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Summary and Recommendations: The tools to balance private property rights and community interests for utility-scale solar already exist. Increased consumer protection for residential solar may be beneficial.

When a private developer began leasing land in Fayette County to construct a 2,600-acre solar facility, the development represented a potential revenue stream both for the landowners as lessors and for the county through property taxes. But some community members opposed the project because of concerns about the loss of agricultural land and the rural nature of the county, leading to a lawsuit that has delayed construction for several years. According to the publication *Farm Progress*,

> As applications for new solar farms in the county continue to roll in, solar energy has divided local residents and even fellow farmers—sparking debates over property rights, effectiveness of green energy, and preservation of natural space. Then there is the growing concern among producers and policy makers that solar farms are eating away at traditional farmland at an unsustainable pace.

Property rights, land use—including the loss of prime farmland—aesthetics, environmental effects, and the desire to protect landowners are driving disputes and raising questions among stakeholders about utility-scale solar development across Tennessee and the country as utilities look to add more large solar facilities to their energy portfolios. Even the expansion of residential solar has led to concerns—though for different reasons—as the Office of the Tennessee Attorney General has taken legal action against two solar installation companies for defrauding customers. In light of these concerns, the General Assembly passed Public Chapter 1043, Acts of 2022 (appendix A), directing the Tennessee Advisory Commission on Intergovernmental Relations to examine 14 points:

1. Short-term and long-term projections on the amount of acreage needed to accommodate utility-scale solar development
2. Hazardous waste as defined in Tennessee Code Annotated, Section 68-212-104, that may exist in photovoltaic modules, energy storage system batteries, or other equipment used in utility-scale solar energy development
3. Federal regulatory requirements regarding decommissioning and managing end-of-life photovoltaic modules, energy storage system batteries, and other equipment used in utility-scale solar energy development

4. Statutory and regulatory requirements in other states regarding decommissioning and managing end-of-life photovoltaic modules, energy storage system batteries, and other equipment used in utility-scale solar energy development
5. Financial assurances and responsibilities of owners and operators in the event of natural disasters, pollution from solar energy system failures, decommissioning of a solar energy system, and end-of-life management of photovoltaic modules, energy storage system batteries, and other equipment used in utility-scale solar development
6. Which federal and state regulatory agencies are responsible for certification and oversight to determine the proper installation and operation of utility-scale solar energy systems
7. The needed state infrastructure to facilitate the collection, transport, and disposal of utility-scale solar energy systems
8. Implications of utility-scale solar energy systems on the local property tax base
9. Local zoning and regulatory templates to ensure consistency throughout the state regarding local siting of utility-scale solar energy development
10. The importance of private property rights and the ability of a landowner to use or transfer interests in property
11. The importance of a variety of energy sources in this state's economic and community development recruiting efforts
12. The efforts of the Tennessee Valley Authority and local power companies to offer utility-scale sustainable power options
13. Required lease terms and conditions to protect future property use and rights of lessors in the event of default or termination of a lease
14. For the purpose of determining any necessary consumer protections, the installation of solar energy generation and storage on the property of residential electric customers

Through its investigation of the 14 points, the Commission has found that many of the issues and concerns raised about solar development are not unique to that industry but are more broadly applicable to development in general. For example, as with other types of development, the construction of utility-scale solar facilities involves the disturbance of land and installation of new infrastructure. But just as with other development, utility-scale solar is subject to local land-use requirements in communities with zoning and is subject to the same federal and state environmental requirements. In some states, there

have been contractors on utility-scale solar projects who failed to properly follow stormwater rules, leading to stormwater issues. But staff of the Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources says that solar projects generally minimize soil disturbance and have better environmental outcomes compared to other types of large construction projects, and since 2009, the Division has received a total of seven complaints about four solar sites out of the 26 known sites in development or operation during that time period. Unlike other development, the likelihood exists that land can be returned to agricultural production after a solar facility reaches the end of its useful life. Tennessee has enacted a decommissioning law intended to help ensure that land can be returned to its prior condition, as some other states have done. Additionally, the Commission has found that while they are operating, solar facilities generate revenue for landowners and tax revenue for local governments.

Currently, solar power is a relatively small part of the Tennessee Valley Authority's (TVA) energy generation mix—TVA is the public utility that serves almost all local power companies in Tennessee. But TVA and the local power companies it serves have programs to support solar development, and the Tennessee Department of Economic and Community Development (ECD) and TVA staff say that solar is an important part of economic development. For specific answers to each of the 14 points, see appendix B, and for a general discussion, see the Analysis section of this report.

Local governments have the authority to address issues related to land use and utility-scale solar through zoning.

Tennessee law authorizes local governments to regulate development in their jurisdictions through zoning to promote the health, safety, morals, convenience, order, prosperity, and welfare of the public. Zoning gives communities a say in how and where different types of development can happen by allowing local governments to set standards including but not limited to the use, location, size, and height of buildings and structures; amount of open space; and the percentage of a lot that can be occupied. For example, to preserve aesthetics in a community, zoning can require a buffer of trees around a development or that structures be set back a minimum distance from roads or property lines. As a result, zoning is among the primary tools local governments have to balance property rights with community interests regarding land use.

Local governments can use zoning authority to regulate utility-scale solar development. At least nine counties and one city in Tennessee already do, and one county and a city within it have created a unified development code that includes solar regulations. Some common elements regulated by Tennessee local governments' solar zoning ordinances include required setbacks and perimeter buffers, maximum panel height, and maximum degree of the slope of the land. To exercise authority over solar development, however,

local governments must have adopted zoning. Whether to adopt zoning is a local decision, and as of May 2023, 40 of the state's 95 counties and 271 of its 345 cities have done so.

Local government representatives say that model ordinances and examples of existing ordinances from other local governments and states would help them make decisions about solar development in their jurisdictions. Model ordinances and templates provide a starting point that covers the basic standards that local governments can modify to align with their communities' values and goals. A model ordinance for utility-scale solar development is available to Tennessee local governments—it was created by the University of Tennessee Municipal Technical Advisory Service (MTAS) and County Technical Assistance Service (CTAS) in coordination with the Tennessee Chapter of the Solar Energy Industries Association (TenneSEIA)—the organization that represents solar companies in the state—and includes required fencing, setbacks, landscape buffering, and submission of the decommissioning plan to the local planning commission. See appendix C for a copy of the model ordinance.

Loss of farmland is a concern that can be addressed using several existing tools.

Some stakeholders are concerned about the potential loss of agricultural land to solar development—particularly prime land where soils are best suited for growing crops. Tennessee has land that is well-suited for utility-scale solar, especially in the western part of the state where there are many acres of flat agricultural land that are near a connection to the electric grid, such as a substation. But solar facilities are unlikely to be the primary driver of agricultural land loss in the next two decades. Currently, TVA plans to add 10,000 megawatts (MW) of solar power generation by 2035 throughout its service area—which includes parts of seven states, not just Tennessee. Even if all these facilities were developed on Tennessee farmland, they would account for approximately 100,000 acres taken out of production, only 1% of farmland in the state. In comparison, the amount of farmland in Tennessee decreased by 1.1 million acres (9.3%) from 1997 through 2017. Moreover, it is possible to develop utility-scale solar facilities without taking farmland out of production. Often referred to as agrivoltaics or dual-use solar, these facilities are built with the solar panels raised higher above the ground, leaving room underneath to graze sheep or raise shade-tolerant crops such as tomatoes or blueberries. This is done in other states but has yet to be implemented on a large scale in Tennessee.

Although utility-scale solar is unlikely to be a primary driver of agricultural land loss in Tennessee, existing tools are available to protect farmland from development. These tools are not necessarily solar-specific, but all can be applied to solar development. They include putting land in trusts, zoning, and the new brownfield redevelopment grant

program. Additionally, the state's decommissioning law sets requirements for returning agricultural or other land to a condition suitable for its former use once a solar project has reached the end of its effective life.

Putting land in a trust is a way to preserve and protect it from any type of development. The state's Heritage Conservation Trust Fund was established to permanently conserve land for promoting tourism and outdoor recreation, conserving natural and cultural resources, and preserving "working landscapes." Tennessee has appropriated $30 million for fiscal year 2023-24 "to revitalize the Heritage Conservation Trust to support public-private partnerships through a matching grant program," and money from the fund could be used to protect land from any type of development, including solar development. Another resource that can help preserve farmland from all development is the Land Trust for Tennessee, a private nonprofit organization that works with landowners to protect their land by creating conservation easements that permanently limit how the land can be developed and subdivided. The Land Trust holds the easement—which is recorded with the register of deeds in the county where the property is located—and is responsible for ensuring that the agreement is upheld in perpetuity.

As previously discussed, local governments can adopt zoning and use it to limit the location and other aspects of utility-scale solar. They can also use zoning to encourage certain types of development in certain areas, for example encouraging solar on land that is not prime farmland. Because of concerns about aesthetics and the best use of land, one local government—Bedford County—looked at vistas, excessive slope, and areas where infrastructure investments had already been made for other uses and established a "renewable energy development zone." The "renewable energy" zone is intended to encourage developers to locate solar facilities only in specific areas of the county by streamlining the approval process for projects inside the zone and setting stricter standards, such as larger setbacks, outside the zone. See appendix D.

The General Assembly passed Public Chapter 86, Acts of 2023, authorizing the Tennessee Department of Environment and Conservation (TDEC) to create a new resource—the Brownfield Redevelopment Area Fund. According to TDEC Division of Remediation staff, the intent of the program is to provide funding to local governments to encourage identification, investigation, and remediation of potential brownfield sites to redevelop. Solar facilities are one potential option, and Division of Remediation staff say they could likely be more cost effective compared to redeveloping for commercial and residential uses because they would generally require less remediation. The new program will rely on local government participation, and Division of Remediation staff acknowledge the need to publicize it in collaboration with other agencies, such as ECD, MTAS, and CTAS.

For land used for utility-scale solar, the state's solar decommissioning law, Public Chapter 866, Acts of 2022, helps to ensure that the land can be returned to its prior condition (see appendix E). A compromise between the two organizations representing key stakeholders—the Tennessee Farm Bureau and TenneSEIA—the law requires the agreements between the solar developers and the landowners who lease them land for the facilities (solar power facility agreements) to include a decommissioning plan with financial assurance to secure that the person leasing the land removes components and restores the land to as close to the condition it was in before construction as reasonably as possible. Financial assurance must be provided to the landowner and cover the decommissioning cost, which is defined as "the estimated cost of performing the removal and restoration obligations . . . less the estimated salvage value of the components of the solar power facility as of the date of removal." Currently, 23 states, including Tennessee, have solar facility decommissioning policies or laws. They share similarities, but unlike Tennessee's law, some specify how the decommissioning cost is calculated, and most provide government oversight authority, including allowing penalties for noncompliance.

Information about utility-scale solar exists that can be shared and made more easily available to stakeholders.

There is abundant information about solar development from many sources including nonprofit organizations and federal and state government agencies. Stakeholders agree that more resources and guidance, including model ordinances like the one developed by CTAS, MTAS, and TenneSEIA, would help local governments and landowners make decisions regarding development of large-scale solar facilities based on their needs, issues, and resources. Solar developers could also benefit from guidance on best practices. Stakeholders and research agree on a few basic practices that are described in table 1 found at the end of this summary and recommendations section.

But there is currently no one-stop shop for information on utility-scale solar development that is specific to Tennessee. Resources exist in separate locations, and stakeholders might not know the resources exist or how to access them. For example, the Tennessee model ordinance described above, TDEC permitting requirements, and best practices are available online but not in one central place. Other states, in particular Kentucky, maintain websites that aggregate information and resources regarding utility-scale solar development for local governments and the public. The TDEC Office of Energy Programs (OEP) has a website with information about renewable energy, and OEP staff agree that working with other agencies to expand the website to be more comprehensive would be beneficial. **The Commission recommends that the TDEC Office of Energy Programs continue to expand and maintain their existing website with additional guidance and**

resources on utility-scale solar for local governments, landowners, developers, and the public, similar to Kentucky. Representatives of that office say they are willing to do so.

Consumers would also benefit from easier access to resources and being more informed about residential solar.

Similar to utility-scale solar, there is abundant information about best practices to help consumers with residential solar, and stakeholders agree that more guidance would help consumers make better decisions and protect themselves from fraud. Best practices for homeowners are also described in table 1. As with utility-scale solar, resources about residential solar are available in different places. Some local electric companies provide guidance for consumers on their websites. TVA's Green Connect website helps consumers find quality solar installers, and the Office of the Tennessee Attorney General and Reporter, Consumer Affairs Division; Board for Licensing Contractors; and TDEC Office of Energy Programs have information for consumers. Other states, in particular Georgia, maintain a central website with information regarding residential solar installations for the public. **The Commission recommends that the TDEC Office of Energy Programs continue to expand and maintain its webpage that provides guidance and resources on residential solar for the public. Representatives of that office say they are willing to do so.**

Most of the fraud in the solar industry occurs in the residential market, and Tennessee has consumer protection laws to help protect homeowners.

Stakeholders generally agree that most of the fraud committed in the solar industry is happening in the residential solar market not the utility-scale market. Consumers who contract with a company to install solar on their residence are protected by Tennessee's consumer protection laws—the Consumer Protection Act and Home Solicitations Sales Act. Although the Division of Consumer Affairs in the Tennessee Office of the Attorney General and Reporter, the state agency that receives complaints from consumers about businesses, received complaints associated with nine residential solar companies between 2020 and 2023, 477 of 498 complaints were directed at two companies. Residential solar installations by these two companies were often expensive—sometimes approaching $100,000—and often included long-term interest payments to a finance company. According to Forbes, the average cost of residential solar panels in Tennessee is $10,293, and the national average is $16,000. Further, financed installations often resulted in liens being placed on homeowners' residences, and for some homeowners, adding a non-functioning solar system led to a decreased home value for a home they may lose because of the additional lien. The maximum civil fine for violations of the Tennessee Consumer Protection Act is $1,000, which is on the low end of civil fine

maximums compared to other states. A review of other states' laws finds their maximum penalties generally range from $1,000 to $50,000 per violation. **Recognizing that care would need to be taken to avoid undermining the intent of the General Assembly's past efforts at tort reform, the Commission recommends that the state consider raising the penalty for violations of the Consumer Protection Act if the good or service involved has a value greater than a monetary threshold set by the state.**

Table 1. Examples of Best Practices for Utility-Scale and Residential Solar Development

Utility-Scale Solar			
Entity	**Best Practices**	**Resource Examples**	**Sources**
State Government	Implement solar decommissioning law	Solar Energy Industries Association (SEIA) model decommissioning legislation (see appendix K)	Curtis et al. 2021b
	Development of model ordinances to guide local governments	Georgia Model Solar Ordinance	Gomez and Morley 2022
	Education about common issues with regulations for permitting solar development	City of Raleigh, North Carolina, "Failing an Inspection: Solar Photovoltaic (PV) Systems"	Interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023; North Carolina Department of Environmental Quality 2018; Virginia Department of Wildlife Resources 2022
	Resource document or webpage for solar development in the state, including but not limited to applicable environmental permits and zoning guidelines	Kentucky Solar Toolkit (arcgis.com)	Kentucky Energy and Environment Cabinet "Kentucky Solar Toolkit;" Fekete et al. 2023
Local Governments	Establish solar zoning ordinances with guidelines for permitting, siting, setbacks, panel height, buffering, and decommissioning plans	Haywood County Zoning Resolution (see appendix D)	Gomez and Morley 2022

	Use authority to adopt zoning	University of Tennessee Municipal Technical Advisory Service (MTAS) and County Technical Assistance Service (CTAS), and Tennessee Chapter of American Planning Association (APA)	Tennessee Code Annotated, Sections 13-7-101 and 13-7-201
	Notify the Federal Aviation Administration and air traffic control about solar facilities larger than 1/2 of an acre that are near an airport	North Carolina Template Solar Ordinance	Barrett and Devita 2011
	Identify and redevelop brownfields, parking lots, and other non-prime farm land with solar	NREL Best Practices for Siting Solar Photovoltaics on Municipal Solid Waste Landfills	Tennessee Code Annotated, Section 68-212-220; and TDEC "Brownfield Voluntary Cleanup Oversight and Assistance Program"
Developers	Use established templates and guidelines for power purchase agreements and leases	SEIA Model Leases and PPAs	US Environmental Protection Agency 2023d; Solar Energy Industries Association "Model Leases and PPAs;" and Solar Energy Industries Association 2016
	Thoroughly evaluate site selection, facility design, and permit and licensing requirements	International Finance Corporation "Utility-Scale Solar Photovoltaic Power Plants"	Doyle et al. 2015
	Communicate and coordinate early in planning and design process with community stakeholders such as state environmental offices (for example TDEC) and local governments	TDEC Division of Water Resources	University of Massachusetts Clean Energy Extension 2022; interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, and Lee Barber, natural resources unit manager, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023
	Follow ethical guidelines	SEIA Solar Business Code	TenneSEIA "Code of Ethics"

	Use land for solar and agriculture or pollinator habitats (dual use, agrivoltaics, or agrisolar)	National Renewable Energy Laboratory "Agrivoltaics Primer"	Macknick et al. 2022; The Nature Conservancy 2023; University of Maine "Cooperative Extension: Maine Wild Blueberries"
	Understand the long-term implications of leasing the land	North Carolina State Extension "Legal Issues Surrounding Due Diligence for Solar Development"	American Farmland Trust "Smart Solar℠ on Farmland and Ranchland Strengthening Farm Viability and Soil Health While Growing Renewable Energy"
Landowners	Understand the limitations of easements and conservation programs for solar development	WeConservePA "Solar Energy Development and Land Conservation"	Conservation Easement Act of 1981, Tennessee Code Annotated, Section 66-9-303; Tennessee Department of Agriculture "Land Protection Options;" Land Trust for Tennessee "Protect Your Land"
	Understand property tax implications and any rollback taxes associated with changes in property use designation	2022GreenbeltManual.SBOEAPPROVED.pdf (tn.gov)	Nuckols 2020; interview Greg Moody, director, Tennessee Office of State Assessed Properties, February 28, 2023
	Compare offers for solar development with other landowners where possible	American Farmland Trust "Solar Leasing: A Guide for Agricultural Landowners in the Pacific Northwest"	Interview with Charles Dacus, farmer, Fayette County, January 18, 2023
	To preserve land, put it in a conservation easement or trust	Tennessee Department of Agriculture "Land Protection Options"	Conservation Easement Act of 1981, Tennessee Code Annotated, Section 66-9-303
Residential Solar			
State Government	Resource webpage with information for consumers	Georgia "Solar Power for Your Home"	Interview with David Callis, executive vice president and general manager, and Mike Knotts, vice president of government affairs, Tennessee Electric Cooperative Association, September 9, 2022

Homeowners	Speak with local electric companies regarding cost effectiveness and return on investment	Middle Tennessee Electric ProSolar	Interview with Brian Solsbee, Executive Director, Jeremy Elrod, Director of Government Relations, and Savannah Gilman, Government Relations Assistant, Tennessee Municipal Electric Power Association, August 30, 2022
	Evaluate residential solar companies for legitimacy and cost	TVA "Green Connect"	Interstate Renewable Energy Council (IREC) 2016
	Call the TDEC Office of Energy programs to answer questions regarding residential solar development and any active incentive programs	TDEC "Office of Energy Programs"	Interview with Molly Cripps, director, Ben Bolton, senior energy programs administrator, and Taylor Tavormina, executive administrative assistant, Office of Energy Programs, Tennessee Department of Environment and Conservation, December 19, 2022
	Use providers certified by the National Board of Certified Energy Practitioners and consider using companies that are members of TenneSEIA as they are bound by a code of ethics	TenneSEIA "Membership"	Solar Energy Industries Association 2015; North American Board of Certified Energy Practitioners "NABCEP Board Certifications"

Note: Some of these best practices are being used in Tennessee.

Source: These examples of best practices are discussed in multiple resources from other states, government agencies, and organizations, and TACIR staff interviews with multiple stakeholders.

Analysis: Like other types of development, solar development needs to be managed, and Tennessee already has laws, policies, and regulations in place to do so.

The development of solar power generation in Tennessee—both utility-scale and residential—has been slow compared to many other states, but it is likely the pace of utility-scale solar development in the state will increase in coming years.[1] Tennessee has land well-suited for utility-scale solar, especially in the western part of the state,[2] where there are many acres of flat agricultural land that are near a connection to the electric grid, such as a substation. The Tennessee Valley Authority (TVA), the federal utility responsible for providing electricity to almost every community in the state, plans to add 10,000 megawatts of new solar capacity in its seven-state service area by 2035. And staff with the Tennessee Department of Economic and Community Development say that solar and renewable energy is at the forefront of conversations with many companies that consider relocating or expanding operations in Tennessee.[3] Stakeholders have expressed concerns about both utility-scale solar and residential solar. For utility-scale solar, stakeholders—including landowners, local community decision-makers, and state leaders—have questions and concerns that generally include land use, property values and local tax base, and protection of landowners.

The prospect of new utility-scale solar facilities brings with it the potential for competing priorities. For example, a decade ago, when a private developer began leasing land in Fayette County to construct a 150-megawatt, 2,600-acre solar facility—the Yum Yum Solar Project—the development represented a potential revenue stream both for the landowners as lessors and for the county through property taxes.[4] Some residents oppose the project because of concerns about the loss of agricultural land and the rural nature of

[1] Tennessee Valley Authority 2022.

[2] Email received from Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, March 22, 2023.

[3] Solar Energy Industries Association 2023; Tennessee Valley Authority 2022; email received from Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, March 22, 2023; and interview with Chassen Haynes, senior director of business development, Tennessee Department of Economic and Community Development, January 24, 2023.

[4] Rowsey 2022; and Tennessee Valley Authority 2019b. A watt is the basic unit of unit of electrical power equal to one ampere under the pressure of one volt. A megawatt is one million watts. US Energy Information Administration 2022b.

the county, leading to an ongoing lawsuit that has delayed construction for several years.[5] According to the publication *Farm Progress*,

> As applications for new solar farms in the county continue to roll in, solar energy has divided local residents and even fellow farmers—sparking debates over property rights, effectiveness of green energy, and preservation of natural space. Then there is the growing concern among producers and policy makers that solar farms are eating away at traditional farmland at an unsustainable pace.[6]

For residential solar, stakeholders—including consumers, local power company officials, solar industry representatives, and representatives of state agencies seeking to protect residential solar customers—have concerns focused on unscrupulous residential solar companies misleading customers and committing fraud. Although the Inflation Reduction Act includes new and enhanced incentives for residential solar, TVA has phased out its residential solar incentive programs, which could affect the speed of adoption.[7]

To answer questions and provide information about solar development—both utility-scale and residential—the General Assembly passed Public Chapter 1043, Acts of 2022 (see appendix A), directing the Commission to study 14 points related to solar development—13 relate to utility-scale solar and one addresses consumer protection in the market for residential solar:

1. Short-term and long-term projections on the amount of acreage needed to accommodate utility-scale solar development
2. Hazardous waste as defined in Tennessee Code Annotated, Section 68-212-104, that may exist in photovoltaic modules, energy storage system batteries, or other equipment used in utility-scale solar energy development
3. Federal regulatory requirements regarding decommissioning and managing end-of-life photovoltaic modules, energy storage system batteries, and other equipment used in utility-scale solar energy development
4. Statutory and regulatory requirements in other states regarding decommissioning and managing end-of-life photovoltaic modules, energy

[5] Tapp v. Fayette Cnty. Tenn., No. W2021-00856-COA-R3-CV (Tenn. Ct. App. Jul. 11, 2022).

[6] Rowsey 2022.

[7] US Department of the Treasury "Fact Sheet: Treasury, IRS Open Public Comment on Implementing the Inflation Reduction Act's Clean Energy Tax Incentives;" and Tennessee Advisory Commission on Intergovernmental Relations 2023.

storage system batteries, and other equipment used in utility-scale solar energy development

5. Financial assurances and responsibilities of owners and operators in the event of natural disasters, pollution from solar energy system failures, decommissioning of a solar energy system, and end-of-life management of photovoltaic modules, energy storage system batteries, and other equipment used in utility-scale solar development
6. Which federal and state regulatory agencies are responsible for certification and oversight to determine the proper installation and operation of utility-scale solar energy systems
7. The needed state infrastructure to facilitate the collection, transport, and disposal of utility-scale solar energy systems
8. Implications of utility-scale solar energy systems on the local property tax base
9. Local zoning and regulatory templates to ensure consistency throughout the state regarding local siting of utility-scale solar energy development
10. The importance of private property rights and the ability of a landowner to use or transfer interests in property
11. The importance of a variety of energy sources in this state's economic and community development recruiting efforts
12. The efforts of the Tennessee Valley Authority and local power companies to offer utility-scale sustainable power options
13. Required lease terms and conditions to protect future property use and rights of lessors in the event of default or termination of a lease
14. For the purpose of determining any necessary consumer protections, the installation of solar energy generation and storage on the property of residential electric customers

For specific answers to each of the 14 points, see appendix B.

Utility-scale solar facilities and residential installations have different characteristics.

Utility-scale solar facilities produce more power and are larger than residential systems. The term utility-scale generally refers to the amount of electric power that a facility produces—it is considered enough to be sold to wholesale utility buyers rather than end-

use consumers.[8] While there is no universal definition of utility-scale solar based on the amount of power (in MW), it generally ranges from at least one MW to at least 20 MW.[9] Although the power these large facilities produce is often sold back to the electric grid, the power can also be used on the property where it is produced. The Volkswagen solar facility in Chattanooga is an example of a utility-scale facility producing electricity that is used to power the company's on-site operations.[10] Table 2 shows utility-scale solar facilities identified in Tennessee as of May 2023.

[8] Solar Energy Industries Association "Utility-Scale Solar."

[9] According to the Solar Energy Industries Association (SEIA)—the national trade association for the US solar industry—utility-scale solar facilities generate at least one megawatt (MW) of power, while TVA and the National Renewable Energy Laboratory (NREL)—a US Department of Energy research agency focusing on the science and engineering of energy—the amount is at least five MW. Some stakeholders consider 20 MW to be the most common threshold. Solar Energy Industries Association "Utility-Scale Solar;" Ramasamy et al. 2021; interview with Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022; and email received from Jeremy Elrod, director of government relations, Tennessee Municipal Electric Power Association. April 27, 2023.

[10] Silicon Ranch "Volkswagen Chattanooga."

Table 2. Utility-Scale Solar Facilities in Tennessee as of May 2023

Utility or Company Name	Facility Name	Megawatts (MW)*	County	Estimated Acreage**
Silicon Ranch Corporation	Vanderbilt I Solar Farm	35	Bedford	350
Nashville Electric Service	Music City Community Solar	1.6	Davidson	16
Adapture Renewables, Inc.	Wildberry	15	Fayette	150
Somerville Solar, LLC	Somerville Solar	2.3	Fayette	closed landfill
SR Enterprise South LLC	Volkswagen Chattanooga Solar Farm	9.6	Hamilton	66
Chattanooga Metropolitan Airport	Chattanooga Metropolitan Airport Solar	2.7	Hamilton	27
CD Arevon USA, Inc.	Latitude Solar Center	15	Hardeman	150
UT West Tennessee Solar Farm	West Tennessee Solar Farm	4.2	Haywood	42
Haywood Solar	Haywood Solar	3	Haywood	30
Silicon Ranch	Paris Solar Farm-Puryear	6.8	Henry	80
NextEra	Elora Solar Energy Center	150	Lincoln	1500
Providence Solar Center, LLC	Providence Solar	16	Madison	160
Silicon Ranch	Jackson Solar Farm	1.5	Madison	15
Onward Energy	Mulberry Farm LLC	15.8	McNairy	158
Onward Energy	Selmer Farm LLC	15.8	McNairy	158
Selmer North Solar I, LLC	Selmer I	16	McNairy	160
Selmer North Solar II, LLC	Selmer II	8	McNairy	80
Origis Energy	Skyhawk Solar Facility	100	Obion	1000
Silicon Ranch	Memphis Agricenter Solar Farm	1	Shelby	10
SR Millington, LLC	Millington I Solar Farm	53	Shelby	530
SR Millington, LLC	Millington II Solar Farm (in development)	74	Shelby	740
IKEA Property Inc	IKEA Memphis 508	1.1	Shelby	rooftop
SR Innovation, LLC	Innovation Solar Farm - Nike	1.5	Shelby	15
SR Jonesborough II, LLC	Telford Solar Farm	4.4	Washington	44
Silicon Ranch	BrightRidge Solar Learning Lab (in development)	unknown	Washington	unknown
SR Washington I, LLC	Martin Solar Farm	9	Washington	90
Total	**26**	**562.3**	**13**	**5,571**

Note: This list includes known solar facilities that generate at least one MW.

*Nameplate MW capacity listed by EIA or solar developer.

**TACIR staff estimated 10 acres per MW, which is the high end of the range for acres needed.

Source: US Energy Information Administration 2022a; Silicon Ranch "Projects;" Silicon Ranch 2022a; Silicon Ranch 2022b; BrightRidge 2023; Hexagon Energy 2019; Origis Energy "TN Solar 1 – Skyhawk Solar;" and email received from Gil Hough, executive director, TenneSEIA, February 27, 2023.

For utility-scale facilities, solar panels are typically attached to racks held up by metal posts in the ground and require between five and 10 acres of land—roughly four to eight football fields—per MW of generating capacity. Large areas of open, flat land are ideal, and a nearby connection to the electric grid is critical. As a result, agricultural land is often well-suited for large solar facilities, but they could also be built on other types of land, such as industrial areas, parking lots, and abandoned land.[11]

Residential solar installations are small systems that a homeowner pays a company to install on their property, usually either on a roof or mounted on the ground. The power generated by the system can either be used solely to provide electricity to the property, or the system can be connected to the electric grid and the power sold back to the local power company.

Both utility-scale solar facilities and residential solar installations use the same basic technology—photovoltaic (PV) cells—a technology that dates to the 1950s in the US.[12] The PV cells have special material—which varies depending on the manufacturer—inside them that absorbs the energy from light and transfers it to electrons that flow through the material generating electricity. That electricity can then be used to power buildings, equipment, and the electric grid.[13] The first utility-scale facility was developed in California in the early 1980s, and residential solar dates from the 1970s, though development and mainstream adoption have varied by region of the country.[14] While they use the same basic solar PV technology, large, utility-scale solar facilities and residential solar installations have different characteristics, benefits, and challenges.

[11] A standard football field is 1.32 acres. Solar Energy Industries Association 2022; Silicon Ranch "Solar Farms: What Communities Need to Know;" and interview with Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022.

[12] US Department of Energy "The History of Solar." Tennessee law defines a solar energy system more broadly as "any device, mechanism, structure, apparatus, or part thereof, whose primary purpose is to collect solar energy and convert and store it for useful purposes including heating and cooling buildings or other energy saving processes, or to produce generated power by means of any combination of collecting, transferring, or converting solar generated energy." The Commission's report focuses solely on photovoltaic solar.

[13] Solar Energy Technologies Office "Solar Photovoltaic Cell Basics."

[14] US Department of Energy "The History of Solar."

Utility-scale solar offers potential benefits to property owners and local governments.

By leasing some or all their land to a solar developer, farmers can generate more income per acre than by leasing it for farming or farming it themselves.[15] The operational phase of a utility-scale solar lease is the most important for lease income because it can last from 20 to 45 years.[16] The four general phases of a solar lease are described by *Solar Leasing: A Guide for Agricultural Landowners in the Pacific Northwest.*

> Solar leases often provide different payment terms based on the project phase. Generally, solar projects are divided into four phases:
>
> 1. "option," "development," or "pre-construction" phase (when the project's viability is being assessed),
> 2. construction phase (once the project is approved and the "option to lease" has been exercised but before energy production has begun),
> 3. operational phase (when the project is generating energy), and
> 4. decommissioning phase (when all materials are removed, and the land is cleaned up).[17]

Other issues farmers consider when contemplating leasing their property for solar energy development include the general hardships of farming, the difficult economics for many family farms, and the farmer's age. "Farming is often 24/7/365,"[18] and "many small American farmers are routinely selling their crops for less than it costs to produce them."[19] Additionally, the average age of a farmer in the US is 58,[20] and many farmers report that their children don't want to take over the family farm. Leasing to a solar developer is a way to generate revenue for retirement while keeping the farm in the family.[21]

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[15] American Farmland Trust "Smart Solar℠ on Farmland and Ranchland Strengthening Farm Viability and Soil Health While Growing Renewable Energy."

[16] Hannum et al. 2022.

[17] Ibid.

[18] Crowell 2015.

[19] Semuels 2019.

[20] Halvorson 2023.

[21] Marshall-Chalmers 2023.

As for local governments, even when only real property taxes are considered, a local government will receive more property tax revenue from a utility-scale solar facility than from the same land if used for farming.[22] Payment-in-lieu of tax (PILOT) agreements are not typically used for encouraging utility-scale solar.[23] Land is classified for property tax purposes as utility, industrial/commercial, residential, or farm based on its use. Land with a solar facility selling power to TVA or a local power company is assessed as a utility at 55% of fair market value.[24] If the power from a utility-scale facility is not sold but is instead used on site, the land is assessed as industrial/commercial property at 40% of its fair market value. In contrast, farm property is assessed at only 25% of fair market value at most.[25] As a result, regardless of whether electricity from a utility-scale solar facility is sold or used on site, the local government would still receive more real property tax revenue from the land alone than it would if the same land were used for farming.

Additionally, local governments would also receive more personal property tax revenue from a utility-scale solar facility than from the same land being used for farming. Individuals owning farm-classed property do not pay tangible personal property taxes on farm equipment.[26] In contrast, the equipment (e.g. solar panels, mounts, etc.) at a utility-scale solar facility is subject to personal property tax. Solar equipment at a facility selling power is appraised at 12.5% of its original cost and assessed at 55% of its appraised value (with the resulting amount reduced by 15% pursuant to Northwest Airlines v.

[22] Interview with Jason Stewart, senior specialist, Tennessee Comptroller of the Treasury, Office of State Assessed Properties, November 24, 2022.

[23] Interviews with Jason Stewart, senior specialist, Tennessee Comptroller of the Treasury, Office of State Assessed Properties, November 24, 2022; Roger Woolsey, county attorney, Amy Tweed, county planner, and Chuck Jeffers, county property assessor, Greene County, January 23, 2023; Chassen Haynes, senior director of business development, Tennessee Department of Economic and Community Development, January 24 2023; and Jake Bynum, mayor, Weakley County, January 17, 2023.

[24] Tennessee Constitution, Article II, Section 28; and interviews with Greg Moody, director, Office of State Assessed Properties, Office of the Comptroller, February 28, 2023; and Roger Woolsey, county attorney, Amy Tweed, county planner, and Chuck Jeffers, county property assessor, Greene County, January 23, 2023.

[25] Farm property without a Greenbelt designation is assessed at 25% of fair market value. Farm property with a Greenbelt designation is assessed at 25% of Greenbelt value. According to Farm Bureau, "the fair market value reflects what a willing buyer would give a willing seller for the property in an open market under normal conditions. The Greenbelt value is the value of the land derived from a formula which attempts to determine the land value if it were sold strictly on a farm to farm basis." In practice, the Greenbelt value is less than the fair market value for any given property. Tennessee Farm Bureau Federation "Understanding Tennessee's Greenbelt Law."

[26] Email correspondence with Greg Moody, director, Office of State Assessed Properties, Office of the Comptroller, May 26, 2023.

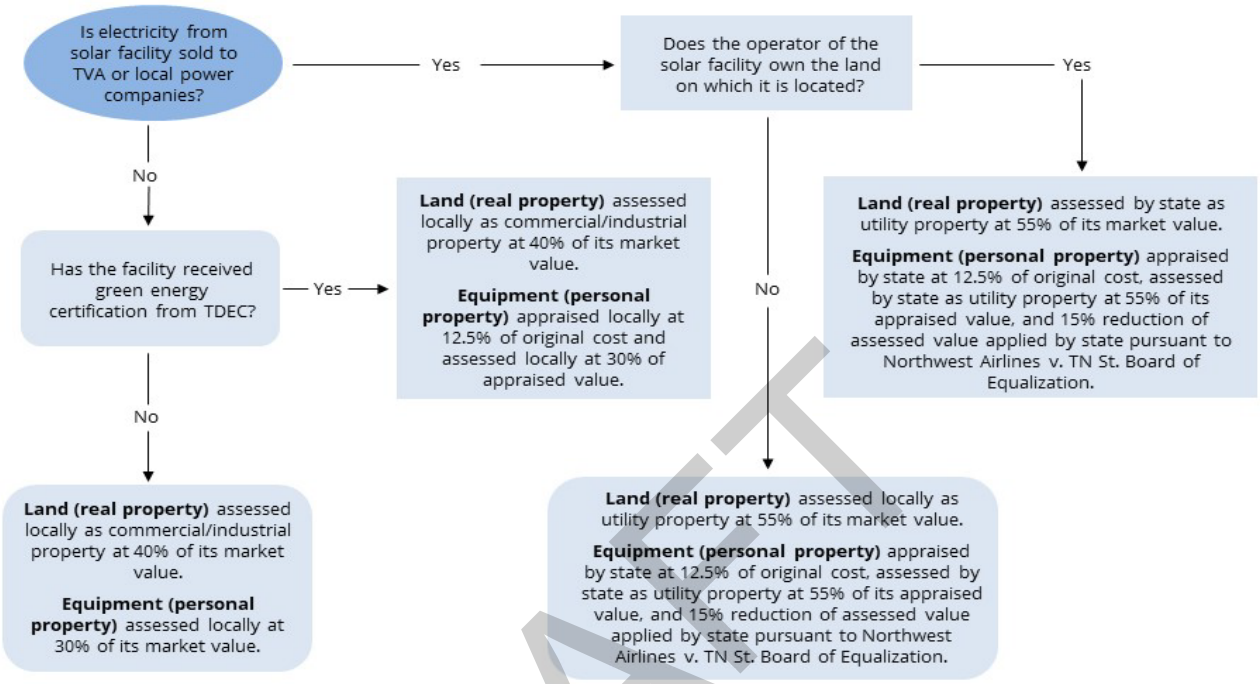
Tennessee State Board of Equalization).[27] And the original cost of solar equipment can be many millions of dollars.[28] For utility-scale facilities where all power is used on site, equipment is appraised at 12.5% of its original cost and assessed at 30% of its appraised value if the facility has received a green energy certification from TDEC—which means TDEC has documented that it is producing or storing electricity using clean energy technology. If the facility has not received a green energy certification, the equipment is assessed at 30% of its market value.[29] Figure 1 shows how solar facilities are appraised and assessed, and appendix F provides a hypothetical example of an assessment of and tax revenue generated by a solar facility compared to agricultural land with the same land appraisal value.

[27] Tennessee Code Annotated, Section 67-5-601(e)(1); and Tennessee Comptroller of the Treasury 2020. The 12.5% appraisal also applies to solar equipment at facilities that have been approved by TDEC as a Certified Green Energy Production Facility regardless of whether they sell electricity offsite. Tennessee Code Annotated, Section 67-5-601 requires the property owner to provide either a Green Energy Production Facility Certification from TDEC or a public utility filing to the Comptroller to document eligibility for the 12.5% assessment rate. See also Tennessee Department of Environment and Conservation 2023a. The Tennessee General Assembly has found that green sources of electricity production are generally capable of producing less electricity than traditional sources and passed a law directing that "the sound, intrinsic and immediate value of solar source property should not initially exceed twelve and one-half percent (12.5%) of total installed costs." Solar equipment at facilities that generate power to use on site that do not have the certification is assessed at 30% of its fair market value.

[28] Hyder 2022.

[29] TDEC says "Clean energy technology is technology used to generate energy from geothermal, hydrogen, solar, and wind sources." Tennessee Department of Environment and Conservation 2023a.

Figure 1. Solar Facility Property Assessment Process



Source: Tennessee Constitution, Article II, Section 28; Tennessee Code Annotated, Sections 67-5-101 et seq., 67-5-601(e), and 67-5-1301 et seq.; Northwest Airlines et al. v. Tennessee State Board of Equalization settlement agreement (1996); and interview with Greg Moody, director, Office of State Assessed Properties, Tennessee Comptroller of the Treasury, February 28, 2023, and email received March 23, 2023.

Most issues raised about utility-scale solar development are common to development in general.

Issues and concerns raised about solar development are typical to development—pitting the rights of landowners to do what they want with their property against the rights of their neighbors and public interests. Some stakeholders have expressed concerns about stormwater runoff, hazardous materials, and land use issues such as aesthetics, which are valid issues related to all types of development, whether agricultural, residential, commercial, or industrial, and are not specific to solar facilities. Conversion of land from one use to another affects the land, environment, and communities during the development's life cycle—including its construction, operation, and end of operation. The main issues to be managed during construction for all types of large developments are soil compaction and sediment entering waterways as a result of disturbances to the land, like grading and moving dirt and rocks with heavy machinery. But just as with

other development, utility-scale solar is subject to the same federal and state environmental requirements statewide and to local land-use requirements in communities with zoning. State and local governments implement and enforce regulations to balance, manage, and mitigate the effects of construction and development.

Solar facilities are subject to the same federal and state environmental requirements for stormwater as other types of development.

The primary federal requirements for stormwater management are outlined in the Clean Water Act (CWA) and apply equally to solar as to all other types of development. The Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources (DWR) carries out the CWA, which "establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters."[30] The US Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) enforces the CWA, and TDEC administers the NPDES program in Tennessee by implementing water quality and stormwater regulations and enforcing permits.[31] Any planned development project in the state that will disturb at least one acre of soil is required to get a NPDES stormwater construction permit, referred to as the construction general permit (CGP).[32] Decommissioning a solar facility also requires a CGP because more than one acre would be disturbed. When the developer has obtained its CGP, it develops the stormwater pollution prevention plan (SWPPP), which is the site-specific plan that describes how issues of water quality will be addressed and includes engineering designs.[33]

In addition to the federal requirements, there are state requirements. If a project will alter a stream, river, lake, or wetland, the aquatic resource alteration permit (ARAP) is also required, and according to DWR staff, most projects in the state affect water resources and require the ARAP.[34] The ARAP is a Tennessee-specific permit that is in addition to the CGP—about half of states have a separate aquatic permitting process like the ARAP permit in addition to the NPDES permit. DWR staff review compliance reports, conduct

[30] US Environmental Protection Agency 2022c.

[31] Tennessee Code Annotated, Sections 69-3-101 et seq.; 33 U.S.C. Section 1342; Rules of the Tennessee Department of Environment and Conservation 0400-40; and Tennessee Department of Environment and Conservation 2023c.

[32] Tennessee Department of Environment and Conservation 2021a.

[33] Interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, and Lee Barber, natural resources unit manager, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023.

[34] Ibid.

inspections, and enforce permits, and they say although penalties can be assessed when a permit is violated, they focus on taking corrective action and fixing the damage. For example, if DWR staff finds that sediment has escaped beyond a containment pond, they issue a notice of violation and require the contractor to repair the pond or install and maintain appropriate sediment control measures within a defined time period.[35] The permit applicant—usually the developer—is liable for violations and civil penalties up to $10,000 per day.[36] The process is the same for all development—there is no permit specifically for solar development. If the land is leased for a solar facility, the developer is required to obtain permits—not the landowners or TVA.[37]

Further, most large solar facilities have an agreement with TVA and therefore are required to go through the National Environmental Policy Act (NEPA) process, which is a comprehensive environmental review that only projects involving a federal agency in some way have to complete.[38] Under NEPA, all executive federal agencies are required to prepare environmental assessments (EAs) and environmental impact statements (EISs).[39] TVA also checks developers' track records and completes performance and business reviews before entering into contracts, requires developers to obtain state and local permits, and inspects the projects before they begin operating.[40] According to TVA's 2019 Integrated Resource Plan, "Compared to most other energy resources, [solar facilities] have a relatively low level of impact to the land."[41]

Stormwater runoff issues are common—especially during construction—for all development not just solar. Since 2009, TDEC Division of Water Resources has received a total of seven complaints[42] about four solar sites out of the 26 known sites in development or operation during that time period (see appendix G, which includes

[35] Tennessee Department of Environment and Conservation 2021a.

[36] Tennessee Code Annotated, Section 69-3-115.

[37] Interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023.

[38] Interview with Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022.

[39] US Environmental Protection Agency 2022d.

[40] Interview with Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022, and email received March 22, 2023.

[41] Tennessee Valley Authority 2019a.

[42] One complaint was for erosion/sediment, two were for other, two were for stormwater-construction, one was for stream debris, and one was for wetland.

complaint year and outcome).[43] In some states, there have been contractors on utility-scale solar projects who failed to properly follow stormwater rules, leading to serious stormwater issues. But Division of Water Resources staff have not found anything specific to Tennessee solar development that would make the projects less compliant.[44] In fact, they say solar projects generally minimize soil disturbance and the effect on the environment compared to other types of projects with heavy construction. Solar facilities also typically require less new infrastructure, such as water, sewer, and roads, reducing disturbance to the site and surrounding area.[45]

In Tennessee, solar facilities during operation are not considered to be impervious—preventing water from absorbing into the soil—unlike parking lots, paved streets, and rooftops that are considered impervious—and DWR staff do not perceive increased water quality or quantity issues resulting from solar development during operation. As long as the site has grass, setbacks, and stable roads, staff don't anticipate any water quality issues after construction is complete, and on those sites, nothing further needs to be done. Issues about the amount of water—the quantity—are addressed by local governments, not by TDEC, because the amount of stormwater runoff that can be handled depends on local drainage and infrastructure.[46]

To improve the process for all development, stakeholders suggest more coordination and communication. Although the state regulates development, some local government officials say that some developers—particularly out-of-state companies—might not understand or be familiar with Tennessee's laws and regulations. For example, Tennessee's ARAP is required in addition to the federal NPDES process,[47] and companies might not be aware of the additional permit because not all states require this type of permit. Additionally, projects that will disturb more than 50 acres at one time must

[43] TDEC's DataViewer shows complaints received as early as 2009. Tennessee Department of Environment and Conservation "DataViewer - Division of Water Resources (DWR);" US Energy Information Administration 2022a; Silicon Ranch "Projects;" Silicon Ranch 2022a; Silicon Ranch 2022b; BrightRidge 2023; and email received from Gil Hough, executive director, TenneSEIA, February 27, 2023.

[44] Interviews with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, and Lee Barber, natural resources unit manager, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023; and Ann Morbitt, integrated water resources consultant, and Karina Bynum, title, Division of Water Resources, Tennessee Department of Environment and Conservation, March 10, 2023.

[45] Interview with Michael Banks, former county attorney, Haywood County, January 17, 2023.

[46] Interview with Ann Morbitt, integrated water resources consultant, and Karina Bynum, title, Division of Water Resources, Tennessee Department of Environment and Conservation, March 10, 2023.

[47] Tennessee Department of Environment and Conservation "Aquatic Resource Alteration Permit (ARAP)."

comply with additional permit requirements, including submission of additional data and more frequent site assessments, inspections, and monitoring.[48] Approximately 100 municipalities have additional requirements that they enforce to manage the quality of stormwater runoff from their storm sewer systems.[49] Communication and coordination between DWR staff, local governments, and developers early in the process about project siting and design would help avoid the need to redesign projects later in the process and save time and money for all types of development. DWR doesn't have a mechanism to do outreach, but staff say they help educate many people about regulations when consulted.

Issues related to solar equipment and materials are managed in the same way as other types of materials.

Some stakeholders are concerned that solar equipment might contain hazardous materials that could harm people or the environment. According to the US EPA "some solar panels are hazardous waste, and some solar panels are not hazardous waste, depending on the leachability of . . . toxic materials present in the solar panel."[50] Leachability means leaking of a component material, such as a heavy metal, out of the panel. The only equipment in a solar PV system that would have any potentially hazardous materials are the PV panels—modules—and batteries, and the material composition of equipment varies by type and manufacturer. Potentially hazardous materials include, but are not limited to, lead, cadmium, arsenic, hexavalent chromium, copper, and selenium.[51] A material in solar module technology commonly used in Tennessee for utility-scale is cadmium telluride, which is a stable compound.[52] Batteries used for energy storage are lithium-ion, and the main risk associated with them is fire if they are damaged or crushed.[53]

Solar modules are unlikely to leach materials even if they are cracked or broken—they are designed and tested to endure harsh outdoor conditions for 25 years or more.[54] The

[48] Tennessee Department of Environment and Conservation 2021a.

[49] Tennessee Department of Environment and Conservation 2023b; and email received from Ann Morbitt, integrated water resources consultant, Division of Water Resources, Tennessee Department of Environment and Conservation, March 23, 2023.

[50] US Environmental Protection Agency 2022b; and US Environmental Protection Agency 2022e.

[51] Association of State and Territorial Solid Waste Management Officials 2022.

[52] Interview with Roger Bredder, vice president, business development, head of utility origination, First Solar, Inc., May 17, 2023.

[53] US Environmental Protection Agency 2023e.

[54] Sinha et al. 2019.

modules are sealed, and a small percentage—an estimated average of 0.04%—break each year.[55] Further, staff at TDEC Division of Solid Waste Management (DSWM), the state agency that administers EPA's Resource Conservation and Recovery Act (RCRA)[56] by regulating the generation, transportation, treatment, storage, and disposal of hazardous waste, says EPA has not yet released any information about leaching being a risk. If the EPA did say leaching is a potential risk, TDEC would investigate to determine whether the concentration of a component material of concern was high enough to be considered a hazardous waste.[57] But research has found leaching from solar panels unlikely to be a significant risk.[58]

TDEC DSWM has regulations in place for both solid waste and hazardous waste to "provide for safe and sanitary processing and disposal of solid wastes" and "safe storage, transportation, treatment and disposal of hazardous wastes."[59] It has authority to regulate disposal of all types of solid waste, including hazardous waste, through permitting and enforcement under the Solid Waste Management Act of 1991 and the Hazardous Waste Management Act of 1977. Staff investigates any complaints they receive about solid waste and, like any type of solid waste, requires that solar panels are disposed of properly.[60]

When solar equipment reaches its end-of-life, it can be recycled, although solar panel recycling is a new and evolving industry.[61] NREL has researched the solar panel

[55] Solar Energy Technologies Office "Farmer's Guide to Going Solar;" Summers and Radde 2003; Sinha et al. 2019; and interview with Craig Almanza, deputy director, and Lisa Hughey, director, Central Office Operations, Division of Solid Waste Management, Tennessee Department of Environment and Conservation, February 6, 2023.

[56] US Environmental Protection Agency 2022e.

[57] US Environmental Protection Agency 2023a; Tennessee Department of Environment and Conservation "Hazardous Waste Program;" interview with Craig Almanza, deputy director, and Lisa Hughey, director, Central Office Operations, Division of Solid Waste Management, Tennessee Department of Environment and Conservation, February 6, 2023; and email received from Lisa Hughey, director, Central Office Operations, Division of Solid Waste Management, Tennessee Department of Environment and Conservation, May 31, 2023.

[58] Summers and Radde 2003.

[59] Tennessee Code Annotated, Sections 68-211-101 et seq. and 68-212-101 et seq.; Tennessee Department of Environment and Conservation 2021b; and Tennessee Department of Environment and Conservation "Hazardous Waste Program."

[60] Interview with Craig Almanza, deputy director, and Lisa Hughey, director, Central Office Operations, Division of Solid Waste Management, Tennessee Department of Environment and Conservation, February 6, 2023.

[61] US Environmental Protection Agency 2023c; and Hicks 2019.

recycling economy that would allow for the recovery and reuse of materials rather than disposing of them in landfills,[62] and the Solar Energy Industry Association (SEIA) has been developing a PV recycling network across the US and is optimistic about the future of PV recycling. SEIA staff say more companies are starting to use recycled and refurbished materials, and the cost will decrease as demand increases.[63] For example, the First Solar company encourages its clients to return modules to its site in Ohio for recycling. Their customers pay a recycling fee and cover the shipping cost, but a representative of the company said their clients report that it is cheaper to dispose of equipment in a landfill.[64] Five states have acted to address PV waste and recycling.[65] New Jersey and North Carolina have created a statewide task force to evaluate disposal issues and available recycling infrastructure and make recommendations to address long-term concerns related to solar waste; California and Hawaii amended waste regulations to include PV modules as one of the waste streams that are subject to increased oversight including training and requiring facilities to track waste; and Washington adopted a statutorily required extended producer responsibility program for PV modules, making the manufacturers of products and materials responsible for the waste.

Local governments have the authority to address issues related to land use and utility-scale solar through zoning.

Zoning is one of the primary tools local governments have to balance property rights with community interests regarding land use. Local governments have authority to implement zoning to promote the health, safety, morals, convenience, order, prosperity, and welfare of the public and regulate most types of land use and development—including solar facilities—in their jurisdictions.[66] Zoning helps communities plan for and provide services, protect property values and lives, and prevent harmful uses of land.[67] Although all local governments are authorized to adopt zoning under Tennessee law, whether to do so is a local decision. As of May 2023, approximately 40 of the state's 95

[62] Curtis et al. 2021a.

[63] Interview with Gil Hough, executive director, Evelyn Butler, vice president of technical services, Robert Nicholson, senior manager of sustainability, and members of utility committee, TenneSEIA, February 9, 2023.

[64] Interview with Roger Bredder, vice president, business development, head of utility origination, First Solar, Inc., May 17, 2023.

[65] Association of State and Territorial Solid Waste Management Officials 2022.

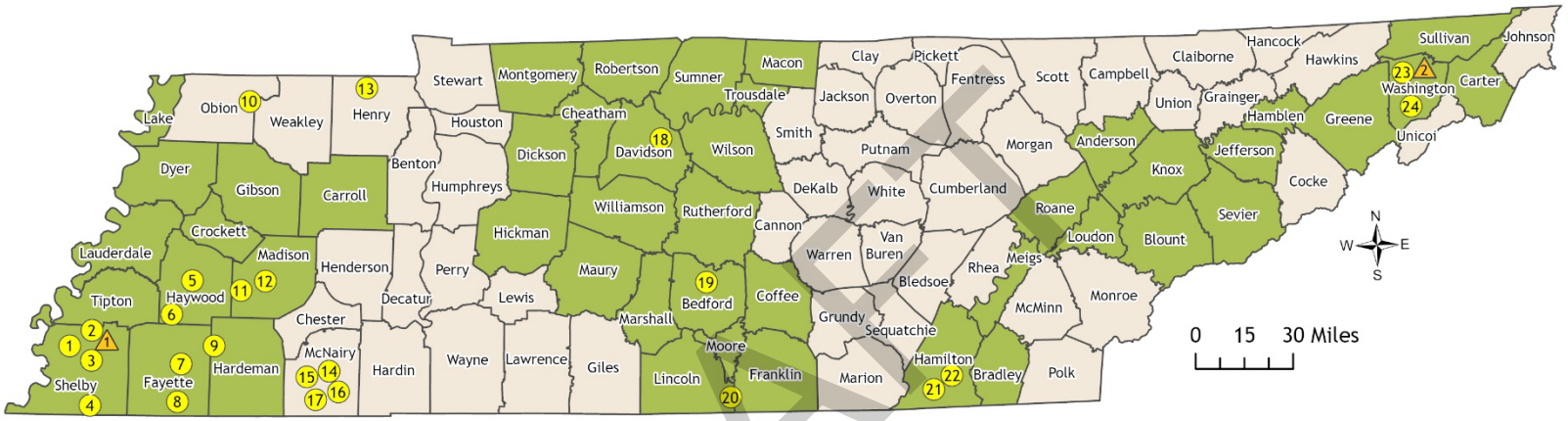
[66] Tennessee Code Annotated, Sections 13-7-101 and 13-7-201.

[67] Email received from Kristy Godsey Brown, manager of legal services, University of Tennessee County Technical Assistance Service, May 10, 2023.

counties and 271 of its 345 cities have adopted zoning.[68] Because cities don't have as much available land as counties, large-scale solar facilities are usually built in the unincorporated areas of counties. As a result, zoning for solar development plays a greater role for counties than cities. Map 1 shows the locations of utility-scale solar facilities and counties that have adopted zoning.

[68] Skehan 2020.

Map 1. Utility-Scale Solar Facilities and Counties that have Adopted Zoning in Tennessee



Operational Solar Facilities

1. SR Innovation - NIKE PV
2. Millington I Solar Farm
3. IKEA Memphis 508
4. Memphis Agricenter Solar Farm
5. Haywood Solar
6. West Tennessee Solar Farm
7. Somerville Solar
8. Wildberry
9. Latitude Solar Center
10. Skyhawk Solar Facility
11. Providence Solar
12. Jackson Solar Farm
13. Paris Solar Farm-Puryear
14. Selmer I
15. Selmer II
16. Selmer Farm LLC
17. Mulberry Farm LLC
18. Music City Community Solar
19. Vanderbilt I Solar Farm
20. Elora Solar
21. Chattanooga Metropolitan Airport Solar
22. Volkswagen Solar System
23. Martin Solar Farm
24. Telford Solar Farm

In-Development Solar Facilities

1. Millington II Solar Farm
2. BrightRidge Solar Lab

County Zoning Adopted

- Yes
- No

Source: TACIR staff map from US Energy Information Administration 2022a; Silicon Ranch "Projects;" Silicon Ranch 2022a; Silicon Ranch 2022b; BrightRidge 2023; Hexagon Energy 2019; Origis Energy “TN Solar 1 – Skyhawk Solar;” email received from Gil Hough, executive director, TenneSEIA, February 27, 2023, and Skehan 2020.

Zoning gives communities a say in how and where different types of development can occur by allowing local governments to set standards including, but not limited to, the use, location, size, and height of buildings and structures; amount of open space; and the percentage of a lot that can be occupied.[69] For example, to preserve aesthetics in a community, zoning can require a buffer of trees around a development or that structures are set back a minimum distance from roads or property lines.

Local governments can also use zoning authority to set standards for utility-scale solar development, and at least nine counties—Bedford, Fayette, Franklin, Greene, Hardeman, Haywood, Jefferson, Sullivan, and Washington—and one city—Brownsville—in Tennessee already do (see appendix D). Additionally, Shelby County and the City of Memphis have created a unified development code that includes solar regulations. Several local governments are considering regulations for solar development. Some common elements regulated by local governments that have adopted solar zoning ordinances include required setbacks, perimeter buffers, and fencing.[70] For example, a minimum setback of 50 feet from the property line or a public road and a buffer and fence both at least six feet high. Several of these communities say zoning, including for solar, helps to develop land in a way that allows businesses to operate and grow while using the land for its best use.[71] To exercise this authority over solar development, however, local governments must have adopted zoning.[72] Without zoning, counties are limited to regulating nuisances—anything determined to be potentially detrimental to "the health, morals, comfort, safety, convenience or welfare of the inhabitants" of the jurisdiction—only in unincorporated areas. The county legislative body must adopt both the authority to regulate nuisances and the nuisance regulations with a two-thirds vote of the legislative body.[73]

[69] Tennessee Code Annotated, Sections 13-7-101 and 13-7-201; and email received from Kristy Godsey Brown, manager of legal services, University of Tennessee County Technical Assistance Service, May 10, 2023.

[70] TACIR staff review of ordinances.

[71] Interviews with Roger Woolsey, county attorney, and Amy Tweed, county planner, Greene County, January 23, 2023; Chris White, director, Office of Planning & Zoning, Bedford County, January 4, 2023, and Michael Banks, former county attorney, Haywood County, January 17, 2023.

[72] Tennessee Code Annotated, Sections 13-7-101 and 13-7-201.

[73] Skehan 2020; Tennessee Code Annotated, Sections 5-1-118 and 6-2-201; email received from David Connor, executive director, Tennessee County Services Association, May 3, 2023; and University of Tennessee County Technical Assistance Service "New Authority for Counties to Regulate Nuisances Introduction."

Zoning can also be used to encourage certain types of development in specific areas. Bedford County uses its zoning authority to encourage solar in parts of the community determined to be preferable for solar.[74] Because of concerns about protecting scenic views and concerns about the best use of land, the county considered aesthetics, excessive slope, and areas where infrastructure investments had already been made for other uses, for example where sewer or water lines have been installed for future development in industrial-zoned areas.[75] Based on these criteria, the county established a "renewable energy development zone" that is intended to encourage developers to locate solar facilities only in specific areas of the county by streamlining the approval process and not requiring rezoning for projects inside the zone.[76] Instead of rezoning, projects are approved as a "conditional use"—as long as they meet all the standards, they are approved in the renewable energy zone. Outside that zone, rezoning is required, and the standards are stricter, such as larger setbacks and allowing less land to be covered with infrastructure. The county planner has found the approach to be effective because it helps the county control where solar development happens while still supporting development in the county. See table 3 for a comparison of the standards for the two zones and appendix D for a copy of Bedford County's resolution.

[74] Interview with Chris White, director, Office of Planning & Zoning, Bedford County, January 4, 2023.

[75] If a local government has invested heavily on infrastructure in an area, then solar wouldn't be the best form of development because it wouldn't make use of the assets that the government (and its citizens) invested in.

[76] Interview with Chris White, director, Office of Planning & Zoning, Bedford County, January 4, 2023, and emailed received November 29, 2022, and email received May 30, 2023.

Table 3. Bedford County Solar Zoning

	Inside Renewable Energy Overlay Zone	Outside Renewable Energy Overlay Zone
Area Characteristics	usually less than 6% slope; areas not identified by the planning department as being in high growth areas or areas where significant public infrastructure investments have been made or planned	determined to be less desirable for solar development
Approval Process	allowed as a conditional use with approval as a special exception in an agricultural zone by the Board of Zoning Appeals; no re-zoning required	parcel must be re-zoned to Renewable Energy Development District and go through approval process with the Board of Zoning Appeals
Minimum Setbacks	Front - 75 feet Side - 75 feet Rear - 75 feet	Front - 400 feet Side - 375 feet Rear - 390 feet
Maximum Height	35 feet	35 feet
Maximum Lot Coverage	95%	66%

Source: Bedford County 2023; and email received from Chris White, director, Office of Planning & Zoning, Bedford County, June 1, 2023.

A model ordinance that includes the basic standards for utility-scale solar development is available to Tennessee local governments—it was created by the University of Tennessee Municipal Technical Advisory Service (MTAS) and County Technical Assistance Service (CTAS) in coordination with the Tennessee Chapter of the Solar Energy Industries Association (TenneSEIA). See appendix C for a copy of the model ordinance. Appendix H provides examples of model ordinances from other states in addition to resources to help local governments develop their ordinances for utility-scale solar. Some local government representatives agree that model ordinances and examples of existing ordinances from other local governments and states would help them make decisions regarding development of large-scale solar facilities based on the needs, issues,

and resources in their jurisdiction.[77] Model ordinances and templates provide a starting point that covers the basic standards—such as required fencing, setbacks, landscape buffering, signage, and submission of the decommissioning plan to the local planning commission—that local governments can modify to align with their communities' values and interests. Models often make specific suggestions that local governments can modify based on local priorities—for example, fencing is suggested to be at least six feet high, setbacks ranging from at least 15 to 50 feet from property lines, and landscaping buffers using trees or other vegetation.[78]

Loss of farmland to solar development is a concern that can be addressed using several existing strategies.

According to some stakeholders, the potential loss of agricultural land to solar development—particularly prime land where soils are suited for growing crops—is a concern. This is especially true in the western part of the state where there are many acres of flat agricultural land (map 2 shows the locations of utility-scale solar facilities and prime farmland in Tennessee). While solar facilities require five to ten acres per MW, the short-term and long-term projections on the amount of acreage needed to accommodate utility-scale solar development show that the amount of land developed for solar is likely to account for a comparatively small portion of the agricultural land developed for non-agricultural purposes in the coming decades.[79]

Currently, TVA plans to add 10,000 MW of solar power generation by 2035 throughout its service area—which includes parts of seven states, not just Tennessee.[80] Even if all these facilities were developed on Tennessee farmland, they would only account for approximately 100,000 acres taken out of production, only 1% of farmland in the state.[81] In comparison, the amount of farmland in Tennessee decreased by 1.1 million acres (9.3%) from 1997 through 2017.[82] A 2022 North Carolina study found that the state's 7,460 MW of installed solar PV "occupies 0.12% of the total land area of the state and 0.28% of

[77] Interviews with Roger Woolsey, county attorney, Amy Tweed, county planner, and Chuck Jeffers, county property assessor, Greene County, January 23, 2023; Michael Banks, former county attorney, Haywood County, January 17, 2023; and Ambre Torbett, director of planning & community development, Planning & Codes Department, Sullivan County, January 12, 2023.

[78] TACIR staff review of model ordinances.

[79] Interview with Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022.

[80] Tennessee Valley Authority 2022.

[81] US Department of Agriculture 2022.

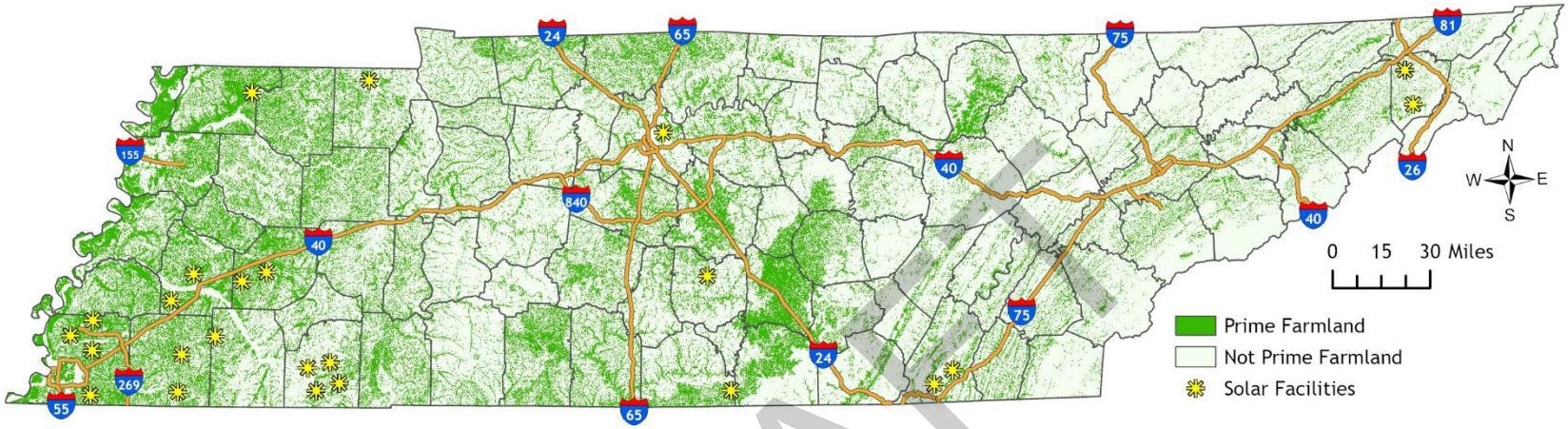
[82] US Department of Agriculture 2017.

agricultural land."[83] TenneSEIA and University of Tennessee Institute of Agriculture are conducting a study focused on how many acres are likely to be used for solar development in Tennessee.[84]

[83] Brookshire, Carey, and Parker 2022.

[84] Interview with Forbes Walker, professor and environmental soil specialist, UT Extension, and Christopher Clark, head, Karen Lewis DeLong, associate professor, and David Hughes, professor Department of Agricultural & Resource Economics, University of Tennessee Institute of Agriculture, February 16, 2023.

Map 2. Utility-Scale Solar Facilities and Prime Farmland in Tennessee



Source: TACIR staff map from Natural Resources Conservation Service SSURGO and US Energy Information Administration 2022a; Silicon Ranch "Projects;" Silicon Ranch 2022a; Silicon Ranch 2022b; BrightRidge 2023; Hexagon Energy 2019; Origis Energy "TN Solar 1 – Skyhawk Solar;" and email received from Gil Hough, executive director, TenneSEIA, February 27, 2023.

Although utility-scale solar is unlikely to be a primary driver of agricultural land loss in Tennessee, existing strategies are available to protect farmland from development. These tools and strategies are not necessarily solar-specific, but all can be applied to solar development. For example, local governments can use zoning to encourage certain types of development in certain areas, such as encouraging solar on land that is not prime farmland. Such zoning can include incentives for developing in certain areas and disincentives for developing in other areas. Other strategies include agrivoltaics, putting land in trusts, and the new brownfield redevelopment grant program.

One strategy to preserve farmland is to develop utility-scale solar facilities without taking the underlying farmland out of production.

Often referred to as agrivoltaics or dual-use solar, these facilities are built with the panels raised higher above the ground, leaving room either underneath or between rows of solar panels to graze sheep or cattle or raise shade-tolerant crops such as tomatoes[85] and blueberries.[86] The American Farmland Trust says that "Agrivoltaics is the practice of installing solar panels on farmland so primary agricultural activities are maintained throughout the life of the project (see figure 2 and appendix I for information about American Farmland Trust's utility-scale solar efforts).[87] Agrivoltaics is sometimes done in other states but has yet to be employed on a large scale in Tennessee.[88] In Massachusetts, "Dual-use systems qualifying as Agricultural Solar Tariff Generation Units receive an additional $0.06 per kWh" to the amount they receive for selling electricity.[89] New Jersey's program is still in the early stages of development with the state government planning to release details of a pilot program in summer 2023.[90] Michigan allows farmers to retain the Michigan equivalent of greenbelt status for property taxation for solar development leases if pollinator species are planted underneath and between solar panels.[91]

[85] Hanley 2022.

[86] The University of Maine "Cooperative Extension: Maine Wild Blueberries;" and Macknick et al. 2022.

[87] American Farmland Trust "Smart Solar℠ on Farmland and Ranchland: Strengthening Farm Viability and Soil Health While Growing Renewable Energy." See also Hunter et al 2022.

[88] Macknick et al. 2022; and Solar Energy Technologies Office 2023.

[89] University of Massachusetts Amherst 2022.

[90] Weaver 2023.

[91] Michigan Department of Agriculture and Rural Development 2022; and Michigan Farm Bureau 2019.

Figure 2. American Farmland Trust Smart Solar℠ on Farmland and Ranchland

Smart Solar projects meet three main goals: they accelerate renewable energy development, strengthen farm viability, and safeguard land for farming and ranching. American Farmland Trust developed the following Smart Solar Principles to guide policymakers, developers, and decisionmakers:

1. Prioritize solar siting on the built environment and land not well suited for farming. Concentrate solar development on rooftops, irrigation ditches, brownfields, and marginal lands.

2. Safeguard the ability for land to be used for agriculture. Policies and practices should protect soil health and productivity, especially during construction and decommissioning.

3. Grow agrivoltaics for agricultural production and solar energy. Agrivoltaic projects allow for farming underneath and/or between rows of solar panels throughout the life of the project.

4. Promote equity and farm viability. Require inclusive stakeholder engagement, including farmers and underserved communities, to ensure widespread benefits from solar energy development.

Smart Solar means directing solar development to where it has the least negative impact on land well-suited for farming while protecting soil health, maintaining opportunities for farming, and ensuring equitable community benefits. Smart Solar elevates agricultural considerations and aims to accelerate renewable energy development by calming community fears over solar project impacts.

Source: American Farmland Trust "Smart Solar℠ on Farmland and Ranchland: Strengthening Farm Viability and Soil Health While Growing Renewable Energy."

Putting land in a trust in which one specifies limits on how that land can be used in the future—even after it is sold—is a way to preserve and protect it from any type of development.

The state's Heritage Conservation Trust Fund was established to permanently conserve land for promoting tourism and outdoor recreation, conserving natural and cultural

resources, and preserving "working landscapes."[92] Tennessee has appropriated $30 million for fiscal year 2023-24 "to revitalize the Heritage Conservation Trust to support public-private partnerships through a matching grant program,"[93] and money from the fund could be used to protect land from any type of development, including solar development. Another resource that can help preserve farmland from all development is creating conservation easements that permanently limit how the land can be developed and subdivided.[94] The Land Trust for Tennessee is a private nonprofit organization that works with landowners to protect their land, and helps ensure the easement or agreement establishing the limits on a property's development—which is recorded with the register of deeds in the county where the property is located—is upheld in perpetuity.[95]

Governments can encourage redevelopment of brownfields over development of farmland.

Brownfields are land that is abandoned or underutilized because of the presence or potential presence of a hazardous substance, pollutant, or contaminant from a former property use.[96] For example, in 2022, the TVA board approved a pilot project to develop a solar facility on a coal ash brownfield in Kentucky.[97]. The development of brownfields for solar is already an option in Tennessee as well. For example, in 2019 Hexagon Energy completed the Somerville Solar facility built on closed sections of the Fayette County, Tennessee, landfill.[98] The General Assembly passed Public Chapter 86, Acts of 2023, authorizing the Tennessee Department of Environment and Conservation (TDEC) to create a new resource—the Brownfield Redevelopment Area Fund (BRAF). According to TDEC Division of Remediation staff, the intent of the program is to provide funding to local governments to encourage identification, investigation, and remediation of potential brownfield sites to redevelop.[99] Division of Remediation staff say solar facilities could likely be more cost effective compared to redevelopment for commercial and

[92] Tennessee Code Annotated, Sections 11-7-101 et seq.

[93] Public Chapter 418, Acts of 2023; and Tennessee Office of the Governor 2023.

[94] Tennessee Code Annotated, Sections 66-9-301 et seq; and Tennessee Department of Agriculture "Land Protection Options."

[95] Tennessee Code Annotated, Section 66-9-303; and Land Trust for Tennessee "Protect Your Land."

[96] US Environmental Protection Agency 2023b.

[97] Fischer 2022; and Flessner 2022b.

[98] Hexagon Energy 2019.

[99] Interview with Steve Sanders, director, and Justin Meredith, environmental fellow, Tennessee Department of Environment and Conservation, Division of Remediation, March 8, 2023.

residential uses because they usually require less remediation.[100] The new program will rely on local government participation, and Division of Remediation staff acknowledge the need to publicize it in collaboration with other agencies, such as the Tennessee Department of Economic and Community Development (ECD), MTAS, and CTAS.

Tennessee's solar decommissioning law was passed to address concerns about protecting landowners that are specific to solar development.

The likelihood exists that land can be returned to agricultural production after a solar facility reaches the end of its useful life, unlike for most other types of development. However, stakeholders have expressed concern that landowners could be responsible if something goes wrong with the solar facility on their land or the company that owns the facility goes bankrupt, doesn't clean up damage, or doesn't restore the site when the facility is no longer operating. According to TenneSEIA, solar companies also have extensive insurance coverage as required by their lenders and lease agreements.[101] To further help ensure that landowners are protected, the state enacted a solar facility decommissioning law—Public Chapter 866, Acts of 2022 (appendix E)—which sets end-of-life requirements for solar facilities of at least 10 MW[102] on leased land intended to ensure the land can be returned to its previous condition and use. The Act represents a compromise between two organizations representing key stakeholders—the Tennessee Farm Bureau and TenneSEIA.[103] Tennessee also sets requirements for other types of energy-related facilities, including oil and gas wells, wind facilities, and coal mines, to decommission, reclaim, or restore the sites when they are no longer in operation.[104]

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[100] Interview with Steve Sanders, director, and Justin Meredith, environmental fellow, Tennessee Department of Environment and Conservation, Division of Remediation, March 8, 2023; and email received from Justin Meredith, June 13, 2023.

[101] Interview with Gil Hough, executive director, and Chris Bowles, attorney, TenneSEIA, August 29, 2023; and email received from Gil Hough, executive director, TenneSEIA, April 5, 2023.

[102] Tennessee's law specifies that MW are alternating current (ac), which is commonly used for the operating capacity or nameplate capacity of solar facilities. National Renewable Energy Laboratory 2013; and Marcy 2018.

[103] Interview with Shelby Vannoy, assistant director, Kevin Hensley, director, and Kristen Walker, associate director of commodity and industry relations, Public Policy Division, Tennessee Farm Bureau Federation, May 16, 2023.

[104] Rules of the Tennessee Department of Environment and Conservation, Chapter 400.52; Tennessee Code Annotated, Section 65-17; Rules of the Tennessee Department of Environmental and Conservation, Chapter 400.42 and 400.44; and Tennessee Code Annotated, Sections 59-8-106, 59-8-109, and 65-17-101 et seq.

For facilities subject to the decommissioning law's requirements, companies must remove components and restore the land to as close to the condition it was in before construction as reasonably as possible.[105] Electrical and communication lines buried more than three feet can remain.

The decommissioning law defines a solar power facility agreement as "a lease or easement agreement for real property between a grantee and a landowner for the construction, installation and operation of all or a part of a solar power facility on such real property that generates electricity primarily for use and consumption off the premises," and the agreement must provide a decommissioning plan that explains in detail how the company will meet these requirements. The solar developer must also provide financial assurance to the landowner. If the landowner and company are affiliated—for example if the company purchases the land and becomes the landowner—the requirements of the law can be waived. Agreements for facilities that are smaller than 10 MW are not prohibited from having a decommissioning plan or financial assurance, though they are not required to have them under the law. Local governments cannot impose requirements that are more stringent than or in addition to those in state law.

Financial assurance required under the law must cover the decommissioning cost, which is defined as "the estimated cost of performing the removal and restoration obligations . . . less the estimated salvage value of the components of the solar power facility as of the date of removal."[106] The law does not specify how the cost of decommissioning is calculated. Several acceptable forms of financial assurance are allowed including a surety bond, collateral bond, irrevocable letter of credit, parent guaranty, cash, cashier's check, certificate of deposit, bank joint custody receipt, an approved negotiated instrument not described in the law, or a combination of the forms of security described in the law. Unless the landowner opts to accept the financial assurance on the 15th anniversary of the facility's operation start date, as allowed by law, specified amounts of financial assurance must be provided at certain times:

(A) No less than five percent (5%) of the decommissioning cost on the date the solar power facility commences commercial operation

(B) No less than fifty percent (50%) of the decommissioning cost on the tenth anniversary of the date the solar power facility commences commercial operation

(C) No less than the decommissioning cost on the fifteenth anniversary of the date the solar power facility commences commercial operation

[105] Tennessee Code Annotated, Section 66-9-207.

[106] Ibid.

Because the legal definition of decommissioning cost accounts for the value of salvaging equipment and materials, it is possible, and even likely, that the salvage value will exceed the cost to decommission the site, including removal and disposal of materials and restoration of the site. Therefore, the amount of financial assurance required under the law could be negligible or zero. In this case, if the solar company didn't fulfill its legal obligation to decommission the site and restore the land, the landowner would have to rely on selling the salvaged equipment to recoup the cost of decommissioning the facility on their own. Appendix J provides an example of a decommissioning plan and cost estimate for a 75 MW facility at the end of 40 years of operation.[107] In this example, the estimated decommissioning cost is $3.1 million, while the total salvage value is estimated at $5.7 million, a difference of $2.6 million. This example decommissioning plan says that if the cost is greater than zero, then the company will provide financial assurance, but if the costs are negative, no financial assurance will be provided. In this example, the result is $2.6 million in the negative, therefore no financial assurance would be provided.

Because the law went into effect on June 1, 2022, and no facilities subject to it have been decommissioned, the Commission could not evaluate its effectiveness at protecting landowners. There is limited data on decommissioning from other states as well. Although states have enacted solar decommissioning policies and laws, at this point, not many solar facilities have been decommissioned in the US. According to the US Energy Information Administration (EIA), data collected through 2021 shows approximately 12 solar sites in six states have been retired, and most of these were one MW or less.[108] Whether or how these facilities were decommissioned is unclear.

However, the Tennessee law can be compared to other states' policies and laws, as well as to the national Solar Energy Industry Association's (SEIA) model decommissioning legislation (see appendix K). Currently, one federal agency—the Bureau of Land Management (BLM)—and 23 states, including Tennessee, have solar facility decommissioning policies or laws (see map 3).[109] As of May 2023, three states—Arizona, New York, and Pennsylvania—have legislation pending that would enact solar panel decommissioning specific policies.[110] The policies share similarities with Tennessee's policy, such as requiring a decommissioning plan and usually proof of financial assurance prior to construction and a minimum MW capacity, although MW thresholds

[107] Email received from a stakeholder who would like to maintain the company's privacy, May 10, 2023.

[108] US Energy Information Administration 2022a.

[109] TACIR staff review of other states' statutes and Curtis et al. 2021.

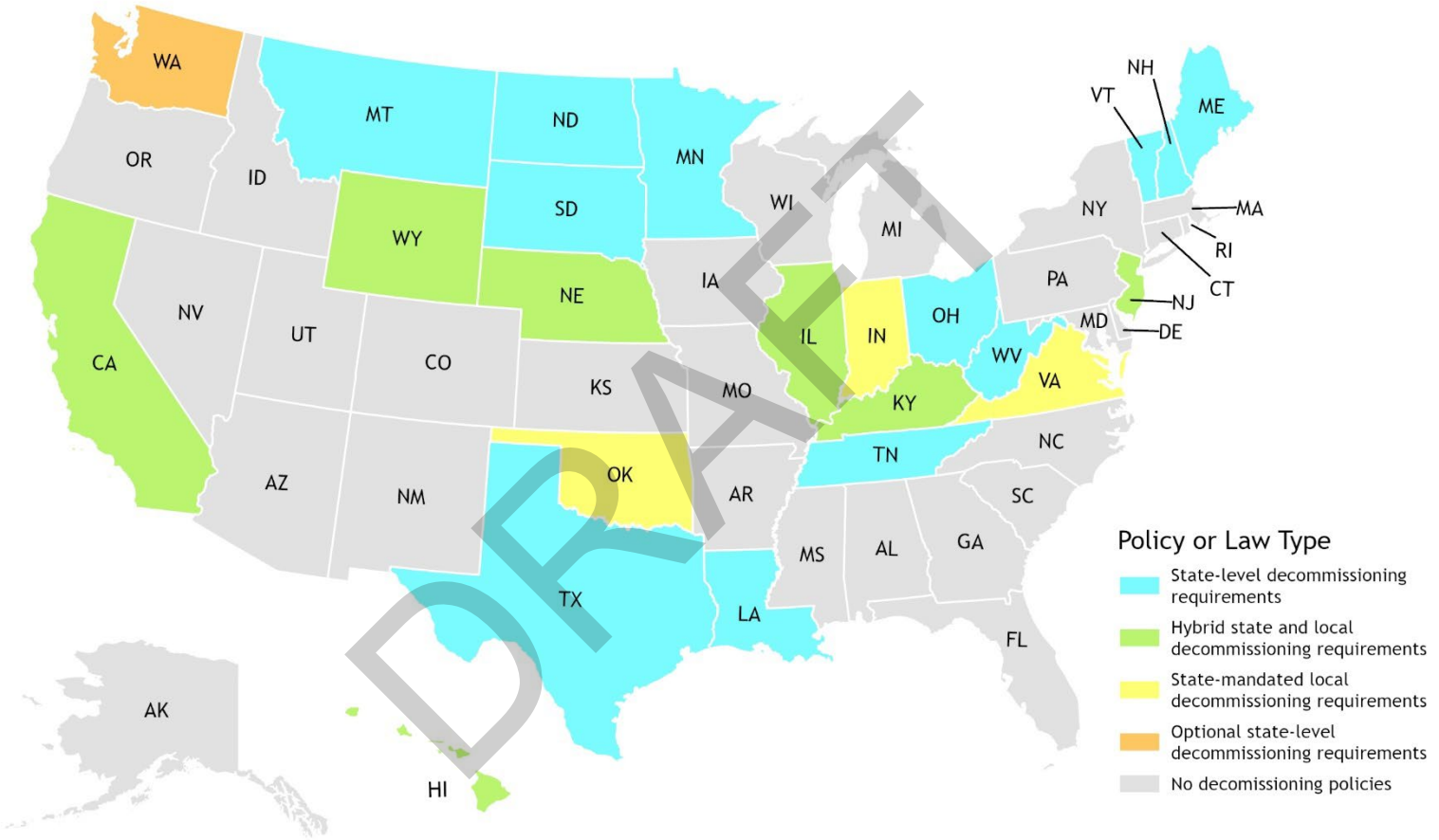
[110] Arizona (H.B. 2618); New York (S.B. 1793); and Pennsylvania (S.B. 211).

vary. But unlike Tennessee's law, eleven states[111] specify how the decommissioning cost is calculated, and all but Tennessee and Texas provide state or local government oversight authority (or both),[112] including allowing penalties for noncompliance. In Tennessee and Texas, disputes between landowners and solar companies regarding the decommission laws are resolved in the courts through civil actions. See table 4 for a summary of decommissioning plan and financial assurance requirements in other states and appendix L for more detail.

[111] California, Illinois, Indiana, Kentucky, Louisiana, Montana, Ohio, Texas, Vermont, Virginia, and West Virginia.

[112] Washington has an optional statewide solar decommissioning program that allows solar project owners to comply with a state certification process in lieu of obtaining local city and county government approvals.

Map 3. States with Solar Decommissioning Policies or Laws



Source: TACIR staff review of US state decommissioning policies; and Curtis et al. 2021b. Tennessee and Texas state law require a decommissioning plan and financial assurance but do not provide for state or local government oversight.

Table 4. Summary of Decommissioning and Financial Assurance Policies

State	Decommissioning Plan Required by State Policy	Financial Assurance Required by State Policy	Specify How Decommissioning Cost is Calculated	Level of Government that Provides Oversight
California	Yes	Yes	Yes	Hybrid state and local
Hawaii	No	Yes	No	Hybrid state and local
Illinois	Yes	Yes	Yes	Hybrid state and local
Indiana	Yes	Yes	Yes	Local-level
Kentucky	Yes	Yes	Yes	Hybrid state and local
Louisiana	Yes	Yes	Yes	State-level
Maine	Yes	Yes	No	State-level
Minnesota	Yes	Yes	No	State-level
Montana	Yes	Yes	Yes	State-level
Nebraska*	No	No	No	Hybrid state and local
New Hampshire	Yes	Yes	No	State-level
New Jersey	Yes	No	No	Hybrid state and local
North Dakota	Yes	Yes	No	State-level
Ohio	Yes	Yes	Yes	State-level
Oklahoma*	No	No	No	Local-level
South Dakota	Yes	Optional	No	State-level
Tennessee	Yes	Yes	No	None
Texas	Yes	Yes	Yes	None
Vermont	Yes	Yes	Yes	State-level
Virginia	Yes	Yes	Yes	Local-level
Washington	Optional	Yes	No	Optional state-level
West Virginia	Yes	Yes	Yes	State-level
Wyoming	Yes	No	No	Hybrid state and local

*Nebraska and Oklahoma do have state-level solar decommissioning policies in place. However, they do not set any requirements for decommissioning plans or financial assurance. Instead, the statutes delegate the authority to the local governments, which may prescribe decommissioning plans and financial assurance requirements. However, R.R.S. Neb. § 70-1014.02(2)(b) says "if the local jurisdiction has not enacted decommissioning requirements, then the Nebraska Power Review Board may bring an action in the name of the State of Nebraska for failure to comply with decommissioning."

Source: TACIR staff review of other states' statutes; and Curtis et al. 2021b.

Fifteen states have enacted policies that require solar project owners to submit both decommissioning plans and proof of financial assurance to a state agency or a local

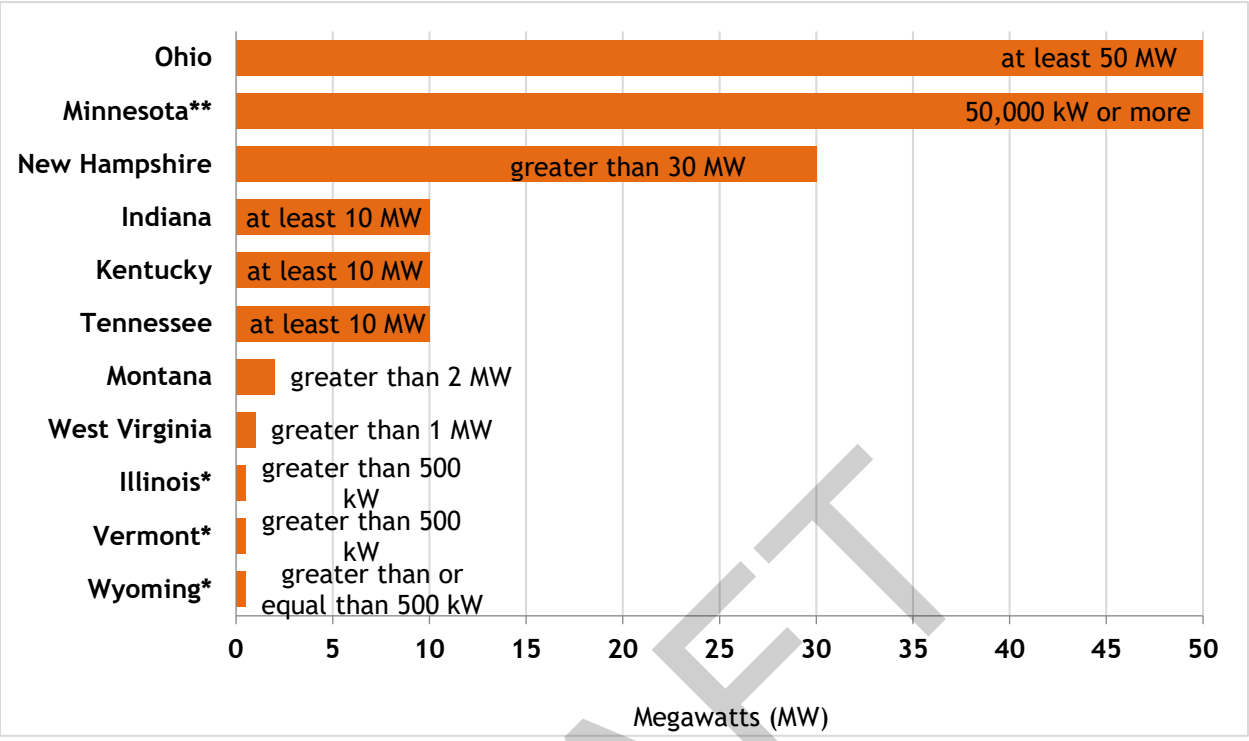
government.[113] New Jersey and Wyoming require a decommissioning plan but not proof of financial assurance. Hawaii does not require a decommissioning plan but does require proof of financial assurance. A decommissioning plan is optional in Washington and financial assurance is optional in South Dakota. Nebraska and Oklahoma do not have specific statewide decommissioning plan requirements but instead require compliance with local government rules and regulations. Tennessee is the only state that requires a decommissioning plan and financial assurance be submitted only to the landowner. Five states[114] require solar facility owners to provide periodic updates to decommissioning plans, cost estimates, or financial assurance instruments after project construction or operation.

States set different MW thresholds in statute for solar decommissioning requirements. The thresholds range from at least 500 kilowatts (kW) in Illinois to at least 50MW in Minnesota and Ohio. Tennessee, Kentucky, and Indiana specify at least 10 MW. The other 39 states do not specify a capacity standard in the state statute. See Figure 3.

[113] California, Illinois, Indiana, Kentucky, Louisiana, Maine, Minnesota, Montana, New Hampshire, North Dakota, Ohio, Texas, Vermont, Virginia, and West Virginia.

[114] Louisiana, Montana, North Dakota, Ohio, and Vermont.

Figure 3. Megawatt (MW) Thresholds for Solar Facility Decommissioning Requirements



*500 kW = 0.5 MW

**50,000 kW = 50 MW

Source: TACIR staff review of other states' statutes.

There are some specific concerns about consumer protection for residential solar installations.

Stakeholders generally agree that most of the fraud committed in the solar industry is happening in the residential solar market, not in the utility-scale market. The Division of Consumer Affairs—the state agency that receives complaints from consumers about businesses—received complaints associated with nine residential solar companies between 2020 and 2023.[115] Of the 498 total complaints received, 477 were directed at two companies. Residential solar installations by these two companies were often expensive—sometimes approaching $100,000[116]—and sometimes included long-term

[115] TACIR staff analysis of data received in an email from Claire Marsalis, director, Office of the Tennessee Attorney General and Reporter, Division of Consumer Affairs, April 6, 2022.

[116] Ibid.

interest payments to a finance company.[117] According to *Forbes*, the average cost of residential solar panels in Tennessee is $10,293, and the national average is $16,000.[118] Further, financed installations often resulted in liens being placed on homeowners' residences, and for some homeowners, adding a non-functioning solar system led to a decreased home value[119] for a home they may lose because of the additional lien.[120]

There are protections but they may not be enough to deter the companies defrauding customers. Consumers who contract with a company to install a solar system on their residence are protected by Tennessee's consumer protection laws—the Consumer Protection Act[121] and Home Solicitations Sales Act.[122] The maximum civil fine for violations of the Tennessee Consumer Protection Act is $1,000, which is on the low end of civil fine maximums compared to other states.[123] A review of other states' laws finds their maximum penalties generally range from $1,000 to $50,000 per violation.[124] Agencies are already working to help consumers avoid fraud—TVA, local power companies (LPCs), and the Office of Energy Programs in TDEC each have information for homeowners on their websites about residential solar installation.[125] Other states are also educating homeowners about protecting themselves—for example, the California Public Utilities Commission hosts a website providing consumer protection information and resources, Georgia's Attorney General's Consumer Protection Division maintains a

[117] Interview with Kelley Groover, senior assistant attorney general; Sam Keen, assistant attorney general; Alicia Daniels-Hill, assistant attorney general; and Claire Marsalis, director, Division of Consumer Affairs, February 24, 2023.

[118] Brill and Ogletree 2023; and interview with Kelley Groover, senior assistant attorney general; Sam Keen, assistant attorney general; Alicia Daniels-Hill, assistant attorney general; and Claire Marsalis, director, Division of Consumer Affairs, February 24, 2023.

[119] Tennessee Attorney General and Reporter 2022; Tennessee Attorney General and Reporter 2023, Commonwealth of Kentucky Office of the Attorney General 2022.

[120] Interview with Kelley Groover, senior assistant attorney general; Sam Keen, assistant attorney general; Alicia Daniels-Hill, assistant attorney general; and Claire Marsalis, director, Division of Consumer Affairs, February 24, 2023.

[121] Tennessee Code Annotated, Sections 47-18-101 et seq.

[122] Tennessee Code Annotated, Sections 47-18-701 et seq.

[123] National Consumer Law Center 2018.

[124] Ibid.

[125] Tennessee Valley Authority "Green Connect"; Middle Tennessee Electric "Renewables"; and Tennessee Department of Environment and Conservation "Energy Resources."

website with guidance, and North Carolina developed a consumer guide to solar electricity.[126]

Representatives of the State Fire Marshal's Office and the Board for Licensing Contractors agree that solar installations are unique and complex, and that there are some safety issues specific to installing solar on residences. Staff from the State Fire Marshal's Office report many instances of improper residential solar installation, including systems not properly grounded, interconnection to the grid wired incorrectly, structural damage to homes, non-functioning panels, and not leaving the required space around panels for firefighters to safely access the roof in case of an emergency.[127] When a residential solar system feeds power to the grid, poor installation can expose local power company line workers to hazardous electrical currents. The National Electric Code requires "qualified personnel" to install solar systems, although this term is loosely defined. The state has implemented this by requiring solar systems to be installed by a licensed electrician.[128]

The Tennessee Valley Authority, local power companies, and the state are encouraging and supporting solar development in Tennessee, and financial incentives are available.

The Tennessee Valley Authority (TVA) is the utility that produces most of Tennessee's electricity and serves local power companies (LPCs) in Tennessee. It sells power wholesale to the LPCs, and LPCs sell it retail to their customers, the consumers. Although solar power is a relatively small part of TVA's energy generation mix, TVA and the local power companies it serves have programs to support solar development, and the Tennessee Department of Economic and Community Development (ECD) and TVA agree that solar is an important part of economic development in the state.[129] Further, state, federal, and private financial incentives assist and encourage both utility-scale and residential solar development. Appendix M is a summary of available incentives.

[126] California Public Utilities Commission "California Solar Consumer Protection Guide Overview & FAQ;" Georgia Attorney General's Consumer Protection Division "Solar Power for Your Home;" and North Carolina Sustainable Energy Association 2019.

[127] Email received from Michael Morelli, executive director, Board of Licensing Contractors, Tennessee Department of Commerce and Insurance, March 23, 2023.

[128] Interview with Michael Morelli, executive director, Board of Licensing Contractors, Tennessee Department of Commerce and Insurance, February 14, 2023.

[129] Interviews with Chassen Haynes, senior director of business development, Tennessee Department of Economic and Community Development, January 24, 2023; and Chris Hansen, vice president, Origination and Renewables, Tennessee Valley Authority, November 14, 2022.

Because of the federal Inflation Reduction Act (IRA), TVA, LPCs, and government agencies are now eligible for tax credits directly—they were not previously.[130]

TVA has programs for both large and residential solar.

TVA is taking several approaches to add 10,000 MW of solar capacity in its service territory by 2035—a "more than a 15-fold increase from today's operating solar."[131] In July 2022, the agency announced a request for proposals for 5,000 MW of carbon-free energy that must be operational before 2029, and in May 2023 said it would begin awarding contracts to 40 solar facilities for a total of approximately 6,000 MW.[132] These facilities could be operational by 2032. TVA's programs have changed over time, but to meet its goals, its current solar programs for commercial, industrial, and residential customers include Dispersed Power Production, Green Invest, Green Switch, and Green Connect. The options it offers are described and compared in its "Valley Renewable Energy Solutions Guide" to help businesses determine which program makes sense for them and their customers.[133]

- Dispersed Power Production: allows residential and commercial renewable electricity-generating facilities up to 80MW to sell all or excess generation to TVA at TVA's monthly avoided cost.
- Green Invest: TVA competitively procures "new-to-the-world" commercial renewables within TVA territory to match customers' renewable energy or carbon-neutral goals.
- Green Switch: allows residential and commercial customers to purchase $2 blocks of 200 kWh of solar power.
- Green Connect: "helps residential customers who are ready to commit to a solar generation system (with or without battery storage) connect with quality installers. Customers have access to objective information and a network of quality installers, as well as receive installation verifications to ensure their systems are installed to TVA Green Connect standards."[134]

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[130].US Department of the Treasury 2022; and US Department of the Treasury "Fact Sheet: Treasury, IRS Open Public Comment on Implementing the Inflation Reduction Act's Clean Energy Tax Incentives."

[131] Tennessee Valley Authority 2021; and Tennessee Valley Authority 2022.

[132] Flessner 2023a; Flessner 2023b; and Pare 2022.

[133] Tennessee Valley Authority "Valley Renewable Energy Solutions Guide;" and Tennessee Valley Authority "Renewable Highlights Fiscal Year 2022."

[134] Tennessee Valley Authority "Green Connect."

- Virtual Solar Education: A website with information to educate the public about solar energy and assist homeowners who are interested in residential solar.[135]

In addition to these programs that encourage businesses and consumers, in 2020, TVA implemented the power supply flexibility option to encourage more utility-scale solar generation and supplement TVA's renewable energy generation.[136] The option allows LPCs with long-term agreements—20 years—in TVA's service territory to produce or purchase 5% of their renewable power from entities within the LPC's service territory other than TVA.[137] Previously, they weren't allowed to do this, and all non-TVA-owned power had to be sold to TVA (then sold back to LPCs, then sold back to customers).[138] In 2022, TVA expanded the authorization in the flexibility agreements by allowing LPCs to generate or purchase the allowed 5% of renewable power from outside their service territories or partner with other LPCs. This helps LPCs with limited access to land, especially in urban and metropolitan areas. As of November 2022, 80 LPCs in TVA's territory have signed on to the flexibility agreement.[139] For example, Nashville Electric Service (NES) is looking at options for utility-scale solar outside Davidson County through TVA's 5% option, and staff from the Knoxville Utility Board (KUB) say the option is helping them reach their renewable goals.[140]

Local power companies are expanding solar options for their customers.

Although LPCs in Tennessee mostly distribute power that TVA produces, some are making efforts to encourage and expand solar power and are at different stages of adjusting to the solar energy transition. For example, some LPCs are working with solar developers on smaller projects of one to two MW—including community solar projects. Knoxville Utility Board (KUB) has a 20% renewable goal because their customers want more renewables.[141] KUB also contracted with TVA to purchase electricity generated by

[135] Tennessee Valley Authority "TVA's Virtual Solar Education Area."

[136] Flessner 2022a.

[137] Tennessee Valley Authority 2020.

[138] Interview with David Callis, executive vice president and general manager, and Mike Knotts, vice president of government affairs, Tennessee Electric Cooperative Association, September 9, 2022.

[139] Tennessee Advisory Commission on Intergovernmental Relations 2023.

[140] Interview with Mike Bolin, vice president of utility advancement, and Chastity Hobby, environmental programs leas, Knoxville Utility Board, September 14, 2022.

[141] Interview with Mike Bolin, vice president of utility advancement, and Chastity Hobby, environmental programs leas, Knoxville Utility Board, September 14, 2022; and Tennessee Valley Authority "Case Study: Knoxville Utilities Board Leads Southeast in Renewable Energy Investment through Green Invest Program."

solar from West Tennessee to reach its goal. It has not contracted directly with any solar developers.

Middle Tennessee Electric (MTE) is another example of an LPC that has developed several programs to assist its customers and encourage solar. Because some of their customers asked for solar, they have tried to provide services for them without burdening the customers that didn't request it.[142] To offer solar to their customers that are unable to do solar on their own but wanted access to it, they built a one MW cooperative, community solar project that allows MTE to take advantage of economies of scale while providing an opportunity for people to participate in solar if they so choose. MTE's Green Switch 100 program is a modified version of TVA's Green Switch—rather than buying blocks of green power, people can match 100% of their electricity consumption with solar generation by paying an extra one penny per kilowatt-hour. This provides an option for people who want to be 100% solar but can't do it on their own. The ProSolar program provides free consultation to provide information about solar installations to its commercial and residential members and help them set realistic expectations.[143]

BrightRidge—formerly Johnson City Power Board—is also moving forward with solar and taking advantage of TVA's 5% option. The LPC, which serves customers in the northeastern part of the state, partnered with TVA and solar developer Silicon Ranch to develop two facilities in Washington County totaling 14 MW and broke ground on a smaller one that will offset electricity use at its administration building and serve as a demonstration project and educational resource.[144]

The state also has programs promoting solar development.

TDEC's Office of Energy Programs (OEP) is the state agency responsible for promoting "efficient, effective use of energy to enhance the environmental and economic health of the state."[145] It does this by providing education, outreach, technical assistance, and funding opportunities for energy-related topics, such as energy efficiency, energy management, and renewable energy. OEP staff respond to inquiries about solar, provide people with information about TVA programs and financial incentives, and refer people

[142] Interview with Brad Gibson, chief operating officer, and Tim Suddoth, distributed energy resources coordinator, Middle Tennessee Electric, April 12, 2023.

[143] Middle Tennessee Electric "Renewables."

[144] BrightRidge 2023; BrightRidge "BrightRidge's Commitment to Clean Energy;" and interview with Jeff Dykes, chief executive officer, BrightRidge, June 2, 2023.

[145] Tennessee Department of Environment and Conservation 2023d.

to the appropriate resources or agencies.[146] They maintain a website with information about renewable energy with links to resources, programs, and organizations.[147] OEP staff say it would be beneficial to have a state website that serves as a one-stop-shop to assist local governments, landowners, developers, and homeowners in Tennessee with solar, and they are open to working with MTAS, CTAS, and the Tennessee Chapter of the American Planning Association to expand, update, and maintain OEP's existing website.[148]

TDEC's Office of Sustainable Practices administers the Certified Green Energy Production Facilities program, which provides an incentive to encourage the use of solar and other clean energy technologies, including geothermal, hydrogen, solar, and wind sources.[149] Facilities that produce or store electricity using clean energy technology can apply to receive certification, and the incentive is either a tax credit, refund for taxes paid, or tax exemption on purchases of machinery and equipment used to produce electricity.[150] From January 2017 through January 2023, the Office of Sustainable Practices received a total of 254 applications (see table 5).[151] In 2022, the General Assembly passed Public Chapter 1139, which allowed projects that produce energy used either on or off site to participate in the program, essentially including small and residential projects in the program.[152] The law also added energy storage projects as eligible to participate.

[146] Interview with Molly Cripps, director, Ben Bolton, senior energy programs administrator, and Taylor Tavormina, executive administrative assistant, Office of Energy Programs, Tennessee Department of Environment and Conservation, December 19, 2022.

[147] Tennessee Department of Environment and Conservation "Energy Resources."

[148] Interview with Molly Cripps, director, Ben Bolton, senior energy programs administrator, Taylor Tavormina, executive administrative assistant, and Blair Beatty, director of legislative affairs, Office of Energy Programs, Tennessee Department of Environment and Conservation, April 24, 2023.

[149] Tennessee Department of Environment and Conservation 2023a.

[150] Tennessee Code Annotated, Sections 67-4-2004 and 67-6-346.

[151] Tennessee Department of Environment and Conservation 2023a.

[152] Interview with Matt Taylor, deputy director, Office of Sustainable Practices, Tennessee Department of Environment and Conservation, January 31, 2023.

Table 5. Certified Green Energy Production Facilities Applications Received From January 2017 through January 2023

Year	Number of Applications Received
2017	84
2018	86
2019	54
2020	18
2021	3
2022	4
2023 (January only)	5
Total	**254**

Note: According to TDEC staff, the decrease in applications is partly related to changes in TVA programs.

Source: Tennessee Department of Environment and Conservation 2023a; and email received from Matt Taylor, deputy director, Office of Sustainable Practices, Tennessee Department of Environment and Conservation, June 8, 2023.

Other states, agencies, and organizations provide many examples of best practices for both utility-scale and residential solar.

Solar development is not new, and across the country, universities, state and federal agencies, and nonprofit organizations have experience and helpful practices to share. There are many resources and guides with best practices available to assist state and local governments, landowners, developers, and homeowners, some of which are included in appendix G, and a few of the best practices are summarized in table 1 (reposted). While these ideas are considered best practices[153] because they are compiled from multiple sources, and there is agreement that they are helpful and beneficial, as researchers from the University of Tennessee's Institute of Agriculture acknowledged, "there are best

[153] The Merriam-Webster Dictionary defines best practice as "a procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption."

practices, but what works varies by location."[154] There is general agreement that gathering information, including best practices, regulations, and laws, in a central, accessible website for all stakeholders in a state is helpful.

When developers work directly with state environmental agencies it can help with the siting, design, and permitting process.[155] Issues with environmental permitting, for instance, can be identified more quickly if TDEC is involved early in the planning process. While permitting for solar development is no different from permitting for other types of development in Tennessee, other states such as North Carolina, Virginia, and Kentucky have developed environmental guidelines specifically for utility-scale solar development.[156] Environmental offices in other states commonly recommend panel height, buffers, and fencing both to solar developers and landowners. Limiting panel height is a method of protecting scenic views and reducing erosion by controlling how fast rainwater runs off panels.[157]

States can also assist local governments with planning and zoning for solar development by providing statewide guidance. Kentucky, Georgia, New York, and North Carolina have created resource toolkits that provide information for local governments, landowners, developers, and homeowners.[158] Toolkits generally provide information on permitting, development timelines, storm water management, and brownfield and greenfield development, among other topics. The US Department of Energy (DOE), Farm Energy Initiative, National Association of State Energy Officials, SolSmart, and other agencies and organizations have also developed guidelines and considerations for decision-making and effective solar development.[159]

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[154] Interview with Forbes Walker, professor and environmental soil specialist, UT Extension, and Christopher Clark, head, Karen Lewis DeLong, associate professor, and David Hughes, professor, Department of Agricultural & Resource Economics, University of Tennessee Institute of Agriculture, February 16, 2023.

[155] Interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023.

[156] North Carolina Department of Environmental Quality 2018; Virginia Department of Wildlife Resources 2022; and Kentucky Energy and Environment Cabinet "Kentucky Solar Toolkit."

[157] Interview with Mike Lawyer, stormwater program supervisor, North Carolina Department of Environmental Quality, April 26, 2023.

[158] Kentucky Energy and Environment Cabinet "Kentucky Solar Toolkit;" EPICenter at Georgia Tech "Georgia's Model Solar Ordinance;" Lovelady 2014; and New York State Energy Research and Development Authority 2022.

[159] Fekete et al. 2023; and SolSmart 2022.

Organizations, federal agencies, and other states have created model ordinances and best practice guides to help local governments plan for solar development. In Tennessee, TenneSEIA, MTAS, and CTAS developed a model ordinance, discussed earlier, to assist local governments (see appendix C). The International City/County Management Association and American Planning Association developed a local government guidebook that includes some ordinances from other states.[160] Some states including Georgia, Kentucky, North Carolina, Illinois, Indiana, Iowa, Minnesota, and Wisconsin have developed model ordinances to help local governments by providing structured and consistent guidelines such as recommendations for setbacks, guidelines for permitting, panel height, decommissioning plans, and buffering guidelines.[161]

Along with state and local governments, best practices exist for solar developers. The National Renewable Energy Lab published a resource document with best practices for developers along with ethical considerations,[162] and SEIA created a solar business code with guidelines for its members to "promote transparency, good faith, and understanding in the US solar energy industry."[163] Developers say ethical practices are important for building trust and minimizing fraud within the community. Developers further build trust when they notify the local planning department about their project and communicate about potential concerns and permitting requirements.[164] Understanding building and environmental permits and licensing requirements ahead of selecting and designing the site and an awareness of how jurisdictions regulate development can save time and money both for solar developers and the community. Communicating with the Tennessee Office of State Assessed Properties about changes to land use, from agriculture to utility for example, is important so that both developers and landowners understand the property tax implications associated with a change in land use designation.[165]

Power purchase agreements and lease agreements are also key components of solar development. SEIA created guides to understanding both types of agreements that

[160] Gomez and Morley 2019.

[161] Gomez and Morley 2022.

[162] Lumby et al. 2015.

[163] Solar Energy Industries Association 2015.

[164] Interview with Erin Curran analyst, government affairs, and Laurel Downen, lead developer, Southeast Region, Invenergy, August 12, 2022.

[165] Interviews with Jason Stewart, senior specialist, Tennessee Office of State Assessed Properties, November 4, 2022; and Greg Moody, director, Tennessee Office of State Assessed Properties, February 28, 2023.

include resources to help both utility-scale and residential solar.[166] To standardize solar transactions and protect consumers, the Solar Access to Public Capital group led by the National Renewable Energy Laboratory created model contracts for solar development. SEIA endorsed the model contract as a best practice for solar developers as well as landowners and consumers.

A couple of practices are particularly helpful for landowners to protect themselves. Consulting with an attorney—if possible one with expertise in solar facility leases—when beginning to consider a solar agreement is one of the most important actions a landowner can take.[167] For example, the North Carolina Extension office published a list of considerations for landowners considering solar options that an attorney could help navigate. Considerations include determining if there is a clear title, evaluating any limitations from easements, conservation programs, farm tenants and lessors, obtaining zoning and special use permits, and resolving property tax issues. In addition, if possible, talking to neighbors and other landowners interested in leasing their land for solar before entering into an agreement and being familiar with general lease and purchase amounts can help landowners make educated decisions.[168]

Similar to landowners, homeowners considering residential solar can take steps to protect themselves. For instance, first reaching out to the local power company helps homeowners evaluate their energy consumption and whether solar panels would be cost effective for them.[169] Additionally, as with any home improvement project, it is good practice to talk with several companies and verify their legitimacy and quality. TennesSEIA maintains a code of conduct and ethical standards for its members that is a good resource for finding companies for both residential and utility-scale solar in Tennessee, and consumers could also hire solar installers with certifications such as those offered by the National Board of Certified Energy Practitioners.[170] The TDEC Office of

[166] Solar Energy Industries Association "Finance & Tax;" Solar Energy Industries Association "Land Use & Solar Development;" Solar Energy Industries Association "Model Leases and PPAs;" and Solar Energy Industries Association 2016.

[167] Branan 2022; and Hannum et al. 2022.

[168] Hannum et al. 2022.

[169] Interview with Brian Solsbee, executive director, Jeremy Elrod, director of government relations, and Savannah Gilman, government relations assistant, Tennessee Municipal Electric Power Association, August 30, 2022.

[170] Solar Energy Industries Association 2015; and interview with Michael Morelli, executive director, Board of Licensing Contractors, Tennessee Department of Commerce and Insurance, February 14, 2023.

Energy Programs also assists homeowners, answers questions, and provides guidance on available incentives.[171]

[171] Interview with Molly Cripps, director, Ben Bolton, senior energy programs administrator, and Taylor Tavormina, executive administrative assistant, Office of Energy Programs, Tennessee Department of Environment and Conservation, December 19, 2022.

Table 1 (reposted). Examples of Best Practices for Utility-Scale and Residential Solar Development

Utility-Scale Solar			
Entity	**Best Practices**	**Resource Examples**	**Sources**
State Government	Implement solar decommissioning law	Solar Energy Industries Association (SEIA) model decommissioning legislation (see appendix K)	Curtis et al. 2021b
	Development of model ordinances to guide local governments	Georgia Model Solar Ordinance	Gomez and Morley 2022
	Education about common issues with regulations for permitting solar development	City of Raleigh, North Carolina, "Failing an Inspection: Solar Photovoltaic (PV) Systems"	Interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023; North Carolina Department of Environmental Quality 2018; Virginia Department of Wildlife Resources 2022
	Resource document or webpage for solar development in the state, including but not limited to applicable environmental permits and zoning guidelines	Kentucky Solar Toolkit (arcgis.com)	Kentucky Energy and Environment Cabinet "Kentucky Solar Toolkit;" Fekete et al. 2023
Local Governments	Establish solar zoning ordinances with guidelines for permitting, siting, setbacks, panel height, buffering, and decommissioning plans	Haywood County Zoning Resolution (see appendix D)	Gomez and Morley 2022

	Use authority to adopt zoning	University of Tennessee Municipal Technical Advisory Service (MTAS) and County Technical Assistance Service (CTAS), and Tennessee Chapter of American Planning Association (APA)	Tennessee Code Annotated, Sections 13-7-101 and 13-7-201
	Notify the Federal Aviation Administration and air traffic control about solar facilities larger than 1/2 of an acre that are near an airport	North Carolina Template Solar Ordinance	Barrett and Devita 2011
	Identify and redevelop brownfields, parking lots, and other non-prime farm land with solar	NREL Best Practices for Siting Solar Photovoltaics on Municipal Solid Waste Landfills	Tennessee Code Annotated, Section 68-212-220; and TDEC "Brownfield Voluntary Cleanup Oversight and Assistance Program"
Developers	Use established templates and guidelines for power purchase agreements and leases	SEIA Model Leases and PPAs	US Environmental Protection Agency 2023d; Solar Energy Industries Association "Model Leases and PPAs;" and Solar Energy Industries Association 2016
	Thoroughly evaluate site selection, facility design, and permit and licensing requirements	International Finance Corporation "Utility-Scale Solar Photovoltaic Power Plants"	Doyle et al. 2015
	Communicate and coordinate early in planning and design process with community stakeholders such as state environmental offices (for example TDEC) and local governments	TDEC Division of Water Resources	University of Massachusetts Clean Energy Extension 2022; interview with April Grippo, deputy director, Ann Morbitt, integrated water resources consultant, and Lee Barber, natural resources unit manager, Division of Water Resources, Tennessee Department of Environment and Conservation, February 13, 2023

	Follow ethical guidelines	SEIA Solar Business Code	TenneSEIA “Code of Ethics”
	Use land for solar and agriculture or pollinator habitats (dual use, agrivoltaics, or agrisolar)	National Renewable Energy Laboratory "Agrivoltaics Primer"	Macknick et al. 2022; The Nature Conservancy 2023; University of Maine "Cooperative Extension: Maine Wild Blueberries"
	Understand the long-term implications of leasing the land	North Carolina State Extension "Legal Issues Surrounding Due Diligence for Solar Development"	American Farmland Trust “Smart Solar℠ on Farmland and Ranchland Strengthening Farm Viability and Soil Health While Growing Renewable Energy”
Landowners	Understand the limitations of easements and conservation programs for solar development	WeConservePA "Solar Energy Development and Land Conservation"	Conservation Easement Act of 1981, Tennessee Code Annotated, Section 66-9-303; Tennessee Department of Agriculture "Land Protection Options;" Land Trust for Tennessee "Protect Your Land"
	Understand property tax implications and any rollback taxes associated with changes in property use designation	2022GreenbeltManual.SBOEAPPROVED.pdf (tn.gov)	Nuckols 2020; interview Greg Moody, director, Tennessee Office of State Assessed Properties, February 28, 2023
	Compare offers for solar development with other landowners where possible	American Farmland Trust "Solar Leasing: A Guide for Agricultural Landowners in the Pacific Northwest"	Interview with Charles Dacus, farmer, Fayette County, January 18, 2023
	To preserve land, put it in a conservation easement or trust	Tennessee Department of Agriculture "Land Protection Options"	Conservation Easement Act of 1981, Tennessee Code Annotated, Section 66-9-303
Residential Solar			
State Government	Resource webpage with information for consumers	Georgia "Solar Power for Your Home"	Interview with David Callis, executive vice president and general manager, and Mike Knotts, vice president of government affairs, Tennessee Electric Cooperative Association, September 9, 2022

Homeowners	Speak with local electric companies regarding cost effectiveness and return on investment	Middle Tennessee Electric ProSolar	Interview with Brian Solsbee, Executive Director, Jeremy Elrod, Director of Government Relations, and Savannah Gilman, Government Relations Assistant, Tennessee Municipal Electric Power Association, August 30, 2022
	Evaluate residential solar companies for legitimacy and cost	TVA "Green Connect"	Interstate Renewable Energy Council (IREC) 2016
	Call the TDEC Office of Energy programs to answer questions regarding residential solar development and any active incentive programs	TDEC "Office of Energy Programs"	Interview with Molly Cripps, director, Ben Bolton, senior energy programs administrator, and Taylor Tavormina, executive administrative assistant, Office of Energy Programs, Tennessee Department of Environment and Conservation, December 19, 2022
	Use providers certified by the National Board of Certified Energy Practitioners and consider using companies that are members of TenneSEIA as they are bound by a code of ethics	TenneSEIA "Membership"	Solar Energy Industries Association 2015; North American Board of Certified Energy Practitioners "NABCEP Board Certifications"

Note: Some of these best practices are being used in Tennessee.

Source: These examples of best practices are discussed in multiple resources from other states, government agencies, and organizations, and TACIR staff interviews with multiple stakeholders.

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