Renewable Energy Ordinance Framework
Solar PV

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DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

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CHAPTER 1: Introduction

This Renewable Energy Ordinance Framework for Solar PV is a resource for municipalities as they develop and update zoning ordinances to govern the siting of small-scale solar PV energy systems in their community.

The purpose of this framework is to provide clear, regionally-consistent guidance on how to construct solar PV zoning ordinance:

- That is in accordance with state laws;
- Is not overly restrictive or contradictory to the nature of solar PV energy systems; and
- Promotes safe and sound community development

Municipalities using this guide should be able to identify ways to regulate solar PV in their zoning codes, subdivision codes, and other regulations and ordinances in a way that aligns with their local land use and community goals.

Source: National Renewable Energy Laboratory (NREL)

This framework does not provide guidance on large-scale, grid supply solar projects, such as solar farms or utility-scale solar projects. If you would like more guidance on utility-scale solar ordinance language, please refer to the resources listed at the end of this framework, or contact DVRPC or your county planning department.

The Case For Solar in the Zoning Code

While it is not required that municipalities zone for solar energy systems, there are many benefits to the municipality and to the applicant in doing so. Zoning and other land use regulations play an important role in enabling renewable energy projects that are cost effective and compatible with existing land use. Further, a supportive regulatory environment can encourage the growth of local solar markets, while an unsupportive environment can deter solar market growth.

Regulations that are overly restrictive, expressly prohibit, or do not designate solar PV as an allowed use can result in challenges with siting solar PV systems, delays in obtaining a zoning permit, or a triggering of the use-variance process. Further, inconsistent and unpredictable land use regulations from one municipality to the next can deter the renewable energy industry from doing business in the region. Delays, increase project costs, and increased strain on limited municipal resources - time added to the zoning and permitting process - is costly for the applicant as well as the municipality.

Understanding Solar Energy Systems

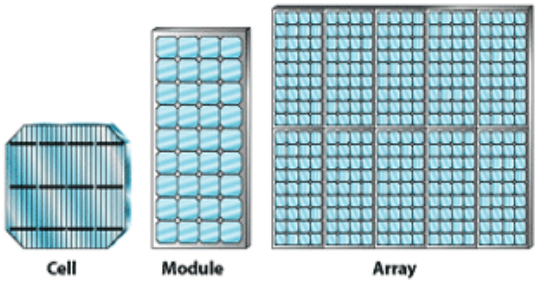
An initial step towards developing an ordinance to regulate solar PV energy systems is to understand how solar PV works and the siting needs that allow systems to operate properly. This way, municipalities that wish to encourage solar can ensure that their ordinance does not impose unnecessarily stringent regulations on solar PV. This guide provides important considerations for how solar energy systems operate that will enable municipalities to understand how zoning language is supportive or restrictive of solar PV.

Solar PV 101

Solar photovoltaic (PV) systems use semi-conductor material to convert sunlight into electricity. PV systems produce electricity when the sun is shining – and the more direct and intense sunlight striking the panels, the more electricity they will generate.

Solar PV energy systems are "modular" in nature: A PV system is made up of several PV cells. An individual PV cell is usually small, typically producing about one or two watts of power. To boost the power output of PV cells, they are connected together to create a PV module or panel, which range in power output from about 10 watts to 300 watts or more. Modules can be connected together to form even larger units, called arrays, which can be interconnected to produce more power, and so on. Because of this modularity, Solar PV can be designed to meet any electrical requirement, no matter how large or how small.

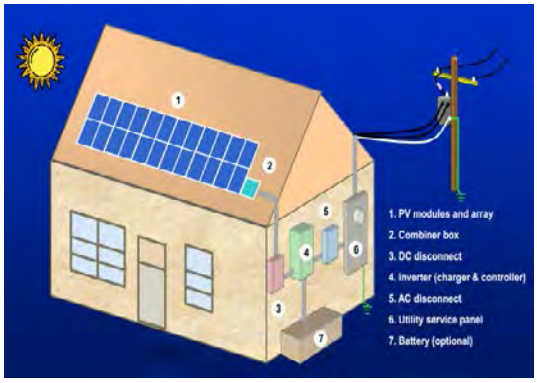
Figure 1: PV System Modularity



Source: energy.gov

By themselves, modules or arrays do not represent an entire system. Systems also include "balance of system" (BOS) components, such as inverters, batteries, and equipment used to connect the system safely to the electric grid. Inverters convert direct-current (DC) electricity produced by modules and "condition" that electricity, usually by converting it to alternate-current (AC) electricity so that it can be used by the appliances and equipment connected to the circuit. Though not a typical component of a PV system, but becoming more common, batteries may be present to provide storage or backup power in case of an outage. Systems that are tied to the electricity grid will include disconnect switches to control the flow of power to the circuit or the grid in case of the need for system repair or an outage.

Figure 2: Residential Grid-Tied PV System components



Source: NREL

Solar PV System Design

When developing a zoning ordinance, it is important to keep in mind three design considerations for optimal performance of solar PV systems:

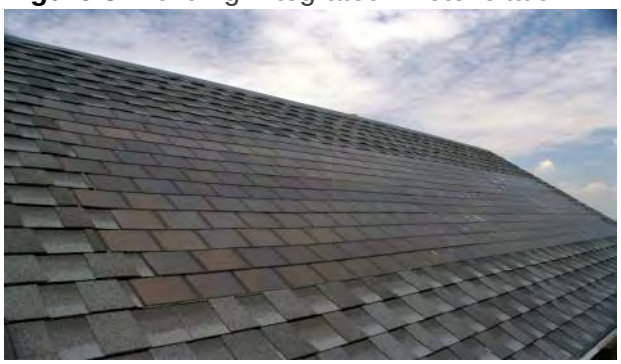
1) Solar panels require full access to sunlight in order to generate electricity – a 10 percent shading of an array can lead to a 50 percent decline in efficiency. The use of micro inverters may help increase panel output when shaded[1], and they are increasingly used in installations today. For more information on micro-inverters, please visit: http://www.nrel.gov/docs/fy12osti/54876.pdf
2) In most cases, solar panels generate the most annual electricity when facing true south and position at the optimum tilt angle, which is generally equal to the latitude in which the system is placed. Thus, Solar PV systems sited on flat roofs will typically need to exceed the height of the roof as a result of the tilt.
3) Solar panel performance declines when the air temperature behind or underneath the panel increases – so allowing for space between the mounting surface and the base of the panels is preferred as it allows airflow to lower the temperature around the panel.

[1] http://www.nrel.gov/docs/fy12osti/54876.pdf

Solar PV – Key Terms

Building-Integrated Photovoltaic (BIPV) Systems: A solar energy system that consists of integrating Solar PV modules into the building envelope, where the solar panels themselves act as a building material (roof shingles) or structural element (i.e., façade).

Figure 3: Building-Integrated Photovoltaic



Source: NREL

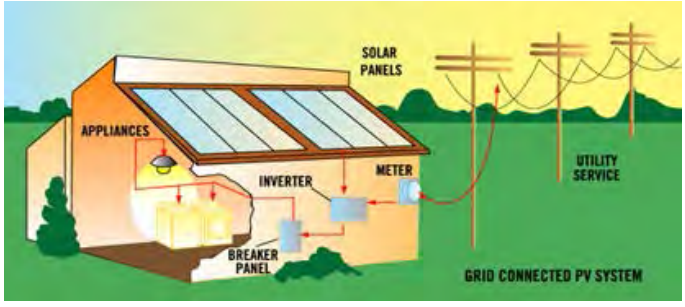
Ground-Mounted Solar Energy Systems: Systems which are not mounted on existing structures.

Figure 4: Ground-Mounted Solar Energy

Source: NREL

On-Grid/Grid Connected/Grid-tied: An energy system connected to the Public Electric Utility. More than 90% of solar energy systems installed in the US are grid-tied.

Figure 5: Grid-tied Solar Energy System



Source: NREL

What is Utility-Scale PV?

A utility-scale solar energy project is not based on the number of panels or energy generated, but on the purpose of the energy. If the power from a solar application's primary purpose is to be sold for commercial gain, and not for off-setting electric usage at a facility through net metering (i.e., distributed generation), then it can be considered a utility-scale solar application. Energy generated by a utility-scale solar application is typically sold to energy companies, rather than end users. The owners of the utility-scale solar project would need to obtain a permit from the state and are listed by the U.S. Department of Energy as a power generation source.

What is a Solar Hot Water System?

Solar hot water systems use a solar thermal collector to convert the sunlight energy to thermal energy. Solar hot water systems typically heat water or air. Solar thermal collectors and Solar PV modules utilize the sun, and therefore need to be mounted similarly for sun exposure. Solar energy is also harnessed for space heating and cooling, and other applications, but these are more rare, particularly in this region of the country.

Net metering: Net metering allows utility customers to apply the electricity generated by their own systems against their electric bills. If they produce more than they consume, the utility pays them for the excess.

Solar Easements: Legal agreements that protect access to sunlight on a property.

Solar Energy: Radiant energy (direct, diffused, or reflected) received from the sun at wavelengths suitable for conversion into thermal, chemical, or electrical energy.

Solar Access: The access of a solar energy system to direct sunlight.

Best Practices – Zoning for Solar

Municipalities have several options for regulating solar PV through the zoning code. Municipalities can simply incorporate solar energy systems into the definitions section of its existing zoning code as an accessory use, making solar energy systems subject to the same use regulations (such as height and setback) as any other accessory use. However, standard accessory use regulations may be overly restrictive for solar energy systems, and may significantly affect performance or prevent outright the ability of a solar PV system from being installed on a property.

Municipalities can develop supplemental regulations that would apply just to solar energy systems that balances solar PV siting needs with the need for compatibility with adjacent land uses. For example, supplemental regulations can be used to specify height exemptions, set structural setbacks from roof edges or lot lines, and establish impervious cover exemptions. Supplemental regulations for solar can encourage installations that are cost effective (e.g. generate the maximum possible amount of solar energy), safe (e.g. do not pose a threat to first responders in the event of a fire in the home), and compatible with existing land use goals (e.g. consistent with historic preservation areas).

For more information, visit:

- Zoning for Non-Commercial Solar and Wind Systems (PA Land Trust)
- *PAS Essential Info Packets: Planning and Zoning for Solar Energy*. (American Planning Association)

Tips for Developing an Ordinance

- *Assemble a team:* Assemble a team of municipal staff, including elected officials, planners, engineers, solicitors, and code enforcement officials.
- *Familiarize with the technology:* Understanding how solar PV systems work can greatly alleviate concerns with the safety of the technology, and can ensure that the regulation of the system doesn't interfere with the necessary requirements for access to sunlight that solar PV systems need to operate most effectively.
- *Review planning goals:* Municipalities should develop an ordinance that is compatible with existing land use plans (comprehensive plans, master plans, zoning code).

CHAPTER 2: ORDINANCE LANGUAGE AND GUIDANCE

How to Use This Document

This framework addresses small-scale accessory-use applications of solar PV energy systems that are intended to reduce consumption of utility power. This framework includes sample language for each section of a zoning ordinance, along with accompanying explanatory text that explains how the language is supportive or restrictive towards siting solar energy systems. This framework includes examples of the best practices mentioned in the previous section, but also includes restrictive language to provide examples of how zoning can be prohibitive of solar. For more information on the language provided, please read "How to use this document" in the next section.

The document is formatted for easy navigation and is organized around the standard sections of a zoning ordinance:

Section 1: Intent/Background

Section 2: Definitions

Section 3: Applicability

Section 4: General Regulations

Each section provides context on how it applies to solar, as well as a table of sample ordinance language options, to allow municipalities to build a customized ordinance that addresses their local issues. The language options include corresponding guidance that explains the breadth of barriers, benefits, and cautions for municipalities when regulating these types of renewable energy systems. Please note that this framework includes both supportive language and restrictive language – please read the "Comments and Guidance" column carefully.

Language Option	Comments and Guidance
Sample language option 1	Comments
Sample language option 2	Comments

The language provided can be modified to become a stand-alone ordinance, or incorporated into a municipality's existing zoning ordinance. **Note: The language provided in this framework is not intended to be wholly adopted.** Options are provided so that municipalities can pick and choose language that suits their needs. Some language options provided are not recommended for use, but are included to serve as an example of what to avoid if a municipality wishes to encourage solar. ***Municipalities should consult their solicitor to understand the implications associated with ordinance adoption and the specific language to be provided in the ordinance.***

These frameworks will be updated regularly as municipalities in our region develop ordinances and more information about renewable energy systems becomes available.

Section 1. Intent/Background

This section offers examples of how to phrase the intent and purpose of the ordinance. The inclusion of intent and purpose language is strongly encouraged in a renewable energy ordinance, as it explains the intent of creating provisions for solar energy development and clarifies a municipality's rationale for establishing a solar energy ordinance. It should also address why the regulations are being adopted, outline the goals of the ordinance, and perhaps refer to the enabling or related Act to make the relevance of the ordinance apparent. If the ordinance is a "stand-alone" ordinance, the municipality may wish to tie the regulations back to its state's Planning Code by referencing applicable language that may apply to solar (e.g., health, safety, welfare) from the Act. An intent or purpose section highlights the benefits of solar energy systems and why they should be protected through the development of the ordinance. This section also serves to establish the rationale for the ordinance in case of a legal challenge. This intent and purpose language may also use the "whereas" clause from the ordinance adoption.

Benefits of solar energy that could be mentioned in this section include the following:

- Solar energy is a renewable energy source;
- Solar energy is a clean energy source;
- Solar energy enhances the reliability, resiliency, and quality of the power grid;
- Solar energy reduces peak power demand and offsets energy usage supplied by the power grid;
- Solar energy helps diversify the State's/Municipality's energy supply portfolio;
- Solar energy promotes customers' choice for electric supply;
- Solar energy helps promote local, green jobs;
- Solar energy reduces electric generation supplied by conventional power plants; and
- Solar energy helps reduce dependence on foreign oil.

Language Option	Comments and Guidance
The purpose of this ordinance is to provide a regulatory framework for the construction of Solar Energy Systems in (Municipality), subject to reasonable restrictions, which will preserve the public health, safety, and welfare, while also maintaining the character of (Municipality).	
The purpose of this ordinance is to define appropriately cited solar energy systems as an inherently beneficial use of all residential and commercial properties. Solar energy systems preserve the municipality's public health, safety, and welfare by reducing the carbon footprint of each property by creating a clean, renewable energy source. Solar energy systems provide the property owner with the choice for electric supply at a fixed price for electricity for over 20 years, the means to reduce the peak power demand of the utility grid, and the ability to enhance the municipality's electric power	Calling a solar energy system "inherently beneficial" may be confusing if local governments are planning to restrict where solar energy systems can be placed. If a local government plans to restrict use, this section might specify that despite its inherent qualities, this ordinance will restrict the use of panels so as to promote their compatibility with existing land uses as specified in (name section) of this ordinance.

reliability and quality.	
The purpose of this article is to provide for the use of solar energy, including specifications related to the land development, installation and construction of solar energy systems in (municipality), subject to reasonable conditions to protect the public health, safety, and welfare. This section applies to solar energy systems to be installed and constructed on any property.	

Source: DVRPC 2014

Section 2. Definitions

Any term used in the text of the ordinance must be defined. This section provides a selection of important terms and their definitions for both large and small-scale solar installations. The definition of each term can greatly impact how an ordinance is enforced - providing accurate definitions of these terms will ensure clarity in the enforcement of the ordinance. Several variations of some terms have been provided to allow flexibility for the individual municipality. Definitions may be included in the body of the alternative energy ordinance, if it is a stand-alone ordinance, or may be incorporated into the Definitions section of the zoning ordinance

Language	Comments and Guidance
Solar Easements: Legal agreements that protect access to sunlight on a property.	Municipalities will typically not want to be involved with the establishment of solar easements, which is an agreement between two property owners, but they can encourage residents to obtain easements in the zoning code. For more information on solar easements, see Section 5.
Solar Energy: Radiant energy (direct, diffused, or reflected) received from the sun at wavelengths suitable for conversion into thermal, mechanical, chemical, or electrical energy.	
Solar Energy System	Several options for definitions of **solar energy systems** are provided below, including one that is not recommended for use (*in italics*).
Solar Energy System: *Any solar collector or other solar energy device, or any structural design feature, mounted on a building or on the ground, and whose primary purpose is to provide for the collection, storage, and distribution of solar energy for space heating or cooling, for water heating, or for electricity.*	This definition is **not recommended** because it does not tie the purpose of the power to a specific end use. It could lead to utility-scale installations because it does not define the purpose of the energy.

Solar Energy System: An energy system which converts solar energy to usable thermal, mechanical, chemical, or electrical energy to meet all or a significant part of a structure's energy requirements.	This definition addresses physically what a solar energy system is (can be solar hot water and PV) and the last half of the sentence allows various forms of financing to be implemented (such as a Solar Power Purchase Agreement). This definition would not allow utility scale because it is tied to an end use.
Solar Energy System: Solar panels or solar energy collectors that generate energy, sometimes in excess of the energy requirements of the property, if it is to be sold back to an investor-owned utility in accordance with the law.	This definition is effective at tying in the use of the system, and would be useful when defining a system that is used as an accessory use. This definition limits system size according to what is allowed by net metering laws, which would prohibit larger systems and utility-scale uses.
Solar Energy System: An energy system that consists of one or more solar collection devices, solar energy related "balance of system" equipment, and other associated infrastructure with the primary intention of generating electricity, storing electricity, or otherwise converting solar energy to a different form of energy. Solar energy systems may generate energy in excess of the energy requirements of a property if it is to be sold back to a public utility in accordance with the law.	This is the most comprehensive definition, including physically what a solar energy system is (can be solar hot water and PV), how it is to be used, and applies only to accessory use systems. Does not allow utility-scale use.
Solar Energy Facilities: An alternative energy facility that consists of one or more ground-mounted, free-standing, or building-integrated solar collection devices, solar energy related equipment and other associated infrastructure with the primary intention of generating electricity or otherwise converting solar energy to a different form of energy for primarily commercial or other off-site use.	This definition applies to ordinances that choose to address commercial/utility-scale solar energy facilities.
Building-Integrated Photovoltaic (BIPV) Systems: A solar energy system that consists of integrating Solar PV modules into the building envelope, where the solar panels themselves act as a building material (roof shingles) or structural element (i.e. façade).	Municipalities may wish to impose specific regulations on building-integrated Photovoltaic systems, in which case, a definition would be important to include.
Ground-Mounted Solar Energy Systems: A solar energy system where an array is mounted onto the ground.	Municipalities may wish to impose specific regulations on ground-mounted solar energy systems, in which case, a definition would be important to include.

Section 3. Applicability

The ordinance review process can be a major barrier to the development of solar energy projects if the ordinance fails to identify solar energy systems as an allowed use (such as an accessory, permitted use – or even a conditional use, or special exception). Further, while a conditional use, or special exception, is suitable for some areas of development where additional scrutiny is common practice (such as historically significant areas), it should only be required in certain limited circumstances, if the overarching desire in your community is to encourage renewable energy. Special use or conditional use permits will discourage projects because they add to the cost of the projects and will require additional time to obtain a permit. This section will provide language that gives a municipality the options to regulate the use for solar energy (principal or accessory), and the level of review required (by-right, conditional use, etc.).

By-right/Permitted Use: Municipalities that wish to encourage solar in their communities should allow solar as by-right (a permitted use) in all districts. Permitted uses in a zoning ordinance are those that the municipality feels should be allowed in a particular zone under all circumstances, though they may be made subject to specific standards that would be reviewed by the municipal zoning officer and planning commission. Typically, municipalities that wish to encourage solar will allow solar as by-right in all districts subject to standards outlined in the ordinance. However, some may wish to allow solar by-right only in some districts because they wish to have an added layer of review for specific districts such as historic districts.

Language	Comments and Guidance
Solar Energy Systems as described in this Article are permitted in all zoning districts as an accessory use to a permitted principal use subject to the standards for accessory uses in the applicable zoning district and the specific criteria set forth in this Article.	These two examples are the most permissive options, allowing solar PV in all districts. It is common to define solar energy systems as an accessory use subject to the requirements of that district. Municipalities can tweak underlying regulations (i.e. height, setback, impervious coverage) within the solar ordinance accordingly. See next section, General Regulations, for language options for underlying regulations.
Solar Energy Systems, as defined by this ordinance, are a permitted use in all zoning districts.	
Solar Energy Systems shall be considered an accessory use and permitted by right if mounted to an existing structure and if any percentage of the energy is used for one or more of the principal uses on the same lot.	This language option is **not recommended** because tying the permitted use to using the energy for one or more principal uses on the same lot would effectively prohibit virtual net metered systems, which is allowed by the laws and regulations established by the Pennsylvania Public Utility Commission. Virtual net metering is not currently allowed in NJ. This language could also restrict the viability of community solar programs, which are not currently supported in Pennsylvania, but may be in the future.

Special Exception/Conditional Use: A special exception or conditional use is a permitted use, but requires that the applicant meet objective requirements specified in the ordinance and that a public hearing is held on the application before the zoning board or governing body. This may add to the cost and amount of time

needed to complete an installation, and should be used only when there are concerns over compatibility with neighboring land uses and the municipality desires a greater level of control over approving proposed energy systems. As such, it is not recommended that municipalities use special exception or conditional use in all districts, though municipalities may wish to require a special exception when regulating utility-scale uses if the municipality wishes to allow this use in their community. In some cases, municipalities will require conditional use in historic districts.

Historic Districts: Municipalities with historic districts should work with their Historical Architectural Review Boards to determine whether there will be restrictions on solar PV installations in historic districts that will require review by a HARB. If design guidelines, siting restrictions or review requirements exist, they should be laid out explicitly in the ordinance to ensure a clear and understandable review process is known to the applicant. Review processes will add time and added labor cost through delayed installations, so municipalities should attempt to make solar provisions for historic districts minimally restrictive. Below are two examples of design guidelines for installing solar on historic properties.

> **Design Guidelines for Solar Installations**, National Trust for Historic Preservation: http://www.preservationnation.org/information-center/sustainable-communities/buildings/solar-panels/design-guidelines-for-solar.html#.VJBtOSvF9TI
>
> **Solar Panels on Historic Properties**, National Park Service: **http://www.nps.gov/tps/sustainability/new-technology/solar-on-historic.htm**

Municipalities can reference the path of review for systems being installed within historic districts. Below are three sample language options for making this reference:

Language
All solar energy systems within a historic district or on a historic resource property are not permitted unless written approval or a Certificate of Appropriateness has been granted by the Historical Architectural Review Boards or Historical Commission.
If a solar energy system is proposed to be located within XXX feet of a Class I, Class I DOE or Class II Historic Resource, the system shall be approved by the Board of Supervisors following recommendation from the Historical Architectural Review Boards or Historical Commission.
All solar energy systems/facilities within _____ (historic district/overlay/etc.) or on a historic resource property as defined by _____ (the municipal inventory/register/etc.) must follow the administrative procedures required by _____ (historic preservation ordinance).

The following is a general statement about the applicability of the ordinance on the date of the installation, not on use or location.

Language
This ordinance applies to Solar Energy Systems to be installed and constructed after the effective date of the ordinance, and all applications for Solar Energy Systems on existing structures or property. Solar Energy Systems constructed prior to the effective date of this ordinance shall not be required to meet the requirements of this ordinance.Any upgrades, modifications, or changes that materially alter the size or placement of an existing Solar Energy System shall comply with the provisions of this ordinance.

Looking Up: The Future of Solar PV

- *Concentrated Solar PV*. : Thinking far into the future, you may want to consider the applicability of ordinances to concentrated solar power systems (CSP). While they are currently only very large systems in the desert, they could become more scalable in the future. Maybe worth another footnote?
- Micro inverters: Micro-inverters are attached directly to each solar module to convert DC to AC power. Micro-inverters may provide more efficient conversion of energy and increased reliability over standard inverters in some applications.

Section 4. General Regulations

The general regulations are guidelines or added requirements that must be integrated into the local review process. This section will present a variety of regulations that the municipality may include in the ordinance, such as height, setbacks, aesthetics/screening, and impervious coverage. The standards that follow may be used in addition to existing special use permits and site plan review standards, or they may be used to create a stand-alone set of review standards that substitute for any existing review standards. Approval standards may be imposed upon specific types of solar energy systems (i.e., ground-mounted/freestanding versus roof-mounted), imposed upon specific districts, or be generally applied to all solar energy systems.

Setbacks

Ground-Mounted: For ground-mounted solar energy systems, setback requirements can help alleviate aesthetic and safety concerns, yet overly restrictive setback requirements can limit the available space in which a solar PV array can be sited. Since solar PV panels rely on adequate access to sunlight, municipalities may want to consider easing setback requirements for ground-mounted solar PV systems.

Fencing: Zoning codes do not need to address fencing or screening of ground-mounted solar PV systems – this is covered by the National Electric Code, which requires that systems be screened.

Language	Comments and Guidance
The location of the Ground-Mounted System shall meet all applicable accessory-use setback requirements of the District in which it is located.	Municipalities that treat ground-mounted systems as accessory use structures (this is how they may be permitted) can use accessory use regulations for setback (and also height) of ground-mounted systems
All Ground-Mounted Systems shall be set back a distance of **X** feet from any property line in a residential zoning district or in conformance with the area and bulk standards for accessory structures in commercial districts as provided herein.	If a municipality feels that their accessory use regulations are outdated or would like to have tighter control over setbacks for ground-mounted systems, this language option can be used to apply a specific setback distance applicable to ground-mounted systems.
Ground-Mounted Systems shall not be permitted in a front yard unless the applicant demonstrates that the rear yard locations will not result in acceptable solar access.	Some municipalities may want to prohibit or discourage the placement of PV systems in front yards if they are visible from the public right of way. The first option, to only permit if PV is not able to be sited elsewhere, is recommended. The second option is considered restrictive.
Ground-Mounted Systems shall not be permitted in a front yard.	

Ground-Mounted Solar Energy System

Source: NREL

Roof-Mounted: Setback regulations for roof-mounted systems can ensure that adequate pathways exist for access along roof edges and ridge lines for first responders in case of a fire or for maintenance crews in the case of system repair. As of 2014, the adopted state building, electric, and fire code for both PA and NJ did not include provisions for roof setbacks. Municipalities can use the zoning code as a way to regulate for these setbacks. Because the building, electric, and fire codes will be updated over time (NJ is slated to adopt the 2014 codes in 2015), municipalities can include a requirement that references the zoning or building code, whichever is more stringent. Further, municipalities may want to institute separate setback regulations for access on commercial buildings (which typically have larger, flat roofs) versus residential buildings (which

may have flat or pitched roofs). Examples of setback language for various roof applications are provided below.

Language	Comments and Guidance
All PV installations shall include a 36 inch wide pathway maintained along three sides of the solar roof. The bottom edge of a roof with a slope that exceeds 2:12 shall not be used as a pathway. All pathways shall be located over a structurally supported area and measured from edge of the roof and horizontal ridge to the solar array or any portion thereof. <u>Exceptions:</u> On structures with a PV array area of 1,000 square feet or less installed on a roof with a slope that exceeds 2:12 and with an intersecting adjacent roof and where no section of the solar PV array is larger than 150 feet measured in length or width: 1. Where the PV array does not exceed 25% as measured in plan view of total roof area of the structure, a minimum 12 inch unobstructed pathway shall be maintained along each side of any horizontal ridge. 2. Where the solar array area exceeds 25% as measured in plan view of total roof area of the structure, a minimum of one 36-inch unobstructed pathway from ridge to eave, over a structurally supported area, must be provided in addition to a minimum 12-inch (305 mm) unobstructed pathway along each side of any horizontal ridge Pathways are not required on non-occupied accessory structures. **Flat roofs - We need language for this** Systems that include a solar array section that is larger than 150 feet measured in length or width shall have additional intermediate pathways. An intermediate pathway not less than 36 inches wide separating the array shall be provided for every 150 feet of array including offset modules or angled installations. The maximum square footage of an array shall not exceed 22,500 square feet. without the installation of an intermediate pathway.	This language, based off of a code developed by the State of Oregon, provides a recommended option for regulating setbacks for various roof sizes, configurations, and pitches. Oregon's code standard requires that all installations must maintain a 3-foot pathway along three sides of the roof for access (not including the edge if the pitch is greater than 2:12 (a roof that rises 2' for every 12' of run). However (importantly), Oregon's regulations provide exemptions for smaller systems (<1,000 square feet) that do not cover the majority of a roof surface, and further exemptions for roofs with a flatter pitch (<3:12). These exemptions may work well for municipalities that feel that a three-foot setback along all sides of the panel would be restrictive to apply to all properties. ***Exemption 1 – 12" pathway required***  ***Exemption 2 – 36" pathway required*** 

A 3-foot setback from all roof edges shall be provided for roof mounted solar panels to ensure that firefighters may access the roof in a quick and safe manner.

A 3-foot setback along the roof ridgelines shall be provided for roof-mounted solar panels to allow available space for firefighters to penetrate the roof to create ventilation.

A 1.5-foot setback from all roof hips and valleys shall be provided for roof-mounted solar panels to ensure that firefighters may access the roof in a quick and safe manner if solar panels are installed on both sides of the roof hip or valley.

This language was developed for the National Fire Protection Association (NFPA) 1: Fire Code (2012 & 2015 versions) and the 2012 International Fire Code (IFC). Many industry experts feel that this standard is too restrictive for all residential roofs because it has the potential to significantly limit the amount of available roof space to site a solar PV system.

First Responder Safety

Roof-mounted solar thermal and solar photovoltaic energy systems can create additional hazards for first responders during a fire, such as tripping/slipping, and structural damage as a result of additional weight on the roof from the system, among other hazards. Photovoltaic energy systems have the potential to present an additional hazard of electric shock, as panels cannot be simply "turned off" and will always generate some electricity when enough light is shining on them. Training and education of first responders, and the incorporation of best practices into guidelines and Standard Operating Procedures, is an essential and important step toward ensuring their safety when responding to a fire. The code and ordinance considerations listed in the above section on setbacks, that regulate for backs on roofs to ensure clearance and ability to ventilate, can also help alleviate hazards by creating space for first responders to move around a roof when responding to a fire. Municipalities should contact their local fire department to determine whether setbacks are needed, according to the local fire departments methods for fighting fires.

For more information on First Responder Safety, please visit:

Rooftop Solar PV & Firefighter Safety
http://solaroutreach.org/wp-content/uploads/2014/09/Rooftop-Solar-PV-Firefighter-Safety_Final.pdf

Solar Energy Systems: A Guide for Pennsylvania Municipal Officials:
http://www.pennfuture.org/UserFiles/File/Energy/Solar_MuniGuide_200912.pdf;

Firefighter Safety and Photovoltaic (PV) Systems, ICLEI Local Governments for Sustainability:
http://www.icleiusa.org/static/ICLEI_Firefighter_and_PV_Safety_Slides.pdf; and

Guidebook for Solar Photovoltaic Projects In Philadelphia:
http://www.phila.gov/green/PDFs/PhillySolarGuidebookFinal.pdf.

Height

Height regulations can help alleviate local land use concerns over aesthetics (e.g. how much of the system can be seen from the street). However, height restrictions can prevent a solar PV system from being installed if the building on which it is sited is already at maximum allowed height if the municipality does not specify an exemption for the system in its ordinance. It is also important to keep in mind that it is beneficial to allow an air space between solar PV panels and the building or structure that they are mounted on because proper ventilation and cooling helps the panels operate more efficiently. Separate height language options are provided for sloped and flat roofs. In communities with both sloped and flat roof types, it may be most appropriate to include separate regulations by roof type

Height – Sloped Roof

Language	Comments and Guidance
For a roof-mounted system installed on a sloped roof, the highest point of the system shall not exceed the highest point of the roof to which it is attached as allowed by setback requirements.	It is appropriate to not allow panels to exceed the height of the roof on a pitched roof to ensure adequate setback from the ridgeline and to protect the system from wind loading.
Solar Energy Systems shall not exceed a height of eight inches from the rooftop surface. In no event shall the placement of the solar panels result in a total height including building and panels than what is permitted in the zoning district.	This language is **not recommended** because it would prohibit the ability to tilt systems. Some systems will be designed with a 10 to 34 degree tilt to maximize solar access. A restriction of distance from the roof surface may prohibit this.

Height – Flat Roof

For a roof-mounted system installed on a flat roof, the highest point of the system shall be permitted to exceed the district's height limit of up to fifteen (15) feet above the rooftop to which it is attached.	It is important to allow PV systems to exceed maximum height of building structure because the building may have already met maximum height. Additionally, as mentioned, some PV systems will be designed with a tilt to maximize solar access. The language option provided here gives a 15 foot flexibility above maximum height. Municipalities can be more restrictive than this, though it is not recommended that they limit to less than six (6) feet above the rooftop surface.

Figure 6: A Tilted System on a Flat Roof

Source: NREL

Height – Ground-Mounted

Ground-mounted or freestanding solar energy systems shall not exceed applicable maximum accessory structure height in the zoning district in which the solar energy system is located.	This language may prohibit solar if the accessory structure height limit of the zoning district is less than 15 feet. If this is the case, the municipality may want to consider a height exemption of up to 15 feet for ground mounted systems.

Height – Parking Canopies

A solar energy system may exceed the applicable maximum accessory structure height if it will cover an impervious surface parking area. Height may not exceed the height of the primary structure that the parking area serves. Minimum height of the parking canopy must allow clearance for emergency service and service vehicles.	This option can be added onto height restrictions for ground-mounted systems to allow use regulations for parking canopies. Parking canopies may need to exceed accessory structure height limits (especially in commercial settings), and should also require a minimum height clearance to allow access by emergency service and service (e.g. snow removal) vehicles.

Figure 7: Solar PV Parking Canopy

Source: NREL

Impervious coverage (for Ground Mounted Systems)

Zoning ordinances will typically set maximum impervious coverage percentages for a zoning district. Counting solar systems as impervious coverage could severely limit a citizen's ability to place solar on their property because a parcel that already has a house, driveway, patio, etc. could be close to, or at, a zoning district's impervious coverage limit. Further, for solar installations in municipalities in Pennsylvania that comply with Act 167 will require Act 167 review for systems that exceed 1,000 square feet. Municipalities around the country have been inconsistent in determining whether solar panels should constitute an impervious surface. Yet, ground-mounted solar energy systems do not completely cap the ground and thereby do not prevent water absorption. Ground-mounted solar energy systems could be excluded from impervious surface calculations, or the impervious surface calculation could be limited to the system's footings (the parts of the system that make contact with the ground). In New Jersey, state law exempts solar energy systems from being counted as impervious surface.

The following are three options for examples of how to regulate impervious coverage.

Language	Comments and Guidance
For purposes of determining compliance with building coverage standards of the applicable zoning district, the total horizontal projection area of all ground-mounted and free-standing solar collectors, including solar photovoltaic cells, panels, arrays, inverters, shall be considered pervious coverage so long as pervious conditions are maintained underneath the solar photovoltaic cells, panels, and arrays.	Ground-Mounted Solar as **Pervious Coverage.** This language options is recommended, and is the most permissive option.
For purposes of determining compliance with building coverage standards of the applicable zoning district, the total horizontal projection area of all ground mounted and freestanding solar collectors, including solar photovoltaic cells, panels, arrays, inverters and solar hot air or water collector devices, shall be considered impervious coverage. For a tracking array or other moveable system horizontal projection area shall be calculated at a 33 degree tilt angle.	Ground Mounted Solar as **Impervious Coverage.** This language option is not recommended because it would be restrictive for systems that are sited on properties that have already met the allowed impervious coverage limit. :
For purposes of determining compliance with building coverage standards of the applicable zoning district, the total horizontal projection area of all ground-mounted and free-standing solar collectors, including solar photovoltaic cells, panels, arrays, inverters and solar hot air or water collector devices, shall be considered ___% impervious coverage. For example, if the total horizontal projection of a solar energy system is 100 square feet, XX square feet shall count towards the impervious coverage standard. For a tracking array or other moveable system, the horizontal projection area shall be calculated at a 33 degree tilt angle	Ground-Mounted Solar as **both Impervious and Pervious Coverage**. This language is provided for municipalities that wish to classify the system as partially but not fully impervious.

Design and Installation

Design and aesthetic concerns may be raised by residents and businesses, especially in locations with historic areas of significance. It should be noted that measures to alleviate aesthetic concerns can compromise the ability of solar energy systems to operate properly, especially in cases where screening or setback requirements would block areas with the most access to sunlight.

Aesthetics: It is generally not recommended that municipalities over-regulate for aesthetic concerns such as "conspicuous panels that are visible from the street, conspicuous equipment tied to the panels, or glare. If the ordinance is enforced properly, then the height and setback restrictions should alleviate these aesthetic concerns in a quantifiable (easier to enforce) manner.

Language	Comments and Guidance
The design of Solar Energy Systems shall, to the extent reasonably possible, use materials, colors, textures, screening, and landscaping that will blend the facility into the natural setting and existing environment.	These language examples are **not recommended** because they are considered very restrictive and hard to interpret. Municipalities may find these restrictions appropriate for Historic Districts. If so, however, these regulations are not typically included in zoning. HARBs and historic review committees are encouraged to codify restrictions for historic districts.
Solar energy equipment shall not be conspicuous from adjacent streets. For example, solar panels directly facing adjacent streets will be considered to be conspicuous.	
Solar panels shall be positioned to prevent solar glare upon any neighboring properties or any public or private street, and to prevent additional heat load upon neighboring properties.	This language is **not recommended** - glare regulations are considered restrictive. Not only is the causation of glare difficult to prove, but PV systems are designed to absorb radiation, not reflect it. Solar PV panels are constructed of dark-colored (usually blue or black) materials and are covered with anti-reflective coatings. Modern solar PV panels reflect as little as 2 percent of incoming sunlight, about the same as water and less than soil or wood shingles.

Trees

Language	Comments and Guidance
Any trees to be removed shall be accompanied by a plan demonstrating the need to remove living trees and replacement of the trees.	While it is true that shade of any kind interferes with solar energy systems' ability to operate, removing trees to install solar technology is generally not recommended. If tree removal is allowed, it is strongly recommended that replanting of an equivalency of lost trees/foliage be required in a solar ordinance. If in the same area of the solar panels, the foliage should be of a type that will not be expected to shade the panels.
An applicant shall locate a Solar Energy System so that tree removal is not required to the extent practical.	

Section 5. Solar Access

Owners of existing systems face potential challenges when trees or new structures on neighboring property shade their solar collectors. Municipalities in Pennsylvania are not allowed to regulate for solar access, however, and municipalities typically do not wish to get involved with agreements between two landowners. Municipalities can encourage applicants for solar energy systems (at the time of permit) to obtain a solar access easement with neighboring/adjacent properties.

What is a Solar Access Easement?

A solar access easements is a negotiated legal agreement between affected parties that is designed to protect a landowner's right to install PV and their access to sunlight. Solar easements are not enforceable through a zoning or permitting process. A solar access easement is a written document of agreement between two (or more?) landowners. This document ensures that all affected parties are aware of the solar installation. The easement can be free, or the parties may agree on a price. Easement holders should register the easement with the County Recorder of Deeds to ensure that the easements stay with the property and are enforced. Any instrument creating a solar easement may include, but is not limited to, all of the following:

1. A description of the dimensions of the easement expressed in measurable terms, such as vertical or horizontal angles measured in degrees, or the hours of the day on specified dates during which direct sunlight to a specified surface of a solar collector, device, or structural design may not be obstructed, or a combination of these descriptions.
2. The restrictions placed upon vegetation, structures, and other objects which would impair or obstruct the passage of sunlight through the easement.
3. The amount, if any, of permissible obstruction of the passage of sunlight through the easement, expressed in measurable terms, such as specific percentage of sunlight that may be obstructed.
4. Any provisions for compensation of the owner of the property benefiting from the easement in the event of impermissible obstruction of the easement.

To encourage solar access easements in a zoning ordinance, municipalities can include the following language in their zoning ordinance:

Language	Comments and Guidance
Owners of solar energy systems are encouraged but not required to obtain solar access easements from neighboring landowners to ensure solar access. The municipality does not guarantee and will not protect any individual property rights with respect to solar access.	Municipalities can encourage applicants for solar energy systems (at the time of permit) to obtain a solar access easement with neighboring/adjacent properties.
When an applicant owns two or more adhacent lots, and at least one of those lots is proposed to utilize solar energy collection devices, the applicant is requested to consider establishing a solar access easement or a similer legal mechanism to make sure that structures or vegetation on one lot does not unreasonably obstruct solar acces for the solar energy collection devices in the adjacent lot.	This lanaguge is recommended especially in locations where several adjacent lots will likely be redeveloped by the same owner/developer (communities that have vacant or underutilized parcels). Easements are likely much more feasible from a signle owner. This way, when the parcels are sold, the easement will stay with the property.

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