Model Ordinance Guidelines

for Municipalities

GO SOLAR

Produced by the North Central Texas Council of Governments
in partnership with the State Energy Conservation Office (SECO)

July 2016

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Introduction

This Ordinance Framework for Solar Photovoltaic (PV) Installations in Texas is designed to be a resource for Texas municipalities as they develop and/or update zoning ordinances. It is intended to provide language options and explanations regarding regulation of the siting of roof or ground-mounted solar energy devices (SED) for the production of electricity to be used primarily on-site at residential and commercial properties. Throughout this document, the term SED is used according to its definition by the Texas Tax Code, Section 171.107, and includes all components of a given system including but not limited to the panels, balance of system components, and batteries. See Page 12 (Recommended Definitions) for the full definition.

The purpose of this framework is to provide clear, Texas-specific guidance on how to construct a solar PV zoning ordinance that:

- Is in accordance with state laws;
- Is not overly restrictive or contradictory to the nature of SED; and
- Promotes safe and sound community development

Using this guide, municipalities will 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, energy, and community goals.

This framework does not provide guidance on grid supply solar projects, such as solar farms or utility-scale solar projects, nor on solar thermal applications, such as hot water systems. If you would like more guidance on ordinance language for these applications, please visit www.gosolartexas.org.

Before You Begin:

Crafting ordinances regarding unfamiliar and rapidly changing technology such as SED can be challenging. Carefully considering the following items will aid in achieving the appropriate regulation for each individual municipality.

Purpose:

What is the proposed ordinance intended to accomplish? Discuss the purposes with those who have proposed the ordinance, and examine the manner in which the ordinance is likely to be applied.

A solar ordinance won't be the best tool for every city!

In many cases, a simpler and more efficient strategy is to rely on national and State building, electrical, and fire codes as adopted by the State of Texas to govern solar installations and to incorporate compliance with these codes into the permitting process. These codes are updated regularly, will generally keep up with solar industry and technology changes and improvements, and address the most critical safety-related aspects of solar installations. Ordinances, by contrast, may not be able to anticipate improving technologies, and may require extensive updating processes. Given this, allowing SED by right in all zones/districts/land uses is considered a **BEST PRACTICE**. In fact, based on a review of statewide processes by North Central Texas Council of Governments staff and members of the North Texas Renewable Energy Group, fewer than 20 Texas cities have a solar-specific ordinance – instead, most cities handle solar installation approval through permitting alone.

While it is not required that municipalities zone for SED, there can be 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 local 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 SED, delays in obtaining a zoning permit, or triggering the use-variance process. Further, inconsistent, overly burdensome, and unpredictable land use regulations from one municipality to the next can deter the renewable energy industry from doing business in the region. Delays, increased project costs, and increased strain on limited municipal resources - time added to the zoning and permitting process - are costly for the applicant as well as the municipality.

Review planning goals:

Municipalities should develop an ordinance that is compatible with existing land use plans (comprehensive plans, master plans, zoning code). There are several options for regulating solar PV through the zoning code (or similar). Municipalities can simply incorporate SED into the definitions section of their existing zoning code as an accessory use, making SED 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 SED, and may inadvertently prevent an SED from being installed on a property.

Municipalities can develop supplemental regulations that would apply only to SED that balance solar PV siting needs with the need for compatibility with adjacent land uses. For example, supplemental regulations can be used to specify height exemptions, define 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). Language suggestions for these supplemental regulations are provided in the "Ordinance Language and Guidance" Chapter of this document.

Be Informed:

The most effective ordinances are those developed by well-informed staff. A best practice would be to include regular consultation with solar energy experts and industry professionals in your region as part of the ordinance-drafting team. In Texas, the Texas Solar Energy Society is a recommended resource and can connect you with local contacts. Contact them at www.txses.org.

Likewise, understanding how SED work can greatly limit concerns with the safety of the technology, and can ensure that the regulation of the device doesn't interfere with the access to sunlight that SED need to operate most effectively. An introduction to the technology basics is provided in the "Understanding SED" section on Page 5 of this document. More in-depth information is available under "Solar 101" at www.gosolartexas.org.

Legal considerations:

Are there regulatory constraints within which you must proceed in drafting the text of the ordinance? In Texas, two State laws have significant impact on solar installations.

- Senate Bill 1626, which became effective in September of 2015, prohibits developments with 50 homes or more from banning or restricting solar installations during the community's development phase. Previously, any developer could choose to prohibit or severely restrict these installations.
- House Bill 362, enacted in 2011, prohibits a Property Owners Association (POA) or Homeowners Association (HOA) from restricting whether and where homeowners may install solar energy equipment if the HOA restrictions would reduce the estimated production of the SED by ten percent or more.

For more information, visit:

- Planning Advisory Service (PAS) Essential Info Packets: Planning and Zoning for Solar Energy. (American Planning Association): www.planning.org/pas/infopackets/eip30.htm
- Solar America Board for Codes and Standards (Solar ABCs): www.solarabcs.org
- Go Solar Texas: www.gosolartexas.org

Understanding Solar Energy Devices (SED)

For a comprehensive list of solar energy-related terms, visit www.gosolartexas.org/solar-glossary.

Key Terms

Building-Integrated Photovoltaic (BIPV) Devices: An SED that integrates 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). These are becoming more common as prices begin to drop with technology improvements, and they save some costs during installation.

Ground-Mounted SED: Devices which are freestanding, or not mounted on existing buildings. Ground-mounted devices can be static or tracked, meaning they have a mechanism that enables them to maintain tilt toward the sun as it moves across the sky.

Inverter: Device that changes the direct current (DC) electricity to alternating current (AC) electricity for use.

Net metering: Net metering allows utility customers to apply the electricity generated by their own devices against their electric bills. If they produce more than they consume, the utility pays them for the excess. Texas does not currently require that utilities offer net metering.

On-Grid/Grid Connected/Grid-tied: An energy device connected to the electric utility provider. More than 90 percent of solar energy devices installed in the US are grid-tied.

Photovoltaic (PV): Electricity from light.

PV Cell: A device that converts sunlight into electricity.

Photovoltaic Module/Array: One or more solar cells connected in one unit is known as a PV module. Multiple PV modules are connected to become an array.

Roof Mounted SED: Devices which are mounted on buildings.

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 an SED to direct sunlight.

Watt: The electrical power available at any given moment.

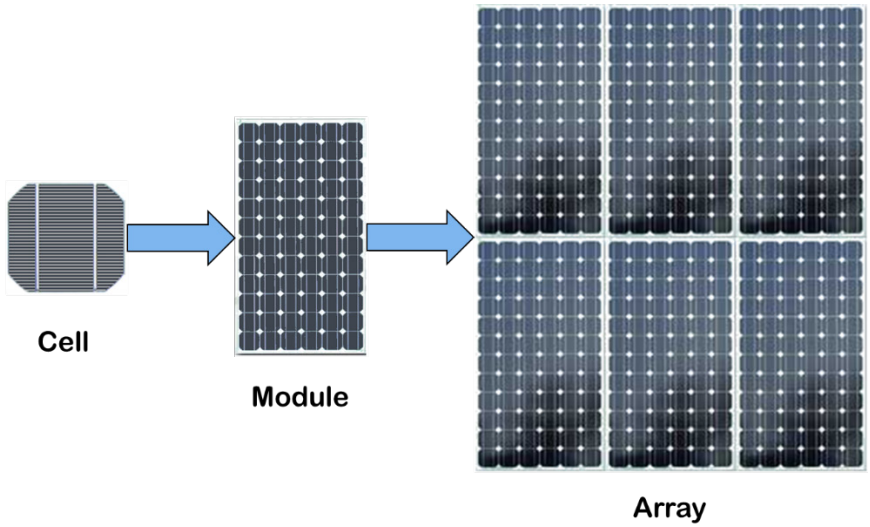
Watt-hours: The quantity of electrical power consumed over time.

How PV Works

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

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

SED are "modular" in nature – an SED 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. Modules can be connected together to form even larger units, called arrays, which can be interconnected to produce more power, and so on; the power output of a solar array is limited only by the space available for the installation and the hours of direct sunlight the panel receives. Because of this modularity, solar PV can be designed to meet any electrical requirement, no matter how large or how small, and is limited only by the installation space available.



By themselves, modules or arrays do not represent an entire device. Devices also include "balance of system" (BOS) components, such as inverters, batteries, and equipment used to connect the device 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 currently a standard component of an SED, batteries may be present to provide storage or backup power in case of an outage. This is expected to become more common as battery technology continues to improve and prices fall. Devices that are tied to the electrical grid will include disconnect switches to control the flow of power to the circuit or the grid in case of the need for device repair.

Source: "Solar PV for Real Estate Professionals" Powerpoint Presentation, Slide 19. Retrieved: http://gosolarnorthtexasorg.fatcow.com/sites/gosolartexas.org/files/docs/Real-Estate-presentation.pdf

SED Design

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

1) Solar panels require full access to sunlight in order to generate electricity – a 10 percent shading of an array can lead to a greater than 10 percent decline in efficiency, depending on the inverter(s) used.
2) In Texas, solar panels generate the most annual electricity when facing south and positioned at the optimum tilt angle, which is generally equal to the latitude in which the device is placed. West-facing panels have peak production later in the day, which can also be useful in some cases.
3) Solar panel performance declines when the air temperature behind 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 and maintain maximum efficiency.

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 electricity used by a facility, then it is 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 register with the Electric Reliability Council of Texas (ERCOT) and may need to obtain a permit from the state. They would be listed by the US Department of Energy and by the State of Texas as a power generation source.

Solar Hot Water System (Houston, Texas)

Source: http://www.solarhoustontx.org/LEEP/Experience/InteractiveMap/tabid/1164/Default.aspx

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 rarer.

This Ordinance Framework does not address these solar energy applications.

Ordinance Language and Guidance

This framework addresses accessory-use applications of SED that are intended to reduce consumption of utility power for a primary building or structure, as opposed to primary- or principal-use applications like solar farms, where solar energy production is itself the primary land use. The document 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 SED. 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 intentionally or unintentionally prohibitive of solar.

This chapter is organized around the standard sections of a zoning ordinance, including:

- Intent/Purpose
- Definitions
- Applicability
- General Regulations
- Design and Installation
- Solar Access

Each section provides context on how it applies to and may impact installations of SED, 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 SED. **Please note that this framework includes recommended, neutral and discouraged language – indicated by green, tan, and red "Comments and Guidance" cells, respectively. Please read the "Comments and Guidance" column carefully.**

Language Option	Comments and Guidance
Sample Language Option 1	 Indicates that the language is supportive of solar installations.
Sample Language Option 2	 Indicates that the language is considered neutral.
Sample Language Option 3	 Indicates that the language is <u>not recommended</u>.

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 or modify language that suits their needs. *Municipalities should consult their city attorney to understand the implications associated with ordinance adoption and the specific language to be provided in the ordinance.*

Intent/Purpose

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 solar 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 and outline the goals of the ordinance. An intent or purpose section highlights the benefits of SED and the reasons 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 low-emission, renewable 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 Texas/Municipality's energy supply portfolio, which facilitates reliability and resiliency in cases of natural disasters, as well as preparedness planning;
- Solar energy promotes customers' choice for electric supply;
- Solar energy supports healthy air quality and provides a variety of environmental benefits;
- Solar energy helps promote local jobs;
- Solar energy reduces electric generation supplied by conventional power plants, which can help improve air quality; and
- Solar energy helps support energy independence.

Language Options: Intent/Purpose	Comments and Guidance
The purpose of this ordinance is to define appropriately sited solar energy devices as an inherently beneficial use of all residential and commercial properties. Solar energy devices preserve the municipality's public health, safety, and welfare by creating a clean, renewable energy source that also diversifies the electrical grid and improves energy security.	 This language would be appropriate for a Municipality that intends the ordinance to support solar by being permissive in nature, such as permitting SED by right in all zoning districts. The municipality may choose to add or subtract language to the second sentence to describe benefits particularly important to its goals or objectives.
The purpose of this ordinance is to set forth standards that will assist industry providers and property owners in the determination of the proper installation and placement of solar related equipment with the understanding that solar capabilities may not be possible or feasible on all properties within [City]. (example drawn from Kingsville, TX)	 This language is considered neutral.
The purpose of these regulations is to accommodate solar panel devices in appropriate locations while protecting the public's health, safety and welfare, and to provide a permitting process for solar panel devices to ensure compliance with the provisions of the requirements and standards established herein. (example drawn from Cedar Hill, TX)	 This language would be appropriate for a Municipality that intends to place certain restrictions on SED installation.
The purpose of the [City]'s Solar Energy Devices Regulations is to promote the safe, effective and efficient use of Solar Energy Devices installed for on-site production and consumption of electricity.	 This language is <u>not recommended</u>. While the intent seems supportive of solar installations, the fact that the language specifies that the electricity must be consumed on-site would prohibit net metering. Net metered systems are not currently required in the State of Texas; however, utilities may choose to offer such systems. This language could inadvertently restrict such systems. By modifying to "…installed for on-site production and primarily on-site consumption of electricity" the ordinance would both enable net metering and avoid utility-scale installations.

The city council finds that the maintenance and integrity of neighborhood beauty is important to all citizens. The uncontrolled proliferation of solar energy devices is likely and such proliferation will adversely affect the health, safety and general welfare of the citizens of the city.	 This language is **not recommended**. While each municipality will chose an approach to solar regulation that is in keeping with the preferences of its citizens and the vision for the community, this language is unnecessarily antagonistic toward SED and its claims that SED can adversely affect health, safety, or welfare are not supported by practical evidence.

Recommended Definitions

Any term used in the text of the ordinance should be defined. This section provides important terms and their recommended or accepted definitions. The definition of any term can greatly impact how an ordinance is enforced - providing accurate definitions of these terms will ensure clarity in the enforcement of the ordinance. Definitions may be included in the body of the solar ordinance, if it is a stand-alone ordinance, or may be incorporated into the Definitions section of any zoning ordinance. Unlike in other sections of this chapter, only one recommended definition has been provided for each term to encourage consistency across jurisdictions. Terms and definitions related to community solar or utility-scale solar projects are not included.

Language Options: Definitions	Comments and Guidance
Solar Access Easement: Legal agreement to prevent adjoining landowners from building any structure that would block sunlight and diminish effectiveness of solar energy devices on one or both properties.	 Easements are usually voluntary and agreed upon by the property owners. Municipalities will typically not want to be involved with the establishment of solar easements, but they can encourage residents to obtain easements in the zoning code. For more information on solar easements, see Section 4, Pages 28-9.
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 Device: A system or series of mechanisms designed primarily to provide heating or cooling or to produce electrical or mechanical power by collecting and transferring solar-generated energy. The term includes a mechanical or chemical device that has the ability to store solar-generated energy for use in heating or cooling or in the	 This is the definition provided by Texas Tax Code § 171.107.

production of power.	
Photovoltaic (PV) System: The total components and subsystem that, in combination, convert solar energy into electric energy suitable for a connection to a utilization load.	 This is the definition provided in the 2014 National Electric Code (NEC).
Building-Integrated Photovoltaic (BIPV) Systems: An SED that consists of integrating Solar PV modules into the building envelope, where the solar panels themselves act as a building material (e.g., roof shingles) or structural element (e.g., 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 Devices: A solar energy device where an array is mounted onto the ground.	 Municipalities may wish to impose specific regulations on ground-mounted SED, in which case, a definition would be important to include.

Applicability

The "Applicability" language determines where and when the provisions of the ordinance apply, as well as the level of review required. The ordinance review process can be a major barrier to the development of solar energy projects if the ordinance fails to identify SED 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), if the overarching desire in the community is to encourage renewable energy such scrutiny should only be required in limited circumstances. 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 options to regulate the use for solar energy (accessory), and the level of review required (by-right, conditional use, etc.).

Best Practice: By-right/Permitted Use

Allowing solar as by-right (a permitted use) in all districts encourages solar deployment overall. 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. 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. A Solar Permitting Checklist and Expedited Solar Permitting Checklist are available at www.gosolartexas.org for municipalities to reference and adopt in order to streamline the permitting process.

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

Language: Applicability (General)	
This ordinance applies to Solar Energy Devices to be installed and constructed after the effective date of the ordinance, and all applications for Solar Energy Devices on existing buildings or property. Solar Energy Devices 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 Device shall comply with the provisions of this ordinance.	 This language is recommended to avoid placing unnecessary burdens on SED already installed within the Municipality's jurisdiction.

Language Options: Applicability (Location, Use, Review)	Comments and Guidance
Solar Energy Devices as described in this ordinance 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 appropriate for Municipalities that intend for the ordinance and regulation to be permissive and support widespread solar deployment. It is common to define SED 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 Devices, as defined by this ordinance, are a permitted use in all zoning districts.	
Solar Energy Devices shall be considered an accessory use and permitted by right if mounted to an existing building 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 <u>not recommended</u> because tying the permitted use to using the energy for one or more principal uses on the same lot would effectively prohibit net metered systems. Net metered systems are not currently required in the State of Texas; however, if that were to change, this language would become restrictive and may require amendment.

Historic Districts

Municipalities with historic districts should work with their Historic Preservation Commission (HPC) or equivalent bodies to determine whether there will be restrictions on solar PV installations in historic districts that will require review by an HPC. If 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 labor cost through delayed installations, so making solar provisions for historic districts minimally restrictive is considered a **BEST PRACTICE**.

Special Exception/Conditional Use/Specific Use

A special exception, conditional or specific 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 SEDs. 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 this use is allowed in their community. In some cases, municipalities will require conditional use requirements in historic districts as appropriate.

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 SED (i.e., ground-mounted/freestanding versus roof-mounted), imposed upon specific districts, or be generally applied to all SED.

Setbacks

Roof-Mounted: Setback regulations for roof-mounted systems refer to the distance from the edge of the PV panel to the edge of the roof, rather than to the distance to the property line. These setbacks 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. Municipalities can use the zoning code as a way to regulate for these setbacks. Because building, electric, and fire codes will be updated over time, 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 on the next page.

The International Fire Code already has specific guidelines for roof-mounted SED setbacks and pathways (IFC 605.11.3.2.4). In order to reduce redundancy and effort, as well as to maintain consistency with industry and regulatory standards, it is critical that municipalities adopt the most current national codes. A recommended BEST PRACTICE is to reference the codes as adopted by the State of Texas, to ensure use of the most recent codes.

Roof-Mounted SED in Hurst, Texas

Source: http://www.dfwsolartour.org

Language Options: Roof-Mounted SED Setbacks	Comments and Guidance
A setback from all roof edges, as defined by the 2012 International Fire Code (IFC) or any code adopted thereafter, shall be provided for roof mounted solar panels to ensure that firefighters may access the roof in a quick and safe manner and may penetrate the roof to create ventilation if necessary.	This language was adapted from the National Fire Protection Association (NFPA) 1: Fire Code (2012 & 2015 versions) and the 2012 International Fire Code (IFC). Many industry experts feel that the standard outlined in these codes is too restrictive for all residential roofs because it has the potential to significantly limit the amount of available roof space to site an SED. However, Municipalities may not enact provisions that are less stringent than the adopted national codes.

First Responder Safety

Roof-mounted SEDs can create additional hazards during a fire. For First Responders, SEDs present additional hazards of tripping/slipping and of electric shock, as panels cannot be simply "turned off" and will always generate electricity when enough light is shining on them. Moreover, there is an increased risk of structural damage as a result of additional weight on the roof from the system, though the added weight is minimal. 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 safety when responding to a fire and minimizing damage. The code and ordinance considerations listed in the above section on setbacks, that regulate for setbacks 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.

Cities are also encouraged to share information with their fire departments when an SED is inspected and approved. Appropriate data to share would include mounting location of PV on the property, system type, location of all safety disconnect switches, presence or absence of batteries, and an emergency contact number, if available.

For more information on First Responder Safety, please visit:

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

Firefighter Safety and Response for Solar Power Systems: http://www.nfpa.org/research/fire-protection-research-foundation/projects-reports-and-proceedings/for-emergency-responders/fireground-operations/fire-fighter-safety-and-response-for-solar-power-systems

Ground-Mounted: For ground-mounted SED, 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 SED, although restrictions of ground-mounted SED on utility easements or rights-of-way should be retained.

Ground-Mounted SED (Little Elm, Texas)
Source: http://www.dfwsolartour.org

Ground-Mounted SED (Houston, Texas)
Source: http://www.solarhoustontx.org

Language Options: Ground Mounted SED Setbacks	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 permit or otherwise treat ground-mounted systems as accessory use structures can simply use accessory use regulations for setback (and also height) of ground-mounted systems. This is recommended for simplicity, clarity, and consistency.
All Ground-Mounted Systems shall be set back a distance of __ 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 considers the existing accessory use regulations to be outdated or would like to have tighter control over setbacks for ground- mounted systems, this language option can be used to apply a setback distance applicable to ground-mounted systems specifically.

Screening

Zoning codes do not need to address fencing or screening of ground-mounted SEDs – this is covered by the National Electric Code (NEC), which requires that ground-mounted systems be screened to protect wiring and prevent unwanted access. Ensuring compliance with the NEC in the permitting process is a recommended **BEST PRACTICE**, but additional screening requirements for purely aesthetic purposes unnecessarily add complications and cost to SED installations and are not recommended. Municipalities should ensure that they have adopted the most current version of the NEC.

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 an SED 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 the cooler the module, the more electricity it produces. 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.

Ground Mounted Solar Panels as Art (Austin, Texas)
Source: NCTCOG

Roof of Oncor Electric building (Dallas, Texas)
Source: NCTCOG

Language Options: Height	Comments and Guidance
Sloped Roof	
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 not to 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 panels shall be parallel to the roofline on a sloped roof. In the event that panel efficiency would be reduced by more than 10 percent as a result of this requirement, tilting the panels may be considered through a special use permit (SUP) process.	 This language permits ventilation by not placing limits on the distance of the panels from the roof. While it does restrict the ability to tilt the panels, tilt on sloped roofs can raise concerns about wind load (lift) and would be appropriately addressed in an SUP process.
Solar panels shall be mounted flush with the existing slope of the roof system.	 This language is <u>not recommended</u>, since it prohibits the ventilation necessary to maximize panel efficiency.

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 10 feet above the rooftop to which it is attached.	 It is important to allow SED to exceed maximum height of building structure on flat roofs because the building may have already met maximum height. Additionally, as mentioned, some SED will be designed with a tilt to maximize solar access and to keep them clean by allowing rainwater to run off rather than collect on the panel. The language option provided here gives a 10 foot flexibility above maximum height. Municipalities can be more restrictive than this, though it is not recommended that they limit to less than six feet above the rooftop surface.

Ground-Mounted	
Ground-mounted or freestanding solar energy devices shall not exceed applicable maximum accessory structure height in the zoning district in which the solar energy device is located, and shall not be considered as or counted toward the applicable zone accessory structure square-footage limit.	This language would be a reasonable regulation of this type of SED. Establishing more restrictive height limitations for ground-mounted SED would create a risk of introducing solar access and system production concerns.
A ground-mounted or freestanding solar energy device 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 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 vehicles.

Solar Parking Canopies, Irving West Library (Irving, Texas)
Source: http://www.dfwsolartour.org

Tilted, Flat-Roof Mounted SED (Bastrop, Texas)
Source: https://www.energysage.com/project/7006/bastrop-solar-tour-rescheduled-for-nov-14-earth-sh/

Impervious Coverage (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. Municipalities around the country have been inconsistent in determining whether solar panels should constitute an impervious surface. Yet, ground-mounted SED do not typically completely cap the ground and thereby do not prevent water absorption. Ground-mounted SED 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).

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

Language Options: Im/Pervious Coverage	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, and 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 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 device is 100 square feet, ___ square feet shall count towards the impervious coverage standard. For a tracking array or other movable 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.

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 <u>not recommended</u> because it would be restrictive for systems that are sited on properties that have already met the allowed impervious coverage limit.

Design and Installation

Design and aesthetics concerns may be raised by residents, homeowners associations (HOAs) 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 SED 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/reflectivity. If the ordinance is enforced properly, then the height and setback restrictions should alleviate these aesthetic concerns in a quantifiable manner that is also easier to enforce. Any language addressing the location of SED (street-facing prohibitions or rear-yard requirements, for example) is considered to address issues of an exclusive aesthetic nature.

Language Options: Aesthetics	Comments and Guidance
Solar energy devices may be located on any roof slope.	 This language would be appropriate for a Municipality that intends the ordinance to be permissive in nature.
Solar energy devices shall not be permitted on a street-facing roof slope or yard unless the applicant demonstrates that other locations will result in a significant (10% or more) decrease in expected energy production.	 This language would be appropriate for Municipalities intending to discourage street-facing solar panels, but not completely prohibit them. It provides a transparent and quantifiable option for properties that could otherwise be negatively impacted.
Solar energy devices must not be visible from any street.	 This language is considered restrictive and is <u>not recommended</u>.

The design of Solar Energy Devices 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 difficult to interpret. If HARBs and historic review committees find these provisions necessary, they 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 and unnecessary. Not only is the causation of glare difficult to prove, but SED 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, which is less than soil or wood shingles.

Glare

Glare from PV panels is often mentioned as a concern for passing aircraft. However, according to the Federal Aviation Administration's (FAA) *Technical Guidance for Evaluating Selected Solar Technologies for Airports* (https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf), PV panels are the most appropriate solar application for airports because they are designed to reduce reflectivity. In fact, Dallas-Fort Worth International Airport has 693 panel SED on the Airport Development and Engineering Building that generates approximately 200,000 kWh of electricity a year! This suggests that residential-scale solar installations are certainly no cause for concern. And remember: the goal of the panels is to absorb light, not reflect it — reflected light is lost energy, and no one wants that! For municipalities still concerned with glare, Sandia National Laboratories provides a series of online tools for assessing solar installation glare, found at https://share.sandia.gov/phlux. It is recommended to consult these tools rather than prohibiting street-facing installations due to unsubstantiated concerns about glare.

Trees

While it is true that shade of any kind interferes with solar energy device's 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.

Language Option: Trees	
An applicant shall locate a Solar Energy Device so that tree removal is not required to the extent practical. Any trees to be removed shall be accompanied by a plan demonstrating the need to remove living trees and replacement of the trees.	 This language is recommended.

Solar Access

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

Solar Access Easement

A solar access easement is a 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. The 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 Appraisal District or Authority Having Jurisdiction (AHJ) to ensure that the easement stays 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 Option: Solar Access Easements	
Owners of solar energy devices 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.	 This language is considered neutral.

Battery Storage

Today, there is a lot of discussion about the potential for solar paired with batteries for storage. The combination would enable customers to use electricity generated by their solar PV panels even when the sun isn't shining. Advanced solutions hitting the market promise to alleviate intermittency, shave peak-demand prices and enable reliable off-grid electricity.

Regulation of solar battery storage is most appropriately addressed in codes, not ordinances. These codes would then be enforceable through the permitting process. However, it is important for municipalities to be familiar with the available options and associated recommendations. Special safety precautions, equipment and personal protective equipment (PPE) are required when installing and maintaining battery systems.

The NEC currently provides general guidelines for: enclosure, ventilation, location, acceptable material for conduit between the battery bank and electrical equipment, use of DC disconnect, and the size, rating, and location for protective fuses, known as “over-current protective devices.”

For additional information about battery storage for SED, please visit:

Photovoltaic (PV) Installer Resource Guide:
http://www.nabcep.org/wp-content/uploads/2012/08/NABCEP-PV-Installer-Resource-Guide-August-2012-v.5.3.pdf

For cities wishing to address battery storage as it pertains to SED in an ordinance, the following language is suggested:

Language	
If the solar energy device includes a battery or batteries, adequate design must be provided to ensure all local, state, and federal requirements, including applicable codes, regulating battery storage have been met.	 This language is considered neutral, and appropriate for keeping regulation from lagging behind technological advancements.

Solar-Ready Construction

Solar-ready requirements are a relatively low cost, but effective, addition to green-building codes and municipal ordinances. A 2015 analysis of solar home in six states found that homes with solar sold up to 50 percent faster than comparable solar-free homes, and a separate study found that in Texas, homes with solar installations commanded an average premium of over $14,000 ($4 per installed watt). Municipalities that incentivize or require solar-ready construction may enjoy benefits from these higher property values as a result. After a commercial or residential building is constructed, structural and solar access issues can prevent a solar project from being cost effective or may make it entirely infeasible; thus, addressing solar readiness prior to and during construction can be a critical factor in the future adoption of solar. One way to achieve solar-ready construction is by including solar-ready construction provisions in the solar ordinance.

Requiring that new construction follow solar-ready design guidelines is also an option. Solar-ready construction specifications are provided in Appendix U of the 2015 International Residential Code (IRC) and Appendix RB of the 2015 International Energy Conservation Code; therefore, municipalities should ensure that Appendix U or RB are adopted together with their respective codes. Access the Appendix at http://codes.iccsafe.org/app/book/content/2015-I-Codes/2015%20ISEP%20HTML/Appendix%20U.html.

For additional information about solar ready construction provisions, visit www.gosolartexas.org/gov/bmps.html.

Language Options: Solar-Ready Construction	Comments and Guidance
All new single-family and duplex residential dwelling units shall include an acceptable method to allow for later installation of a system which utilizes solar energy as a means of providing electrical power as outlined in Appendix U of the 2015 International Residential Code/Appendix RB of the 2015 International Energy Conservation code. This requirement may be waived when it can be satisfactorily demonstrated to the Building Official that compliance with these regulations is impractical due to such issues as shading, building orientation, construction constraints, or configuration of the parcel.	 This language would be appropriate for municipalities seeking to be at the forefront of solar-ready development. This option is the most supportive of solar.
Every individual or company that builds a new single-family detached residence for which a buyer is under contract shall offer the buyer the opportunity to have the residence's electrical system include one of the following: (I) A residential photovoltaic solar generation system (II) upgrades of wiring planned by the builder to accommodate future installation of such a system (III) A chase or conduit, or both, constructed to allow ease of future installation of the necessary wiring or plumbing for such systems.	 This language would be appropriate for municipalities seeking to encourage solar energy installations while providing flexibility for homeowners.

Other Ordinance Considerations

In addition to the solar ordinance language and structure suggestions provided in this document, an ordinance may include sections such as, but not limited to:

- Exemptions
- Procedures
- Enforcement and Penalties
- Board of Appeals, Variances and Appeals

This document does not address these sections directly. Nevertheless, they may also have significant impact on the ease or difficulty with which an applicant may install SED on their home or business. Therefore, similar guiding principles apply to these sections as to those explored in this document. Best practices include:

- Consult with subject-matter professionals.
- Only establish limitations, restrictions, or penalties when absolutely necessary. This will reduce time and money expenditures for both the applicant and for municipal staff.

Let the Sunshine In!