

Introduction to Solar and Wind Energy Technologies

A Conservation Tools.org Supplement for the Guide to

Zoning for Non-Commercial Solar and Wind Systems

There are a number of different technologies used for solar and wind energy systems. The following summarizes current technologies. For additional information, refer to: the Montgomery County Planning Commission's [series of publications on renewable energy](#); the US Department of Energy's [web site](#); or, the US Environmental Protection Agency's [web site](#).

Solar Energy Systems

Photovoltaic solar panels and films for electricity generation

Photovoltaic (PV) solar panels can be either free-standing (i.e., placed in a building's yard) or attached to a building. Building-mounted solar panels can either be physically separated from the building's construction materials, such as panels attached to a building's roof, or incorporated in the construction materials. Examples of the latter include PV solar films that also function as roof shingles, or PV solar films attached to windows. PV solar panels and films commonly utilize silicon, cadmium, or copper to chemically convert sunlight to direct-current (DC) electricity. A PV system typically also includes wiring, supports, and other appurtenant materials such as an inverter that converts the PV-generated DC electricity to the more commonly used alternating current.

Solar water heaters

Similar to PV systems, solar water heating systems include the actual solar energy collection mechanism (for water heating, these include glazed flat-plates and evacuated tubes), wiring, supports, and other appurtenant materials. Solar hot water systems also include at least one storage tank. A solar water heating system can be either passive or active (i.e., circulating pumps and controls are used). In turn, an active solar water heating system either directly heats water moved through the solar collectors, or indirectly by increasing the temperature of a heat transfer liquid that then warms water within the structure where it will be used. The warmed water is commonly used for domestic uses as well as for building heating. In residential and recreational settings, a solar water heating system may be used to warm pool water.

Other solar structures and uses

The sun's energy has been captured by various solar technologies for many uses in addition to those described above (e.g., landscape lighting, traffic signals). The amount of electricity generated, or hot water heated, is limited primarily by the surface area of the solar collectors.

Wind Energy Systems

Turbines

A wind turbine generates electricity when its blades, axes, or sails spin while collecting moving air. In addition to these integral components that are fixed to a tower, a wind turbine also typically includes a separately-housed generator and gear box, plus wiring, supports, and other appurtenant materials. Typical electricity generated for the use of homeowners or small businesses is 100 kilowatts (kW) or less. For a map of potential wind energy generation in Pennsylvania, refer to page 2 of the document, [Small Wind Electric Systems, A Pennsylvania Consumer's Guide](#).

The following sections describe free-standing and roof-mounted turbines that generate electricity for the homes, businesses, public buildings, and farms that are the principal uses on a building lot.

Free-standing turbines

A free-standing wind turbine is affixed to a tower whose height is principally a function of prevailing winds, applicable regulations (e.g., local zoning as subsequently described and Federal Aviation Administration standards for proximity to air traffic patterns, etc.). Another consideration is the dimensions of the building lot on which the free-standing wind turbine is located. For safety and legal reasons, these turbines are usually no taller than 1.2 to 1.5 times the distance between it and the closest property line, public right-of-way, or nearby structures should it fall or need to be lowered. Refer to the “Performance Standards” section of this Tool. The wind turbine’s tower is usually stabilized by guy wires, and protected from vandalism by fencing or a limit on its “climbable” height.

Roof-mounted turbines

A roof-mounted wind turbine is attached to a building on the building lot. These turbines are designed to generate electricity at much lower wind speeds than a free-standing wind turbine, and typically generate correspondingly less electricity. As such, they are appropriate for affixing to, and helping to meet the electricity needs for, residential, business, or farm buildings.