW) units. kW is used to measure the demand component of electric bills. It can also be used to designate the electrical output of generation systems.
<b>BTU (British Thermal Unit)</b>	The amount of heat energy needed to heat 1 pound of water 1 degree Fahrenheit.
<b>Sun Hours</b>	The average number of hours per day when usable solar radiation. In 1 hour under ideal conditions, 1 square meter receives the equivalent of approximately 1 kWh of solar energy. 5.5 hours per day is a good average to use in Northeastern Pennsylvania.

[www.awea.org](http://www.awea.org)

[www.builditsolar.com](http://www.builditsolar.com)

<http://paaeps.com/credit>

[www.depweb.state.pa.us](http://www.depweb.state.pa.us)

<http://www.depweb.state.pa.us/energyndependent/site/default.asp>

[www.dsireusa.org](http://www.dsireusa.org)

<http://www.phillysolar.org/Solar%20Matrix.pdf>

[www.findsolar.com](http://www.findsolar.com)

[www.focusonenergy.com](http://www.focusonenergy.com)

[www.homepower.com](http://www.homepower.com)

<http://www.pasolar.org>

<http://energy.sourceguides.com>

[www.eere.energy.gov](http://www.eere.energy.gov)

[http://rredc.nrel.gov/solar/old\\_data/nsrdb/](http://rredc.nrel.gov/solar/old_data/nsrdb/)

**American Wind Energy Association**

**Build It Solar**

**PA AEPS Alternative Energy Credit Program**

**PA Department of Environmental Protection**

**PA Department of Environmental Protection – Energy Independence Strategy**

**Database of State Incentives for Renewables & Efficiency**

**Eastern-Central PA Solar Contractors**

**Find Solar**

**Focus on Energy**

**Home Power Magazine**

**Solar Energy in Pennsylvania**

**Renewable Energy Installation Businesses in Pennsylvania by Business Name**

**U.S. Department of Energy – Energy Efficiency and Renewable Energy**

**National Renewable Energy Laboratory (U.S. Solar Radiation Data)**