

SOLAR ENERGY SYSTEMS (SES)

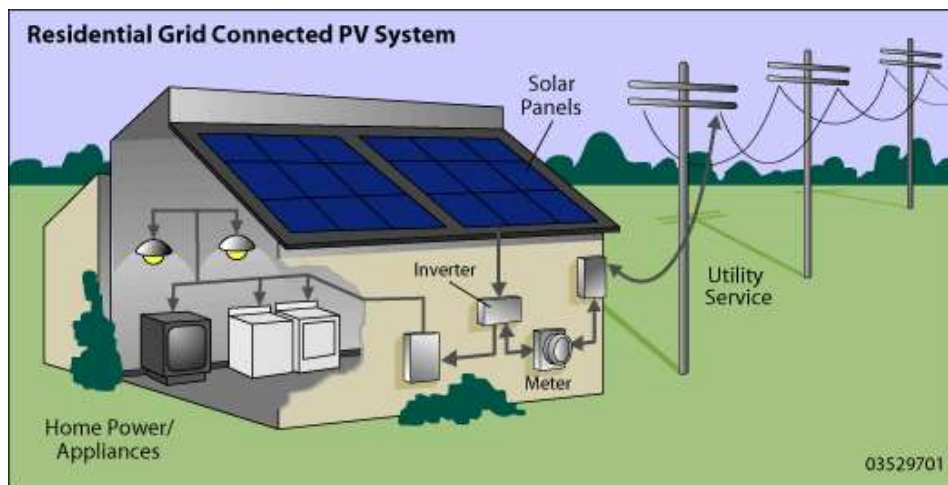
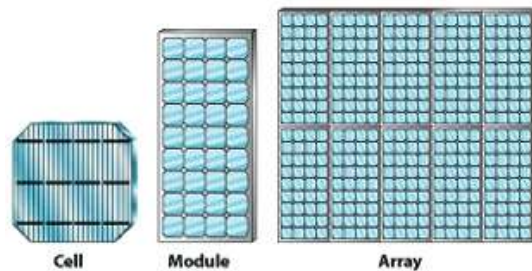
INTRODUCTION

There are two major forms of solar energy technology: photovoltaic (PV) systems and solar thermal systems.

Photovoltaic Systems

A photovoltaic system is made up of multiple solar cells. An individual PV cell is usually small. To boost the power output of PV cells, they are connected together to form larger units called modules. Modules, in turn, can be connected to form even larger units called arrays, which can be interconnected to produce more power. In this way, PV systems can be built to meet almost any electric power need, small or large.¹ Despite their scalability, PV systems are rarely able to provide enough energy to meet the entire energy needs of a given facility.

In solar PV systems, a flow of direct current (DC) electricity is produced when sunlight strikes an array of solar modules. Appliances and machinery, however, operate on alternating current (AC), such as the electricity supplied by a utility. The DC energy produced by the modules is fed into an inverter that converts DC power into AC power and feeds into the main electrical panel that powers a home or business. PV systems can be installed on a roof or building, integrated into the building or ground mounted on poles or racks.²

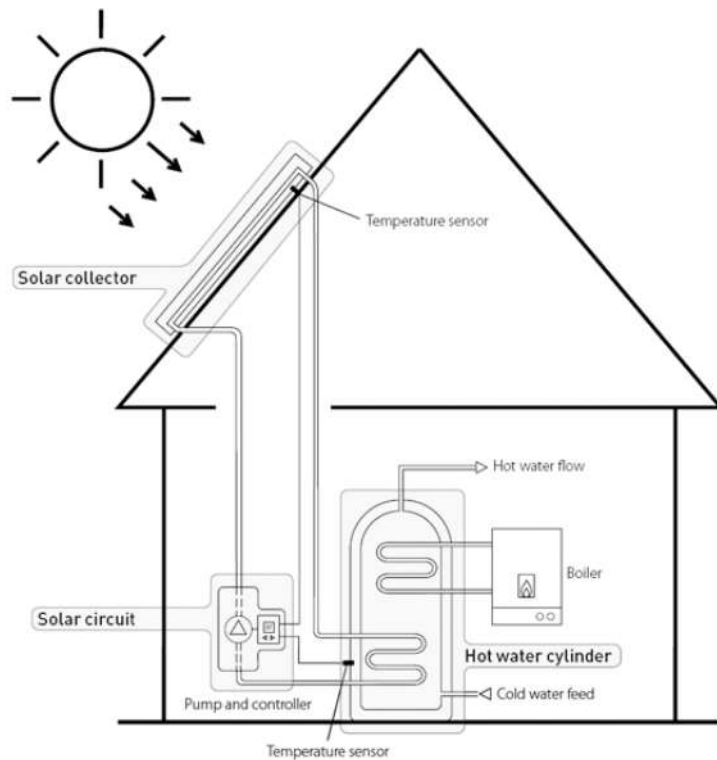


¹ US Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/basics/renewable_energy/pv_systems.html

² Solar Energy Systems, A Guide for PA Municipal Officials, 12/2009 http://solarpropa.com/images/PA_MunicipalSolarGuide.pdf

Solar Thermal Systems

Solar thermal systems use solar energy to heat a fluid, such as water or an antifreeze solution, or heat a gas, such as air. Solar thermal systems are most commonly utilized for heating residential hot water systems, though they are also used for space heating, spas or swimming pools and even space cooling. Solar thermal heating systems collect solar radiation from a flat plate collector or evacuated tubes. Most systems transfer the heat to a safe antifreeze solution, which is pumped into a solar heat storage tank to store each day's hot water supply. This is used as preheated water before using conventional energy to finish heating the water to a set temperature. Often solar thermal energy meets almost all of the residential hot water needs in the summer months, requiring little conventional energy for backup. Solar thermal systems are most commonly roof mounted, but can also be installed on the side of a building or ground mounted on racks.³



ORDINANCE CONSIDERATIONS

When regulating SES, a distinction should be made between accessory solar energy systems and principal solar energy systems:

- An accessory SES supplies electrical or thermal power primarily for the principal on-site use. Typical accessory systems are rated between 1 and 10 kW (kilowatt).
- A principal SES generates electric or thermal power for offsite commercial use. Principal systems are typically rated over 10 kW. Large principal SES can generate hundreds of megawatts (MW) of energy.

Both types of SES should be defined and regulations developed for each type of use. Only providing for accessory systems could be construed as exclusionary. Further, regulating all solar energy facilities with a one-size fits all approach will result in inconsistent and inappropriate regulation.

It is also critical to examine industry standards when developing ordinances for solar energy systems. Technology is changing at a rapid pace and failure to seek advice from industry professionals may result in an ordinance that may not reflect the requirements and capabilities of the industry.

³ Solar Energy Systems, A Guide for PA Municipal Officials, 12/2009 http://solarpropa.com/images/PA_MunicipalSolarGuide.pdf

In 2008, the Governor's Office and the Department of Environmental Protection convened the Solar Working Group. One of the tasks identified by the group was to provide information to local officials, residents and businesses. In December 2009, the publication [Solar Energy Systems, A Guide for Pennsylvania Municipal Officials](#) was released and provides information and guidance on developing ordinances regulating solar energy. Following is a summary of ordinance considerations from the Solar Working Group and other models for both accessory and principal SES.

Accessory Solar Energy Systems (ASES)

- **Zoning District/Use Standards** – ASES are generally permitted by right as an accessory use in all zoning districts where structures are permitted.

- **Height Restrictions** – Building and roof mounted ASES shall not exceed the maximum allowed building height in the zoning district. Ground or pole mounted ASES shall not exceed the maximum accessory structure height within the zoning district.

- **Setbacks** – At minimum, the ASES and associated structures should meet the accessory structure setbacks for the zoning district. Additional setbacks should be considered for ground mounted SES (and accessory structures) as they could reach heights of up to 15 feet depending upon the specific installation and type of technology.



Roof Mounted Solar Panels

- **Location** – The municipality should consider where on the property or building the ASES should or should not be located (i.e. front, side or rear yards). Municipalities can exercise broad discretion in how closely to regulate the location of ASES. Municipalities may consider prohibiting the installation of ground mounted ASES between the principal structure and the street right of way. Similarly, roof mounted systems could be oriented away from street right of ways. It should be noted that access to open south facing skies is a locational requirement for solar which should be reasonably accommodated.
- **Impervious Cover** –The area beneath ground mounted ASES systems is typically not considered impervious cover. ASES do not block the infiltration of precipitation to the underlying ground surface. Rather, ASES are typically designed with gaps between each module which when combined with the south slanting orientation, allows for water to drain and infiltrate the underlying ground. The only area considered impervious should be the foundation systems of the solar panels themselves, generally less than 2% of the ground surface assuming that the solar energy systems are mounted upon driven piles or monopoles or helical screws with or without small (generally one foot diameter) concrete collars.

Municipalities should require grass surfaces beneath the panels that allow infiltration of precipitation into the underlying soils as a Best Management Practice (BMP) for stormwater management. "No Mow" mixes of low growing grass species like certain fescue grasses should be encouraged, These No Mow formulations, if properly installed and maintained, should only need one annual mowing. In addition the low growing grasses are necessary to avoid shading of the solar modules which would occur from higher growing warm season grasses.

- **Design and Installation** - The ASES shall comply with all applicable building and constructions codes and any regulations adopted by the Department of Labor and Industry. The design of the ASES should conform to applicable industry standards, including those of the State Electric Code, National Electric Code and American National Standards Institute. The applicant shall submit certificates of design compliance obtained by the equipment manufacturers from Underwriters Laboratories (UL), Institute of Electrical and Electronics Engineers (IEEE), Solar Rating and Certification Corporation (SRCC), Electrical Testing Laboratory (ETL), Florida Solar Energy Center (FSEC) or other similar certifying organizations.

Some municipalities require applicants to use or meet the requirements of installers on the Pennsylvania Department of Environmental Protection's Approved Solar Installer list. Solar installers on this list have certifications, technical training, insurance requirements, and a proven track record of successfully installing SES equipment.

- **Utility Notification** – The owner of an ASES should provide written confirmation that the public utility company has been informed of the customer's intent to install a grid connected system and approved of such connection.
- **Glare / Visual Appearance** - Industry experts indicate glare is not an issue as solar panels are designed to absorb light and not reflect light. Further measuring and regulating glare for enforcement purposes will prove a challenging, if not unnecessary task. On-site electrical power and transmission lines or plumbing lines associated with or connected to the ASES should be located underground.
- **Signage** – Warning signs concerning voltage should be placed near ASES equipment. Aside from manufacturer's identification, no ASES should be used for advertising purposes.
- **Decommissioning** – The municipality should consider requiring owners to decommission ASES that are inoperable for a period of time (6-12 months).
- **Applicability** – The ordinance shall apply to all ASES installed and constructed after the effective date of the ordinance. Any upgrades, modifications or changes that materially alter an existing ASES shall comply with the ordinance.
- **Permit Requirements/Registration** – Zoning and/or building permit applications for ASES should be accompanied by horizontal and vertical drawings. The drawings should show the location of the system on the building or property, including property lines. Applications for roof mounted ASES should be accompanied by engineer stamped plans that demonstrate the structural sufficiency of the roof to hold the weight of the ASES.



Principal Solar Energy Systems (PSES)

- **Zoning District/Use Standards** – PSES should be considered a principal use and should be restricted to agricultural, rural, commercial, and industrial districts. Typically these districts have the larger lot sizes required for PSES. PSES are generally not permitted by right, but are permitted by conditional use or special exception. With appropriate regulation in place, municipalities may consider allowing PSES by right, which in turn can accelerate project schedules and decrease overall project costs.

Disparate views exist on the appropriateness of PSES in agriculture districts, particularly those on prime agriculture soils. PSES do not remove or disturb the soil, thereby prime soils still exist and could be farmed after the PSES use ends. In addition, PSES provide farmers with nonfarm income which could be a viable alternative to selling the farm and developing it for another use. Alternatively, the land on which PSES are constructed cannot be actively farmed, thus, the prime agriculture soils may be taken out of production until/if the PSES use ends.

- **Height Restrictions** – Ground mounted panels should be subject to the building height regulations in the zoning district.
- **Setbacks** – At a minimum, the PSES, associated accessory structures and mechanical equipment should comply with the building setback requirements for the zoning district where the PSES is installed.
- **Impervious Cover** –The area beneath ground mounted PSES systems is typically not considered impervious cover unless it is paved or otherwise covered by an impervious surface. PSES do not block the infiltration of precipitation to the underlying ground surface. Rather, PSES are typically designed with gaps between each module which when combined with the south slanting orientation, allows for water to drain and infiltrate the underlying ground. The only area considered impervious should be the foundation systems of the solar panels themselves and any accessory structures. , Generally less than 2% of the ground mounted PSES surface is impervious assuming that the solar energy systems are mounted upon driven piles or monopoles or helical screws with or without small (generally one foot diameter) concrete collars.

Municipalities should require grass surfaces beneath the panels to allow and encourage infiltration of precipitation into the underling soils as a Best Management Practice (BMP) for stormwater management. "No Mow" mixes of low growing grass species like certain fescue grasses should be encouraged. These No Mow formulations, if properly installed and maintained, should only need an annual mowing. In addition the low growing grasses are necessary to avoid shading of the solar modules which would occur from higher growing warm season grasses.



SunPower Corporation

- **Design and Installation** - The PSES shall comply with all applicable building and constructions codes and any regulations adopted by the Department of Labor and Industry. The design of the PSES should conform to applicable industry standards, including those of the State Electric Code, National Electric Code and American National Standards Institute.

The Applicant shall submit certificates of design compliance obtained by the equipment manufacturers from Underwriters Laboratories (UL), Institute of Electrical and Electronics Engineers (IEEE), Solar Rating and Certification Corporation (SRCC), Electrical Testing Laboratory (ETL), Florida Solar Energy Center (FSEC) or other similar certifying organizations.

- **Glare** - Industry experts indicate glare is not a major problem with PSES as solar panels are designed to absorb light and not reflect light. Major solar installations exist at the Denver International Airport, Nellis Air Force Base and many other flight paths, thereby demonstrating that glare is typically not a real issue with PSES. Further measuring and regulating glare for enforcement purposes will prove a challenging, if not unnecessary task.
- **Decommissioning** - The applicant shall have a plan for decommissioning of the PSES. The owner shall be responsible for the removal of the facility if the owner ceases use of the facility for a period of time (6-12 months) or the facility becomes obsolete.
- **Warnings and Safety Measures** – A clearly visible warning sign concerning voltage should be placed at the base of all pad-mounted transformers and substations. The site should be completely enclosed by a fence with a self-locking gate. The spacing and location of the PSES equipment should provide for access roads that allow for the maintenance of the PSES and emergency vehicle access.

On-site electrical power and transmission lines or plumbing lines associated with or connected to the PSES should be located underground.

- **Signage** - PSES should not be permitted to display any advertising.
- **Permit Requirements/Registration** – As a principal use, the PSES would be subjected to the municipal subdivision and land development process and the requirements contained therein.

Solar Easements

A solar easement means a right, expressed as an easement, restriction, covenant, or condition contained in any deed, contract, or other written instrument executed by or on behalf of any landowner for the purpose of assuring adequate access to direct sunlight for solar energy systems.⁴ Solar easements require agreements between landowners that:

- Describe the dimensions of the easement including vertical and horizontal angles measured in the degrees or the hours of the day, on specified dates, during which direct sunlight to a specified surface or structural design feature may not be obstructed;
- Restrict the placement of vegetation, structures, and other objects which may impair or obstruct the passage of sunlight through the easement;
- Enumerate terms and conditions, if any, under which the easement may be revised or terminated;
- Explain the compensation for the owner of the real property subject to the solar easement for maintaining the easement and for the owner of the real property benefiting from the solar easement in the event of interference with the easement⁵.

⁴ Washington State Legislature, RCW 64.04.150 <http://apps.leg.wa.gov/rcw/default.aspx?cite=64.04.150>

⁵ American Solar Energy Society, February 2010. http://www.ases.org/index.php?option=com_content&view=article&id=928&Itemid=23

Several states have enacted solar easement statutes that provide the opportunity for neighboring property owners to voluntarily negotiate easements between themselves to provide for unobstructed solar access now and into the future. Other states have also enacted legislation to mandate the right to solar installations. Pennsylvania has not adopted any solar easement or access statutes. Thus, municipalities should consider what role, if any, they will assume in requiring solar easements. Typically solar easements would be recorded as part of a property's deed and run with the land. Disputes and enforcement actions would be the responsibility of the property owners to settle through civil litigation.

