The Georgia Model Solar Zoning Ordinance Guide

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Introduction

Representatives from Emory Law School, Georgia Institute of Technology, and University of Georgia came together to develop a model solar zoning ordinance for Georgia counties and cities to utilize as a template in amending their zoning codes. The Georgia Model Solar Zoning Ordinance (Georgia Model Solar Ordinance or Model Ordinance) is a comprehensive solar land use ordinance based on best practices learned nationwide and shaped to fit Georgia's specific needs. It is meant to be an example—a place for counties and cities to look when deciding how best to regulate the siting of solar energy systems in their communities.

This Guide to the Georgia Model Solar Ordinance provides additional information and resources that counties and cities may need to better understand (1) the purpose and use of the Model Ordinance, (2) why and how the provisions in the Model Ordinance were chosen, (3) acceptable ranges and alternatives to the chosen provisions, and (4) additional considerations when siting solar energy systems.

This **Introduction Section** of the Guide provides a background to and the scope of the Model Ordinance. It explains why the three universities developed the Model Ordinance, lays out the development process, and defines the role of zoning ordinances in addressing the siting of solar energy systems.

Next, the Guide's **Zoning for Solar Energy Section** follows the format of the Model Ordinance to explain various provisions a solar ordinance might include, why the Model Ordinance did or did not include those provisions, and alternatives to the Model Ordinance provisions that counties and cities could include in their zoning codes. Counties and cities can use this section of the Guide to understand how to adapt the Model Ordinance to fit their unique community needs.

Finally, the Guide's **Coordinating Interests Section** considers some of the broader land use implications of solar energy development. This section provides counties and cities a larger context of various interests that will need to be balanced when deciding how to zone for solar energy.

Figure 1. Representatives and drafters of the Georgia Model Solar Ordinance and Guide from Emory Law School, Georgia Institute of Technology, and University of Georgia standing behind a solar array in Tifton, Georgia.

Statement of Need

Georgia is the third fastest-growing producer of solar energy in the United States.[1] From a baseline of effectively zero in 2010, more than 1,300 megawatts (MW) of solar capacity are now online in the state.[2] Georgia, counties and cities, and electric utility companies have established formal targets and state-approved plans that will further increase installed capacity of solar,[3] presenting both opportunities and challenges. While many enthusiastically embrace this growth, others are more cautious. Potential problems are associated with both ends of this spectrum—unfettered support of solar power can lead to uncontrolled development without regard to local communities and sensitive environments, while total opposition toward solar can stamp out a renewable energy resource that can boost the local economy and improve environmental quality. Striking the proper balance must be a priority for Georgians. The smart and pragmatic development of solar in Georgia is a multi-step, multi-stakeholder process, and a critical first step is determining how and where to site different types of solar energy systems throughout the state.

Counties and cities are eager to embrace the smart development of solar in Georgia. Many communities, however, lack the technical expertise and experience necessary to facilitate such development. And while there are many great resources available that suggest best practices for developing solar generally,[4] there was little Georgia-specific information available. Counties and cities were looking for help. Industry was also looking for communities to standardize their practices. Emory, Georgia Tech, and UGA saw and responded to the gap in available Georgia-specific information and developed the Georgia Model Solar Ordinance and this Guide in the hope that both can provide the information that counties and cities want and need, as well as help streamline the requirements for solar siting across the state.

Each county and city in Georgia has four potential options moving forward:

1. Pursue no solar energy development,
2. Rely on existing zoning codes for standards in siting solar energy,
3. Independently research and adopt a solar ordinance to set specific land use standards for solar energy development, or
4. Utilize the Model Ordinance and this Guide as a framework and tool to guide the drafting of a solar ordinance to set specific land use standards for solar energy development.

Emory, Georgia Tech, and UGA collectively recommend adopting the fourth option. While the other options are viable, they may not generate significant and predictable growth of solar energy development throughout the state. The Model Ordinance is intended to create a clear path forward to meaningfully increase the state's solar capacity by addressing common questions, allowing flexibility, and respecting local conditions. **The Model Ordinance and this Guide provide a comprehensive toolkit of options and research for siting solar energy systems that will allow counties and cities to more efficiently and appropriately develop solar power in their communities.**

[1] Urvaksh Karkaria, Atlanta Business Chronicle, *Georgia 3rd Fastest-Growing Solar Power Producer in the U.S* (Feb. 17, 2017), https://www.bizjournals.com/atlanta/news/2017/02/17/georgia-8th-largest-solar-power-producer-in-the-u.html.
[2] *See*, Southface, *Georgia Energy Data*, http://www.georgiaenergydata.org/solarmap.
[3] *See, e.g.,* Georgia Power Integrated Resource Plan, Docket # 40161, http://www.psc.state.ga.us/factsv2/Docket.aspx?docketNumber=40161.
[4] American Planning Association, *SunShot Solar Outreach Partnership*, https://www.planning.org/research/solar/. National Renewable Energy Laboratory, *Best Practices in Zoning for Solar*, https://www.nrel.gov/technical-assistance/blog/posts/best-practices-in-zoning-for-solar.html. Solar Outreach Partnership, http://solaroutreach.org/.

Development Process

Representatives from Emory, Georgia Tech, and UGA shared a vision that a team of unbiased academics, each possessing a range of relevant expertise within this field of study, would collectively oversee an academically rigorous process that would ultimately result in a useful and effective product for counties and cities pursuing solar power in Georgia. Together, these three universities conducted in-depth research while connecting with many diverse stakeholder groups across the state, which ultimately informed and guided each provision of the Model Ordinance.

Over the **year and a half** that the universities worked on the Model Ordinance, the team put in **hundreds of hours** researching, drafting, and discussing solar ordinances. At no stage in the drafting process were the universities or individual researchers advocating for a given cause or outcome; rather, the goal was to establish, through transparent decision-making, the best practices for siting solar energy systems in Georgia. To that end, the work conducted by each of the universities was ***pro bono* and completely voluntary**. Elected county and city officials are ultimately responsible for determining what, if any, action should be taken and may or may not draw upon this work.

The framework for the Georgia Model Solar Ordinance was developed by surveying model documents from other states across the country and by reviewing the solar ordinances from counties and cities in Georgia.

The following solar ordinance models and guides were referenced:

- American Planning Association, *Planning for Solar Energy Briefing Papers,*
- California County Planning Directors Association, *Model Solar Energy Facility Permit Streamlining Ordinance* and *Model Solar Energy Facility Permit Streamlining Guide* (Feb. 2012),
- Central Savannah River Area Regional Commission, *Integrating Solar Land Uses: A Regulatory Template for CSRA Communities* (2015) ("CSRA Model"),
- Cumberland County Planning Department, *Solar Energy Systems Model Ordinance* (Apr. 2011) ("Cumberland Model"),
- Delaware Valley Regional Planning Commission, *Renewable Energy Ordinance Framework: Solar PV* (Feb. 2015) ("Delaware Model"),
- Massachusetts Department of Energy Resources, Massachusetts Department of Environmental Protection, and Massachusetts Clean Energy Center, *Clean Energy Results, Question & Answers Ground-Mounted Solar Photovoltaic Systems* (June 2015),
- Massachusetts Executive Office of Energy and Environmental Affairs, *Model Zoning for the Regulation of Solar Energy Systems* (Dec. 2014) ("Massachusetts Model"),
- Minnesota Department of Commerce, Division of Energy Resources, *From Policy to Reality: Updated Model Ordinances for Sustainable Development, Solar Energy Standards – Urban Communities* and *From Policy to Reality: Updated Model Ordinances for Sustainable Development, Solar Energy Standards – Counties* (Feb. 2014) and Great Plains Institute, *Grow Solar Local Government Solar Toolkit Minnesota* (Aug. 2017) ("Minnesota Model"),
- NC Sustainable Energy Association and NC Clean Energy Technology Center, *Template Solar Energy Development Ordinance for North Carolina* (Oct. 2016) ("North Carolina Model"),
- Pace Law School, Land Use Law Center, *Zoning for Solar Energy: Resource Guide (2015),*
- Sabin Center for Climate Change Law at Columbia Law School, *Model Small-Scale Solar Siting Ordinance* (2012) ("Sabin Model"),
- Solar Ready Florida, *Model Zoning Ordinance* (Sept. 2014) ("Florida Model"),

- Sustainable Jersey, *Guidance for Creating a Solar Friendly Zoning Ordinance* (Apr. 2017) ("New Jersey Model"),
- Sustainable CUNY, *New York State Model Solar Energy Law* (May 2016) ("New York Model"),
- Environmental Planning & Design, LLC, *Zoning and Permitting Solar in Your Municipality* (Dec. 2012) – prepared for Citizens for Pennsylvania's Future (PennFuture), City of Pittsburgh, Allegheny County, Southwestern Pennsylvania Commission, CONNECT (Congress of Neighboring Communities), and SUNWPA (Solar Unified Network of Western Pennsylvania) ("Pennsylvania Model"),
- North Central Texas Council of Governments and State Energy Conservation Office, *Model Ordinance Guidelines for Municipalities* (July 2016) ("Texas Model"),
- University of North Carolina School of Government, Adam Lovelady, *Planning and Zoning for Solar in North Carolina* (2014),
- Utah Clean Energy, *Solar Friendly Zoning Toolbox* ("Utah Model"), and
- Virginia Department of Environmental Quality and Local Government Outreach Group, *Model Ordinance for Larger-Scale Solar Energy Products in Virginia* and *Model Ordinance for Smaller-Scale Solar Energy Projects in Virginia (By Right Permitting)* (Dec. 2012) ("Virginia Model").

<u>Existing and proposed solar ordinances from the following Georgia counties and cities were also referenced</u>:

- Adel City,
- Bartow County,
- Bulloch County,
- Catoosa County,
- Dawson County,
- DeKalb County,
- Dooly County,
- Dougherty County,
- Douglass County,
- Dublin City,
- Early County,
- Echols County,
- Effingham County,
- Fayette County,
- Floyd County,
- Gordon County,
- Greene County,
- Haralson County,
- Harris County,
- Jackson County,
- Jefferson County,
- Long County,
- Madison County,
- McDuffie County,
- McIntosh County,
- Meriwether County,
- Mitchell County,
- Oglethorpe County,
- Pike County,
- Polk County,
- Putman County,
- Rome City,
- Sumter County,
- Terrell County,
- Thomas County,
- Twiggs County, and
- Walton County.

Based on this review, the universities produced a **Georgia Model Solar Ordinance Draft Template.** The goal of the Draft Template was to summarize the necessary elements of a model solar ordinance and provide examples of those elements in order to establish a broad framework within which the Model Ordinance could be drafted. This document was then circulated to a small group of stakeholders for review as a means of ensuring that all necessary elements and questions were accounted for and addressed.

Next, the universities began drafting the language of a solar ordinance. During this process, the universities held a **pre-brief meeting** with representatives from key stakeholder groups to ensure the drafting was on track. Representatives were invited from cities and counties, electric utilities, environmental and land use attorneys, non-governmental organizations, solar associations, solar development companies, state agencies, and UGA extension. The purpose of this meeting was to begin to introduce the Model Ordinance and gather feedback on a few central provisions. At this meeting, the universities provided an overview of the project, explained the nature of a zoning ordinance, and opened discussion up to attendees on the possible substance of the solar ordinance. The universities provided attendees with the document **Georgia**

Model Solar Ordinance: Outline & Excerpts, which proposed a format for the Model Ordinance and specific language for (1) definitions of solar energy systems, (2) permissible use types, (3) setbacks, and (4) permits. This meeting and the feedback received on the Outline & Excerpts was an important step in beginning conversations with stakeholders and understanding potential points of contention.

The universities then finalized and published a **Draft Georgia Model Solar Ordinance**. This Draft Model Ordinance distilled best practices for regulating the development of solar energy systems based on the above-listed documents, additional research, and feedback from the pre-brief meeting. It was a fully formed ordinance to provide a starting point for in-depth stakeholder conversation, but it was never intended for implementation by counties or cities. During this time, the university partners also began drafting this Guide to capture the research relied upon in making determinations for the Model Ordinance.

The universities and interested partners then **circulated the Draft Model Ordinance to hundreds of Georgia stakeholders** for feedback and open, fact-based discourse to ensure the finished product would be tailored to Georgia's needs. **These stakeholders included:**

- Business owners,
- Consumer protection non-government organizations,
- Community members and residents,
- County and city associational organizations,
- County and city board members and commissioners,
- County and city planners and zoning commissioners,
- County attorneys,
- Electric utilities,
- Engineering firm representatives,
- Environmental organizations,
- Farmers,
- Green building analysts,
- Individual industry representatives from rooftop, distributed, and utility solar developers,
- Lawyers with zoning and land use expertise,
- Legislative aides,
- Local and national non-governmental organizations,
- Local finance directors,
- Local sustainability officers,
- Mayors,
- Private and non-profit law firms,
- Ratepayer advocacy groups,
- Regional commissioners,
- Solar advocates,
- Solar industry associations for Georgia, industrial-size systems, and distributed-size systems,
- Solar lobbyists,
- State agencies with environmental, energy, and planning focuses,
- UGA Extension officers,
- University representatives, and
- Wildlife biologists.

The universities planned a series of stakeholder meetings to review, discuss, and receive feedback on the Draft Model Ordinance. The universities planned **three public meetings** for open discussion on the Draft Model Ordinance. These took place in Savannah, Tifton, and Atlanta in an attempt to capture comments from the different regions of Georgia, representing the varying degrees of rural and urban landscapes present throughout the state. During this time, the universities also spent **hundreds of hours meeting** with any interested parties who requested the time on an individual and group basis to capture as many voices and opinions as possible. No requests for meetings were declined. The universities also reached out to additional stakeholders to ensure that voices that might otherwise be missing would have a chance to participate in the process. The purpose of each of these various meetings was for the universities to understand the present range of views and concerns, but consensus was not required for the final provisions in the Model Ordinance. All told, the universities **met with hundreds of stakeholders** and **processed thousands of verbal and written comments**.

After the comment period on the Draft Model Ordinance closed, the universities **catalogued the comments and feedback, conducted additional research, and made substantive changes to the Model Ordinance**. The universities also continued to update and expand this Guide to ensure the reasoning for each decision made for the Model Ordinance was adequately captured and that all reasonable alternatives were documented.

The final Model Ordinance and this Guide are the result of a **thorough, transparent, 16-month effort** in which diverse stakeholders had extensive opportunities to provide input to create a set of balanced and well-researched standards that are uniquely tailored to encourage smart development of solar energy in Georgia.

<u>The following is the timeline of the production, outreach, and release dates for the Georgia Model Solar Ordinance and Guide</u>:

April – October 2017	University team coordination, and initial scoping, planning, and research.
August 2017	Draft Template published.
November 2017	Pre-brief meeting held.
December 2017	Initial feedback on Draft Model Ordinance Outline & Excerpts gathered.
February 2018	Draft Model Ordinance published.
February – April 2018	Stakeholder meetings convened. Feedback on Draft Model Ordinance gathered.
May – June 2018	Model Ordinance and Guide finalized, taking into account stakeholders’ input.
July 2018	Final Model Ordinance and Guide published.

Local Planning: What is a Zoning Ordinance?

Before getting into the specific provisions and policy considerations, it is important to understand the scope of the Georgia Model Solar Ordinance. The Model Ordinance, and solar ordinances generally, are provisions of a zoning code. Counties and cities both have the authority to adopt zoning codes and ordinances—the city's zoning code will ultimately control land use within its incorporated limits, while the county's zoning code will apply to the land within the county's boundary that has not been incorporated into a city.

The purpose of a zoning code is to manage land development. A zoning code will divide the land into districts by basic type of use (for example residential, commercial, agricultural, and industrial) and often also by density or intensity of use (for example single-family residential, multi-family residential, light industrial, and heavy industrial).

A zoning code will then set use restrictions and standards for each district. The zoning code will prescribe what uses are allowed, what uses require a permit, and what uses are prohibited. The zoning code may also prescribe design standards, including building height, setbacks, lot sizes, and aesthetics.

Solar energy systems are just another type of land use, similar to shopping centers, substations, or cemeteries. Zoning for solar energy systems has gained attention because the widespread development of solar energy is still new, and the majority of zoning codes do not currently contemplate such development. As with any new land use, counties and cities will need to make determinations about where solar energy systems are appropriate, what sort of review they will require, and the standards with which they will need to comply. The Model Ordinance provides an example of how counties and cities can make these determinations. This Guide helps counties and cities ensure the solar ordinance they adopt into their zoning code conforms with their unique land use requirements.

A ZONING ORDINANCE CAN:	A ZONING ORDINANCE CANNOT:
• Define what size and type of solar facilities can be located in different parts of the county or city, • Provide facility setbacks and height limitations, • Protect against nuisance and aesthetic violations, and • Define and prescribe site plan requirements.	• Address state and federal permitting requirements, • Address every legal barrier to solar facilities. • Influence Public Service Commission decisions related to solar, • Resolve issues related to taxes and tariffs, or • Regulate activities preempted by state law, or prescribe individual lease terms.

Zoning for Solar Energy: The Georgia Model Solar Ordinance

This section of the Guide provides an in-depth discussion on potential provisions in a solar ordinance. It follows the structure of the Georgia Model Solar Ordinance. Each part first discusses how a solar ordinance generally can address the topic, then explains how the Model Ordinance specifically addresses the topic, and finally provides alternatives that a county or city can consider when drafting its own solar ordinance.

Figure 2. A photovoltaic (PV) solar system. [5]

Preamble

A solar ordinance's preamble is an explanatory provision that sets out the aspirational (as opposed to the enforceable) goals of the ordinance and the reasons why a county or city adopted it. For example, it can highlight the benefits of solar energy and why its development should be encouraged, as well as identify any impacts of solar energy systems the county or city is specifically concerned with addressing. Generally, the preamble should include the overarching purpose and intent of promoting and regulating solar energy systems, but should not include specific benchmarks, such as the exact amount or type of solar energy a county or city would like to install. Counties and cities can connect this language to the goals in their comprehensive plan, if they have one.

The Georgia Model Solar Ordinance is drafted broadly to account for the many goals a county or city may consider when adopting a solar zoning ordinance.

Counties and cities may choose to include all of the goals listed in the Georgia Model Solar Ordinance's preamble, only the ones that are applicable to their community, or determine additional goals and rationales for their solar ordinance.

A county or city could choose to ratify these goals within the zoning ordinance itself by including a purpose and intent section in their solar ordinance with similar language.

[5] By Grendelkhan [CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)], from Wikimedia Commons.

Definitions

A solar ordinance must define important terms of art that the ordinance will rely upon. The definitions in an ordinance affect how the ordinance can and will be enforced. Precisely defining terms clarifies when the ordinance applies and what it requires. The definitions section of an ordinance can be very simple or extremely robust.[6] Striking the right balance is important—defining too few words can leave those unfamiliar with solar energy systems confused, but defining too many words can be unnecessary and overwhelming, as well as leave little flexibility for the ordinance to "bend" as technology changes.

The Georgia Model Solar Ordinance's definition section is not a glossary of solar related terms. Rather, it focuses on terms of art that the Model Ordinance utilizes in setting land use standards.

Counties and cities should, at a minimum, define the types of solar energy systems the solar ordinance will address. Counties and cities can also choose to include a more comprehensive list of terms in the definitions section of their zoning ordinance.

Solar Energy System

A solar ordinance can define "solar energy system" based on multiple parameters, including how the system converts the sun's rays into usable energy, the design of the system, and the size of the system.

How It Converts Energy: Photovoltaic, Solar Thermal, and Concentrated Solar

A solar ordinance can define solar energy systems by the way that a system can convert the rays from the sun into useable energy. The three main technologies for converting sun into energy are photovoltaic, solar thermal, and concentrated solar power.

Figure 3. A photovoltaic (PV) solar energy system.

First, most solar energy systems in the Georgia are **photovoltaic (PV)**. PV systems convert sunlight (solar energy) into electricity through PV cells. PV cells are typically 4 to 6 inch square or circular pieces that are grouped together into flat, rigid PV panels.[7] When sunlight hits the PV cells, it excites the electrons of a semiconductor material (usually silicon) that makes up the cell. This phenomenon causes the flow of

[6] *Compare* Long County, GA, *with* Greene County, GA.
[7] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 4 (2014), https://sogpubs.unc.edu/electronicversions/pdfs/pandzsolar2014.pdf.

electrons that ultimately generates electricity. The PV system is connected and provides energy to the grid or directly to a facility.

Second, **solar thermal systems**, otherwise known as solar hot water systems, absorb the sunlight's solar energy as heat, which is then most commonly used to heat residential and commercial spaces and water.[8] Solar thermal systems look very similar to PV systems in terms of size and color. Therefore, the community and land impacts from solar thermal systems are very similar to those from PV systems.[9] Although solar thermal is currently less widespread than PV in Georgia, its popularity may increase in the future.

Third, **concentrated solar power (CSP)** uses mirrors to reflect and concentrate sunlight. Either the concentrated sunlight hits PV panels, making them more efficient than non-concentrated PV systems, or it hits receivers that convert solar energy to electricity by heating a liquid and creating steam to move a traditional turbine.[10]

The Georgia Model Solar Ordinance defines solar energy system to include PV and solar thermal systems, while explicitly excluding CSP, because this technology currently is not expected to play a significant role in Georgia.[11] Additionally the generally large nature of CSP and the intense heat and light that is generated from using mirrors to concentrate sunlight produces impacts from CSP that are notably different from those of PV and solar thermal systems.[12] Not including CSP within the Model Ordinance does not prohibit all development of CSP. Instead, anyone who wishes to build CSP will need to comply with all applicable requirements of the existing zoning code and, if necessary, apply for a zoning variance.

A county or city may choose to address CSP in its solar ordinance, but should first understand the full land use impacts of these systems to ensure that they are appropriately sited. This Guide will *not* outline these impacts.

System Designs: Integrated, Rooftop, Ground Mounted, and More

A solar ordinance can further define solar energy systems by how the system is designed and mounted. Different designs of solar energy systems will result in different land use impacts.

Integrated solar energy systems do not have the mounting or racking equipment that other solar energy systems require. Instead, the photovoltaic (PV) material that makes up the solar energy system is incorporated into or replaces standard building materials. For example, these systems can be added to the sides of structures, on rooftops to replace traditional roofing materials, as awnings or canopies, or as

[8] National Renewable Energy Laboratory, *A Consumer's Guide: Heat Your Water with the Sun*, 2 (Dec. 2003), https://www.nrel.gov/docs/fy04osti/34279.pdf.
[9] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 4 (2014).
[10] Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, *Concentrating Solar Power Basics* (Aug. 20, 2013), https://www.energy.gov/eere/solar/articles/concentrating-solar-power-basics.
[11] *Cf.* Solar Energy Industries Association (SEIA), *Major Solar Projects List* (Feb. 2018), https://www.seia.org/research-resources/major-solar-projects-list (almost all concentrated solar systems are being developed in the southwest). *See also*, Joint Institute for Strategic Energy Analysis, *Concentrating Solar Power and Water Issues in the U.S. Southwest* (Mar. 2015), https://www.nrel.gov/docs/fy15osti/61376.pdf.
[12] *See,* Joint Institute for Strategic Energy Analysis, *Concentrating Solar Power and Water Issues in the U.S. Southwest* (Mar. 2015), https://www.nrel.gov/docs/fy15osti/61376.pdf.

skylights and windows.[13] Integrated systems "can provide savings in materials and electricity costs, reduce pollution, and add to the architectural appeal of a building."[14] While integrated systems are most commonly installed as a part of a new building, they can also be added on existing structures as retrofits.[15] As technology advances, the possibilities for integrated solar energy systems will likely increase.

Most integrated systems use thin-film technology that, rather than utilizing the traditional rigid silicon-based panels, utilizes a thin film of PV material deposited on a substrate such as glass, metal, or plastic. This allows PV to be integrated into building materials such as roof shingles or glazing. Flexible sheets of thin-film PV can also be adhered to existing building materials, such as a metal or membrane roof.

Few existing solar ordinances in Georgia address integrated solar energy systems.[16] However, the technology is expected to become more common. Including integrated system designs in a solar ordinance therefore can preempt future land use conflicts.

Rooftop solar energy systems are mounted to a building's roof on metal racks and can be added to almost all types of roofs—including commercial or residential roofs, and sloped or flat roofs—so long as the roofs are structurally sound or can be reinforced to handle the load of the panels. For efficiency reasons, the most common practice is to install rooftop solar energy systems on south facing roofs.

Ground mounted solar energy systems have metal or concrete structures that mount the solar panels on or above the ground.[17] While some ordinances may separately define ground mounted systems (systems that have multiple panel arrays mounted together) and pole mounted systems (systems with a single panel array mounted on a single pole), they usually require both types of systems to meet the same standards.[18]

Figure 4. A ground mounted solar energy system in Brattleboro, Vermont.

[13] Whole Building Design Guide, *Building Integrated Photovoltaics (BIPV),* https://www.wbdg.org/resources/building-integrated-photovoltaics-bipv.
[14] Solar Energy Industries Association (SEIA), *Building-Integrated Photovoltaics*, https://www.seia.org/initiatives/building-integrated-photovoltaics.
[15] *Id.*
[16] McDuffie County, GA.
[17] Insolargy, *Types of Solar Systems and Methods of PV Installation*, http://www.insolergy.com/blog/solar-basics/types-and-methods-of-solar-power-installation/.
[18] *See,* Utah Model. Long County, GA.

Solar canopies are solar energy systems that are significantly elevated above the ground such that the land beneath the panel can be used for a second purpose. For example, these systems are often installed above parking lots (also referred to as solar car ports) or in yards to provide shade. Solar canopies above parking lots can also include electric car charging stations.[19] By installing a solar energy system above a space that serves a secondary purpose, solar canopies use land more efficiently. (See, Coordinating Interests when Siting Solar Energy Systems, p.65). A solar ordinance can independently define solar canopies and include specific standards, or a solar ordinance can include solar canopies within the definitions of another solar design, such as integrated or ground mounted.

Figure 5. Solar canopies overlaying outdoor seating and garage.[20]

Figure 6. Solar canopies over an escalator.[21]

Floating solar are solar energy systems that float on a body of water. Some of the benefit of installing a solar energy system on a body of water is that it keeps the panels cooler and therefore more efficient, reduces evaporation, and saves land space—either for other development or to preserve land-based ecosystems. [22] (See, Dual Land Use, p.71). While this technology is already widely used in Europe and Asia, it is only now beginning to be built in the United States. Today, Georgia's first floating solar energy system

[19] Energy Sage, *Solar Canopy Installations: bring shade and clean energy to your parking lot*, https://news.energysage.com/solar-canopy-installations-bring-shade-clean-energy-parking-lot/.
[20] By Xnatedawgx [CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)], from Wikimedia Commons.
[21] Photo by Daniel Genser, https://unsplash.com/license.
[22] Benjamin Mow, National Renewable Energy Laboratory, *STAT FAQs Part 1: Floating Solar* (Apr. 4, 2018), https://www.nrel.gov/technical-assistance/blog/posts/stat-faqs-part1-floating-solar.html.

is being developed.[23] Because of the many benefits of floating solar, more systems are expected to be built in the future.

The Georgia Model Solar Ordinance includes in the definition of solar energy systems three designs: integrated, rooftop, and ground mounted.

Following best practice and because the land use impacts of a ground mounted system and a pole mounted system of the same acreage will be equivalent, the Model Ordinance does not differentiate between ground and pole mounted systems.

The Model Ordinance defines solar canopies as either an integrated or a ground mounted system, depending on the technology utilized. A solar canopy is an integrated system if the solar materials are reasonably incorporated into the canopy materials or if the solar materials are used in place of traditional building components, such that the system is structurally part of the canopy. These integrated solar canopies, in addition to the Model Ordinance, will need to comply with existing zoning standards regarding traditional canopies or accessory structure more generally. The Model Ordinance defines any solar canopies that do not meet this definition as a ground mounted system. This may include solar canopies not attached to the ground, such as those mounted on a parking deck or other platform, because the impacts of the canopy will be similar to those of a ground mounted system. Additionally, beyond land use standards, solar canopies will need to comply with Georgia's mandatory construction codes, including building, electric, and fire.

Finally, the Model Ordinance does not address floating solar energy systems because no best practices yet exist for this innovative type of solar energy system.

Counties and cities can choose not to address all designs of solar energy systems in their solar ordinance. It is quite common in Georgia to only address ground mounted systems,[24] but this is not advisable. Failing to address integrated and rooftop solar energy systems may preclude their development in a community. It is recommended that counties and cities take a comprehensive approach in their solar ordinances to equally encourage all system designs.

While counties and cities are encouraged to address all designs of solar energy systems in their solar ordinance, if a county or city wishes to address only one design, the Model Ordinance was designed to be easily separable.

For example, if a county or city is only interested in zoning for integrated and rooftop systems, it should include in its ordinance the following provisions from the Model Ordinance:

- Preamble,
- Definitions—*Solar Energy System, Integrated Solar Energy System, and Rooftop Solar Energy System,*
- Uses—*only include language for Integrated Solar Energy System and Rooftop Solar Energy System,*
- Section 1. Applicability,
- Section 2. Requirements for Integrated Solar Energy Systems, and

[23] Emma Hurt, WABE, *DeKalb County Moves Forward with Floating Solar Panels* (May 8, 2018), https://www.wabe.org/dekalb-county-moves-forward-with-floating-solar-panels/.
[24] Bartow County, GA, Bulloch County, GA, Catoosa County, GA, Early County, GA, Effingham County, GA, Greene County, GA, McIntosh County, GA, Meriwether County, GA, Oglethorpe County, GA, Pike County, GA, and Sumter County, GA.

- Section 3. Requirements for Rooftop Solar Energy Systems.

Or, if a county or city is only interested in zoning for ground mounted systems, it should include in its ordinance the following provisions from the Model Ordinance:

- Preamble,
- Definitions—*Solar Energy System and Ground Mounted Solar Energy System,*
- Uses—*only include language for Ground Mounted Solar Energy System,*
- Section 1. Applicability,
- Section 4. General Requirements for All Ground Mounted Solar Energy Systems,
- Section 4A. Specific Requirements for Intermediate Scale Solar Energy Systems,
- Section 4B. Specific Requirements for Large Scale Solar Energy Systems,
- Section 5A. Solar Energy System Special Use Permit Application, and
- Section 5B. Solar Energy System Special Use Permit Review.

Additionally, a county or city could choose to include specific standards for solar canopies. This may be a good idea if a county or city specifically wants to encourage solar canopies and therefore would like clear, concise standards. For example, solar ordinances often allow solar canopies in all commercial and industrial districts, but establish height standards:

> *"A solar canopy 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 solar canopy must allow clearance for emergency service and service vehicles."*[25]

A county or city could also choose to address floating solar, either by including floating solar within the definition of another design of solar energy system like ground mounted or by adopting independent standards for floating solar energy systems. Floating solar is a beneficial and innovative design of solar energy, but communities should conduct research before deciding how to address the siting of this design.

System Sizes: Small, Intermediate, and Large Scale

A solar ordinance can further define solar energy systems based on their size. A large system will have different land use impacts than a small system and thus will require different standards to address those impacts. Subdividing a type of system in a solar ordinance by its size ensures appropriate standards apply based on the intensity of the land use.

As an initial matter, most solar ordinances do not subdivide integrated and rooftop solar energy systems by size because the size of these systems, and their land impact, is constrained by the size of the structure to which the system is attached.

The size of a ground mounted system, however, is not necessarily constrained and can vary greatly, from a single solar panel to panels covering hundreds of acres. Ground mounted systems of different sizes can cause vastly different impacts. Solar ordinances, therefore, often do subdivide ground mounted solar energy systems by their size.[26]

[25] New Jersey Model.
[26] *See,* Massachusetts Model. North Carolina Model. Fayette County, GA. Floyd County, GA. Oglethorpe County, GA.

To understand the different sizes of ground mounted solar energy systems, it can be beneficial to consider the sizes of ground mounted systems currently in operation in Georgia.[27] Based on best available and reported information as of March 2018, there are relatively few systems that exceed 30 acres:

- Approximately 100 ground mounted solar energy systems produce less than 1 megawatt (MW) of power—thus requiring no more than approximately 10 acres of land,[28]
- Approximately 100 ground mounted systems produce between 1 MW and 3 MW of power—thus requiring between approximately 10 and 30 acres of land, and
- Approximately 30 ground mounted systems produce more than 3 MW of power—thus requiring more than 30 acres of land.

While solar ordinances often set forth different standards for various sizes of ground mounted solar energy systems, there is no single, uniform practice for subdividing these systems by size (e.g. into categories of small, intermediate, and large). States themselves range dramatically in size—what is “large scale” in Massachusetts may not be the same as what is “large scale” in Texas.

Figure 7. A large scale ground mounted solar energy system.[29]

The metric for defining sizes can also vary. Defining size by the amount of land the system will occupy is most appropriate. While the solar industry refers to the size of a system based on its MW capacity, area is a more accessible metric for a larger number of people—few people are familiar with how a 3 MW solar energy system differs from a 50 MW system. However, most people can understand the difference between a 5-acre system and a 500-acre system. Additionally, rapidly changing technology means that less land will be required to produce more electricity in the near future. While a 1 MW system currently requires approximately 4 – 10 acres of land, in ten years, the number of acres required to produce 1 MW may be significantly smaller. Therefore, defining sizes of solar energy systems by MW of electricity capacity would limit the usefulness of a solar ordinance. Determining the size of a solar energy system depends on how the solar ordinance defines the footprint of the system. Most solar ordinances define the footprint as the land within the perimeter fence.

[27] *See, eg*, Southface, Georgia Energy Data, Solar Map, http://www.georgiaenergydata.org/solarmap.
[28] There are likely many more ground mounted solar energy systems falling into this category that have simply not been reported.
[29] Photo by Ryan Searle. https://unsplash.com/license.

But, not all solar ordinances follow the best practice of subdividing ground mounted solar energy systems by size. Instead, some adopt a different metric, such as on-site versus off-site energy use.[30] For example, ground mounted systems can be divided into large scale solar farms that produce energy for a utility, community scale distributed projects that produce energy for a single large electricity user or the community, and very small backyard projects that produce energy for a residence. This metric does not directly relate to how the land will be impacted, and it may be difficult for zoning authorities to enforce.

Finally, some solar ordinances subdivide solar energy systems through a hybrid system that includes multiple considerations. For example, North Carolina's model ordinance defines three levels of solar energy systems: level 1 includes rooftop, building integrated, and parking lot systems; level 2 includes ground mounted systems of no more than ½ acre in residential districts, no more than 10 acres in commercial/business districts, and of any size in industrial districts; and level 3 includes all remaining solar energy systems.[31]

The Georgia Model Solar Ordinance does not subdivide integrated or rooftop solar energy systems by their size, but does subdivide ground mounted systems by their size. The Model Ordinance defines sizes of ground mounted solar energy systems based on acreage for ease of understanding, application, and enforceability.

The Model Ordinance measures the footprint of a solar energy system from the equipment of the solar energy system because there is no required fence to measure from. The footprint therefore should be drawn around equipment necessary for the system to function, but not around transmission lines connecting the system to the grid. The footprint also does not include any setbacks, visual buffers, or fence.

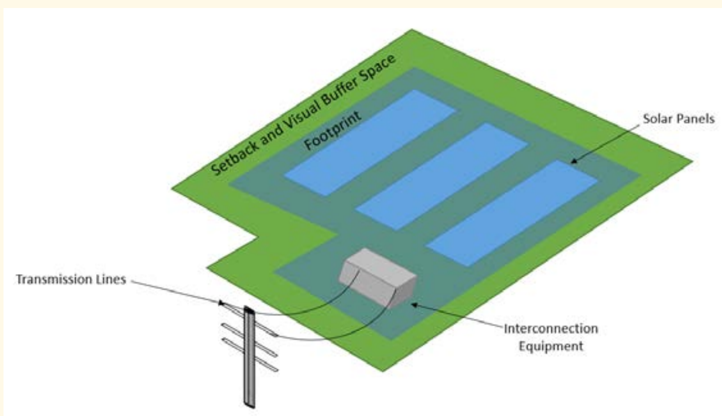

Figure 8. A diagram showing how to measure the footprint of a ground mounted solar energy system.

The Model Ordinance subdivides ground mounted solar energy systems into three sizes: small, intermediate, and large. The Model Ordinance aims to provide neutral land use standards for all types of solar energy systems and therefore intentionally avoids terms of art such as "solar farm," "community solar," or "distributed solar." These terms refer to a specific use of the energy, not the amount of land required for the system.

[30] *See,* New York Model.
[31] North Carolina Model.

The Model Ordinance provides a potential range for how to define small, intermediate, and large solar energy systems rather than setting specific numbers. While almost every provision in the Model Ordinance could reasonably be adopted by the majority of Georgia, the acceptable sizes of ground mounted systems in communities is more variable. What makes sense in a rural community may not make sense in an urban center.

The Model Ordinance bases the size ranges on a variety of factors, including:

- Other model ordinances;
- Solar ordinances enacted by Georgia counties and cities;
- The range of sizes of existing solar energy systems in Georgia;
- Potentially comparable land uses, such as shopping centers, cemeteries, and substations;
- Discussions with solar energy experts; and
- The fact that Georgia Power, the largest energy provider in Georgia, currently delineates its solar programs between systems producing more than 3 MW of energy and those producing less.

Counties and cities should carefully consider how their solar ordinance will define the sizes of ground mounted solar energy systems. This is one of the most important decisions a county and city must make in drafting a solar ordinance. The sizes dictate the potential location of systems and the standards each system must adhere to.

Counties and cities must choose specific numbers, rather than the range in the Model Ordinance, in defining sizes. To decide what specific numbers to use, counties and cities should consider both how their existing zoning code treats other, similar forms of development (such as shopping centers, cemeteries, and substations) and with which standards each size system will eventually need to comply.

Depending on the size and nature of the community adopting the ordinance, there is a broad spectrum of what may be considered reasonable size distinctions. Generally, it may be more appropriate for urban areas to pick numbers on the smaller end of the spectrum, while rural areas may more appropriately pick numbers on the larger end of the spectrum.

For purposes of fairness and consistency, it is recommended that counties and cities adopt a solar ordinance that addresses all sizes of ground mounted solar energy systems. However, if a county or city wishes to address only certain sizes, the Model Ordinance was designed to be easily separable.

For example, **if a county or city is only interested in zoning for small and intermediate scale ground mounted systems** (those that generally fall within a category often referred to as community scale), it should include in its ordinance the following provisions from the Model Ordinance:

- Preamble,
- Definitions—*Solar Energy System, Ground Mounted Solar Energy System, Small Scale Ground Mounted Solar Energy System, and Intermediate Scale Ground Mounted Solar Energy System,*
- Uses—*only include language for Small and Intermediate Scale Ground Mounted Solar Energy Systems,*
- Section 1. Applicability,
- Section 4. General Requirements for All Ground Mounted Solar Energy Systems,
- Section 4A. Specific Requirements for Intermediate Scale Solar Energy Systems,
- Section 5A. Special Use Permit Application, and
- Section 5B. Special Use Permit Review.

Or **if a county or city is only interested in zoning for large scale ground mounted** systems (those that generally fall within a category often referred to as utility scale or solar farms), it should include in its ordinance the following provisions from the Model Ordinance:

- Preamble,
- Definitions—*Solar Energy System, Ground Mounted Solar Energy System, and Large Scale Ground Mounted Solar Energy System,*
- Uses—*only include language for Large Scale Ground Mounted Solar Energy Systems,*
- Section 1. Applicability,
- Section 4. General Requirements for All Ground Mounted Solar Energy Systems,
- Section 4B. Specific Requirements for Large Scale Solar Energy Systems,
- Section 5A. SES Special Use Permit Application, and
- Section 5B. SES Special Use Permit Review.

Additional Terms

A solar ordinance can define additional terms related to solar energy. The following is a list of common terms that may be important to understand when discussing solar energy systems:

- **Active Solar Energy System** means a solar energy system whose primary purpose is to harvest energy by transforming solar energy into another form of energy or transferring heat from a collector to another medium using mechanical, electrical, or chemical means.[32]
- **Array** means multiple solar modules (panels) connected together to create one system that provides a single electrical output.[33]
- **Battery Storage (also known as Battery Back-Up)** means a battery system that stores electrical energy from a solar photovoltaic system, making the electricity available for future use. Battery Back-Up systems are common in Off-Grid Systems and Hybrid Systems.[34]
- **Cell** means the smallest basic solar electric device that generates electricity when exposed to light. Multiple solar cells make up a module.[35]
- **Combiner or Junction Box** means a device that combines the inputs (electrical flows) from multiple strings of solar panels (or micro-inverters) into one output circuit.[36]
- **Distributed Solar** means solar energy systems located on-site and designed to provide solar thermal energy or solar photovoltaic electricity to a property owner, occupant, and/or facilities.[37]
- **Electricity Generation (also known as Production or, Output)** means the amount of electric energy produced by transforming other forms of energy, commonly expressed in kilowatt-hours (kWh) or megawatt-hours (MWh).[38]
- **Electrical Equipment** means any device associated with a solar energy system, such as an outdoor electrical unit/control box, that transfers the energy from the solar energy system to the intended on-site structure.[39]

[32] Minnesota Model. Massachusetts Model.
[33] Pennsylvania Model. Texas Model. Utah Model. Douglas City, GA. Jackson County, GA. Long County, GA.
[34] Utah Model. Long County, GA.
[35] Pennsylvania Model.
[36] Utah Model. Long County, GA.
[37] *Id.*
[38] Utah Model. Long County, GA.
[39] *Id.*

- **Evacuated Tube Collector** means the part of a solar thermal system composed of hollow tubes that contain a liquid that absorbs solar energy and converts it into usable heat.[40]
- **Flat Plate Collector** means a solar thermal system made up of a heat absorber plate (panel) over tubes or pipes that contain a liquid, which together collect solar radiation that will be used to heat water, enclosed areas, or processes.[41]
- **Grid-tied (also known as On-grid, Grid-connected, Utility-interactive, Grid-intertied, or Grid-direct)** means a solar energy system that is interconnected with the utility power grid via net metering or interconnection agreements with the utility.[42]
- **Hybrid Solar Energy Systems (also known as Grid-tied System with Battery Back-up)** means a solar energy system designed to serve the electricity needs of the building to which it is connected, thus offsetting a home's or business's electricity usage, while also utilizing a battery back-up in the event of a power outage.
- **Interconnection** means the technical and practical link between the solar energy system and the power grid.[43]
- **Inverter** means a device that converts direct current (DC) electricity to alternating current (AC).[44]
- **Kilowatt (kW)** means a unit measurement of the use of electrical power equal to 1000 Watts, which constitutes the basic unit of electrical demand.[45]
- **Kilowatt-hour (kWh)** means a unit of energy equivalent to one kilowatt (1 kW) of power expended for 1 hour of time.[46]
- **Megawatt (MW)** means a metric unit measurement of the use of electrical power equal to 1000 Kilowatts (kW).[47]
- **Megawatt-hour (MWh)** means a unit of energy equivalent to one megawatt (1 MW) of power expended for 1 hour of time.[48]
- **Module** means one or more solar cells connected in one unit.[49]
- **Mounting** means the manner in which a solar energy system is affixed to the roof or ground (i.e. roof mount, ground mount, pole mount).[50]
- **Mounting Devices** mean the racking, frames, or other devices that allow the mounting of a solar energy system onto a roof surface or the ground.[51]
- **Net Meter** means a device, typically provided and installed by the local utility, used to measure the flow of electricity from the solar energy system for the purposes of net metering grid-tied solar energy systems.[52]

[40] McDuffie County, GA.
[41] *Id.*
[42] Utah Model. Long County, GA.
[43] Pennsylvania Model.
[44] Texas Model. Utah Model. Long County, GA. McDuffie County, GA.
[45] Pennsylvania Model. Utah Model. Long County, GA. McDuffie County, GA.
[46] Utah Model. Long County, GA. McDuffie County, GA.
[47] *Id.*
[48] *Id.*
[49] Texas Model.
[50] Utah Model. Long County, GA.
[51] Minnesota Model.
[52] Utah Model. Long County, GA.

- **Net Metering** means a billing arrangement that allows customers with grid-tied solar energy systems to receive credit against their electric bills for any excess electricity generated on-site and provided to the utility grid. If they produce more than they consume within the billing period, the utility pays them for the excess.[53]
- **Off-Grid Solar Energy Systems (with Battery Back-up)** means a solar energy system designed such that the circuits energized by the solar energy system are not electrically connected in any way to electric circuits that are served by an electric utility company. These systems operate independently from the local utility grid and generally provide electricity directly to a home, building, boat, RV, or remote agricultural pumps, gates, traffic signs, etc. These systems typically require a battery bank to store the solar electricity for use during nighttime or cloudy weather (and/or other back-up generation).[54]
- **Passive Solar** means techniques, designs, and materials that take advantage of the sun's position throughout the year (and the local climate) to heat, cool, and light a building. Passive solar incorporates elements (strategic design and architecture, building materials, east-west and building lot orientation, windows, landscaping, awnings, and ventilation) to strategically maximize the solar potential of any home or building (namely, maximizing solar heat gain in winter months and minimizing solar heat gain in summer months to reduce heating/cooling demand, and maximizing the use of daylighting to reduce demand for electricity for lighting).[55]

Figure 9. Close up of PV panels. [56]

- **Pole-Mounted Solar Energy System** means a solar panel or array that is mounted and elevated from the ground by a single pole. Pole-mounted systems can be designed to track the sun (with single-axis or dual-axis tracking motors) and maximize solar output throughout the year.[57]
- **Photovoltaic-Direct Systems** means the simplest of photovoltaic solar energy systems with the fewest components (no battery back-up and not interconnected with the utility) designed to only provide electricity when the sun is shining.[58]

[53] Texas Model. Utah Model. Long County, GA.
[54] Massachusetts Model. Minnesota Model. Utah Model. Long County, GA.
[55] Utah Model. Long County, GA.
[56] Photo by Carl Attard, https://www.pexels.com/photo-license/.
[57] Utah Model.
[58] Utah Model. Long County GA.

- **Racking** means the equipment that securely attaches and anchors solar energy systems to structural sections of a roof or the ground.[59]
- **Rated Capacity (also known as Nameplate Capacity or Installed Capacity)** means the maximum electrical power a solar energy system can produce.[60]
- **Solar Access** means the unobstructed access of a solar energy system to direct sunlight, including access across property lines without obstruction from another's property.[61]
- **Solar Collector** means a solar energy system.[62]
- **Solar (Access) Easement** means an easement recorded pursuant to O.C.G.A. § 44-9-20 et seq., the purpose of which is to secure the right to receive sunlight across the real property of another for the continued access to sunlight necessary to operate a solar energy system.[63]
- **Solar Energy** means radiant energy (direct, diffused, or reflected) received from the sun that can be collected and converted into thermal, chemical, or electrical energy.[64]
- **Solar Equipment/Solar Energy Device** means any device associated with a solar energy system used for or intended to be used for the collection of solar energy, including solar photovoltaic cells, panels, or arrays; lines, mounting brackets, framing, and foundations; electrical energy storage devices, outdoor electrical unit/control box, material, hardware, and inverters.[65]
- **Solar Heat Exchanger** means a component of a solar thermal system that is used to transfer heat from one substance to another, either liquid or gas.[66]
- **Solar Panel** means a device capable of collecting and converting solar energy into heat or electrical energy.[67]
- **Solar-Ready** means the concept of building and planning with the purpose of enabling future use of solar energy systems. Solar-ready buildings, lots, and developments make it easier and more cost-effective to utilize passive solar techniques and to adopt in the future active solar technologies by including structural reinforcement, pre-wiring or plumbing for solar, and east-west building orientation. Solar-Ready Lots are oriented to take maximal advantage of a location's solar resource. Solar-Ready Developments expand this concept to entire subdivisions.[68]
- **Solar Resource** means the amount of solar energy that reaches a specific point. A space will generally be considered to have sufficient solar resource for developing solar energy if it is not obscured by any vegetation, building, or object for a minimum of four hours between the hours of 9:00 AM and 3:00 PM standard time on any day of the year.[69]
- **Thin Film Photovoltaic Solar Energy System** means photovoltaic cells consisting of depositing one or more thin layers of semiconductor materials on a substrate such that the solar energy system is a few micrometers thick. This allows for greater flexibility to install the solar energy system on products like rooftop shingles and tiles, building facades, the glazing for skylights, and other building integrated materials.[70]

[59] Utah Model. Long County, GA.
[60] Massachusetts Model. Virginia Model.
[61] Massachusetts Model. Minnesota Model. Utah Model. Long County, GA.
[62] Massachusetts Model. Minnesota Model. Utah Model. Long County, GA.
[63] Delaware Model. Texas Model. Utah Model. Douglas City, GA. Jackson County, GA. Long County, GA.
[64] Texas Model. Florida Model. Massachusetts Model. Douglas City, GA. Jackson County, GA.
[65] New York Model. Harris County, GA. Walton County, GA.
[66] Minnesota Model.
[67] New York Model. Utah Model. Long County, GA. Pike County, GA.
[68] Utah Model. Long County, GA.
[69] Minnesota Model.
[70] Utah Model. Long County, GA.

- **Tilt** means the angle of the solar panels relative to their latitude. The optimal tilt to maximize solar production is perpendicular, or 90 degrees, to the sun's rays at true solar noon, when the sun is at its highest during its daily east-west path across the sky (this is also known as 0° Azimuth). Solar energy systems can be fixed to remain at a static tilt, or the tilt of the panels can be manually or automatically adjusted throughout the year.[71]
- **Tracking System** means a solar array that moves to follow the path of the sun to optimize energy production. A tracking solar array may be ground mounted or building mounted.[72]
- **Watt (W)** means a measure of the use of electrical power (power [watts] = voltage [volts] x current [amps]).[73]
- **Watt-hours** means a unit of energy equivalent to one watt (1 W) of power expended for 1 hour of time.[74]

The Georgia Model Solar Ordinance does not define these terms because they are either not used or were deemed to be easily understood without definition.

Counties and cities should consider which terms, if any, would help clarify the restrictions and standards the county or city's zoning code will require for solar energy systems.

[71] Utah Model. Long County, GA.
[72] Pennsylvania Model. Douglas City, GA. Jackson County, Ga.
[73] Texas Model. Utah Model. Long County, GA.
[74] Texas Model.

Permissible Uses

A solar ordinance is a single piece of a larger zoning code. Zoning codes divide a county or city into zoning districts based on the predominant use and often also by density or intensity. Some common zoning districts include single-family residential, multi-family residential, commercial, mixed use, light industrial, heavy industrial, and agricultural. Zoning codes then list the specific uses that can be sited in each zoning district. The zoning code will prescribe if a use is allowed, is allowed after a review with a permit, or is prohibited. A zoning code also divides uses by primary and accessory use. The primary use is the main use of the land, and the accessory uses are subordinate or incidental to the primary use. Generally, each lot of land may only have one primary use.

Solar energy systems can be appropriate in all zoning districts. To encourage solar development, solar ordinances generally allow integrated, rooftop, and small scale systems in most, if not all, zoning districts. But solar ordinances often require a zoning permit, usually called a special or conditional use permit, if the system is large or if the system is proposed in a more sensitive zoning district. For solar energy, sensitive zoning districts may be residential, agricultural, or commercial. A permit review allows the county or city to ensure community character, prime agricultural land, and city plans and pre-built infrastructure are respected.

Figure 10. Solar panels located within a residential area.[75]

The Georgia Model Solar Ordinance offers two formats for how zoning codes depict permissible uses in zoning districts—a table and a list. Both formats provide the same use restrictions for solar energy systems.

The Model Ordinance uses a simplified, generic zoning district selection of residential, commercial, industrial, and agricultural. This is meant to provide counties and cities with a general idea of which zoning districts a solar energy system is appropriately allowed or allowed with a permit.

[75] Photo from https://en.wikipedia.org/wiki/Solar_power_in_California.

The Model Ordinance allows integrated and rooftop solar energy systems to be developed only as an accessory use—both designs must be installed on a structure, and that structure is likely the primary use. All sizes of ground mounted systems, on the other hand, are allowed as either an accessory or primary use. This means that ground mounted systems can either be developed on a lot with another use, or they can be developed on an empty lot.

The Model Ordinance lists integrated, rooftop, and small scale ground mounted solar energy systems as allowed uses in all zoning districts. This means that these systems can be built in any district without undergoing a zoning permit review process with the county or city zoning authority. But, the system must still follow all federal, state, and local laws, including the Model Ordinance requirements. Keep in mind, these systems may need to go through other review processes, such as to check compliance for mandatory building, fire, electric, or plumbing codes, but these processes are beyond the purview of the Model Ordinance and Guide.

The Model Ordinance also lists intermediate scale ground mounted solar energy systems in commercial and industrial districts as an allowed use, but lists these systems as requiring a Special Use Permit in residential and agricultural districts. Commercial and industrial zoning districts generally allow most industrial uses without a review process. Thus, also allowing intermediate scale solar energy systems without a permit places solar energy on a fair footing with other industries.

Finally, the Model Ordinance lists large scale ground mounted solar energy systems as requiring a Special Use Permit in all zoning districts. The potential size of a large scale system means it is reasonable to require a zoning authority review the proposed system. In fact, a significant portion of large scale solar energy developers expressed their approval for this review as it allows the developer an opportunity to engage with the community.

(See, Special Use Permit Application, p.54 and Special Use Permit Review, p.64).

Counties and cities should review their existing zoning code to understand how to incorporate solar energy systems into their districts. Existing zoning codes likely have a larger variety of zoning districts than the Model Ordinance. Counties and cities should use the Model Ordinance's generic zoning districts as guidance.

Counties and cities can also consider in which zoning districts other types of development are allowed, require a permit, or are prohibited. Solar energy systems should be treated fairly and similarly to other comparable land uses.

Applicability

A solar ordinance can clarify the scope of the ordinance by explaining where and to what it applies in the Applicability section. This section can include, for example:

- The date the solar ordinance will be effective,
- The phases of a solar energy system's life cycle the solar ordinance applies to,
- If major modifications to an existing solar energy system must also comply with the solar ordinance, and
- That the solar ordinance does not supersede other laws.

Zoning ordinances are forward looking—they regulate future land uses rather than existing ones. A solar energy system that is installed and constructed or has reached a certain point in the planning process at the time a new ordinance goes into effect should not have to comply with that new ordinance. For example, if a building permit has been granted for a solar energy system, and then a new solar ordinance takes effect, that solar energy system should not be required to comply with the new ordinance.[76] This is a basic tenant of property law that ensures that investment in the existing development is not unfairly cut short.[77]

However, solar energy systems that do not conform to existing ordinances can also interfere with community planning. Therefore, zoning ordinances also generally include mechanisms to limit such nonconforming uses, for example restrictions on expansions or changes to the solar energy system. Limiting such "major modifications" balances allowing existing, nonconforming uses to continue while limiting their ability to expand the nonconforming behavior.[78]

Figure 11. Solar panels in a field. [79]

[76] *See, Barker v. Forsyth Cty*., 248 Ga. 73 (1981) *citing Keenan v. Acker*, 226 Ga. 896 (1970).
[77] Peter O. Olson, Jenkins, Bowen & Walker, P.C., *Vested Rights, and Moratoria*, https://www.jbwpc.com/Zoning-and-Land-Use-General/VESTED-RIGHTS-GRANDFATHERING-AND-MORATORIA.shtml.
[77] Photo from https://pixabay.com/en/alternative-cell-clean-ecological-21761/.
[78] Mark White, Planners Web, *Nonconformities: Dealing with Uses, Part 1*, http://plannersweb.com/2013/10/nonconformities-part-1/. Peter O. Olson, Jenkins, Bowen & Walker, P.C., *Vested Rights, and Moratoria*, https://www.jbwpc.com/Zoning-and-Land-Use-General/VESTED-RIGHTS-GRANDFATHERING-AND-MORATORIA.shtml.
[79] Photo from https://pixabay.com/en/alternative-cell-clean-ecological-21761/.

The Georgia Model Solar Ordinance's applicability section provides that the ordinance's requirements apply to any new development after the effective date, which is bracketed to be filled in by counties and cities. The section also explains that the Model Ordinance includes requirements for the siting, construction, installation, and decommissioning of systems because, as with any land use, solar energy systems can cause impacts from their inception to the end of their lifespan.

The Model Ordinance is carefully drafted to avoid disrupting the majority of projects already underway when a county or city chooses to adopt their ordinance. Specifically, the applicability section includes three instances when a solar energy system will not need to comply with the Model Ordinance: when systems (1) are already in operation, (2) have begun lawful siting, construction, or installation, or (3) have incurred substantial liability from siting, construction, or installation. In an effort to encourage solar development in Georgia and protect as many planned solar energy projects as possible—even those in the beginning planning stages—this exemption is broader than that required by basic legal tenants and other solar ordinances.

The Model Ordinance also carefully considers which major modifications to existing solar energy systems require an otherwise exempt system to comply with the Model Ordinance. An existing system is only required to comply with the Model Ordinance if that system substantially increases its footprint. This decision balances allowing existing and ongoing projects to continue uninterrupted with protecting the local community and land from experiencing significant change without oversight. The Model Ordinance only provides a reasonable range for the percentage increase of the footprint, as there is no single best practice.[80] Counties and cities must choose a specific number within this range—a smaller number will subject more existing solar energy systems that expand their footprint to the requirements of the ordinance, while a larger number will subject less.

Counties and cities can make their solar ordinance apply to more solar energy systems that are underway by including the following provision in place of the Model Ordinance provision:

> *"This ordinance applies to all solar energy systems installed and constructed after [the effective date]."*

Additionally, counties and cities can define major modification based on diverse changes to the status quo. For example, the county or city could add the following provisions to the definition of major modification:

> *"more than [90]% of the solar panels on the solar energy system are replaced at one time."*

If a county or city includes the former option, it should be aware that solar panels may be replaced for many reasons. For example, a strong storm with hail may damage many panels at one time, requiring them to be replaced. Therefore, the percentage of panels replaced at one time to require compliance with the ordinance should be very high.

[80] The North Carolina Model defines major modification as change greater than 5% of footprint. A solar industry representative, on the other hand, suggested a 25% increase would be a reasonable definition of major modification.

Requirements for Integrated Solar Energy Systems

Solar ordinances rarely address integrated solar energy systems both because they are still relatively uncommon,[81] and because they have relatively few impacts that are independent from the impacts of the structure into which the system is integrated. As to the former, as the technology of solar energy advances, these systems likely will be used more. As to the latter, the more integrated the system is to the structure, the less a solar ordinance needs to address the system itself.

Keep in mind, beyond land use standards, all integrated solar energy systems will need to comply with Georgia's mandatory construction codes, including building, electric, and fire.[82]

Figure 12. Integrated solar system in Louisville, Kentucky.[83]

The Georgia Model Solar Ordinance establishes only the minimum requirements of solar access and tree removal for Integrated Solar Energy Systems for the above-mentioned reasons and to avoid overly restrictive standards in light of advancing technology.

A county or city may consider including separate standards for specific types of integrated solar energy systems, like integrated solar canopies. (See, System Designs: Integrated, Rooftop, Ground Mounted, and More, p.10). It is not recommended that a county or city include glare standards for integrated solar energy systems unless the county or city's zoning ordinance includes a glare standard for other reflective objects, such as windows or water bodies.

[81] Pennsylvania Model. Sabin Model. Virginia Model. DeKalb County, GA.
[82] Ga. Code Ann. § 8-2-20(9)(B).
[83] Photo from https://www.flickr.com/photos/westbywest/1703642879.

Solar Access

A solar ordinance can address the possibility that vegetation or new structures on neighboring property may block a solar energy system's access to sunlight. While a landowner has no inherent right to sunlight, Georgia recognizes the benefit of solar energy and allows landowners to establish their right to unobstructed sunlight through a solar easement.[84]

Solar easements are voluntarily negotiated agreements between neighboring landowners, which provide that one landowner will not obstruct the sunlight reaching the other's property. Georgia law requires that a solar easement be recorded, be in writing, clearly define the space affected by the easement, and describe conditions, if any, when the easement would terminate. Unless expressly stated in the easement, the solar easement continues to control even if the land is sold to new owners.

The Georgia Model Solar Ordinance acknowledges a landowner's right to obtain a solar easement from another property owner to ensure adequate sunlight exposure. While the Model Ordinance generally avoids redundant provisions, communities showed special interest in solar access. The Model Ordinance therefore includes this provision to highlight the existence of the state law.

A county or city can further preempt landowner disputes due to shading of solar energy systems from trees by including tree removal requirements in its ordinance. (See Tree Removal, below).

Tree Removal

A solar ordinance can address potential conflicts between solar energy systems and trees. Most frequently, development of solar energy clashes with tree growth in the following situations: either a tree or tree canopy grows to shade an existing solar energy system and reduces its efficiency, or an existing solar energy system prevents the planting of new trees because of shading concerns.

While legitimate arguments exist for and against limiting tree growth or removing trees to improve a solar energy system's access to sunlight, tree removal for this purpose is generally discouraged.[85] There has already been a steady trend of declining tree coverage throughout Georgia, and an increase in solar energy could exacerbate this trend.[86] Solar energy systems offer many benefits, but trees do as well, including increasing property values, decreasing people's stress, and improving air quality.[87] Additionally, removing trees can "result[] in a net energy loss because the elimination of shade heats the [building] so much, it generally outweighs the gain from solar panels."[88]

With smart planning, solar energy systems can coexist with healthy tree coverage. This is especially true within Georgia's residential and commercial districts, where the best places to plant trees for energy

[84] Ga. Code Ann. § 44-9-20 et seq.
[85] New Jersey Model. Texas Model.
[86] Georgia Forestry Commission, *Georgia: The State of the Urban Forest Report 2012* (2012), http://www.gfc.state.ga.us/community-forests/Georgia%20-%20The%20State%20of%20the%20Urban%20Forest%20Report%202012.pdf.
[87] American Planning Association, *Solar Briefing Papers, Balancing Solar Energy with Competing Interests* (2012), http://achfonline.org/wp/wp-content/uploads/2015/06/APA-potentialcompetinginterests.pdf.
[88] Georgia Urban Forest Council (GUFC), Shade: The Role of Trees in Our Future, *Solar Power and Trees Create a Win-Win Team: How Arborists and Solar Installers Can Work Together for a Common Goal* (2013), http://www.gufc.org/wp-content/uploads/2013/02/SHADE_0206131.pdf.

savings is typically on the west side of structures, while the best places to install solar energy systems is on the south side of structures and roofs. To avoid shadowing potential solar energy sites, tall trees should therefore be grown on the west and north sides of structures, while short trees should be grown south and east.[89] It is especially important to protect mature trees, given both the length of time it takes for trees to grow and the greater benefits associated with mature trees. If a tree is cut down for solar development, best practice is to aim for no net loss—meaning that new trees of a similar type to those cut down should be planted.

Figure 13. Trees and solar panels functioning in proximity.[90]

The Georgia Model Solar Ordinance encourages avoiding removing trees and other vegetation to the extent practicable. Rather than create new standards for tree removal, the Model Ordinance relies on the county or city's existing tree ordinance, if any, to set such standards.

If a county or city does not currently have a tree ordinance,[91] it should consider:

- Developing forest management or green infrastructure plans,
- Adopting an ordinance that addresses both trees and solar energy systems, or
- Creating tree pruning guides that first encourage or require other alternative energy conservation strategies and tree pruning before tree removal.[92]

[89] Georgia Urban Forest Council (GUFC), Shade: The Role of Trees in Our Future, *Solar Power and Trees Create a Win-Win Team: How Arborists and Solar Installers Can Work Together for a Common Goal* (2013), http://www.gufc.org/wp-content/uploads/2013/02/SHADE_0206131.pdf.
[90] Photo from: https://www.publicdomainpictures.net/en/view-image.php?image=240006&picture=solar-panels.
[91] Georgia Urban Forest Council, *Georgia's Tree Ordinances* (Nov. 2006), http://www.gufc.org/wp-content/uploads/2013/06/Georgias-Tree-Ordinances-Report.pdf.
Georgia Forestry Commission, *Tree Ordinance Development Guidebook* (Sept. 2005), http://www.gatrees.org/community-forests/planning-policy/tree-ordinances/2005TreeOrdinance-100.pdf
[92] American Planning Association, *Solar Briefing Papers*, *Balancing Solar Energy Use with Potential Competing Interests* (2012), http://achfonline.org/wp/wp-content/uploads/2015/06/APA-potentialcompetinginterests.pdf.

Alternatively, a county or city can take non-legislative measures to ensure that trees and integrated solar energy systems can coexist, including but not limited to the following:

- Involve both foresters and solar experts in county and city planning efforts,
- Invite and encourage foresters to become members of local solar advisory committees and councils,
- Educate citizens as to the benefits of both solar and trees, and increase their awareness of best practices of sensible planning to avoid shading of solar energy systems, and
- Utilize planning software and tools, like i-Tree and solar maps, which provide relevant data on tree growth, forest benefits, and shading (other free tools include Google Earth, Sketchup, and Paint.NET).[93]

Glint and Glare

Solar ordinances generally do not include a requirement addressing potential glint and glare from integrated solar energy systems. Glint is a momentary flash of bright light and glare is the continuous, bright reflection of light. Both glint and glare, when severe enough, may cause disturbed vision.

Solar energy systems can cause glint and glare, but the occurrence is limited. To be most efficient, solar panels are designed to absorb rather than reflect light. Additionally, most solar energy systems tilt upward—causing any glint or glare to also reflect upward, rather than horizontally onto nearby buildings and streets. (But see, Airports, p.69). Additionally, this glint and glare will only be intermittent and temporary. Thus, solar energy systems are generally less disruptive than other common sources of glare, including normal window glass and snow,[94] and systems can generally be treated the same as windows or bodies of water like swimming pools when considering glare impacts.

The Georgia Model Solar Ordinance does not include a glare requirement for integrated solar energy systems because glare impacts are negligible.

Counties and cities should treat solar energy systems no differently than other potential sources of glare, such as building windows or bodies of water. If a county or city is especially concerned with glare, it may consider including the following provision:

> *"Solar energy systems shall be positioned in such a way that glare does not affect adjacent properties or roadways."*[95]

[93] American Planning Association, *Solar Briefing Papers*, *Balancing Solar Energy Use with Potential Competing Interests* (2012), http://achfonline.org/wp/wp-content/uploads/2015/06/APA-potentialcompetinginterests.pdf.
[94] Roger Colton, Solar Pro, *Evaluating Glare from Roof-Mounted PV Arrays* (Mar./Apr. 2015), http://solarprofessional.com/articles/design-installation/evaluating-glare-from-roof-mounted-pv-arrays?v=disable_pagination&nopaging=1#.W0i3M9JKiUl.
[95] *See,* Floyd County, GA. Greene County, GA. Madison County, GA. McDuffie County, GA. Thomas County, GA.

Requirements for Rooftop Solar Energy Systems

Solar ordinances will often address rooftop solar energy systems.

Keep in mind, beyond zoning requirements, all rooftop solar energy systems will still need to comply with Georgia's mandatory construction codes, including building, electric, plumbing, and fire.[96]

Figure 14. A rooftop solar energy system.[97]

The Georgia Model Solar Ordinance establishes minimum requirements for rooftop solar energy systems—addressing only solar access, tree removal, and height—in order to encourage their development. Additionally, the Model Ordinance's minimal requirements should remain applicable, appropriate, and not overly restrictive as technology advances.

A county or city may be interested in more standards for rooftop solar energy systems than the baseline requirements in the Model Ordinance—such as standards for glint and glare, aesthetics, safety, or the angle of the panel.

Solar Access

For a discussion on solar access, see Requirements for Integrated Solar Energy Systems – Solar Access, p.27.

Tree Removal

For a discussion on tree removal, see Requirements for Integrated Solar Energy Systems – Tree Removal, p.31.

[96] Georgia Department of Community Affairs, *Construction Codes*, https://dca.ga.gov/local-government-assistance/construction-codes-industrialized-buildings/construction-codes.
[97] Photo from https://pixabay.com/en/solar-panel-array-roof-home-house-1591358/.

Height

A solar ordinance that includes a height standard for rooftop solar energy systems generally provides separate requirements for sloped and flat roofs because the purpose of the height standard is different for each.[98]

For a rooftop solar energy system on a **flat roof**, the purpose of a height standard is to encourage solar development where it might otherwise be restricted.[99] Zoning ordinances often have maximum building heights, above which a rooftop solar energy system could not be installed. A solar ordinance, however, can create an exception that allows a rooftop system to exceed the maximum building height of the applicable zoning district. There is no single height exception that is considered best practice. Some solar ordinances provide the same exception as the zoning district provides for other common rooftop equipment, like heating and air conditioning units.[100] Other ordinances allow the highest point of a solar energy system to exceed the maximum height limit by a specific amount, generally ranging between 6 and 15 feet.[101]

For solar energy systems installed on **sloped roofs**, a height limit in a solar ordinance addresses aesthetic and safety concerns.[102] For example, to address potential wind lift concerns, many solar ordinances require that rooftop solar energy systems on sloped roofs not exceed the highest point of the roof to which they are attached.[103]

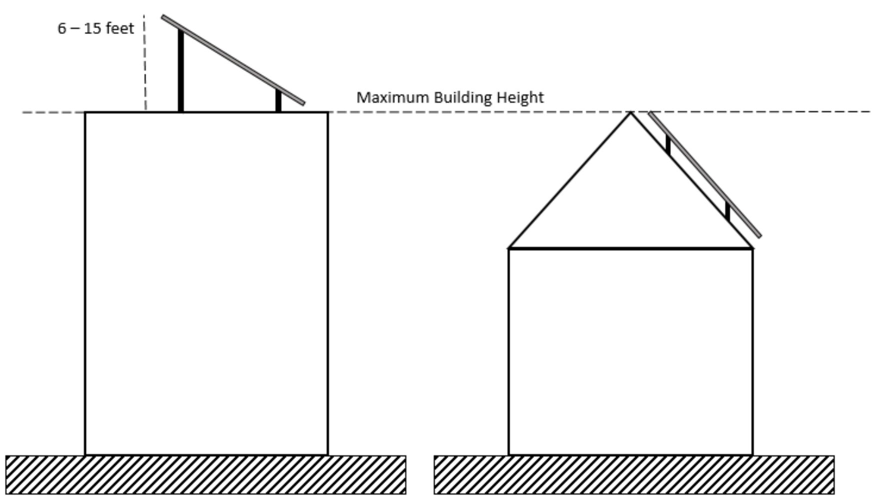

Figure 15. Diagram defining maximum building height.

[98] New Jersey Model.
[99] Environmental Planning & Design, LLC., *Zoning and Permitting in Your Municipality* (Dec. 2012), https://www.pennfuture.org/Files/Admin/SunSHOT_Guide.compressed.pdf.
[100] Minnesota Model. Massachusetts Model. New York Model.
[101] New Jersey Model (allows exceedance of 15 feet). Texas Model (allows exceedance of 10 feet). Dekalb County, GA (allows exceedance of 6 feet). McDuffie County, GA (allows exceedance of 10 feet).
[102] Texas Model.
[103] New Jersey Model.

The Georgia Model Solar Ordinance allows rooftop solar energy systems to exceed the underlying height limits by the same amount as roof-mounted mechanical devices or equipment, rather than establishing a separate exception to the height limit. This ensures that solar energy systems are treated the same as other similar devices.

The Model Ordinance complies with best practice for sloped roofs and does not allow solar energy systems on sloped roofs to vertically exceed the highest point of the roof to which it is attached.

Counties and cities can instead set a specific limit for how high above the maximum building height a solar energy system can extend with the following language:

> *"For a rooftop solar energy system installed on a flat roof, the highest point of the system shall be permitted to exceed the applicable zoning district's height limit by up to [6 – 15] feet above the rooftop to which it is attached."*

Glint and Glare

For a discussion on glint and glare, see Requirements for Integrated Solar Energy Systems – Glint and Glare, p.33.

Aesthetics

When a **solar ordinance** includes standards for rooftop solar energy systems, it generally is for aesthetic reasons. Counties and cities must balance maintaining the character of their communities with compromising the ability of a solar energy system to operate efficiently. (See, Historic Neighborhoods, p.65). As the technology of solar energy systems advances to address aesthetic concerns, it will become increasingly less necessary to address the aesthetics of rooftop solar in zoning ordinances.

Figure 16. Angled rooftop solar panels on a flat roof visible from the ground.[104]

The Georgia Model Solar Ordinance does not include standards to address aesthetics of rooftop solar energy systems as the Model Ordinance is designed to be permissive and encourage solar development.

[104] Photo by Scott Webb, https://unsplash.com/license.

A county or city that is especially concerned about aesthetics can consider including in its ordinance the following sample provisions, which, while restrictive, are considered a reasonable balance of interests:

> *"Solar energy systems shall not be allowed on a street-facing sloped roof unless the building owner demonstrates that other locations will result in a decrease in expected energy production of at least [XX]%."*[105]
>
> *"Solar energy equipment shall be installed, when possible, inside walls and attic spaces to reduce their visual impact."*[106]

A county or city should **avoid** the following sample provisions, on the other hand, because they are overly restrictive:

> *"Solar energy systems shall not be visible from any street."*
>
> *"The design of solar energy systems shall, to the extent reasonably practicable, use materials, colors, textures, screening, and landscaping that will blend the facility into the natural setting and existing environment."*[107]

Safety

A solar ordinance can address safety concerns of rooftop solar energy systems. However, the most appropriate location for addressing the safety of a solar energy system is in mandatory construction codes, rather than in a zoning ordinance. Developers must already comply with these codes, which robustly address safety requirements. Georgia currently requires all buildings and structures to adhere to:

- 2012 International Fire Code with Georgia Amendments,
- 2012 International Building Code with Georgia Amendments,
- 2012 International Residential Code with Georgia Amendments,
- 2012 Plumbing Code with Georgia Amendments, and
- 2017 National Electric Code.[108]

Updated versions of some of these codes exist, but Georgia has not yet adopted them. Counties and cities should be aware that Georgia likely will update the versions it mandates in the future.

One safety requirement for rooftop solar energy systems that a solar ordinance can include, however, is a setback. For rooftop solar energy systems, a setback is the requisite free space between the edge of the solar energy system and the edge of the roof.[109] Setbacks ensure adequate pathways exist for first responders along roof edges and ridgelines in case of emergency. If a first responder does not have adequate space to move around a solar energy system and is not familiar with the structure of the system, there is risk of injury to the first responder or structural damage to the solar energy system.

[105] Texas Model.
[106] New York Model.
[107] Texas Model.
[108] Georgia Department of Community Affairs, *Construction Codes*, https://dca.ga.gov/local-government-assistance/construction-codes-industrialized-buildings/construction-codes.
[109] Texas Model.

The Georgia Model Solar Ordinance does not include safety requirements to prevent redundancy or contradiction of mandatory construction codes. The Model Ordinance also does not address building, fire, plumbing, and electric permitting requirements because the Model Ordinance attempts to focus exclusively on land use impacts.

A county or city can reference the mandatory construction codes within its ordinance. It is best practice to reference the most recent national codes adopted by Georgia to ensure consistency with industry and regulatory standards.[110] For example, a city or county can include the following sample provision:

> *"A setback from all roof edges, as defined by most recent the International Fire Code adopted by Georgia at the time the rooftop solar energy system is installed, shall be provided for rooftop solar energy systems to ensure that firefighters may access the roof in a quick and safe manner and may penetrate the roof to create ventilation if necessary."*[111]

A county or city can further mitigate risks by:

- Providing training and education to first responders to ensure familiarity,[112]
- Requiring the property owner to provide a site plan to local emergency personnel, or
- Requiring inspection before the solar energy system can operate or, if the county or city has a permitting process, before the system is permitted.

For counties and cities interested in a streamlined building, fire, plumbing, and electric review, the city of Atlanta has recently created such a process.[113]

Flush, Parallel, or Angled Panels

A solar ordinance can include different requirements based on the angle of the solar panels on the roof. The panels of rooftop solar energy systems can be installed flush, parallel, or angled with respect to the underlying roof. The orientation of solar panels can have effects on aesthetics, performance, and wind lift.

Flush panels are fitted directly against roofing materials. It is not recommended that a solar ordinance require solar panels be mounted flush with the existing slope of the roof for two reasons. First, rooftop panels may need to be angled relative to the roof surface to maximize solar exposure. Second, flush panels may prohibit ventilation necessary to maximize panel efficiency.[114] Communities often balance functionality with aesthetics, however, and compromise by allowing flush rooftop solar energy systems where systems might otherwise be prohibited outright.

Parallel panels are raised slightly above roofing materials but parallel to the angle of the roofline. Requiring a parallel angle is generally an acceptable compromise between efficiency and aesthetics. While it restricts the ability to tilt the panels to gain efficiency, parallel rooftop solar energy systems are typically considered more aesthetically pleasing than angled rooftop solar energy systems.

[110] *See*, Georgia Department of Community Affairs, *Construction Codes*, https://dca.ga.gov/local-government-assistance/construction-codes-industrialized-buildings/construction-codes.
[111] Texas Model.
[112] Go Solar California, *Solar and Fire Safety*, http://www.gosolarcalifornia.ca.gov/solar_basics/fire_safety.php. Texas Model.
[113] City of Atlanta, *Solar PV Installation for Residential & Commercial properties*, https://www.atlantaga.gov/government/departments/city-planning/office-of-buildings/solar-pv-installation.
[114] Texas Model.

Angled panels are raised above roofing materials at an angle different than that of the roofline. Allowing angled panels is generally the best practice for encouraging solar development because angled rooftop solar energy systems can greatly increase efficiency of the system and allow rainwater to run off rather than collect on the panel.[115] Too much of an angle can raise concerns about wind lift, but height limitations typically already address this concern.[116]

Figure 17. Angled solar panels on a flat roof.[117]

The Georgia Model Solar Ordinance does not make specifications regarding the orientation of solar panels for rooftop solar energy systems because panel orientation is site-specific and regulation can easily become overly restrictive.

Counties and cities generally should not require flush rooftop panels. However, if a county or city would like to require parallel panels to address aesthetic concerns, the following language may be included in the county or city's solar ordinance:

> *"Street facing solar panels shall be parallel to the roofline on a sloped roof. Tilting the panels may be considered through a special use permit (SUP) process."*[118]

[115] Texas Model.
[116] *Id.*
[117] By Lucas Braun [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)], from Wikimedia Commons
[118] Texas Model.

Requirements for Ground Mounted Solar Energy Systems

A solar ordinance may include heightened standards for ground mounted solar energy systems because these systems have the potential to cause greater land impacts than integrated or rooftop systems. Specifically, due to the large size of some ground mounted systems, the impacts of a ground mounted solar energy system may go beyond aesthetics.

Figure 18. A ground mounted solar energy system.[119]

The Georgia Model Solar Ordinance first sets forth general requirements for all sizes of ground mounted solar energy systems, addressing solar access, impervious surfaces, lighting, tree removal, and decommissioning.

For small scale ground mounted systems, the Model Ordinance does not impose any requirements beyond these general ones. Due to their limited size, small scale systems have minimal land impacts.

Intermediate and large scale ground mounted solar energy systems, by contrast, have greater potential to impact the land, community, and ecosystem. The Model Ordinance consequently places additional requirements on these systems to ensure smart development. These additional requirements include setbacks, visual buffers, and signage.

Counties and cities may be interested in requirements for ground mounted solar energy systems that go beyond the baseline requirements in the Model Ordinance. These may include lot coverage, fencing, electrical connections, noise, height, safety, glint and glare, and maintenance.

Solar Access

For a discussion on solar access, see Requirements for Integrated Solar Energy Systems – Solar Access, p.28.

[119] Photo from https://www.pexels.com/creative-commons-images/.

Impervious Surface & Lot Coverage

A solar ordinance can include an impervious surface or lot coverage standard. In a zoning code, these are interrelated and potentially interchangeable dimensional standards. Impervious surfaces are hard, man-made areas that do not readily absorb water. Lot coverage is the area of a lot that can be built-upon, often defined by impervious surfaces. These standards are meant to limit density and mitigate stormwater runoff impacts.

To be most effective, solar energy systems cannot be densely built. Rows of solar panels must be a certain distance apart to avoid shading one another. Thus, the more important reason to consider the impervious surface or lot coverage of a solar energy system is its stormwater impacts.

Stormwater runoff is generated from rain and snowmelt events that flow over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground. Poor development practices can lead to greater runoff flow and volume, increasing flooding and the amount of pollutants the water picks up, thereby degrading water quality.[120] Minimizing stormwater runoff provides a community many benefits.[121] While there are federal, state, and local stormwater management requirements that solar energy systems will likely need to comply with, an impervious surface or lot coverage requirement establishes separate and distinct standards.[122]

Determining the impervious surface area of solar energy systems can be tricky because they have an impervious surface (the mounted solar panel) raised above another surface that may be pervious (ground cover of vegetation). Unlike roads, parking lots, and buildings, solar energy systems do not completely prevent the ground below them from absorbing water. Depending on the site preparation, the groundcover beneath systems, and the layout of the systems, ground mounted solar energy systems may allow water retention as good or better than if the system had not been built. Thus, most solar ordinances define solar energy systems as pervious surfaces or semi-pervious surfaces.

The Georgia Model Solar Ordinance's imperious surface provision only defines whether a solar energy system is pervious for the purposes of determining a lot's compliance with the county or city zoning code's impervious surface standard. The Model Ordinance's provision does not apply to any stormwater management requirements outside of zoning.

The Model Ordinance's impervious surface standard is flexible, allowing a system to be considered pervious so long as the system adheres to certain standards that limit stormwater runoff. For example, the "sheet flow" the Model Ordinance requires is continuous, thin water movement off the solar panels and over the ground rather than concentration of water into channels. While the Model Ordinance encourages pervious groundcover, it does not mandate any specific practices, allowing the solar developer necessary flexibility in design.

[120] *See*, Atlanta Regional Commission et al., *Georgia Stormwater Management Manual*, *1 Stormwater Policy Guidebook*, 7-23 (2016), http://atlantaregional.org/wp-content/uploads/gsmm-2016-edition-final-v1.pdf.
[121] *Id.*
[122] *See, Georgia Stormwater Management Manual, Volume 1: Stormwater Policy Guidebook* (2016), http://atlantaregional.org/wp-content/uploads/gsmm-2016-edition-final-v1.pdf. *Georgia Stormwater Management Manual, Volume 2: Technical Handbook* (2016), http://atlantaregional.org/wp-content/uploads/2017/03/gsmm-2016-edition-final-v2.pdf. Georgia Soil and Water Conservation Commission, *Manual for Erosion and Sediment Control in Georgia* (2016), https://gaswcc.georgia.gov/sites/gaswcc.georgia.gov/files/related_files/site_page/GSWCC-2016-Manual-As-Approved-by-Overview-Council.pdf.

Counties or cities have many reasonable alternatives to the Model Ordinance's provision. The impervious coverage of a solar energy system can be calculated based on the parts of the system that actually make contact with the ground or can be completely excluded from impervious surface standards.

If a county or city zoning ordinance includes lot coverage standards, there are three common methods to address a solar energy system's lot coverage:

> *"The panels of a ground mounted solar energy system shall not be included in total lot coverage."*
>
> *For primary use: "A ground mounted solar energy system shall not exceed [XX%] of the lot on which it is installed."*
>
> *For accessory use: "A ground mounted solar energy system shall not exceed [XX%] of the footprint of the principal building."*

Counties, cities, and developers should also consider the following better site design practices for minimizing stormwater and soil erosion impacts from solar development.

Practices for better ground cover include:[123]

- Avoiding soil compaction underneath and around the panels during and after construction by using low impact construction techniques such as avoiding running construction equipment on disconnection areas and tilling any soil that is compacted.
- Avoiding earth disturbance and grading.
- Maintaining natural soil and vegetative groundcover in good condition underneath the panels, rather than cement, gravel, or bare dirt. A meadow condition with native grasses is preferable because native grasses are low growing, low maintenance, and have deeper roots which help decrease soil compaction. Planting pollinator friendly habitat can also produce additional win-win benefits. (See, Dual Land Use, p.71).
- Avoiding chemical fertilizers, pesticides, and fungicides, which can pollute stormwater runoff and may require that the runoff be treated. Mowing should be used to control vegetation instead of chemicals, and mowing can be done with animals rather than equipment. (See, Dual Land Use, p.71). However, mowing should not be excessive—keeping plants above four inches is best.

Practices for arranging the solar panels include:[124]

- Developing on mild slopes (less than 10%).
- If the ground slope is steeper than 5%, adding level spreaders in the ground at each dripline to slow the movement of the water and maintain sheetflow.

[123] *See*, Maryland Department of the Environment, *Stormwater Design Guidance – Solar Panel Installations*, http://mde.maryland.gov/programs/Water/StormwaterManagementProgram/Documents/ESDMEP%20Design%20Guidance%20Solar%20Panels.pdf. Minnesota Stormwater Steering Committee, Manual Subcommittee, *Minnesota Stormwater Manual, Stormwater Management for Solar Projects and Determining Compliance with the NPDES Construction Stormwater Permit*, https://stormwater.pca.state.mn.us/index.php?title=Stormwater_management_for_solar_projects_and_determining_compliance_with_the_NPDES_construction_stormwater_permit. North Carolina Department of Environmental Quality, *Stormwater Design Manual, Solar Farms* (Apr. 5, 2017), https://files.nc.gov/ncdeq/Energy%20Mineral%20and%20Land%20Resources/Stormwater/BMP%20Manual/E-6%20%20Solar%20Farms.pdf. Pennsylvania Department of Environment Protection, Southeast Reginal Office, Watershed SW DR, *Information to Use in the Determination of Stormwater Management (SWM) Impacts for Solar Projects* (Oct. 4, 2011), https://www.chesco.org/DocumentCenter/View/7375.

[124] *Id.*

- Using structures/foundations for the solar energy system that occupy minimal space (no more than 5% of total site area).
- Including a sufficient distance between rows of panels to allow for capture of rainfall and growth of vegetation beneath and between. This disconnection distance between rows of panels should be greater than the width of a single solar panel.
- Limiting the lowest vertical clearance of the panels to no greater than 10 feet to avoid erosion at the dripline.

Lighting

A solar ordinance can help limit light pollution from ground mounted solar energy systems. Light pollution is a global and growing problem that not only minimizes the ability to see stars, but also can seriously impact both human health and ecosystem functions. A significant amount of light pollution comes from excessive and inefficient lighting, which is essentially wasted energy.[125]

The Georgia Model Solar Ordinance follows the best practices for limiting lighting and light pollution from solar energy systems. By defining the standard based on "reasonableness" of the requirements, the Model Ordinance addresses the issue while remaining flexible.

A county or city can decide to be more or less restrictive in setting lighting standards for ground mounted solar energy systems. For example, a county or city could decide not to include a lighting standard at all or require compliance with a general lighting standard within the county or city's existing zoning ordinance.

Tree Removal & Forests

For a discussion on individual tree removal, see Requirements for Integrated Solar Energy Systems – Tree Removal, p.28.

A solar ordinance can also address larger scale tree removal—including potential impacts of solar development on forests. Worldwide, we are losing forestland at an incredible rate. The destruction of forests for development results in the loss of vital carbon sinks and key habitat for flora and fauna,[126] and many states and communities have grappled with this concern.[127] In Georgia, a recent report found that 21% of solar farms were developed on land classified as evergreen forest.[128]

Georgia is unique, however, in that over the last 30 years the state has maintained a net neutral acreage of forestland.[129] Forestland has not remained in the same location, however. Between 1982 and 2012,

[125] International Dark Sky Association, *Light Pollution*, http://www.darksky.org/light-pollution/.
[126] *See*, Food and Agriculture Organization of the United Nations, *Global Forest Resources Assessment 2015, How are the world's forests changing?* (2016), http://www.fao.org/3/a-i4793e.pdf.
[127] *E.g.*, Connecticut Council on Environmental Quality, *Energy Sprawl in Connecticut: Why Farmland and Forests are Being Developed for Electricity Production; Recommendations for Better Siting* (Feb. 3, 2017), http://www.ct.gov/ceq/lib/ceq/Energy_Sprawl_in_Connecticut.pdf.
[128] NASA DEVELOP, The Nature Conservancy, & University of Georgia, *Georgia Energy II, Reducing Conflicts in Siting Solar Power Facilities by Identifying Sensitive Habitats and Wildlife Populations in Areas with High Generation Potential* (Fall 2017).
[129] U.S. Department of Agriculture, Natural Resources Conservation Service & Iowa State University, Center for Survey Statistics and Methodology, National Resources Inventory: *Georgia's Land: Its Use and Condition*, 9 (4th ed. Mar. 2017), https://www.nrcs.usda.gov/wps/portal/nrcs/main/ga/technical/dma/nri/. David Dickinson, U.S. Forest Service & Georgia Forestry

approximately 1.7 million acres of forestland was converted to developed land, while Georgia planted approximately 1.6 million acres of forestland by converting farmland.[130]

Georgia must do more than just maintain a net neutral acreage of forestland. It must pay special attention to protecting old growth forests, which provide more ecological benefits than newly planted forests. And these benefits are substantial—the ecological benefits of forestland in Georgia are valued at $37 billion.[131] This value is derived by evaluating their clean water filtration capacity, soil erosion control, clean air, wildlife habitat, aesthetics, and recreation potential. All of these benefits are greatly impacted not only when a full forest is clear cut, but also when pieces of forest are bifurcated. Severing the connectivity of forestland is especially harmful because of the fragmentation it creates of species habitat. (See, Wildlife, p.56).

Scientists have attempted to quantify the value of forestland as a carbon sink versus the value of a solar energy system in producing carbon-free energy, but have not yet been able to determine which provides a greater benefit.[132] Even if the carbon-free energy from solar energy systems balances the loss of the forest as a carbon sink, developing a system where a forest current exists still negatively impacts the ecosystem.

Figure 19. A solar energy system built within forested land in Shuzenji, Izu, Japan.[133]

The Georgia Model Solar Ordinance prohibits removing trees and other vegetation to the extent reasonably practicable. Rather than create new standards for tree removal, the Model Ordinance relies on the county or city's existing tree ordinance, if any, to set such standards. For intermediate and large scale solar energy systems that require a visual buffer, the Model Ordinance also encourages maintaining existing growth to create this buffer.

Commission, *Forest Inventory and Analysis Program: Updates for Georgia's Forest Land – 2013 FIA Data*, 8 (2013), http://www.gfc.state.ga.us/forest-management/private-forest-management/forest-inventory/FIAGAUpdate.pdf.

[130] U.S. Department of Agriculture, Natural Resources Conservation Service & Iowa State University, Center for Survey Statistics and Methodology, National Resources Inventory: *Georgia's Land: Its Use and Condition*, 9 (4th ed. Mar. 2017), https://www.nrcs.usda.gov/wps/portal/nrcs/main/ga/technical/dma/nri/.

[131] Southern Group of State Foresters, *Georgia Forests Provide $ 37 Billion in Ecological Benefits*, http://www.southernforests.org/resources/publications/the-southern-perspective/southern-perspective-online-april-2011/georgia-forests-provide-37-billion-in-ecological-benefits-to-state/.

[132] Rebecca Moore et al., University of Georgia Warnell School of Forestry and Natural Resources, *Quantifying the value of non-timber ecosystem services from Georgia's private forests*, 33 (Jan. 2011), http://www.gfc.state.ga.us/utilization/ecosystem-services/Quantifying%20the%20Value%20of%20Non-Timber%20Ecosystem%20Services%20from%20Georgia's%20Private%20Forests.pdf.

[133] Photo by Mark Merner, https://unsplash.com/license.

Counties and cities should consider when solar development may impact trees and forests and encourage adherence to the following best practices:

- First and foremost, site solar energy systems to avoid clear cutting forests entirely.[134] (See, Developed and Degraded Land, p.66).
- If a solar energy system is proposed on forestland, the footprint or design of the project should (i) avoid the healthiest sections of forest and oldest trees, and (ii) adopt habitat corridors. (See, Wildlife, p.56).
- A policy of zero net loss should be followed, meaning both planting the same number of trees that were cut elsewhere and replanting the solar site after decommissioning with the same number and species of trees. Replanting with non-native trees or only planting with one type does not capture the same habitat and carbon sink gains that the site originally produced. (See, Decommissioning, below, and Decommissioning Plan, p.62).

Decommissioning

A solar ordinance can address what must be done when a ground mounted solar energy system is no longer in use—including how to remove the system and recycle its parts, and what improvements should be made to the land after removal. This process is called decommissioning.

A solar energy system may need to go through decommissioning when the developer has formally shut down or walked away from the system, which may be triggered when the system ceases to produce energy efficiently, damage occurs that will not be repaired, the user of the electricity generated no longer wants it, or the land lease ends.[135]

Currently, solar energy systems are predicted to operate for approximately 20 to 35 years, after which the aging solar panels will no longer be efficient. As technology changes and improves, this lifespan could conceivably be longer. Even if older panels are less efficient, they may still produce sufficient energy to justify keeping them in place. Additionally, while the panels themselves may reach the end of their useful lives, the panels may be replaced, extending the operating time of the entire solar energy system. Thus, it is difficult to estimate exactly when a solar energy system will need to be decommissioned.

Because widespread, large scale solar energy is relatively new, some counties and cities express concern about what will happen to systems no longer in operation. Concerns about the long-term impact to the land are generally unfounded. Solar energy systems are very safe and rarely, if ever, contaminate the land on which they are installed. (See, Requirements for Ground Mounted Solar Energy Systems— Safety, p.51).

More viable are concerns about the waste decommissioned solar energy systems will create. With solar development increasing worldwide, more thought needs to go into how solar panels are disposed. Solar panels should not be sent to landfills—not only because they may contain materials that are usually banned

[134] *See,* American Planning Association, *Balancing Solar Energy Use with Potential Competing Interests*, https://www.planning.org/research/solar/briefingpapers/potentialcompetinginterests.htm (citing the following good examples for cities and counties interested in adopting an ordinance addressing both solar energy systems and trees: Ashland, Oregon (§18.70); Madison, Wisconsin (§16.23(8)(a)); Sunrise, Florida (§16-130, §16-172, §16-277); and Greenwich, New Jersey (Ordinance No. 17-2011)).
[135] North Carolina Model.

from landfills, but also because they are readily reusable and recyclable.[136] Multiple recycling programs already focus on solar panels[137] and the recycling industry is expected to expand rapidly as solar energy systems begin being decommissioned on a large scale.[138]

It is because the recycling of solar energy systems is expected to be lucrative that counties and cities generally do not need to worry about systems being abandoned (instead of decommissioned). Because the materials that make up solar energy systems are valuable even after years of use, system owners should be able to afford decommissioning and counties and cities generally should not have to fund it.

For counties and cities with concerns about decommissioning, a decommissioning plan is a reasonable and common way solar ordinances address those concerns.[139] (See, Decommissioning Plan, p.62). Some counties and cities have taken it a step further, requiring solar energy system owners to pay a decommissioning bond to fund future decommissioning. Requiring such a bond is an extreme and unnecessary burden for developing solar energy. Very few land uses require bonds, and those that do tend to pose unique safety risks. For example, decommissioning bonds are popular for wind turbines because abandoned wind turbines pose the safety risk of collapsing.[140] Solar energy systems, however, do not share this level of risk.

The Georgia Model Solar Ordinance requires decommissioning for all ground mounted solar energy systems once they cease to generate electricity or thermal energy. The decommissioning requirement balances addressing community concerns, ensuring that the applicant considers the end of the solar energy system's life, and avoiding excessive burdens on the development of solar energy. Thus, the Model Ordinance allows systems to sit idle for no more than a year before decommissioning must begin. The Model builds in flexibility, however, by allowing the zoning authority to give permission to alter this decommissioning timeline, including waiving it altogether.

To ensure that decommissioning is complete, ground mounted solar energy systems allowed without a permit must finish decommissioning within 6 months of decommissioning starting. Ground mounted systems allowed with a permit, on the other hand, simply must follow the most recent decommissioning plan. (See, Decommissioning Plan, p.62).

The Model Ordinance requires all sizes of ground mounted systems to remove all materials and recycle or otherwise reuse them upon end of life to the extent reasonably practicable. The Model Ordinance also requires that the property be returned to its original condition or another reasonably appropriate condition. The Model Ordinance requires systems that are allowed with a permit to explain how each of these will be achieved in a decommissioning plan. (See, Decommissioning Plan, p.62).

The Model Ordinance follows best practices and does not require a decommissioning bond.

[136] Illinois Prairie Research Institute, Illinois Sustainable Technology Center, *Solar PV*, https://www.istc.illinois.edu/research/resource_recovery/solarPV/.
[137] First Solar, *Recycling*, http://www.firstsolar.com/Modules/Recycling. PV Cycle, http://www.pvcycle.org/homepage/. Solar Energy Industry Association (SEIA), *SEIA National PV Recycling Program*, https://www.seia.org/initiatives/seia-national-pv-recycling-program.
[138] Tina Casey, Clean Technica, *Old Solar Panels: E-Waste Today, Gold Mines* Tomorrow (June 21, 2016), https://cleantechnica.com/2016/06/21/recycling-old-solar-panels-e-waste-today-gold-mines-tomorrow/.
[139] North Carolina Clean Energy Technology Center, *Working Paper: State Regulation of Solar Decommissioning* (Feb. 2016), https://nccleantech.ncsu.edu/wp-content/uploads/Solar-Decommissioning-Policy-Working-Paper.pdf.
[140] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 4 (2014), https://sogpubs.unc.edu/electronicversions/pdfs/pandzsolar2014.pdf.

A county or city does not need to include decommissioning provisions in its solar ordinance. Most forms of development are not required to be decommissioned. However, there are legitimate reasons a county or city may want assurances for removing solar energy systems and returning the land to a suitable use. Approximately half of the counties with solar ordinances in Georgia currently include a decommissioning provision.[141]

A county or city should avoid requiring decommissioning bonds. But, if a county or city feels strongly otherwise, the bond should only be required for the largest solar energy systems and the county or city should consider not requiring the bond be posted until at least 5 or 10 years after the start of the system.

Setbacks

A solar ordinance may require setbacks—the distance a structure must be from a property line, public right-of-way, or sensitive site like a residence—to reduce impacts from adjacent land uses, enhance the aesthetics of a property by creating yard space, minimize the density of a community by ensuring adequate air and light between structures, and reduce the hazards of street corners by providing motorists with unobstructed views.[142]

These are legitimate reasons to require setbacks. However, excessive setbacks become barriers to development—the larger the setback required, the less surface area on the property may be used. While most solar ordinances require solar energy systems to simply follow the underlying zoning ordinance's setback requirements, it is important to carefully consider the reasons for the setback and whether those specifically apply to solar energy systems.

The Georgia Model Solar Ordinance independently addresses the setback requirement for intermediate and large scale solar energy systems to provide reasonable examples. The Model Ordinance does not include separate setback requirements for small scale systems.

The Model Ordinance includes setbacks from a property line, road, and residence based on increasing sensitivity. The setback distances are minimal to encourage solar development while still limiting impacts of the system to abutting properties. As the concerns setbacks address are generally greatest near residences, the Model Ordinance includes greater residential setbacks. This residential setback distance will ensure that any noise generated by the solar energy system will not be heard from the residence. (See, Noise, p.50).

Additionally, the setback standards for ground mounted solar energy systems in the Model Ordinance exclude any visual buffer. This means that the visual buffer may be located within the setback area. Depending on the type of visual buffer chosen, however, the applicable zoning district may impose setback requirements for the visual buffer itself. For example, if the visual buffer of an intermediate scale system is a fence and the underlying zoning district requires fences to be set back 30 feet from a property line, then the fence, and the solar energy system behind it, must follow the 30-foot setback requirement. Of course, if the setback required for the solar energy system is greater than the setback required for the visual buffer, the solar energy system must still comply with that greater setback.

[141] Bulloch County, GA. Catoosa County, GA. Dooly County, GA. Douglas County, GA. Early County, GA. Greene County, GA. Harris County, GA. Jackson County, GA. Jefferson County, GA. Long County, GA. Madison County, GA. McDuffie County, GA. Pike County, GA. Putnam County, GA. Sumter County, GA. Thomas County, GA. Walton County, GA.
[142] Thomas D. Horne, *Zoning: Setback Lines: A Reappraisal*, *10 Wm. & Mary L. Rev.* 739, 740 (1969), http://scholarship.law.wm.edu/wmlr/vol10/iss3/14.

A county or city can reasonably rely on the setback requirements of its existing zoning code. If a county or city is especially concerned with aesthetics, density, or street hazards, it may want to adopt separate setback standards for solar energy systems. Best practices for setbacks from large and intermediate systems include:

- 15-50 feet setbacks from property lines or roads for solar energy systems in commercial, industrial, and agricultural districts;
- 15-100 feet setbacks from property lines or roads for solar energy systems in residential districts;
- Specify larger setbacks from residences, ranging between 50-100 feet; and
- Setbacks may be larger for the front of properties and smaller for the side and rear.

Counties and cities should keep in mind that ground mounted solar energy systems range greatly in size. Thus, while a 100-foot setback from a property line may not be overly burdensome for a 50-acre system, it may be overly burdensome for a 5-acre system.

Visual Buffer & Fencing

A solar ordinance may require a visual buffer or fencing for aesthetic and safety reasons. There is no single best practice regarding visual buffers, and existing solar ordinances offer a wide variety of standards ranging from reasonable to burdensome and flexible to rigid. This is because the need, ability, and means to protect the visual character of a community differs greatly on a case-by-case basis.

In requiring a visual buffer, the goal is to shield a solar energy system from the public eye to ensure that the system does not impact the community culture.[143] This is most pressing in residential zoning districts or along scenic view sheds. However, completely shielding the entire solar energy system from view is not always the best option. Allowing views of the system can help the community become familiarized with solar energy and its benefits.[144] In some cases, such as where residences are elevated high above a system, building a complete visual buffer is impossible. Visual buffers can also simply be unnecessary. For example, the view of a solar energy system will likely not disrupt the character of a commercial or industrial zoning district and they are generally unnecessary to shield glare from a system. (See, Requirements for Integrated Solar Energy Systems – Glint and Glare, p.30 and Airports, p.69).

Visual buffers can take a variety of forms. Existing mature tree growth, vegetation, and natural landforms may provide a sufficient buffer, and leaving them in place minimizes the impact of the solar energy system on the environment. (See, Tree Removal & Forests, p.40 and Wildlife, p.56). Any vegetative visual buffers can also mitigate stormwater runoff and provide wildlife habitat. (See, Impervious Surface & Lot Coverage, p.38, Wildlife, p.56, and Dual Land Use, p.71). However, it can be difficult for a zoning authority to accurately enforce standards for vegetative visual buffers—whereas fences and earth berms can completely and immediately obscure the view of a solar energy system, vegetative buffers take time to grow into place and likely provide more of a screen than a total obstruction of the view. It can also be

[143] American Planning Association, *Zoning Buffers: Solution or Panacea?* (Apr. 1960), https://www.planning.org/pas/reports/report133.htm.
[144] *See,* Usayd Casewit, Georgia Tech Scheller College of Business, *Solar Developer Business Model Emphasizes Local Community Engagement* (Apr. 17, 2017), https://www.scheller.gatech.edu/centers-initiatives/ray-c-anderson-center-for-sustainable-business/blog/posts/4-10-17-Solar-Developer-Business-Model-Emphasizes-Local-Community-Engagement.html ("The company also nurtures trust and partnership by engaging with local schools in the rural areas it operates in to host field trips and site tours. This gets young students excited about the underlying science of solar energy and helps stimulate interest in the solar energy industry.").

difficult to clearly state what amount of vegetative growth is sufficient to constitute a visual buffer and to determine a reasonable timeframe for when the vegetative visual buffer must be fully developed, as growth of vegetation can vary from year to year depending on weather.

Figure 20. A solar energy system in Brattleboro, Vermont, as seen through a partial visual buffer of trees.

Some solar ordinances specifically require fencing around solar energy systems, not just for aesthetic but also for safety and security reasons. Ground mounted solar energy systems without borders can be inviting to curious children or metal and electronics scavengers, leading to potential damage to the system and people.[145] The national electric code, which is a mandatory construction code in Georgia, already requires that certain solar energy systems have a 6-foot chain link fence with three strands of barbed wire or an 8-foot fence.[146]

Figure 21. The Clarendon Solar Farm in Vermont with no visual buffer but with a security fence.

[145] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 23 (2014), https://sogpubs.unc.edu/electronicversions/pdfs/pandzsolar2014.pdf.
[146] NC Clean Energy Technology Center, NC State University, *Health and Safety Impacts of Solar Photovoltaics*, https://nccleantech.ncsu.edu/wp-content/uploads/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper.pdf.

Overly specific requirements for either a visual buffer or fencing can be burdensome and discourage the development of solar energy systems. This is especially true if the ordinance requires that a vegetative buffer either be an excessive depth or reach a height that then casts shadows on the land, making large portions of the property unusable for solar energy development.

The Georgia Model Solar Ordinance only requires a visual buffer for those ground mounted solar energy systems needing a special use permit. This ensures that the systems with the potential for the most impact are addressed, but creates a certain flexibility for the county or city, community, and developers to determine the correct standards on a case-by-case basis during the permitting process. The Model Ordinance requires that visual buffers comply with the most recent visual buffer plan approved by the zoning authority. (See, Visual Buffer Plan, p.56).

Also, to allow for flexibility, the Model Ordinance broadly defines visual buffer as "natural vegetation, plantings, earth berms, and/or fencing" because all visual buffers achieve the same goal of shielding the solar energy system from public view.

The Model Ordinance does provide some certainty by requiring that visual buffers reduce the view for residential dwellings on adjacent lots, including those across a public right of way. To ensure this rigid requirement does not become unreasonable—such as requiring a visual buffer screen the view of a solar energy system from a six story residence on an adjacent lot—the Model Ordinance includes the standard "to the extent reasonably practicable."

The Model Ordinance also requires that, when reasonably practicable, existing vegetation be used in order to reduce costs for developers and limit the solar energy system's impact on trees and wildlife. (See, Tree Removal & Forests, p.40, and Wildlife, p.56). For newly planted vegetative visual buffers, however, the Model Ordinance allows the zoning authority and developer to determine the timeframe for growth in the visual buffer plan, which allows for flexibility depending on the unique site features. (See, Visual Buffer Plan, p.56).

Finally, while the Model Ordinance includes the option of fencing as a visual buffer, it does not specifically require a fence. This is because mandatory construction codes should already address fencing for safety reasons and solar developers, for self-protection, will likely adopt whichever security measures are most appropriate for each solar energy system without being prompted by a zoning mandate.

A county or city should first look at its existing zoning code to understand when it requires a visual buffer. Solar energy systems generally do not need to be treated differently than other forms of development. If the existing zoning code already defines a visual buffer standard, the county or city may rely on that definition and standard for its solar ordinance as well. For example, if the existing zoning code allows large, ground mounted satellite dishes to be built in a residential area without a visual buffer, then the county or city may also allow small ground mounted solar energy systems to be built in residential districts without a visual buffer.

Where the Model Ordinance provides flexibility, such as allowing any type of buffer, it does not provide certainty. And where the Model Ordinance provides certainty, such as requiring a screen for adjacent residences, it may not sufficiently address the visual impact. For example, the Model Ordinance would not address the visual impacts of a residence with a vacant lot between it and a solar energy system.

There are other reasonable ways to balance flexibility and certainly when requiring a visual buffer. Counties and cities should be careful to avoid over regulating, but may consider including some of the following provisions in place of the Model Ordinance's:

> *"A ground mounted solar energy system shall require a visual buffer where the solar energy system is visible from an adjacent [residential lot, public right-of-way, or scenic vista.]"*
>
> *"A ground mounted solar energy system shall have, to the extent required by the [zoning authority], a visual buffer of natural vegetation, plantings, earth berms, and/or fencing that minimizes impacts of the solar energy system on the visual character of the community."*
>
> *"All [intermediate or large] scale ground mounted solar energy systems shall be screened from view with a visual buffer to the extent reasonably practicable."*
>
> *"A visual buffer shall be a [minimum or maximum] of [6 – 8] feet tall."*[147]
>
> *"A vegetative visual buffer shall be [XX] feet deep."*
>
> *"If the visual buffer utilizes natural vegetation or plantings, it shall be of a size and thickness sufficient to provide a visual and lighting screen within [2 – 3] years from the completion of construction of the solar energy system. All other visual buffers shall be in place at the time the solar energy system commences operation."*

A county or city that requires a visual buffer but would also like to familiarize the community to solar energy systems might also consider including the following language in its ordinance:

> *"A solar energy system that requires a visual buffer may include a break in the visual buffer for a length of up to [XX] feet in order to provide an educational viewing space for the community."*
>
> *"A sign that contains educational information about solar energy shall be installed along a perimeter of the solar energy system that is visible to the public."*

If a county or city would like to take advantage of the benefits vegetative visual buffers can provide, including mitigating stormwater runoff and helping wildlife, it may consider requiring solar energy systems to minimize the amount of chemical fertilizers, pesticides, and herbicides used or require native plant species for vegetative visual buffers. (See, Dual Land Use, p.71).

Finally, if a county or city is especially concerned with security, the following are provisions that can be included in an ordinance to require fencing around solar energy systems:

> *"A ground mounted solar energy system shall be fenced from adjacent properties to restrict unauthorized access."*
>
> *"A ground mounted solar energy system shall be enclosed by a security fence to deny access to unauthorized individuals."*

[147] Bartow County, GA. Catoosa County, GA. Dooly County, GA. Early County, GA. Floyd County, GA. Greene County, GA. Jackson County, GA. Jefferson County, GA. Madison County, GA. McDuffie County, GA. Pike County, GA. Sumter County, GA. Thomas County, GA.

Signage

Solar ordinances can address three types of signage: warning and safety signs, advertisements, and educational signs.

Warning signs that include emergency contact information are the most common signage requirement in solar ordinances. Requiring this information be posted is a basic safety best practice.

Prohibiting advertisement signage is primarily an aesthetic requirement. Solar energy systems use a lot of land, but not densely, making it conceivable that landowners or system owners would consider leasing advertisement space on the land. Many solar ordinances prohibit advertisements, but a significant number rely on the existing requirements of the zoning code, applicable to all land uses. It should be noted that prohibiting advertisement for just one land use can violate the First Amendment right to freedom of speech.

Allowing educational signs is a novel provision from Virginia's Model. Solar energy is relatively new technology and solar energy systems are still uncommon ornaments in many landscapes. It is therefore likely that a significant portion of communities are unfamiliar with solar energy systems. Specifically opening visual barriers along the borders of solar energy systems and providing educational information on how solar energy works and its benefits help the community better understand and support solar energy. (See, Visual Buffer Plan, p.56).

The Georgia Model Solar Ordinance follows the best practice and requires safety-warning signs for ground mounted solar energy systems. The Model Ordinance also treats solar energy systems the same as other development by requiring them to comply with requirements of the existing zoning code regarding advertising signs. Finally, the Model Ordinance permits educational signs to encourage increasing the understanding of solar energy.

Counties and cities should consider what signage standards their zoning code requires for other similar uses when setting signage standards for solar energy systems.

Electrical Connections

A solar ordinance can address electrical connections.

It is common for solar ordinances to restrict the placement of solar energy systems' electrical connections for aesthetic and safety reasons. Having lines underground can declutter a site, improve reliability by limiting exposure to weather, and reduce liabilities associated with overhead or exposed lines.[148] Only approximately a third of solar ordinances, however, address electrical connections.[149] This may be because requiring lines be buried can significantly increase the cost of developing solar energy, especially for larger systems.[150] Additionally, electrical connections overhead last twice as long as buried electrical connections.

[148] CSRA Model.
[149] Minnesota Model. Pennsylvania Model. Utah Model. Catoosa County, GA. Dooly County, GA. Douglas County, GA. Early County, GA. Jefferson County, GA. Long County, GA. McDuffie County, GA. Sumter County, GA. Thomas County, GA.
[150] Pennsylvania Model.

The Georgia Model Solar Ordinance follows the most common practice and does not include a provision regarding electrical connections.

Counties and cities, especially those in urban areas with heavy foot traffic, may want to address the aesthetic and safety concerns of electrical connections. For example, they may include the following:

> *"All electrical collection lines within the solar energy system footprint shall be placed underground to the extent reasonably practicable, depending on appropriate soil conditions, shape, and topography of the property."*
>
> *"If a solar energy system is connected to the electric grid, connections to the electric grid shall comply with the interconnection requirements set forth by the appropriate public utility to which the solar energy system is interconnected."*

Counties and cities should look to their existing zoning code to understand what standards are already in place regarding electrical connections. If the existing zoning code does not require other similar industry to bury electrical connections underground, then counties and cities should consider whether it should treat solar energy systems differently.

Noise

While **a solar ordinance** can restrict the amount of noise that can be heard from solar energy systems, systems generally do not produce enough noise to be a nuisance. Therefore, most solar ordinances do not include noise standards.

There are two potential sources of noise from solar energy systems. The primary source is the system's transformers and inverters, which can produce a "humming" sound. Additionally, some solar energy systems are built so the solar panels can move and track the sun during the day, which can produce sound.

Each of the sounds a solar energy system may make is minimal. A person standing 50 to 150 feet away from a solar energy system will be unable to hear them.[151] The sound level for someone standing next to a solar energy system has been compared to the sound generated from a refrigerator or air conditioning unit. Additionally, a solar energy system will generally only produce noises when the sun is up.

The Georgia Model Solar Ordinance does not include a provision for noise as the Model Ordinance's setback standards should ensure that any minimal humming noises a solar energy system may produce will not be heard from residences and will be minimal in all other locations. (See, Setbacks, p.44).

If **a county or city** has special reason to be concerned with noise, it may consider including some of the following in its ordinance:

- Requiring inverters be housed within enclosures;
- Requiring inverters be off and silent after dark;

[151] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 19 (2014), https://sogpubs.unc.edu/electronicversions/pdfs/pandzsolar2014.pdf (citing to Peter H. Guldberg, Massachusetts Clean Energy Center, *Study of Acoustic and EMF Levels from Solar Photovoltaic Projects*, § 3 (Dec. 17, 2012), http://files.masscec.com/research/StudyAcousticEMFLevelsSolarPhotovoltaicProjects.pdf).

- A standard for the maximum decibels (generally no greater than 50 decibels, which is considered a typical ambient noise level for a suburb) that may be heard from solar energy systems at a set distance (generally 100 feet); or
- Explicitly requiring solar energy systems adhere to the underlying zoning district's noise standards.

Height

Solar ordinances follow two common practices for regulating the height of ground mounted solar energy systems. First, a solar ordinance may require the solar energy system follow the applicable zoning district's existing height standards for accessory structures. Second, a solar ordinance may set a specific height standard. Generally, specific height standards require the tallest point of the solar energy system to be no higher than 20 or 25 feet.

The Georgia Model Solar Ordinance follows the first approach and does not dictate a specific height standard for any ground mounted solar energy systems. The applicable zoning district's existing height standard will apply to ground mounted solar energy systems.

If a county or city has very restrictive general height requirements in place but does not want to deter solar development, it may want to consider following the second approach and setting a specific standard.

Safety

Solar ordinances usually include very few provisions addressing the safety of solar energy systems both because systems are considered safe and because mandatory construction codes address most safety concerns that do exist.[152]

The most common safety risk associated with solar energy systems is fire. While it is extremely rare that a solar energy system independently sparks a fire, faulty or damaged wiring may start a fire.[153] As stated, construction codes that apply to all structures in Georgia will generally address this issue. Emergency responders to fires face the greatest risk from solar energy systems and should be trained to respond to incidents at these sites.[154] (See, Requirements for Rooftop Solar Energy Systems – Safety, p.33).

There have been unfounded allegations of solar panels releasing hazardous chemicals and creating health risks for the surrounding community. A quick review of the science, however, reveals that there is almost no health risk associated with the materials in solar energy systems. [155] Solar panels predominantly consist of very strong glass and aluminum, which pose no health risk. All other materials are contained safely within

[152] Georgia Department of Community Affairs, *Construction Codes*, https://dca.ga.gov/local-government-assistance/construction-codes-industrialized-buildings/construction-codes.
[153] Solar Energy Industries Association, *Fire Safety & Solar*, https://www.seia.org/initiatives/fire-safety-solar. *See also*, Solar America Board for Codes and Standards, *Ground-Fault Detection Blind Spot*, http://www.solarabcs.org/about/publications/reports/blindspot/index.html.
[154] *See*, North Carolina Model.
[155] Massachusetts Department of Energy Resources et al., *Clean Energy Results, Questions & Answers Ground-Mounted Solar Photovoltaic Systems*, 5 (June 2015), http://www.mass.gov/eea/docs/doer/renewables/solar/solar-pv-guide.pdf. NC Clean Energy Technology Center, *Health and Safety Impacts of Solar Photovoltaics* (May 2017), https://nccleantech.ncsu.edu/wp-content/uploads/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper-1.pdf.

the panel. These other materials—most often silicon, but sometimes cadmium telluride, copper indium diselenide, or gallium arsenide—do not simply leach out of the panels. They could only be released if the panels were ground into a fine dust, which is unlikely, or exposed to extremely high heat, at temperatures that very few fires ever reach.

There have also been some inquiries into whether electric and magnetic fields from solar energy systems can pose health threats. Solar energy systems produce the same type of electric and magnetic fields as household appliances and wiring, and at levels much lower than what cell phones and microwaves produce. Inverters and transformers used for the solar energy system are the greatest source of electric and magnetic fields, but even these generally produce less than a common household.[156]

Finally, solar panels do not attract sunlight but instead convert the sunlight that falls on their surface into energy, and therefore will not deprive their surroundings from sunlight. There is no potential for less sunlight to fall on other areas because of solar energy systems, except for the specific area that the solar energy system temporarily casts a shadow on, as is true of any object that is placed in the sun.

The Georgia Model Solar Ordinance does not include express safety provisions to avoid redundancy. Mandatory construction codes already ensure solar energy systems are designed and built safely.

A county or city that would like to reiterate that solar energy systems must comply with mandatory construction codes could include the following language:

> *"Solar energy systems must meet applicable code requirements established by the State of Georgia (including O.C.G.A. §8-2-20(9)(B) and §46-3-64)."*

Glint and Glare

For a discussion on glint and glare, see Requirements for Integrated Solar Energy Systems – Glint and Glare, p.33.

For a discussion on how glint and glare may impact airports, see Airports, p.69.

Maintenance

A solar ordinance can require that a solar energy system be well maintained—both visually and functionally. If a system is not maintained, it can become a hazard, nuisance, or cause aesthetic problems. Mandatory construction codes, however, should address safety concerns. And most zoning codes include general maintenance standards that apply to all developments to limit nuisance and aesthetic concerns. It is therefore relatively uncommon for solar ordinances to include specific maintenance standards.[157]

The Georgia Model Solar Ordinance does not include a provision regarding maintenance as existing construction and zoning codes should suffice.

[156] Massachusetts Department of Energy Resources et al., *Clean Energy Results, Questions & Answers Ground-Mounted Solar Photovoltaic Systems*, 10-11 (June 2015), http://www.mass.gov/eea/docs/doer/renewables/solar/solar-pv-guide.pdf.
[157] Jackson County, GA. Thomas County, GA. Oglethorpe County, GA. Sumter County, GA.

A county or city may decide to more specifically define the required maintenance of a solar energy system, but should be careful to avoid being overly restrictive. For example, a county or city may include the requirement to mow or trim vegetation or relate the maintenance requirement to a system keeping up with mandatory construction code requirements. Other provisions that can be included in a solar ordinance are:

> *"A solar energy system shall be maintained in good condition. Maintenance shall include, but not be limited to, painting, structural repairs, and integrity of security measures. Site access shall be maintained to a level acceptable to [the local fire chief, emergency management director, and emergency medical services]. The owner or operator shall be responsible for the cost of maintaining the solar energy system and any access road(s), unless accepted as a public way."*[158]

> *"The solar energy system shall be maintained in good working order in accordance with standards of the existing zoning code. Failure of the property owner to maintain the solar energy system in good working order is grounds for appropriate enforcement actions by [County/City] in accordance with applicable ordinances."*[159]

> *"A solar energy system must be properly maintained and be kept free of all hazards, including but not limited to, faulty wiring, lose fastenings, being in an unsafe condition or detrimental to public health, safety or general welfare. In the event of a violation of any of the foregoing provisions, the [zoning authority] shall give written notice specifying the violation to the owner of the solar energy system to conform or to remove the solar energy system."*[160]

[158] Massachusetts Model.
[159] Cumberland Model.
[160] *Id.*

Special Use Permit Application

A solar ordinance may require developers submit certain information before granting a solar energy system a special use permit, often also called a conditional use permit. A zoning authority may always include conditions for granting a permit, and the permit application should provide the zoning authority with the information it will need in order to decide what those conditions, if any, may be. Thus, a permit application should help the zoning authority, and the community, understand the type of development proposed and its potential land use impacts. At the same time, the permitting process can heavily burden solar development. Solar ordinances therefore often attempt to streamline the process to the extent practicable.

The Georgia Model Solar Ordinance ensures that counties and cities have sufficient information to understand the issues of most concern to Georgians when siting solar energy systems, while at the same time not overly burdening solar development. The main concerns repeatedly expressed by non-industry stakeholders in developing the Model Ordinance are impacts on agricultural land, impacts to wildlife, and decommissioning.

Counties and cities should consider in drafting the requirements for their special use permits:

- What the existing zoning code requires developers submit for other types of development before receiving a special use permit, and
- If there are specific resources or impacts that the county or city is particularly concerned about.

Basic Information

A solar ordinance that requires a permit application will always require basic information regarding the location of the solar energy system, who is involved with the development, and how to contact those individuals or entities. Ordinances will also often require proof that the developer has permission to build on the property.

The Georgia Model Solar Ordinance requires basic information regarding the location of the proposed solar energy system and those involved with developing it. As zoning permits are often an early step in the development of solar energy systems, the Model Ordinance provides flexibility regarding information that may not yet be available to the applicant at the time the application is submitted by requiring it only "if known."

Counties and cities should first look at their existing zoning code and what their existing special use permit application requires. Counties and cities can then consider if additional information should be asked of solar developers specifically or if the existing application requirements will be sufficient.

Planning

A solar ordinance can require developers submit information about a proposed solar energy system—including the characteristics of the land and plans to mitigate impacts—for the zoning authority to review before approving a permit.

The Georgia Model Solar Ordinance asks developers to provide a site plan and topographic map, a visual buffer plan, a list of protected wildlife that may be on the property, a map identifying prime agricultural land, and a decommissioning plan.

Counties and cities should first look at their existing zoning code and what maps and plans their existing special use permit application requires. Counties and cities can then consider if additional information should be asked of solar developers specifically or if the existing application requirements will be sufficient.

Site Plan and Topographic Map

Solar ordinances may require an applicant submit information on the current uses and features of the land, and the applicant's plan to develop a solar energy system on that land. This information helps the zoning authority and community understand the impacts of development. Because zoning permitting is an early step in developing a solar energy system, the design of a solar energy system is unlikely to be finalized. A zoning permit application should therefore avoid requiring a detailed design of the system. That level of detail is not needed to generally assess land use impacts, and it is more appropriate for a building or electric permit.

The Georgia Model Solar Ordinance requires both a site plan and a topographic map.

The site plan shows the man-made elements currently on the property and what man-made elements the applicant is proposing to build.

The topographic map shows the natural shape of the land. The Model Ordinance also requires this map provide information on natural elements such as rivers, wetlands, and forests. Maps depicting these natural features are easily available for download free of charge from multiple website.[161] Providing this information can help the zoning authority understand if this is appropriate land to develop, or if there are natural elements, such as forests or wetlands, that make solar development incompatible. (See, Tree Removal & Forests, p.40).

A county or city should first look at their existing zoning code and what their existing special use permit application requires. Counties and cities can then decide if the Model Ordinance's requirements provide the zoning authority with necessary information regarding the man-made and natural elements on the property.

Counties or cities could require more or less information than the Model Ordinance. For example, while state and federal management plans should address stormwater and soil erosion concerns, solar energy systems have the potential to cause stormwater and soil erosion issues, especially larger solar energy systems located near sensitive wetlands or important water features. (See, Impervious Surface & Lot Coverage, p.38). Counties and cities may therefore require an applicant also submit a stormwater drainage map of the property with the proposed solar energy system constructed on it:

> *"The applicant shall submit, based on the most current and accurate information reasonably available, a topographic drawing of the property that indicates how stormwater currently drains from the property, identifies the location of discharge points or areas, and identifies any conditions present on the property that may contribute to significant soil erosion."*

[161] USGS, *How do I find and download US Topo maps and historical topographic maps?*, https://www.usgs.gov/faqs/how-do-i-find-and-download-us-topo-and-historical-topographic-htmc-maps. For instructions on how to create a topographic map with the US Topo maps, *see,* USGS, *US Topo Map Users Guide* (Apr. 2018), https://nationalmap.gov/ustopo/quickstart.pdf.

Visual Buffer Plan

Few **solar ordinances** require visual buffer plans, as it is more common for solar ordinances to include rigid standards for visual buffers. However, the benefit of a visual buffer plan is that it allows for flexibility for the zoning authority, community, and developer.[162]

The Georgia Model Solar Ordinance requires a visual buffer plan as part of the special use permit application. Requiring a plan allows the zoning authority, community, and developer to work together to ensure that visual buffers are appropriate for the specific location. Thus, rather than mandating a generic standard that is hard to enforce or overly burdensome, the plan ensures visual buffers are:

- Placed only in those areas where a solar energy system would actually impact community character;
- The right height, depth, and width to reasonably shield the system from view;
- Made of appropriate materials for the location; and
- Designed to preserve existing vegetation that already acts as a buffer.

A visual buffer plan also allows for discussion and compromise on areas that would otherwise be difficult to standardize, for example, the timeframe for a vegetative buffer to grow to the agreed upon height, depth, and width.

Counties and cities should first consider whether their existing zoning code requires a visual buffer plan for special use permit applications. Counties and cities should then consider whether they would like to provide certainty by adopting rigid visual buffer standards or allow for flexibility and adopt the Model Ordinance's visual buffer plan requirement. (See, Visual Buffer & Fencing, p.45).

Wildlife

A solar ordinance can address impacts to wildlife. While state and federal laws largely address these impacts already,[163] local governments also have the authority to limit development to protect wildlife species and habitat though zoning. Solar energy can and should be developed in such a way as to avoid wildlife impacts, thereby also decreasing costs to developers associated with navigating federal, state, and local wildlife laws. (See, Developed and Degraded Land, p.66).

Georgia is home to many **sensitive species** that solar development may impact, including bald eagles, Indiana and Northern bats, indigo snakes, hognose snakes, and gopher frogs.[164] State and federal endangered species lists currently include some of these species as threatened or endangered, while others are on the brink of inclusion. Being aware of the potential for solar energy development to impact all of

[162] Virginia Model. Olgethrope County, GA.
[163] R.R. Hernandez et al., Renewable and Sustainable Energy Reviews, *Environmental Impacts of Utility-Scale Solar Energy*, 766-779 (Sept. 8, 2013), https://www.e-education.psu.edu/eme812/sites/www.e-education.psu.edu.eme812/files/1-s2.0-S1364032113005819-main.pdf.
[164] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.,* 3 (Mar. 2017), https://www.southernenvironment.org/uploads/audio/Solar_EnvReviewProcess_SitingSolar_Final.pdf. Georgia Department of Natural Resources, *State Wildlife Action Plan* (Sept. 2015), http://georgiawildlife.com/sites/default/files/wrd/pdf/swap/SWAP2015MainReport_92015.pdf.

these species is important. Of particular concern, however, is the potential impact of solar development on the gopher tortoise.[165]

The gopher tortoise is a keystone species—it digs burrows underground, altering the landscape and providing habitat and resources for multiple other species.[166] Harm to the gopher tortoise can therefore have a significant impact on the whole ecosystem. Solar development has the potential to uniquely effect this keystone species and its ecosystem, because the same land most suitable for solar energy systems is also most suitable for gopher tortoise habitat.[167] Both flourish in landscapes of sandy soil, relatively flat topography, and a high rate of sunshine. As a result, sparsely forested land in south and central Georgia is highly attractive to both gopher tortoises and solar developers, making it the most competitive land for these two purposes in the state.

Figure 22. Gopher tortoise laying in the grass. [168]

Multiple groups are trying to address this competition. For example, the Nature Conservancy partnered with NASA DEVELOP and the Georgia Department of Natural Resources with the hope of developing a mapping tool that overlays ideal solar energy sites with environmentally sensitive areas (including gopher tortoise habitat) to provide easy access to information on the best places to develop solar energy systems. Based on their initial research, they discovered both that the majority of existing solar energy systems have been developed on land with high solar potential and low environmental sensitivity and that over 5 million acres of land still exists in Georgia that is suitable for solar energy development.[169] This tool should be widely available soon.

[165] U.S. Army Corp of Engineers, *Species Profile: Gopher Tortoise (Gopherus Polyphemus) on Military Installations in the Southeastern United States* (Sept. 1997), http://www.fwspubs.org/doi/suppl/10.3996/062015-JFWM-055/suppl_file/062015-jfwm-055.s7.pdf?code=ufws-site.
[166] Georgia Department of Natural Resources, Wildlife Resources Division, *Gopher Tortoise Profile*, http://gakrakow.github.io/profiles/gopherus_polyphemus.pdf. Florida Fish and Wildlife Conservation Commission, *Gopher Tortoise*, http://myfwc.com/wildlifehabitats/profiles/reptiles-and-amphibians/reptiles/gopher-tortoise/.
[167] Meg Mirshak, The Augusta Chronicle, *Georgia's solar industry growth threatening state's gopher tortoise population* (May 16, 2015), http://www.augustachronicle.com/news/metro/2015-05-16/georgia-solar-industry-growth-threatening-states-gopher-tortoise-population. Dan Chapman, The Atlanta Journal-Constitution, *Clean Energy in Georgia Comes with some Nasty Side Effects* (Sept. 18, 2015), https://politics.myajc.com/news/state--regional-govt--politics/clean-energy-georgia-comes-with-some-nasty-side-effects/d0PvKFIS2IxAb307Wk0AaP/.
[168] Photo from https://commons.wikimedia.org/wiki/File:Foraging_Gopher_Tortoise_(5960563007).jpg.
[169] NASA DEVELOP National Program, *Georgia Energy II, Reducing Conflicts in Siting Solar Power Facilities by Identifying Sensitive Habitats and Wildlife Populations in Areas with High Generation Potential*, 10 (Fall 2017).

Beyond gopher tortoises, there are two predominant ways that solar energy systems may also impact **species and their habitat** more generally. First, development can directly destroy habitat. The construction of solar energy systems often involves vegetation stripping and land grading, which in turn tears up burrows and may kill individual animals.[170] Systems are then generally fenced off, eliminating the land as potential habitat. Second, development can fragment habitat by segmenting it into smaller, non-contiguous parcels. The loss of contiguous habitat increases the threat to already struggling species by causing genetic isolation, increased susceptibility to predation and natural disasters, and food scarcity.[171] Consider the Sandhills Wildlife Management Area (WMA) in Taylor County, which is known for its high diversity of rare species on a small tract of protected land. While the Sandhills WMA has been protected by the state of Georgia, the WMA has been bordered by solar energy on three sides, and other industry on the fourth side.[172] The development isolates the sensitive habitat, thereby severely limiting the survival abilities of species on the site.[173]

The Georgia Model Solar Ordinance strikes a balance between encouraging development of solar energy systems and protecting wildlife. The Model Ordinance does not prescribe behavior, but rather requires developers submit basic information about what species and habitat could potentially be impacted by development on the property. This information is easily available online free of charge.[174] The Model Ordinance requires information not just about the property itself, but also about neighboring properties, because development next to sensitive habitat can greatly impact species.

Communities should keep in mind that the required list is of species that have the *potential* to be present on the property but that there may not actually be any individuals located there. Depending on the information provided regarding the presence of sensitive species and habitat, a zoning authority may deny the permit and require the development to occur on a less sensitive site, determine the solar energy system can be built if it complies with certain conditions to protect the species and habitat, or determine the solar energy system can be built as requested. Regardless of the zoning authority's decision, developers will still need to comply with state and federal law regarding wildlife protection.

Counties and cities should always first consider how their existing zoning code treats development that may impact wildlife. Solar energy systems should be treated no differently than other types of development. If a county or city normally would not dictate what can be developed on sensitive species habitat, it should not dictate whether or not solar energy systems may be built there.

[170] David Fleshlerl, Sun Sentinel, *Tortoises win protection from being buried alive* (June 14, 2007), http://articles.sun-sentinel.com/2007-06-14/news/0706130718_1_gopher-tortoises-species-decline-new-policy.
[171] U.S. Fish and Wildlife Service, *Energy Development, Solar Energy* (Nov. 15, 2017), https://www.fws.gov/ecological-services/energy-development/solar.html; U.S. Department of Agriculture, Natural Resource Conservation Service, *Chapter 2: Habitat Fragmentation*, https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_015259.pdf.
[172] Two of the largest systems currently installed in Georgia—the Sandhills Solar Facility (911 acres and 146 MW energy capacity) and the Butler Solar Facility (1070 acres and 103 MW energy capacity) surround the Sandhills WMA. *See*, Southface Energy Institute, *Georgia Energy Data, Solar Map*, http://www.georgiaenergydata.org/solarmap.
[173] *See,* North Carolina Model (explaining that NC Wildlife Resources Commission recommends solar energy systems not be sited next to wildlife management areas).
[174] Georgia Department of Natural Resources, *Biodiversity Portal*, http://georgiabiodiversity.org/natels/home.html. Georgia Fish and Wildlife Service, *IPAC*, https://ecos.fws.gov/ipac/.

Counties and cities that are concerned with the impacts of development on species can include stricter requirements in their solar ordinance or special use permit application. For example, a county or city could include the following language:

> *"Principal solar energy systems proposed for development in an environmentally sensitive area or on critical spices habitat must provide an environmental impact statement for evaluation prior to approval."*[175]

Counties and cities that utilize this language should consider requiring an environmental impact statement for any development in environmentally sensitive areas, not just solar development.

Counties, cities, and solar developers who want to take steps toward mitigating the effects of both habitat destruction and fragmentation should also consider the following steps: [176]

- Gather information early in the development process for a solar energy system by consulting with the appropriate state or federal agency. In Georgia, the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and Georgia Department of Natural Resources all may be appropriate. These agencies can share resources and information that would be useful in both preventing and mitigating negative impacts to species habitat.
- Select sites for development that avoid known habitat. Developers should attempt to locate solar energy systems to avoid habitat destruction or fragmentation, for example by using developed land. (See, Developed and Degraded Land, p.66). Mapping and ID tools to find sites that will not impact sensitive species are available.[177] Avoiding known habitat is best for both developers and wildlife because, while impacts can be mitigated, such measures are often expensive and "do not guarantee the long-term reproduction of the threatened species or habitat."[178]
- Conduct an on-site census before beginning construction to confirm that no sensitive species are present. For example, the best means of determining whether or not gopher tortoises are present is by doing an on-site walk-through and looking for their distinctive burrows.[179]
- If development at a specific site is unavoidable, follow best practices for mitigating impacts to sensitive species. This may include planning corridor connections,[180] planting pollinator habitat under and around the solar energy system (see, Dual Land Use, p.71), and translocating sensitive species to appropriate offsite habitat.[181]

The gopher tortoise is a vital species to consider when developing solar energy in Georgia, but impacts to other species should not be ignored.

[175] CSRA Model.
[176] Gopher Tortoise Council, *Voluntary Best Management Practices for Solar Development Compatible with Conservation of Gopher Tortoises*, http://www.gophertortoisecouncil.org/conserv/gtc_solar_development.pdf.
[177] Southern Environmental Law Center, *The Environmental Review Process of Solar Farms in the Southeast U.S.,* (Mar. 2017), https://www.southernenvironment.org/uploads/audio/Solar_EnvReviewProcess_SitingSolar_Final.pdf.
[178] *Id.*
[179] Florida Model.
[180] Ecological Society of America, *Habitat corridors help preserve wildlife in the midst of human society,* (Aug. 2, 2011), https://www.esa.org/esablog/ecology-in-policy/habitat-corridors-help-preserve-wildlife-in-the-midst-of-human-society/.
[181] C. Kenneth Dodd, Jr. & Richard A. Seigel, The Herpetologists' League, Inc., *Relocation, Repatriation, and Translocation of Amphibians and Reptiles: Are They Conservation Strategies that Work?*, 336-350 (1991), http://www.seaturtle.org/PDF/DoddCK_1991_Herpetologica.pdf.

Prime Farmland

A solar ordinance can address concerns that solar development may impact the availability of prime farmland. The United States is losing arable farmland at an alarming rate, with Georgia ranking third in loss of prime farmland nationwide.[182] Currently, it is unclear whether solar energy development contributes to this loss, or if solar energy could in fact be helping farms remain profitable and thus in productive use. Studies show that less than 2% of land in crop production could be converted to solar development—less than is used for corn ethanol production—to generate 100% of the nation's required energy.[183]

The concern that solar energy systems are taking over agricultural land, whether or not justified, can be enough to slow or stop solar development. States across the nation, including Connecticut, Michigan, Washington, and North Carolina, have all seen pushback against solar development due to such fears.[184] The Connecticut Agricultural Commissioner even said that solar is "the greatest threat to agriculture and the land available for farming today."[185]

Solar development on farmland is most controversial when large plots of land that has previously been used to grow crops is completely rededicated to solar energy.[186] This happens because farmland is often ideal for solar development as it is "flat, open land that doesn't need to be cleared of trees."[187] Some solar developers will pay almost triple the normal rent to lease this land. Therefore, landowners may make the decision to stop farming (or leasing their land to farmers) and switch their land use to solar energy.[188]

Even when this occurs, solar development may not be a permanent contributor to the loss of farmland. "Solar farms do not pose the same level or type of risk to agricultural practices as does housing or commercial development."[189] This is primarily because solar development is considered temporary. Solar energy systems are projected to operate for 20 to 30 years, after which time they may be removed. (See, Decommissioning, p.42). Depending on the design of the solar energy system, the soil beneath panels may even improve, and productive farming activities can resume. (See, Dual Land Use, p.71).

Additionally, "some farmers see solar as a potentially key source of revenue that might allow them to continue raising crops on the rest of their land."[190] For example, a family-owned farm in Maine reduced

[182] U.S. Department of Agriculture, Natural Resources Conservation Service, *2012 National Resources Inventory Summary Report*, 5-18 (Aug. 2015), https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd396218.pdf.
[183] Southern Environmental Law Center, *Solar Power & Local Communities, https://www.southernenvironment.org/uploads/words_docs/SolarLocalComm_Handout_0217_F.pdf.*
[184] Gregory B. Hladky, Hartfort Courant, *State Encouraging Solar Development at Expense of Farmland* (Aug. 1, 2016), http://www.courant.com/business/hc-solar-versus-farmland-20160801-story.html. NC Sustainable Energy Association, *North Carolina Solar and Agriculture* (Apr. 2017), https://energync.org/wp-content/uploads/2017/04/NCSEA_NC_Solar_and_Agriculture_4_19.pdf.
[185] Gregory B. Hladky, Hartfort Courant, *State Encouraging Solar Development at Expense of Farmland* (Aug. 1, 2016), http://www.courant.com/business/hc-solar-versus-farmland-20160801-story.html.
[186] Scott Thill, Civil Eats, *Solar Farming Brings Benefits—and Concerns—to the Land* (Mar. 20, 2017), https://civileats.com/2017/03/20/solar-farming-brings-benefits-and-concerns-to-the-land/.
[187] Gregory B. Hladky, Hartfort Courant, *State Encouraging Solar Development at Expense of Farmland* (Aug. 1, 2016), http://www.courant.com/business/hc-solar-versus-farmland-20160801-story.html.
[188] Scott Thill, Civil Eats, *Solar Farming Brings Benefits—and Concerns—to the Land* (Mar. 20, 2017), https://civileats.com/2017/03/20/solar-farming-brings-benefits-and-concerns-to-the-land/.
[189] Minnesota Model.
[190] Gregory B. Hladky, Hartfort Courant, *State Encouraging Solar Development at Expense of Farmland* (Aug. 1, 2016), http://www.courant.com/business/hc-solar-versus-farmland-20160801-story.html. See NC Sustainable Energy Association, *North*

costs by $14,000 to $20,000 a year by installing one of the largest commercial solar thermal systems in the Northeastern U.S. on its roof.[191] Utilizing a solar energy system reduces reliance on volatile energy costs and, after the initial investment, the "fuel" for solar energy is free and the equipment requires relatively little maintenance.[192] Currently, farms in the U.S. most commonly use solar energy for pumping irrigation water, livestock watering, sprinkler control, electric fences, building lighting, and battery charging.[193]

Figure 23. USDA-funded solar array located on productive hay farm.[194]

The Georgia Model Solar Ordinance ensures that communities are aware of any quality agricultural lands being redeveloped for solar energy by requiring special use permit applications identify prime farmland and farmland of statewide importance on the property. The U.S. Department of Agriculture Natural Resources Conservation Service defines prime farmland and farmland of statewide importance primarily by soil type to identify and protect the land with the best potential food production value.[195] Prime farmland and farmland of statewide importance can be mapped for free through the Natural Resource Conservation Service's Web Soil Survey.[196]

A county or city may be more or less concerned with impacts to farmland. Counties and cities should always first consider how their existing zoning code treats development on agricultural land. Solar energy systems should be treated no differently than other types of development. If a county or city normally would not dictate what can be developed on prime agricultural land, it should not dictate whether or not solar energy systems may be built there.

Carolina Solar and Agriculture (Apr. 2017), https://energync.org/wp-content/uploads/2017/04/NCSEA_NC_Solar_and_Agriculture_4_19.pdf.

[191] Scott Thill, Civil Eats, *Solar Farming Brings Benefits—and Concerns—to the Land* (Mar. 20, 2017), https://civileats.com/2017/03/20/solar-farming-brings-benefits-and-concerns-to-the-land/.

[192] Ohio State University Extension, Energize Ohio, *On-Farm Solar Energy Development*, https://energizeohio.osu.edu/farm-solar-energy-development.

[193] U.S. Department of Agriculture Office of the Chief Economist & Office of Energy Policy and New Uses, *Solar Energy Use in U.S. Agriculture Overview and Policy Issues* (Apr. 2011), https://www.usda.gov/oce/reports/energy/Web_SolarEnergy_combined.pdf.

[194] U.S. Department of Agriculture, https://www.flickr.com/photos/usdagov/5651929730.

[195] 7 C.F.R. § 657.1 (2018).

[196] U.S. Department of Agriculture, Natural Resources Conservation Service, *Prime Farmland in Georgia*, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ga/soils/?cid=nrcs144p2_021870.

In addition to the Model Ordinance's suggested provision, there are other ways a county or city could protect prime farmland. For example, a solar ordinance could include the following provision, which is more restrictive than the Model Ordinance's:

> *"Applicant should document that less than [half of the acreage] proposed for conversion is prime farmland, or that the proposed site is not suitable for agriculture due to adjoining land uses [or for other reasons]."*[197]

In making the decision on how to balance protecting prime farmland and permitting solar development, counties, cities, and solar developers should consider the following: [198]

- Engage with the community and consider the following questions: Is farmland already disappearing in the area as overall development increases? Will the loss of farmland change the character of the community? Would the community seek to prevent other, more impactful development from occurring on this land? To what extent does agriculture support the local economy? Consider also if the farms draw tourists to the area.
- Engage with farmers regarding their needs.
- Encourage solar energy systems be installed on already developed or degraded land. On farms, systems can be placed on fields of poor soil quality, fallow fields, or on unused parts of a farm such as the edges of a field or rooftops. (See, Developed and Degraded Land, p.71).
- Consider creative solar energy installations that utilize dual land use designs. (See, Dual Land Use, p.71).

Decommissioning Plan

A solar ordinance may require a decommissioning plan. Zoning codes generally only require decommissioning plans for very impactful development, which solar development is not. Many solar ordinances nevertheless require decommissioning plans for solar energy systems.[199] This may be because widespread solar development is relatively new and communities seek reassurance that the full lifecycle of the solar energy system has been considered. Or, counties and cities may simply be reacting to concerns over other abandoned development in their communities.

When a decommissioning plan is required, it should not be extensive. A few pages answering the required considerations may be sufficient.[200]

The Georgia Model Solar Ordinance requires a decommissioning plan that identifies who is responsible for decommissioning, when decommissioning must happen, the structures to be removed, how materials will be recycled or reused, how the land will be restored, and the timeline for decommissioning. (See, Decommissioning, p.62).

[197] Dooley County, GA.
[198] Georgia Department of Community Affairs, *Best Practices: Achieving Quality Community Objective*, 4-5, https://apps.dca.ga.gov/toolkit/downloads/BestPractices.pdf.
[199] *See,* North Carolina Model. Virginia Model. Minnesota Model. Jackson County, GA. Jefferson County, GA. Thomas County, GA.
[200] *See,* North Carolina Model.

Realizing that a solar energy system will not be decommissioned for many years and conditions may have changed while the system is operating, the decommissioning plan requirement of the Model Ordinance has built-in flexibility. The Model Ordinance permits the land to be restored to any "reasonably appropriate" condition and allows the decommissioning plan to be updated and revised, subject to approval from the zoning authority.

Counties and cities should consider if their existing zoning codes require decommissioning plans in special use permit applications for any other type of development, as solar energy systems should generally be treated no differently from similar land uses. Counties and cities may consider requiring decommissioning plans for other types of development if they require one for solar energy systems.

Certifications

Solar ordinances generally do not require certifications.

The Georgia Model Solar Ordinance requires applicants certify that the construction and operation of the solar energy system will (1) comply with applicable federal and state laws and regulations, (2) comply with all local laws and codes unless waived by the zoning authority, and (3) maintain commercial general liability insurance.

The Model Ordinance was drafted with flexible provisions. This helps ensure that the Model Ordinance is widely applicable to counties and cities across Georgia, remains applicable as technology changes, and does not overly burden development. Flexibility is also practical—zoning approval is an early step in the development process, and developers often do not have extensive, detailed information to provide a community regarding the proposed project. This flexibility, however, requires that counties and cities put significant trust in developers. Reviewing a zoning permit is potentially the only opportunity the local community has to consider how the solar development will impact its local culture and resources. Thus, the Model Ordinance includes the certification requirements as an assurance against violations of this trust.

A county or city should first consider their existing zoning code and special use permit application requirements.

Special Use Permit Review

A solar ordinance may set forth the procedures for reviewing a permit application. Usually a public hearing is required. After the review is complete, the zoning authority can approve the application as is, may impose special conditions on approval, or deny the application. Burdensome and complex permitting requirements and procedures can slow the development of solar energy systems and ultimately bar development entirely.

Figure 24. Solar panels from the ground. [201]

The Georgia Model Solar Ordinance ensures that counties and cities are able to review solar energy systems without unnecessarily burdening solar development. The Model Ordinance requires that developers of intermediate scale systems in residential and agricultural districts and all large scale systems first submit a permit application to the applicable zoning authority. (See, Permissible Uses, p.23 and Special Use Permit Application, p.54). The Model Ordinance then defers to the existing zoning code for the Special Use Permit review process. This ensures that solar energy development will be treated the same as other similar land uses.

Counties and cities should first look at their existing zoning code's special use permit review process. The permitting process for solar energy systems should not be more burdensome than the standard permitting process in the existing zoning code.

Additionally, before a county or city reviews a permit application or hosts a public hearing on a proposed solar energy system, the zoning authority and county or city planners should be aware of how solar technology works and how to respond to concerns that the community might have with correct and current information. By becoming knowledgeable about common solar energy concerns and using a variety of strategies and tools for increasing awareness, the county or city can help boost their local economies while moving their communities toward a more sustainable future.

The permitting process can significantly delay solar development. If a county or city would like to encourage timely review of a special use permit application, it could include the following:

> *"The Special Use Permit shall automatically be granted if the [zoning authority] does not schedule and hold the required public hearing within [XX days] after a completed application has been submitted or does not make a final determination within [XX days] of the public hearing, unless a longer period is mutually agreed upon."*

[201] Photo by Asia Chang, https://unsplash.com/license.

Coordinating Interests when Siting Solar Energy Systems

The following sections discuss additional common topics that arise when a community is faced with siting solar energy systems. They are part of the larger discussion of how solar development affects land use in a community.

Property Values

One potential concern communities may have is that solar energy systems will lower residential property values. Research has shown the opposite—that residential properties with solar energy systems may actually sell for higher prices than comparable properties without systems.[202] Less clear, however, is how neighboring property values will be affected. Currently, there is little data on if and how solar energy systems impact neighboring property values, but data will become more available as solar energy systems become more common in Georgia.

If a county or city is particularly concerned with the impact of solar energy systems on neighboring property values, it could hire appraisers to review the matter.[203] Local community associations can also be contacted and public meetings held to address any such concerns. Generally, these are considered unnecessarily burdensome measures for assessing solar energy systems, and a county or city should only consider them if experiencing both a significant increase in systems in residential districts and in complaints about those systems.

Historic Neighborhoods

Some communities may be concerned that solar energy systems will change the character of their neighborhood. This can be especially concerning if solar energy systems are allowed unrestricted on historic buildings or in historic districts. However, solar energy systems can be built in these locations without damaging a site's historic culture.

There is no uniform or concrete approach to mitigating historic preservation concerns**. There is a general consensus, however, that the installation of solar energy systems on historic buildings and in historic neighborhoods is not acceptable when:**

- The installation involves removal of historic building materials;
- The historic building configurations have to be removed or altered to add solar panels; or
- The installation procedure would cause irreversible changes to historic features.[204]

[202] Ben Hoen, et.al., Environmental Energy Technologies Division, Earnest Orlando Lawrence Berkeley National Laboratory, *An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California* (Apr. 2011), http://emp.lbl.gov/sites/all/files/lbnl-4476e.pdf.
[203] Adam Lovelady, University of North Carolina at Chapel Hill, School of Government, *Planning and Zoning for Solar in North Carolina*, 18 (2014), https://sogpubs.unc.edu/electronicversions/pdfs/pandzsolar2014.pdf.
[204] American Planning Association, Solar Briefing Papers, *Balancing Solar Energy Use with Potential Competing Interests*, http://hsbroswell.com/wp-content/uploads/2015/11/solarbriefing.pdf.

Solar energy systems in historic districts are more likely to be viewed as acceptable when the following precautions are taken:

- Encourage the placement of systems on new additions to historic buildings.
- Consider placing systems on existing, non-historic additions or accessory structures.
- To the greatest extent possible, avoid placing systems on street-facing walls, roofs, or land. Integrated and rooftop systems below and behind parapet walls and dormers, or on rear-facing roofs, are often good choices. Ground mounted systems located inconspicuously out of general sight can also be a good choice.
- Avoid installations that would result in the permanent loss of significant, character-defining features of historic resources. For example, avoid installations that obstruct views of significant architectural features such as overlaying windows.
- Make sure that panels are not visible above the roofline of a primary façade.
- On flat roofs, set solar panels back from the edge.
- Avoid disjointed solutions; i.e., attempt to keep panels consolidated.[205]

A county or city should work with its historic preservation commission or equivalent bodies to determine whether specific review of solar energy systems will be necessary.[206] If an existing zoning code includes design guidelines, siting restrictions, or review requirements for historic sites, they should be clearly referred to in the county or city's solar ordinance.[207] Otherwise, counties and cities may consider including a separate provision addressing solar and historic preservation in their ordinances.[208] The following are sample provisions a county or city may choose to include:

> *"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 [Historic Preservation Commission] as established by [historic preservation ordinance]."*[209]

> *"All solar energy systems 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]."*[210]

Developed and Degraded Land

Solar energy systems, especially intermediate and large scale ground mounted systems, can interfere with existing land uses, such as farming, grazing, forestry, and minerals production, and can impact sensitive

[205] *Id.* National Renewable Energy Laboratory, *Implementing Solar PV Projects on Historic Buildings and in Historic Districts* (Sep. 2011), https://www.nrel.gov/docs/fy11osti/51297.pdf. U.S. Department of Energy SunShot, North Carolina Solar Center, & National Trust for Historic Preservation, *Installing Solar Panels on Historic Buildings* (Aug. 2012), https://nccleantech.ncsu.edu/wp-content/uploads/Installing-Solar-Panels-on-Historic-Buildings_FINAL_2012.pdf. National Park Service, *Solar Panels on Historic Properties*, https://www.nps.gov/tps/sustainability/new-technology/solar-on-historic.htm.
[206] Texas Model.
[207] New Jersey Model.
[208] American Planning Association, Solar Briefing Papers, *Balancing Solar Energy Use with Potential Competing Interests*, http://hsbroswell.com/wp-content/uploads/2015/11/solarbrisefing.pdf.
[209] New Jersey Model. Texas Model.
[210] *Id.*

environments and wildlife.[211] (See, Requirements for Integrated Solar Energy Systems – Tree Removal, p.28, Tree Removal & Forests, p.40, Wildlife, p.56, and Prime Farmland, p.60). Counties and cities can avoid these impacts by siting systems on developed or degraded lands, and thereby realize a number of cost, environmental, and other benefits.

The term "developed land" is best understood as "previously developed or degraded lands," as opposed to undeveloped, intact lands.[212] While no single definition of "developed lands" exists, best practices suggest that the term includes "any former industrial or commercial sites that could be repurposed for solar development." [213] Developed land encompasses all potentially contaminated or underutilized sites, including but not limited to: brownfields,[214] underutilized rooftops, parking lots, sites contaminated by hazardous materials, Superfund sites, abandoned mining sites, landfills, and retired coal plants.[215] These lands typically have undesirable characteristics, such as poor soil quality, and little potential for profit, making them prime site locations for solar energy systems.

Figure 25. A solar energy system built atop the parking deck of the Mercedes-Benz Stadium in Atlanta, Georgia.[216]

The siting of intermediate and large scale systems on pristine, undeveloped lands can require the clearing of all vegetation prior to construction, covering the area with gravel, and using water to suppress dust prior to and throughout construction.[217] Siting on developed lands, however, can reduce or eliminate the wasted resources and costs such preparation entails. Perhaps the greatest benefit of siting on developed lands is

[211] Solar Energy Development Programmatic EIS Information Center, *Solar Energy Development Environmental Considerations*, http://www.solareis.anl.gov/guide/environment/.
[212] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.* (Mar. 2017), https://www.southernenvironment.org/uploads/words_docs/Solar_EnvReviewProcess_SitingSolar_Final.pdf.
[213] *Id.*
[214] U.S. Environmental Protection Agency, *Overview of the Brownfields Program: What is a Brownfield?* (Nov. 17, 2017), https://www.epa.gov/brownfields/overview-brownfields-program (defining a Brownfield as a "property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant").
[215] U.S. Environmental Protection Agency, *Learn More About RE-Powering: What is Re-Powering?* (Feb. 14, 2017), https://www.epa.gov/re-powering/learn-more-about-re-powering#what_is: U.S. Environmental Protection Agency, *RE-Powering America's Land: Renewable Energy on Potentially Contaminated Land and Mining Sites* (Mar. 15, 2012), https://archive.epa.gov/region02/PR_Landfills_Solar/web/pdf/re-poweringamericasland.pdf.
[216] *See,* Mercedes-Benz Stadium, *4,000+ Georgia Power Solar Panels in Place at Mercedes-Benz Stadium* (Oct. 17, 2017), http://mercedesbenzstadium.com/4000-georgia-power-solar-panels-place-mercedes-benz-stadium/.
[217] Jordan Macknick et al., National Renewable Energy Laboratory, *Solar Development on Contaminated and Disturbed Lands*, 1 (Dec. 2013), https://www.nrel.gov/docs/fy14osti/58485.pdf.

the transformation of otherwise unproductive or valueless land into an asset that can serve the surrounding community for decades.

Additional benefits of siting on developed land include: [218]

- Reduces stress on intact, undeveloped lands;
- Potentially requires less site preparation and destruction of green space;
- Lowers development costs and time;
- Provides an economically viable reuse for sites that may have significant cleanup costs or low real estate development demand;
- Makes unproductive land, with environmental conditions that are not well suited for other redevelopment, productive again;
- Allows for locating near existing roads and energy transmission or distribution infrastructures;
- Requires little upfront investment;
- Provides annual tax revenue by making lands productive, thereby increasing the tax base;
- Provides job opportunities in urban and rural communities;
- Revitalizes local and state economies; and
- Garners greater public support and engages communities.

Counties and cities encouraging solar development on developed and degraded land should consult with community and economic development offices to ensure that the solar development does not interfere with planned community development.

For counties and cities wishing to site solar energy systems on developed land, several resources exist to help guide the process.

Georgia established the Georgia Environmental Protection Division Brownfield Program to encourage voluntary cleanup and reuse of Georgia's Brownfields.[219] In exchange for site cleanup, the Georgia Brownfields Program protects new landowners from third party lawsuits based on groundwater contamination and prior contamination. It also provides tax incentives so that the new landowner can recoup investigation and cleanup costs.[220] If a county or city wishes to consider siting on a Georgia Brownfield, the Brownfields Program website provides summary tables for properties that have cleanup actions planned, in progress, or completed under Georgia's Brownfield Act.[221]

[218] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.*, 2 (Mar. 2017), https://www.southernenvironment.org/uploads/words_docs/Solar_EnvReviewProcess_SitingSolar_Final.pdf. Jordan Macknick et al., National Renewable Energy Laboratory, *Solar Development on Contaminated and Disturbed Lands*, 20 (Dec. 2013), https://www.nrel.gov/docs/fy14osti/58485.pdf. U.S. Environmental Protection Agency & National Renewable Energy Laboratory, *Best Practices for Siting Solar Photovoltaics on Municipal Solid Waste Landfills,* 1 (Feb. 2013), https://www.epa.gov/sites/production/files/2015-03/documents/best_practices_siting_solar_photovoltaic_final.pdf.
[219] Georgia Department of Natural Resources, Environmental Protection Division, *Brownfield*, https://epd.georgia.gov/brownfield#files.
[220] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.*, 8 (Mar. 2017), https://www.southernenvironment.org/uploads/words_docs/Solar_EnvReviewProcess_SitingSolar_Final.pdf.
[221] Georgia Department of Natural Resources, Environmental Protection Division, *Brownfield*, https://epd.georgia.gov/brownfield#files.

At the federal level, the Environmental Protection Agency (EPA) established the Re-Powering America's Land Initiative to encourage renewable energy projects on current and formerly contaminated lands.[222] Through this program, EPA created the Electronic Decision Tree tool, which guides interested parties through a process to screen sites for their suitability for and barriers to solar development. Counties and cities interested in siting on any developed lands may download the Electronic Decision Tree tool from the EPA's website.[223]

Airports

Research indicates that, while rarely problematic, a solar energy system may create sufficient glint or glare to potentially affect airport safety. (See, Requirements for Integrated Solar Energy Systems – Glint and Glare, p.30). Pilots are familiar with the glint and glare phenomenon as bodies of water naturally cause glint and glare.[224] Solar energy systems built near an airport or in the flight path of airplanes, however, can create new sources of glint and glare. Although solar energy systems have occasionally been moved due to glare concerns,[225] the United States had at least 30 functional solar energy systems on active airfields in 15 different states as of June 2013[226] and airplane data from the United States and United Kingdom include no accidents citing as a factor glare from a solar energy system.[227] Thus, solar energy systems can safely coincide with airports, but proper care should be exercised.[228]

The Federal Aviation Administration (FAA) is the main regulator of glint and glare from solar energy systems.[229] The FAA acknowledges that glint and glare from some solar energy systems could affect pilots and air traffic controllers sufficiently to create safety concerns.[230] Currently however, the FAA has not finalized a policy to address the concern.[231] Rather, the FAA published an interim policy in 2013 that

[222] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.*, 8 (Mar. 2017), https://www.southernenvironment.org/uploads/words_docs/Solar_EnvReviewProcess_SitingSolar_Final.pdf.
[223] U.S. Environmental Protection Agency, *RE-Powering's Electronic Decision Tree* (Oct. 7, 2016), https://www.epa.gov/re-powering/re-powerings-electronic-decision-tree.
[224] Caroline Palmer & Chad Laurent, Meister Consultants Group, Inc., *Solar and Glare* (June 2014), http://solaroutreach.org/wp-content/uploads/2014/06/Solar-PV-and-Glare-_Final.pdf.
[225] New Hampshire Union Leader, *Almost $2m to Correct Out-of-position Airport Solar Panels* (Aug. 20, 2012), http://www.unionleader.com/apps/pbcs.dll/article?AID=/20140215/NEWS05/140219416/-1/newhampshire05.
[226] Stephen Barrett, Solar Industry Magazine, *Glare Factor: Solar Installations and Airports* (June 2013), https://solarindustrymag.com/online/issues/SI1306/FEAT_02_Glare_Factor.html.
[227] Massachusetts Department of Energy Resources, Massachusetts Department of Environmental Protection, and Massachusetts Clean Energy Center, *Clean Energy Results Question & Answers Ground-Mounted Solar Photovoltaic Systems*, 22 (June 2015), https://www.mass.gov/files/documents/2017/10/16/solar-pv-guide_0.pdf.
[228] *See*, Anurag Anurag et al., Energies, *General Design Procedures for Airport-Based Solar Photovoltaic Systems* (Aug., 12, 2017).
[229] *See*, Stephen Barrett, Solar Industry Magazine, *Glare Factor: Solar Installations and Airports* (June 2013), https://solarindustrymag.com/online/issues/SI1306/FEAT_02_Glare_Factor.html.
[230] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, 78 Fed. Reg. 63276 (Oct. 2013), https://www.gpo.gov/fdsys/pkg/FR-2013-10-23/pdf/2013-24729.pdf.
[231] The FAA did release a technical guidance in 2010, but it explicitly states that "As of October 23, 2013, the FAA is reviewing multiple sections of the 'Technical Guidance for Evaluating Selected Solar Technologies on Airports' based on new information and field experience, particularly with respect to compatibility and glare. All users of this guidance are hereby notified that significant content in this document may be subject to change, and the FAA cautions users against relying solely on this document at this time." FAA, *Technical Guidance for Evaluating Selected Solar Technologies on Airports* (Nov. 2010), https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide-print.pdf.

requires qualifying airports (those receiving federal funding) to conduct a glint and glare study if a solar energy system is proposed for development on airport property.[232]

While the FAA suggested that solar energy systems not obligated to comply with the interim policy still consider following it (meaning any solar energy system built on any airport property submit a glint and glare analysis) the vast majority of solar ordinances still do not include airport glint and glare standards for solar energy systems. Only a few have taken a more cautious approach. The Department of Defense suggested that solar energy systems within 2 miles of airport control towers, airports, and helipads conduct an analysis,[233] and the North Carolina Model Ordinance Template includes a provision requiring solar energy systems within 5 miles of an airport conduct an analysis.[234]

When each of these policies were written, there existed a free glare analysis tool, the Solar Glare Hazard Analysis Tool (SGHAT).[235] This tool uses an interactive map with built-in topography where developers can select the exact location of the potential solar energy system. Developers also enter any other variables that may be relevant about the system, for example, tilt of panels. The tool has built-in data on the angle of the sun relative to the time of year and can predict any potential interferences with flight patterns or nearby airports.[236] Unfortunately, SGHAT and all other existing glint and glare technology are no longer freely accessible to the public.

Counties and cities with airports or helipads in their jurisdiction should consult with these facilities when drafting their solar ordinance.[237] Working together can ensure counties and cities develop the appropriate standards for their individual situation. Counties, cities, and airport authorities may decide it is appropriate to include one of the following requirements:

> *"If the solar energy system is located within [2 – 5] nautical miles of an airport or helipad, an applicant shall submit a glare hazard analysis result by the Solar Glare Hazard Analysis Tool or its equivalent."*
>
> *"If the solar energy system is located within [2 – 5] nautical miles of an airport or helipad, the applicant shall consult with the airport or helipad's appropriate authority regarding the solar energy system before beginning construction."*
>
> *"Solar energy systems shall not be placed in the vicinity of any airport in a manner that would interfere with airport flight patterns."*

[232] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, 78 Fed. Reg. 63276 (Oct. 2013), https://www.gpo.gov/fdsys/pkg/FR-2013-10-23/pdf/2013-24729.pdf.
[233] Memorandum from John Conger, Acting Deputy Under Secretary of Defense for Installations and Environment, for Assistant Secretary of the Army, Assistant Secretary of the Navy, & Acting Assistant Secretary of the Air Force on Glint/Glare Issues on or near Department of Defense (DOD) Aviation Operations (Jun. 11, 2014), https://www.acq.osd.mil/dodsc/library/Procedures_Memo_4_Glint%20Glare%20Issues%20on%20or%20near%20DoD%20Aviation%20Operations.pdf.
[234] North Carolina Model.
[235] Sandia National Laboratories, *Solar Glare and Flux Mapping Tools*, https://share.sandia.gov/phlux.
[236] Sandia National Laborites, *Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual* (Sept. 2014), https://share.sandia.gov/phlux/static/references/glint-glare/SGHAT_Technical_Reference-v5.pdf.
[237] Caroline Palmer & Chad Laurent, Meister Consultants Group, Inc., *Solar and Glare* (June 2014), http://solaroutreach.org/wp-content/uploads/2014/06/Solar-PV-and-Glare-_Final.pdf.

Dual Land Use

Dual land use refers to the practice of using a piece of land for two purposes, here, for both solar energy generation and a secondary use. There are many advantages to dual land use solar siting, including increased economic efficiency of the land.[238]

Many common ground covers for solar energy systems lack the advantages of dual use. Systems that use bare ground, artificial turf, or concrete as ground cover risk stormwater runoff and erosion problems. (See, Impervious Surface & Lot Coverage, p.38). These ground covers may also cause a heat island effect that significantly raises the temperature in and around the solar energy system.[239] Planting grass as the groundcover can avoid stormwater and heat island issues, but comes with other concerns. Financially, the necessity for regular mowing creates costs associated with labor, wear and tear on equipment, and fuel. Environmentally, mower emissions and harmful herbicides also raise concerns.[240]

Dual land use, however, mitigates problems associated with traditional ground covers. For solar energy systems, common dual land uses include livestock grazing, growing crops, and establishing pollinator habitat. These practices maximize land use efficiency, economic benefit, and environmental conservation. Such strategies also support agriculture and mitigate fears that solar energy development negatively impacts farmland and rural culture. (See, Prime Farmland, p.60). In addition to these common benefits, each method has unique advantages.[241]

There are many benefits to **grazing livestock** among solar energy systems. Livestock keep vegetation from shadowing the solar panels and eliminate the need for motorized mowers. To reap this benefit, a farmer could use her own livestock or could contract with a third-party, but either should cost less than traditional maintenance.[242] Additionally, according to at least one study, planting vegetation for livestock grazing among solar panels increased biodiversity at the site,[243] benefitting the long-term health of the soil and ecosystem.

Best practice is to use sheep or fowl to graze among solar panels, as larger animals such as goats and cows can damage the solar equipment. If a facility would like to utilize larger animals, this preference could be taken into account when designing the solar energy system to decrease the chance of damage.[244] Regardless of animal size, panels should be positioned 2 feet or more above the ground and cabling and

[238] Jordan Macknick, et al.,National Renewable Energy Laboratory (NREL), *Overview of Opportunities for Co-Location of Solar Energy Technologies and Vegetation* (Dec. 2013), https://www.nrel.gov/docs/fy14osti/60240.pdf.
[239] Greg A. Barron-Gafford et al., Scientific Reports, *The Photovoltaic Heat Island Effect: Larger solar power plants increase local temperatures* (Oct. 13, 2016), https://www.nature.com/articles/srep35070.pdf.
[240] Airell O. Swanson, *Establishing Pollinator Habitat at Solar Farms in North Carolina: a Feasibility Study*, 9 (2015), https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8663/Swanson%2C%20Airell%20Final.pdf?sequence=1&isAllowed=y (unpublished paper in pursuance of Master of Environmental Assessment, North Carolina State University).
[241] U.S. Department of Energy Efficiency & Renewable Energy, *Farmer's Guide to Going Solar* https://www.energy.gov/eere/solar/farmers-guide-going-solar.
[242] Jim Malewitz, The Texas Tribune, *With Lamb-scaping Crew, Texas Solar Farm Aims to Shave Maintenance Costs* (July 11, 2014), https://www.texastribune.org/2014/07/11/sheep-power-texas-solar-farm-hires-4-legged-landsc/.
[243] G.E. Parker & C. McQueen, Wychwood Biodiversity, *Can Solar Farms Deliver Significant Benefits for Biodiversity?* (July-Aug. 2013), http://www.wychwoodbiodiversity.co.uk/assets/solar-and-biodiversity-report-parker-mcqueen-2013d.pdf.
[244] *See*, Renewable Energy World, *Apple Explores Dual Land Use Solar Siting in Celebration of Earth Day* (Apr. 20, 2017), http://www.renewableenergyworld.com/articles/2017/04/apple-explores-dual-land-use-solar-siting-in-celebration-of-earth-day.html.

wires should be protected.[245] To avoid stormwater runoff, soil erosion, and increased costs of reseeding, landowners should be careful not to allow livestock to overgraze.

Figure 26. Sheep grazing amidst solar panels.[246]

Next, **double-cropping or agrivoltaics**, or planting crops around and under a solar energy system—can also increase land use efficiency.[247] A lot of research is currently being done to determine how best to double-crop solar energy and agriculture.[248] Shade-loving crops, such as leafy greens, can be grown successfully under the panels, especially in climates like Georgia's with relatively long growing seasons.[249] In areas of direct sunlight between the panels, there is opportunity for small scale mixed cropping or short plants, such as fresh herbs. Many of these plants will not grow above 24-30 inches, thereby eliminating the cost of mowing taller groundcover. Farmers and solar developers also benefit from good publicity gained by growing produce alongside a solar energy system. For best results, double-cropping plans should be taken into account in the planning stages of the solar energy system.

Finally, solar energy systems provide an opportunity to plant new **pollinator habitat** between, below, and alongside solar panels. Pollinator habitat is comprised of native plant species, such as shrubs, grasses, and wildflowers. These plants not only provide habitat for important pollinators, but also have many additional economic and environmental benefits.

National pollinator populations in the United States have decreased dramatically over the last ten years,[250] an alarming trend when considering the dependence of both agriculture and biodiversity upon

[245] BRE National Solar Centre, *Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems*, 7 (Oct. 2013), https://www.bre.co.uk/filelibrary/pdf/other_pdfs/KN5524_Planning_Guidance_reduced.pdf.
[246] Photo from https://commons.wikimedia.org/wiki/File:Antioch_College_solar_sheep.JPG.
[247] Fran Ryan, Greenfield Recorder, *Farms That Grow Crops and Solar Power Together* (Sep. 14, 2017), http://www.recorder.com/UMass-farm-raises-veggies-and-power-12470559.
[248] *See*, NC Sustainable Energy Association, *North Carolina Solar and Agriculture* (Apr. 2017), https://energync.org/wp-content/uploads/2017/04/NCSEA_NC_Solar_and_Agriculture_4_19.pdf. C. Dupraz et al., *Combining Solar Photovoltaic Panels and Food Crops for Optimizing Land Use: Towards New Agrivoltaic Schemes* (Oct. 2011), http://www.sciencedirect.com/science/article/pii/S0960148111001194?via%3Dihub. Harshavardhan Dinesh, *The Potential of Agrovoltaic Systems* (Feb. 2016), http://www.sciencedirect.com/science/article/pii/S136403211501103X?via%3Dihub. APV-RESOLA, *Agrophotovoltaics*, http://www.agrophotovoltaik.de/english/agrophotovoltaics/.
[249] Colleen Vanderlinden, Mother Earth News, *Best Vegetables to Grow in the Shade* (Feb./Mar. 2011), https://www.motherearthnews.com/organic-gardening/vegetables/vegetables-to-grow-in-shade-zm0z11zsto.
[250] Bee Informed Partnership, *Colony Loss 2015-2016: Preliminary Results* (May 4, 2016), https://beeinformed.org/results/colony-loss-2015-2016-preliminary-results/.

pollinators.[251] Solar energy systems can thus play a role in restoring pollinator populations by increasing pollinator habitat through dual use siting, a practice already well established in the United Kingdom.[252] In the United States, Minnesota and Wisconsin are at the forefront of dual siting solar energy systems with pollinator habitat, and the practice is expected to become common nationwide.[253]

Planting pollinator habitat under and around solar energy systems has many additional benefits:

- Pollinator habitat requires significantly less maintenance than other forms of ground cover vegetation. Native grasses and wildflowers generally do not grow to be too tall, so mowing is only recommended once in the fall and once in spring for the health of the meadow.[254] These plants also require little fertilization and may be drought tolerant.[255]
- Wildflower coverage increases biodiversity and helps restore nutrients to the soil.[256]
- Native grasses tend to have deeper root systems than other groundcovers, which decreases erosion and stormwater runoff and can improve soil quality.
- Pollinator habitat can give solar energy systems popular appeal by maintaining a community's agrarian culture, improving the site's aesthetics, and enhancing the environmental benefits of the facility.

Picking the right mix of native plant seeds is critical to maximizing pollinator populations. Best practices include:

- Growing a diverse mix of native plant species which flower during multiple seasons;[257]
- Building in nesting areas to habitat design (usually small areas of bare ground);
- Minimizing mowing and chemical herbicide, pesticide, fungicide, and fertilizer use; and
- Maintaining a vegetation buffer made up of native plants adjacent to the solar energy system.[258]

[251] *See,* U.S. Fish and Wildlife Service, *Pollinators*, https://www.fws.gov/pollinators/Index.html.
[252] G.E. Parker & C. McQueen, Wychwood Biodiversity, *Can Solar Farms Deliver Significant Benefits for Biodiversity?* (July-Aug. 2013), http://www.wychwoodbiodiversity.co.uk/assets/solar-and-biodiversity-report-parker-mcqueen-2013d.pdf.
[253] Christina Nunez, National Geographic, *Beekeepers Sweeten Solar Sites With the 'Tesla of Honey'* (June 24, 2017), http://news.nationalgeographic.com/2017/06/chasing-genius-solar-honey-pollinator-friendly-energy/.
[254] Airell O. Swanson, *Establishing Pollinator Habitat at Solar Farms in North Carolina: a Feasibility Study*, 9 (2015), https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8663/Swanson%2C%20Airell%20Final.pdf?sequence=1&isAllowed=y (unpublished paper in pursuance of Master of Environmental Assessment, North Carolina State University).
[255] Southern Environmental Law Center, *The Environmental Review of Solar Farms in the Southeast U.S.,* 6 (Mar. 2017), https://www.southernenvironment.org/uploads/audio/Solar_EnvReviewProcess_SitingSolar_Final.pdf.
[256] G.E. Parker & C. McQueen, Wychwood Biodiversity, *Can Solar Farms Deliver Significant Benefits for Biodiversity?* (July-Aug. 2013), http://www.wychwoodbiodiversity.co.uk/assets/solar-and-biodiversity-report-parker-mcqueen-2013d.pdf.
[257] *See* Pollinator Partnership and North American Pollinator Protection Campaign, *Selecting Plants for Pollinators: a Regional Guide for Farmers, Land Managers, and Gardeners in the Southeastern Mixed Forest Province*, http://www.pollinator.org/PDFs/Guides/SoutheastMixedForestrx5FINAL.pdf. Pollinator Partnership and North American Pollinator Protection Campaign, *Selecting Plants for Pollinators: a Regional Guide for Farmers, Land Managers, and Gardeners in the Central Appalachian Broadleaf Forest, Coniferous Forest, Meadow Province*, http://pollinator.org/assets/generalFiles/CentralAppalachianrx7FINAL_170624_124216_1.pdf. Pollinator Partnership and North American Pollinator Protection Campaign, *Selecting Plants for Pollinators: a Regional Guide for Farmers, Land Managers, and Gardeners in the Outer Coastal Plain Mixed Province*, http://pollinator.org/assets/generalFiles/OuterCoastalrx7FINAL_171017_085728.pdf.
[258] Pollinator-Friendly Solar Initiative of Vermont, *Solar Site Pollinator Habitat Planning & Assessment Form* (Jan. 18, 2018), https://www.uvm.edu/sites/default/files/Agriculture/Pollinator_Solar_Scorecard_FORM.pdf.

While solar pollinator habitat will provide significant long term economic and environmental benefits, one potential barrier is their large upfront cost. However, this cost is made up in savings and increased land use efficiency. One North Carolina report estimates that for a 42-acre solar installation, the initial cost of establishing a wildflower meadow, $10,775, would be offset by savings of $77,625 in costs associated with mowing over a 25-year period.[259]

Additional Legal Requirements

In addition to a county or city land use ordinance, the siting of solar energy systems will need to comply will many additional statutes, regulations, and other laws, the majority of which the solar developer will be responsible for satisfying. The following is a compilation of federal and Georgia statutes and regulations that the construction and operation of solar energy systems may implicate. It does not purport to be an all-inclusive list. For example, solar energy systems must also comply with mandatory construction codes that are not included below.

The laws listed below are beyond the scope of a zoning ordinance because they are state or federal requirements rather than local. Thus, the Georgia Model Solar Ordinance does not address these requirements.

Federal

Law	*Permit/Review*	*Government Agency*	*Description*
National Historic Preservation Act of 1966 (NHPA) 16 U.S.C. § 470	– Section 106 Consultation	Advisory Council on Historic Preservation (ACHP)	If there is a federal action, requires federal agencies to review potential impacts to sites on the National Register of Historic Places. Consultation with the State Historic Preservation Officer/Tribal Historic Preservation Officer recommended. If the action will result in an adverse effect, will be resolved through mitigation and/or avoidance.
National Environmental Policy Act (NEPA) 42 U.S.C. § 4331	– Environmental Assessment (EA) – Finding of No Significant Impact (FONSI) – Environmental Impact Statement (EIS)	Lead Agency varies by project	Requires federal agencies review environmental impacts of proposed federal action, for example when siting on federal lands, accessing federally owned transmission lines, receiving federal grants, or obtaining a federal permit.

[259] Airell O. Swanson, *Establishing Pollinator Habitat at Solar Farms in North Carolina: a Feasibility Study*, 9 (2015), https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8663/Swanson%2C%20Airell%20Final.pdf?sequence=1&isAllowed=y (unpublished paper in pursuance of Master of Environmental Assessment, North Carolina State University).

Clean Water Act (CWA) **33 U.S.C. § 1342**	– Section 402 National Pollution Discharge Elimination System (NPDES) Stormwater Permit	Environmental Protection Agency (EPA), delegated to Georgia Department of Natural Resources	Regulates discharges of pollutants into waters of the United States and the quality of surface waters. A permit is required when there is potential for stormwater to discharge pollutants from construction that disturbs 1 or more acres.
Clean Water Act (CWA) **33 U.S.C. § 1344**	– 404 Permit	U.S. Army Corps of Engineers	Regulates discharge of dredged or fill material into waters of the United States. Activities that impact federal waters, including wetlands, may require permits.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) **42 U.S.C. § 9601**	– Environmental Site Assessment	Environmental Protection Agency (EPA)	Governs liability with respect to contaminated properties. If hazardous waste or other pollutants contaminate the property, an assessment is needed to discern liability and develop a remediation plan.
Safe, Efficient use, and Preservation of the Navigable Airspace **14 C.F.R. Part 77**	– Airspace Review	Federal Aviation Administration (FAA)	Lays out standards for determining obstructions to air navigation, the notice requirements, and the process to petition the FAA for review. Generally applicable to installations on or near airport property or flight path.
Endangered Species Act (ESA) **16 U.S.C. § 1531**	– Consultation – Incidental Take Permit	U.S. Fish and Wildlife Service (FWS)	Regulates activities affecting threatened or endangered species. Consultation is always recommended for activities that may result in take or harm to species and/or their critical habitat, such as site clearing.
Migratory Bird Treaty **16 U.S.C § 703**	– Consultation – Possibly a permit	U.S. Fish and Wildlife Services (FWS)	Makes it illegal for anyone to harm, possess, or take any migratory bird species, nests, and eggs. Consultation is recommended when there is a potential impact to migratory bird species protected by the Act.

Georgia

Law	*Permit/Review*	*Government Agency*	*Description*
Endangered Wildlife Act of 1973 **O.C.G.A. § 27-3-130** **Wildflower Preservation Act of 1973** **O.C.G.A. § 12-6-170**	– Consultation	Georgia Department of Natural Resources	Georgia's protection for endangered species, but is considerably narrower than the federal ESA. Consultation recommended for projects on public property with endangered, threatened, rare, and/or unusual species.

Georgia Water Quality Control Act **O.C.G.A. § 12-5-20**	– General Permit No. GAR100002	Georgia Department of Natural Resources	Requires a permit for certain discharges into the waters of the State of Georgia. Necessary for stormwater discharges associated with construction activity.
Georgia Environmental Policy Act (GEPA) **O.C.G.A. § 12-16-1**	– Finding of a significant adverse effect – Environmental Effects Report (EER)	Georgia Department of Natural Resources / Lead Agency	Requires disclosure of the environmental effects of proposed State projects. Review is required for Government action that may significantly, adversely affect the quality of the environment.
Georgia Erosion and Sediment Control Act **O.C.G.A. § 12-7-1**	– Land Disturbing Activity Plan/Permit	Georgia Department of Natural Resources (delegated to approved counties or cities)	Protects soil and water resources, while reducing the major source of water pollution in Georgia. A permit is necessary for any activity/project involving more than 1 acre or within 200 feet of State Waters that may result in soil erosion from water or wind and the movement of sediments into State Waters or onto land within the State.
Georgia Hazardous Site Response Act **O.C.G.A. § 12-8-90**	– Site evaluation	Georgia Environmental Protection Division	Lays out requirements for all list sites prior to attainment of cleanup and for certain sites even after cleanup. Responsible parties are required to submit a compliance status report, then a corrective action plan if the site is not in attainment. Often relevant for brownfields.
Rules of Georgia Public Service Commission **GA R&R: Department 515**	– Project approval	Georgia Public Service Commission	Gives the Georgia Public Service Commission the power to approve or deny commercial projects.