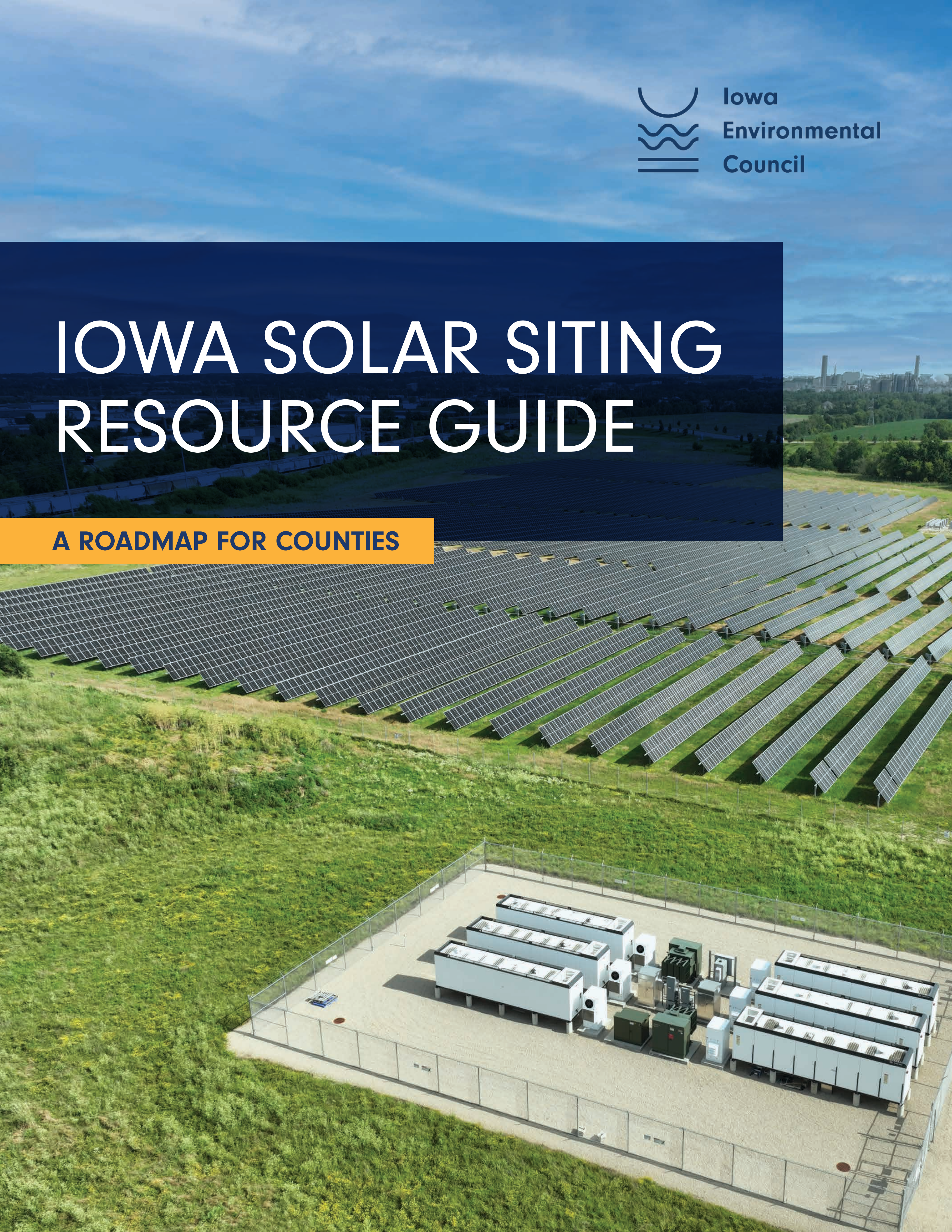
Iowa Environmental Council

IOWA SOLAR SITING RESOURCE GUIDE

A ROADMAP FOR COUNTIES



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INTRODUCTION

Solar at all scales is a growing opportunity in the state of Iowa.

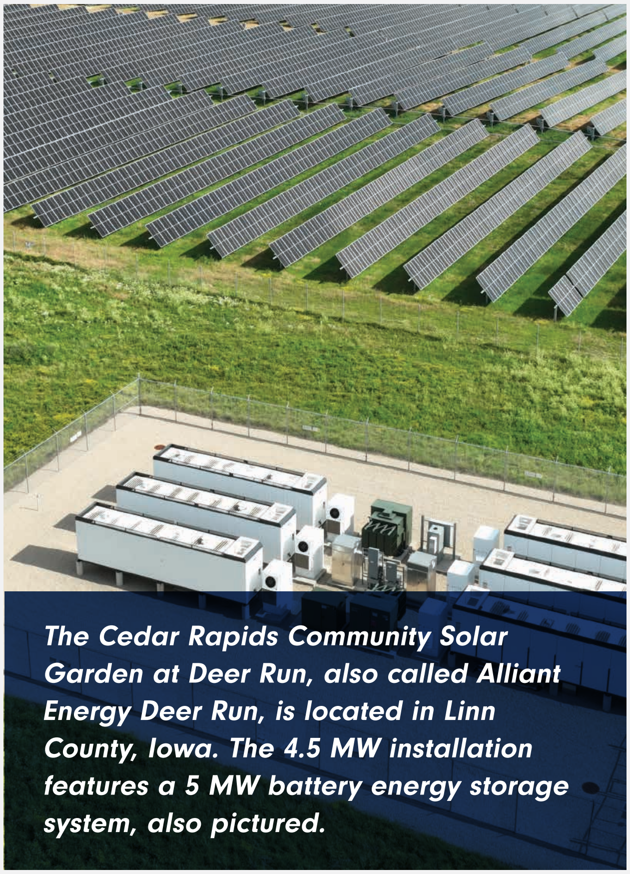
From immense growth in the customer-owned solar market to the expansion of utility-scale projects, Iowa is in the midst of a solar boom. For counties presented with the opportunity to engage in large-scale solar projects, an important tool to consider is a well-drafted ordinance. A good ordinance will preserve the interests of the county and its residents while enabling developers to build workable, cost-effective projects. Under Iowa's home rule policy, counties have some latitude to adopt ordinance provisions related to solar development.

A well-crafted ordinance will take into consideration the jurisdiction of the Iowa Utilities Commission (IUC) to approve projects that are 25 megawatts (MW) or larger in size.

Solar from all sources in Iowa has grown from around two MW in 2012 to an estimated 1,030.1 MW in May 2025.[1] The first utility-scale project, 127.5 MW, came online in 2021 in Louisa County. The largest utility-scale project, 200 MW, came online in May 2025 in Linn County.

This guide focuses on siting practices for utility-scale solar. We will not focus on personal solar energy systems, such as those used at homes, farms, and businesses to produce electricity for usage on-site.

A number of Iowa counties, along with many of our neighbors in the Midwest, have already adopted solar ordinances and experienced utility-scale development. In addition to the existing Iowa ordinances, **we have reviewed the ordinances and best practices from neighboring states and identified specific provisions that local officials can use as a road map for their own ordinances.**



The Cedar Rapids Community Solar Garden at Deer Run, also called Alliant Energy Deer Run, is located in Linn County, Iowa. The 4.5 MW installation features a 5 MW battery energy storage system, also pictured.

WE ENCOURAGE...

Counties that are crafting an ordinance, or updating an ordinance, to use this document as a reference to support the development and adoption of a well-designed ordinance rooted in existing successful siting practices.

OPERATING SOLAR INSTALLATIONS IN IOWA

ENTITY NAME	PLANT NAME	COUNTY	NAMEPLATE CAPACITY (MW)	OPERATING MONTH/YEAR
CITY OF OSAGE - (IA)	OSAGE (IA)	MITCHELL	0.8	NOV-16
INTERSTATE POWER AND LIGHT CO	MARSHALLTOWN GENERATING STATION	MARSHALL	2.6	FEB-20
CENTRAL IOWA POWER COOPERATIVE	EASTERN IOWA SOLAR	MUSCATINE	1.8	NOV-16
INTERSTATE POWER AND LIGHT CO	WEST DUBUQUE SOLAR	DUBUQUE	3.8	SEP-17
SOCORE ENERGY LLC	STRAWBERRY POINT DPC SOLAR	CLAYTON	1.3	NOV-17
ALTUS POWER AMERICA MANAGEMENT, LLC	CEDAR FALLS SOLAR FARM	BLACK HAWK	1.5	APR-16
AEP ONSITE PARTNERS, LLC	BLOOMFIELD MUNICIPAL UTILITIES SOLAR	DAVIS	1.6	APR-19
BUTTER SOLAR, LLC	FOREST CITY SOLAR	WINNEBAGO	3.0	SEP-19
WAPELLO SOLAR LLC	WAPELLO SOLAR LLC	LOUISA	100.0	MAR-21
FOREFRONT POWER, LLC	IA – CITY OF AMES – AIRPORT ROAD	STORY	2.0	DEC-20
MIDAMERICAN ENERGY CO	HOLLIDAY CREEK SOLAR	WEBSTER	100.0	JUL-22
MIDAMERICAN ENERGY CO	ARBOR HILL SOLAR	ADAIR	25.0	JAN-22
MIDAMERICAN ENERGY CO	WATERLOO SOLAR (IA)	BLACK HAWK	3.0	MAR-22
MIDAMERICAN ENERGY CO	JOHNSON COUNTY HILLS SOLAR	JOHNSON	3.0	JAN-22
MIDAMERICAN ENERGY CO	FRANKLIN COUNTY SOLAR	FRANKLIN	7.0	JAN-22
AZIMUTH 180 SOLAR ELECTRIC, LLC	GRINNELL COLLEGE	POWESHIEK	3.9	APR-24
MIDAMERICAN ENERGY CO	NEAL ENERGY CENTER SOLAR	WOODBURY	4.0	FEB-22
GREENBACKER RENEWABLE ENERGY CORPORATION	MAPLE CITY	MITCHELL	1.5	DEC-22
INTERSTATE POWER AND LIGHT CO	CEDAR RAPIDS COMMUNITY SOLAR	LINN	4.5	FEB-24
INTERSTATE POWER AND LIGHT CO	FAREWAY CUSTOMER HOSTED SOLAR	BOONE	1.0	MAY-24
INTERSTATE POWER AND LIGHT CO	HY-VEE CUSTOMER HOSTED SOLAR	LUCAS	2.3	JUL-24
INTERSTATE POWER AND LIGHT CO	ISU CUSTOMER HOSTED SOLAR PROJECT	STORY	1.4	MAY-24
INTERSTATE POWER AND LIGHT CO	PERRY CUSTOMER HOSTED SOLAR PROJECT	DALLAS	1.0	JUL-24
INTERSTATE POWER AND LIGHT CO	PLEASANT CREEK UNIT 1	LINN	50.0	MAR-24
INTERSTATE POWER AND LIGHT CO	CRESTON SOLAR	UNION	50.0	OCT-24
INTERSTATE POWER AND LIGHT CO	PLEASANT CREEK UNIT 2	LINN	150.0	DEC-24
INTERSTATE POWER AND LIGHT CO	WEVER SOLAR	LEE	150.0	NOV-24
SOCORE ENERGY LLC	DPC MADISON	WINNESHIEK	1.5	FEB-19

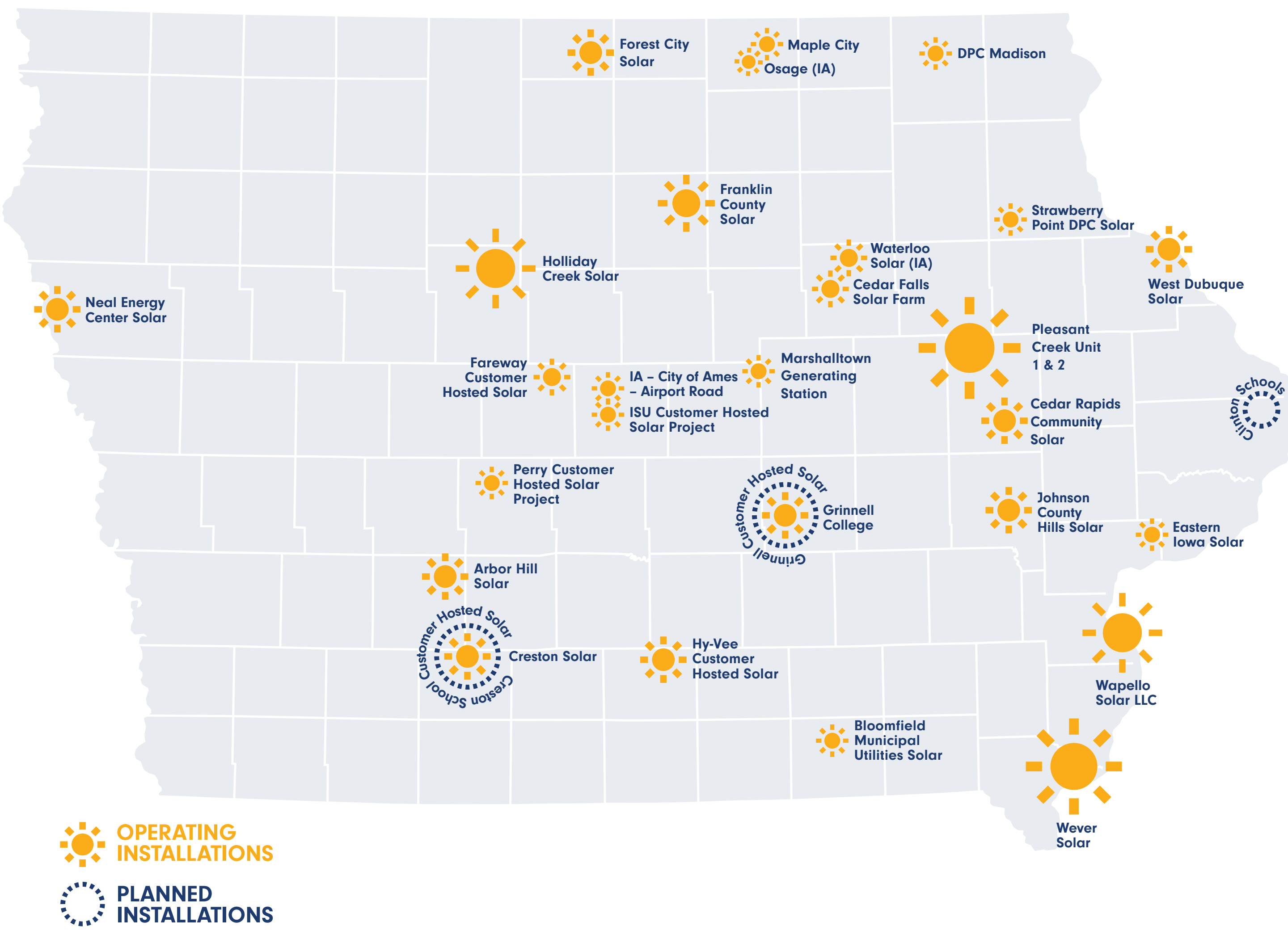
Operational and planned solar projects in Iowa with a combined nameplate capacity of 1 MW or greater, up to date through July 2025. Data from the U.S. Energy Information Administration's Preliminary Monthly Electric Generator Inventory (based on Form EIA-860M as a supplement to Form EIA-860).

PLANNED SOLAR INSTALLATIONS IN IOWA (Under Construction, more than 50% Complete as of July 2025)

ENTITY NAME	PLANT NAME	COUNTY	NAMEPLATE CAPACITY (MW)	OPERATING MONTH/YEAR
INTERSTATE POWER AND LIGHT CO	CRESTON SCHOOL CUSTOMER HOSTED SOLAR	UNION	1.4	MAY-25
INTERSTATE POWER AND LIGHT CO	GRINNELL CUSTOMER HOSTED SOLAR	POWESHIEK	5.0	SEP-25
INTERSTATE POWER AND LIGHT CO	CLINTON SCHOOLS	CLINTON	1.3	SEP-25

PLANNED SOLAR INSTALLATIONS IN IOWA

(Under Construction, more than 50% Complete as of July 2025)



EIA's Preliminary Monthly Electric Generator Inventory (based on Form EIA-860M as a supplement to Form EIA-860), July 22, 2025.

A. STATE AND LOCAL BENEFITS FROM SOLAR DEVELOPMENT AND FUTURE POTENTIAL

Iowa has what it takes to be a national leader in solar energy. The state ranks 16th among U.S. states in technical production for solar energy production, putting Iowa ahead of states such as Florida, Georgia, and South Carolina. A solar photovoltaic (PV) array located in Iowa produces a comparable amount of electricity as one located in Miami or Atlanta, and more than arrays located in Chicago.[2]

Driven by rapidly improving economics of solar energy, Iowa is poised for significant continued development of large-scale projects. A recent report found that the levelized cost of energy for utility-scale solar declined 84% from 2009 to 2025, and 4% from 2016 to 2025.[3] There were 2,994 MW of potential solar projects in Iowa being studied for connection to the grid by the regional grid operator Midcontinent Independent System Operator (MISO) at the beginning of May 2025.[4]

Counties may play a role in solar development by reviewing and approving specific solar projects. County policies that guide review and approval need to strike a balance between concerns expressed by county residents and successful, cost-effective solar development. An ordinance can play a critical role in achieving a balance and seeing maximum local benefits from solar generation.

Solar development offers a number of benefits to county residents and the county itself. These benefits include:

- **Lease or easement payments to landowners.** Payments to landowners provide long-term, stable streams of revenue.
- **Property tax revenue to counties.** Solar arrays generate property tax revenue paid to counties that can support a range of public benefits, including roads and bridges, health services, schools, debt service, and reduced need for revenue from other sources.
- **Replacement tax revenue to counties.** State law provides a defined replacement tax for electric generating facilities to ensure similar tax treatment for potential competitors within the state.
- **Clean energy resources.** Unlike fossil-fuel power plants, solar arrays do not produce air pollutants or mercury, thus reducing acid rain, smog, and public health impacts such as pulmonary and heart disease and asthma. Solar arrays do not use water or produce water pollution in the process of generating electricity or produce hazardous waste that threatens public health, unlike fossil and nuclear power plants.
- **Local economic development.** In 2023, over 898 jobs in Iowa were supported by the solar industry, according to the Interstate Renewable Energy Council [IREC].[5] The U.S. Bureau of Labor Statistics found employment of solar PV installers is expected to grow 48% from 2023 to 2033, with about 4,100 openings projected each year. In total, there were an estimated 25,000 solar PV installer jobs throughout the U.S. in 2023.[6] These jobs are located across the state in a range of sectors including manufacturing, installation, and operations and maintenance.

B. COMPREHENSIVE PLAN

Iowa Code specifies that zoning ordinances and decisions "shall be made in accordance with a comprehensive plan…" (Iowa Code § 335.5).[7] Iowa Code also specifies that "it is the intent of the general assembly to encourage the development of renewable electric power generation. It is also the intent of the general assembly to encourage the use of renewable power to meet local electric needs…" (Iowa Code § 476.53A).[8] For this reason, **we recommend counties contemplate and encourage renewable energy development by adopting ordinances that align a county's comprehensive plan with the state's and county's intentions to attract such development.**

CEDAR COUNTY[9]

"**Goal III.** Encourage the creation and use of alternative and renewable energy sources.

Objective 1: Increase alternative and renewable energy sources in the county.

Strategies: Review and modify the zoning ordinance and other relevant county regulations as necessary to remove barriers to the use of renewable energy systems such as solar, wind, and geothermal.

The County should promote the use of renewable and inexhaustible energy sources over non-renewable energy sources..."

C. DEFINITION OF TERMS

Like many areas of technology and regulation, solar siting uses terminology that is critical for local government officials to understand and define in order to create a clear ordinance. The list of terms provided here is not exhaustive, but defines many of the terms and recommended definitions counties should consider adding to the definitions section of a solar siting ordinance.

- **Utility-Scale Solar Energy System.** A solar energy system above a certain capacity that is intended to produce electricity to sell into the market, not to directly supply end-use customers. These systems are larger than small-scale residential or business solar installations and many community systems, often covering more land area.

Note: *If a system is 25 MW or larger, it will need to obtain a siting certificate from the Iowa Utilities Commission (IUC). The hearing for the siting certificate will be held in the county where construction is to occur, and the county will be a party to the proceeding. Solar energy systems smaller than 25 MW do not require a siting certificate.*[10]

- **Applicant:** The owner or operator of a utility-scale solar energy system.
- **Easement:** A legal agreement for the use of property for a specified purpose.
- **Feeder circuit/lines:** A power line or network of lines used as a collection system that carries energy produced by a solar energy system to an interconnection point like a substation. Feeder circuits are most often placed underground.
- **Glare/glint:** Light reflected off a surface.
- **Interconnection:** Link between a generator of electricity and the electric grid. Interconnection typically requires connection via infrastructure such as power lines and a substation, as well as a legal agreement for the project to be connected to the grid.
- **Lease:** A contract between two parties where one party, the lessor, allows the other party, the lessee, use of its property for a period of time in exchange for consideration, usually a monthly sum of money. The original landowner ultimately retains possession of the property.
- **Module:** An individual unit comprised of multiple photovoltaic (PV) cells, with multiple modules used in a solar energy system.
- **Mounting:** The method of anchoring solar energy systems modules to the ground or a building.
- **Non-participating landowner:** Any landowner that has not signed a lease agreement for an easement with the project owner or developer, often adjacent to or near the project.

- **Operator:** The entity or individual that operates a solar energy system.
- **Owner:** The entity or individual that has ownership over a solar energy system.
- **Participating landowner:** A landowner who has signed a lease agreement for an easement with a project owner.
- **Residential/small-scale solar energy system:** A solar energy system that is installed at a residence or business to meet the electric demand at the location. These systems are typically intended to offset electricity use for the owner and are not intended to be net generators of electricity.
- **Solar energy system:** A system that converts energy from sunlight into electricity or additional energy source such as heat.
- **Structure:** Anything constructed or erected on the ground or attached to the ground, including but not limited to, antenna(s), buildings, sheds, cabins, dwellings (built on-site or factory-built homes), signs, storage tanks, towers, windmills, or other similar uses.
- **Substation:** A facility that converts electricity produced by a generator like a solar system to a higher voltage, allowing for interconnection to high-voltage transmission lines.
- **System height:** The height of a solar energy system, usually referring to ground mounted systems. Total system height is the measurement from the ground to the top of a mounting or modules associated with the system at maximum tilt. Counties may also wish to include an additional height definition for ground clearance, or measurement between the ground and at the bottom of modules or mounting.
- **Transmission lines:** Power lines used to carry electricity from collection systems or substations over long distances.

Establishing perennial vegetation on a solar project site is considered a best practice with multiple benefits. See Section III Part C for more information.

APPROVAL PROCESS AND LOCATION

Iowa Code constrains to some extent the procedural options available to counties for consideration and approval of large-scale solar. The best practices recommended in this section apply primarily to counties that have adopted zoning and may not apply to counties without zoning.

A. RECOMMENDATIONS

- **We recommend that counties adopt ordinances that are consistent with their comprehensive plan including a statement about their interest in attracting solar development, and the key considerations around regulating solar siting.**
- **We recommend that county officials prioritize creating a clear application and review process with well-defined steps and conditions for approval. This allows a solar developer to clearly identify the application requirements for a solar project which, if met, will result in county approval of the application.**
- **Any application fees should not exceed the cost of processing the application, including any required inspection, or be used as a revenue-generating mechanism.**[11]

B. OPTIONS FOR SITING

Counties can use various processes to govern solar siting. The two most straightforward options are to make solar systems a permitted use (also sometimes called an "allowed" or "principal" use) in specific zones or designate solar systems as a conditional use (also called a "special" use or "special exemption"). In the case of a conditional use, supervisors should define the conditions that the project must meet to be approved.

1. Solar as a Permitted Use

If a county ordinance designates solar as a permitted use, county staff review projects to determine compliance with objective ordinance requirements. County staff would be able to determine objective requirements, such as whether a project meets required setbacks, but would not be able to decide subjective requirements. If the project complies with the ordinance, it can move forward. County staff typically issue a building or zoning permit under this approach.

2. Solar as a Conditional Use

The term "conditional use" in a zoning code usually means that a use may be allowed or permitted in a specific district (or districts) on the condition that certain requirements are met. Conditional use permitting decisions depend on the applicant's compliance with the standards specified in the zoning code as conditions for permit approval. These conditions may be more subjective, but the decision criteria must be included in the ordinance. Conditional uses can only be permitted subject to review and approval of a county zoning board of adjustment (ZBA) after a public hearing. The ZBA should base its decision on evidence presented in the public hearing and evaluate the project based on the project's compliance with the conditions in the ordinance. In counties where the approval of the Board of Supervisors (BOS) is required, the BOS should approve the recommendations of the ZBA. If conditions are met, the permit should be issued.

Uses permitted on this basis are typically those that a county considers not generally adverse to the public interest, but requiring some special review and precautions as well as an opportunity for public input.

Counties may wish to require the filing of items such as site plans, road use agreements, and decommissioning plans as conditions for approval. These are described in more detail later in the document.

If a county opts for conditional use permitting through the ZBA, **we recommend providing applicants with the opportunity for a preliminary review and pre-application process**. Iowa law provides that appeals of a final decision of the ZBA go to court for review.[12] Allowing for preliminary review and a pre-application process helps provide applicants with a more predictable process and can minimize the potential for time-consuming or expensive judicial review.

For solar projects that are 25 MW or larger, the county has the opportunity to state whether the solar energy system meets the county zoning requirements, as a designated party to the Iowa Utilities Commission's public hearing held in the county as part of the single hearing process required under Section 476A.11 of the Iowa Code.[13]

EXAMPLES OF DISTRICTS WHERE IOWA COUNTIES WITH ZONING ALLOW SOLAR DEVELOPMENT

Jones County
A2, I1, I2, and Planned Development (PD)

Louisa County
Agricultural District, Business District, and Industrial District

Mills County
Agricultural Zoning District (AG), Agricultural/Residential Zoning District (AR), and Industrial Zoning District (I)

Muscatine County
Special permitted use in A-1 Agricultural District, permitted use in I-1 Light Industrial District

C. DESIGNATING ZONING DISTRICTS FOR SOLAR

Counties may allow siting of utility-scale solar in a variety of districts. An easy place to start for solar development in zoning districts would be designating at a minimum industrial and agricultural as eligible for utility-scale projects.

D. APPLICATION REQUIREMENTS

1. Recommendations

- **Project applications should provide essential information to county boards and zoning officials. While some information may be required at the time of application, officials may wish to allow applicants to submit additional information at a later date.**
- **For projects 25 MW or larger, we recommend that the county accept the Application for Certificate, required by the Iowa Utilities Commission, in lieu of a separate county application.**

2. General Requirements

County ordinances may include a number of site and structure requirements, many of which are discussed in further detail within this document. Some counties may ask for this information as part of a "site plan." Items required in an application for a utility-scale solar energy system may include:
1) Name of applicant.
2) Name of the project owner.
3) Description of the project – number of modules, manufacturer, mounting type, system height, system

Counties should require a site maintenance plan that addresses both the short-term and long-term maintenance of the project. See Section IV Part B for more information.

capacity, total land area covered by the system, and information about associated facilities like substations, feeder lines, battery storage, etc.

4) Legal description of the property line where the solar energy system will be located.
5) Map of the project location and the surrounding area.
6) A decommissioning plan outlining the process for system removal – including individual modules and mounting – and property restoration.
7) Evidence of a power purchase agreement or interconnection application for the project.
8) Consultation with or notifications from relevant state and federal agencies showing the project will not be a hazard to wildlife, communications, air traffic, etc.
9) Documentation of easement locations acquired for solar energy systems and associated facilities.

Because the IUC requires similar types of information as part of the Generating Certificate application process, **we recommend that for projects above 25 MW, counties accept the information submitted in such an application to the IUC in lieu of a separate application to avoid duplication.**

SYSTEM DESIGN RECOMMENDATIONS

Successful solar siting ordinances will balance the interests of the county, project participants, and non-participants while allowing for cost-effective development. Ordinances can preserve the interests without imposing onerous restrictions. To allow for successful solar development, ordinances should rely on established best practices.

County officials should carefully consider whether site and structure provisions are unnecessarily restrictive. Well-established solar zoning guides describe the importance of avoiding inadvertent obstacles in ordinance's major provisions:

SOLAR ZONING GUIDES RECOMMENDATIONS [14] [15]

From the American Planning Association (APA):

"Even in cases where zoning codes explicitly address solar energy systems, subtle barriers such as height restrictions, lot coverage limitations, and setback, screening, landscaping, and utility requirements may still impede solar development."

From the Great Plains Institute (GPI):

"Limit regulatory barriers to developing solar resources. Ensure that access to solar resources is not unduly limited by height, setback, or coverage standards, recognizing the distinct design and function of solar technologies and land uses."

A. SETBACKS

1. Recommendations

- **Setback distances should not exceed 50 feet from adjacent non-participating property lines.**
- **Setback distances should not exceed 300 feet from occupied residences, but can be shorter.**
- **Property line setback distances should allow for waiver if mutually agreed upon by owners sharing a property line.**

Counties may choose to put into place setbacks, which specify the required distance of the project from homes, roads or existing rights-of-way, property lines, and other locations. Unlike setbacks for wind turbines, which are intended to address rare but dangerous scenarios such as turbine collapse, there are no safety concerns that point to the necessity of a specified setback requirement for solar facilities. Before putting setbacks into place, counties should consider the issues that a setback is meant to address and whether there is a separate project requirement that may better address it.

Many counties require solar installations to follow the same setback requirements (from property lines and rights-of-way) as other structures in the zoning district where they are located. Some counties opt for prescribed setbacks.

2. Setbacks from Residences and Property Lines

Some counties require specific setback distances between the solar system and property lines of occupied residences.

According to our research, a 50-foot property line setback is included in a number of county ordinances from Iowa's neighboring states. Many of Iowa's counties already have a 100- to 150-foot setback for participating residential dwellings, with some as low as 0 feet. These distances, a setback of no more than 300 feet for participating residences, seem workable for developers, participants, and non-participants.

Utility-scale solar energy systems are likely to be sited in zones where residential dwellings are uncommon but may occur (agricultural, industrial, commercial). Counties can adopt an occupied structure setback that both reflects the needs and local characteristics of these zones and stays within the 300-feet range. There is no justification for larger setbacks from a safety perspective, and larger setback distances would unnecessarily limit solar development in a county.

We recommend that property lines setbacks do not exceed 50 feet from a property line and do not exceed a range of 300 feet from an occupied residence. We also recommend that counties include a provision for property line setbacks to be waived if mutually agreed upon by owners sharing a property line.

3. Setbacks Based on Zoning District

Although we recommend counties adopt specific setback distances for solar systems, counties could also choose to follow the minimum setback requirements of the zoning district where they are located, similar to Clayton and Clinton counties.

Since structures or vegetation on neighboring properties may cast shadows onto a solar system, causing a decline in solar panel efficiency, both Clayton and Clinton counties recommend greater setbacks may be needed in lieu of a "solar access agreement." These agreements are discussed further later in this document.

4. Shared Property Lines

When a solar array is built across the property line of two participating landowners, no property line setback is required in Winneshiek County.[17]

WINNESHIEK COUNTY

"[Solar Farm Energy Systems] to be built on more than one parcel, and parcels are abutting, a zero (0) side or rear setback shall be permitted to the property line in common with the abutting parcel(s)."

In the case that a property line is shared by two participating landowners, a setback serves no purpose, so we recommend this as best practice.

5. Waivers or Negotiated Setbacks

Waivers are an important tool to improve flexibility and allow for the potential for additional land area to become available for solar development. However, providing a waiver is not a substitute for a setback policy that can enable cost-effective solar development.

CLAYTON COUNTY

"Setback. Setbacks for all structures (including solar arrays) must adhere to the minimum principal use setback standards for the zoning district where the project is located; greater setbacks may be recommended absent a solar access agreement."

CLINTON COUNTY[16]

"Setback. Setbacks for all structures (including solar arrays) must adhere to the minimum principal setback standards for the zoning district where the project is located; greater setbacks may be required by the Board of Supervisors."

MONTGOMERY COUNTY[18]

Montgomery County allows for written wavier agreements to be executed pursuant to the specific requirements set forth in the ordinance along with approval by the Zoning Board of Adjustment:

"Setback. Setbacks for all structures (including solar arrays) must adhere to the minimum principal setback standards for the zoning district where the project is located and a minimum of 100 feet from any occupied residence unless the occupant grants a waiver. Waivers must be submitted no later than the day before the Board of Adjustments hearing."

We recommend that counties allow for a waiver of the mandated setback distance with the consent of the participating landowner and adjacent property owner.

B. LAND ACREAGE CAP

We recommend counties do not put a cap on the total number of acres that can be utilized by solar facilities. Placing a limit on the number of acres available for solar projects restricts Iowa's capabilities to meet clean energy goals and discourages the local economic development associated with solar development.

Implementing a land acreage cap on utility-scale solar projects makes a county less attractive to solar developers by effectively restricting solar development as these projects typically require a significant space to be economically viable. By limiting the amount of land available, developers may be required to secure multiple smaller parcels of land or navigate more complex zoning and permitting processes, increasing costs and potentially making projects unfeasible. With projects potentially unviable due to acreage caps, counties will not receive the economic benefits associated with utility-scale solar, including increased tax revenues, job creation, and lease payments to landowners. In Iowa specifically, capping the number of acres available for utility-scale solar projects may prevent innovative practices such as agrivoltaics from being scaled up. The dual-land use technology allows for farmland to be used for agriculture (e.g., grazing and pollinator habitats) as well as for energy generation. Acreage limits can not only reduce the scale of these benefits but also prevent them completely as developers may look elsewhere to find a more viable location.

C. GROUND COVER AND BUFFER AREAS

Utility-scale project sites often occupy multiple acres of land, offering an opportunity for project owners to demonstrate a commitment to environmental stewardship by establishing perennial vegetation on their solar project site(s). Investing in this practice will create habitat for a variety of at-risk pollinators, including honeybees, bumblebees, and monarch butterflies. For local officials considering the creation of a solar ordinance, this section explores a variety of considerations that can inform sound policy.

Historically, there were 28 million acres of native prairie across the state of Iowa. There is less than one-tenth of 1 percent of that native prairie remaining. Investments in perennial vegetation on solar project sites can also help restore habitat for wildlife like ring-necked pheasants, quails, and other grassland birds such as the dickcissel or the sedge wren.

Meanwhile, other important environmental outcomes are also achieved through planting perennial vegetation such as improved soil health and water quality, and carbon sequestration. Importantly, the deep root systems of perennial vegetation can penetrate the soil surface as deep as 15 feet, allowing for increased soil structure and denitrification of water. Improving soil health and water quality also provides developers with practical benefits of meeting stormwater drainage permit requirements and reducing erosion on project sites.

CLAYTON COUNTY[19]

After considering the potential positive environmental outcomes, Clayton County included a requirement within its solar ordinance to establish perennial vegetated ground cover:

"Ground Cover and Buffer Areas. Ground around and under solar arrays in project site buffer areas shall be planted and maintained in perennial vegetated ground cover, and meet the following standards:

1. Top soils shall not be removed during development, unless part of a remediation effort.

2. Soils shall be planted and maintained in perennial vegetation to prevent erosion, manage run off and build soil.

3. Seed mixes and maintenance practice should be consistent with recommendations made by qualified natural resource professionals such as those from the Iowa Department of Natural Resources, County Soil and Water Conservation Service, or Natural Resource Conservation Service.

4. Plant material must not have been treated with systemic insecticides, particularly neonicotinoids."

The benefits of establishing even small areas of perennial vegetation have been proven to significantly improve pollinator and wildlife populations while helping developers maintain stormwater permitting requirements, reduce erosion, and mitigate land use concerns. However, there are many important considerations for developers who wish to install perennial vegetation on their solar project site. **We recommend that counties wishing to require perennial vegetation consult qualified natural resources professionals such as those from the Iowa Department of Natural Resources, County Soil and Water Conservation Service, Natural Resource Conservation Service, or Iowa State University Extension and Outreach.**

Hills Solar Project in Johnson County, Iowa. The 3.9 MW solar installation features wildlife fencing around the project.

D. FENCING

To protect the solar array and to provide for safety by preventing entry into a project area, counties should require fencing around the solar array.

Project developers are required to follow the specific fencing requirements of the National Electrical Code (NEC), which is updated every three years. Currently the NEC requires a 7-foot-tall fence; therefore, we do not recommend counties set their own fence height requirements.

CARROLL AND CLAYTON COUNTIES[20]

Both Carroll County and Clayton County use the same language to address fencing requirements:

"A security fence must be installed along all exterior sides of the utility scale solar installation and be equipped with a minimum of one gate and locking mechanism on the primary access side. Security fences, gates, and warning signs must be maintained in good condition until the utility scale solar installation is dismantled and removed from the site."

Project developers are required to follow the specific fencing requirements of the National Electrical Code (NEC), which is updated every three years. Currently the NEC requires a 7-foot-tall fence; therefore, **we do not recommend counties set their own fence height requirements.**[21]

Specific types of fencing may be desirable for reducing impacts to wildlife or limiting aesthetic concerns related to a project. For example, deer fencing may be less visually obtrusive while also allowing wildlife and pollinators to move through a project area. This practice could soon be deployed at a large scale in Iowa, as the developers of a 3,000 acre solar project in Howard & Mitchell Counties have proposed to surround the area with deer fencing: Perimeter fencing for the site shall not include barbed wire or chain-link and shall use wire woven or other wildlife-friendly fencing.[22]

E. HEIGHT RESTRICTIONS

The height of solar arrays is typically measured by the maximum tilt of the panels.

In some counties where large-scale solar is a permitted use, the height restrictions of solar arrays match the zoning district where they are located, or are less restrictive to accommodate agrivoltaic practices. Counties could also consider allowing for more lenient height restrictions if coupled with longer setbacks from neighboring properties. An example is adding 2 feet to the setback distance for each additional 1 foot of height.

We recommend counties do not adopt additional requirements regarding the maximum height of utility-scale projects. An ongoing study at Iowa State University is helping developers learn what heights will maximize the benefits and potential for agricultural land-use along with solar projects.[23] In order to encourage agrivoltaic practices, such as horticulture crops and beekeeping, the county should not include height restrictions.

Counties may also wish to adopt a minimum height above ground requirement for solar panels. **If counties choose to require a minimum height, we recommend that it is done so in consideration of ensuring there is enough room beneath panels for vegetation growth, snow to be cleared, wind to pass through, and for agrivoltaic practices to be implemented.**

F. SOLAR ACCESS SPACE AND AGREEMENTS

Since solar panel performance relies on the amount of sunlight collected, counties may consider how improvements or new vegetative plantings on neighboring properties could cast shadows onto solar arrays. Developers may want an assurance of continued future access to sunlight to ensure project success over the 25-to-40-year life expectancy.

The Cedar Rapids Community Solar Garden at Deer Run, also called Alliant Energy Deer Run, is located in Linn County, Iowa. The 4.5 MW solar installation features a 5 MW battery energy storage system, also pictured.

There are several Iowa statutory provisions that address access to solar energy and are intended to "facilitate the orderly development and use of solar energy."[24] The Iowa Code encourages voluntary solar access easements and sets out requirements for easements to protect solar access. The Code also authorizes city councils and county boards of supervisors to establish solar access regulatory boards (or authorize certain existing boards for this purpose).

These regulatory boards have the power to grant solar access easements to properties hosting solar projects in order to protect access to solar energy. The Code allows public bodies to include provisions that would compensate the owner of the solar project if shade interferes with the project and/or that would compensate the owner of the easement for maintaining the easement space. Consistent with Iowa Code 564.A7, Carrol County's ordinance provides for a "solar access agreement" process which allows any property owner to purchase an easement across neighboring properties to protect access to sunlight; such an agreement can apply to buildings, trees, or other structures that would diminish solar access.[25]

WINNESHIEK COUNTY[26]

"Solar Farm Energy Systems] shall provide the following at all locked entrances: (a) a visible "High Voltage" warning sign, (b) name(s) and phone number(s) for the electric utility provider, (c) name(s) and phone number(s) for the site operator, (d) the facility's 911 address, (e) a lock box with keys as needed."

G. SAFETY AND SIGNAGE

Projects may be required to post signs that clearly feature the name, address, emergency contact information for the operator, and warnings. Safety requirements typically include clear safety notices for the public, such as high voltage warnings. The above requirements are an appropriate best practice.

H. CO-LOCATING WITH BATTERY STORAGE

Counties may wish to consider adding provisions regarding the co-location of battery energy storage systems (BESS) with utility-scale solar installations. BESS can enhance a project's flexibility and enable higher levels of renewable energy system integration, especially for solar projects far from load centers. A BESS can help address the variable nature of renewable energy and potentially underutilized transmission lines. Co-locating a BESS with solar panels can reduce the required transmission capacity and "increase the ability to utilize leftover transmission capacity by using storage to charge excess generation during periods of high resource availability and discharge during periods of low resource variability." BESS can further reduce the need to curtail solar energy production, either due to transmission congestion or a lack of demand, along with provide ancillary services.[27]

The benefits of co-locating BESS with utility-scale solar projects and the increasing affordability of doing so may lead developers to seek locations where both technologies can be sited together. Implementing clear guidelines for the co-location of BESS with utility-scale solar projects will allow developers to decide early in the process whether to incorporate BESS as part of a proposed project. **At a minimum, we recommend counties consider how co-location of BESS with utility-scale solar can enhance the project, and that counties allow for BESS implementation either at the time of project installation or in the future.**

IEC will release a dedicated battery storage siting guide, with best practices and recommendations in 2027.

I. NOISE

Inverters, the equipment that converts direct current (DC) electricity into alternating current (AC) electricity, can produce a soft sound during daytime when the solar array is producing energy. Noticeable noise is not a common or expected impact, and any noise should be imperceptible to neighboring properties without specific noise provisions. It is also important to note that if noise can be heard from inverters, that does not indicate harmful effects.

We do not recommend adding standards for noise. Minimum setback requirements should sufficiently address these issues without adding specific, separate provisions for noise. Counties may include a section encouraging solar project

The Pleasant Creek Solar Project is located in Linn County, Iowa. The 200 MW solar installation was designed to minimize visual disruption.

developers to design a facility in a manner that minimizes noise. Developers are often required to present modeling that displays setbacks and other aspects of the project; counties may ask developers to simultaneously present modeling that demonstrates a project is designed with noise concerns in mind.

NATIONAL RENEWABLE ENERGY LABORATORY (NREL)[28]

According to NREL:

"While aesthetic requirements are appropriate for historic districts, requiring solar energy systems to be screened from public view, can cause shading, and may prevent many installations."

J. SCREENING

Some counties have chosen to adopt screening requirements in conjunction with setbacks. Counties should consider whether screening requirements would be arbitrary, and what, if any, other uses currently require screening.

We do not recommend that counties adopt screening provisions or requirements.

K. GLARE

The American Planning Association advises that "[s]ome residents may express concerns that glare from solar collectors will be either a public or private nuisance. However, because they are constructed of dark-colored materials and covered with anti-reflective coatings, new solar PV and thermal systems typically reflect as little as 2 percent of incoming sunlight."[29]

Similarly, a summary of research from the National Energy Research Laboratory states, "Local objections to proposed solar photovoltaic (PV) installations sometimes include concerns that the modules will cause glare that could impact neighbors or aviation. Research on this subject demonstrates that PV modules exhibit less glare than windows and water. Solar PV modules are specifically designed to reduce reflection, as any reflected light cannot be converted into electricity. PV modules have been installed without incident at many airports."[30] Around 20 percent of America's public airports already host solar on-site, including panels atop terminals at the Eastern Iowa Airport (Cedar Rapids, IA) and the Quad Cities International Airport (Moline, IL).[31]

Given how solar panels are constructed, glare or reflected light is not typically a major issue.

We do not recommend glare provisions in a solar ordinance. However, local authorities may require a glare study that shows the potential impact to the surrounding area, particularly on infrastructure like airports and roadways. For example, the Federal Aviation Administration (FAA) required the City of Ames to conduct a glare study for its community solar project as a result of its proximity to an airport.[32] If the study indicates that there is potential for glare, a project developer should submit a mitigation plan for glare produced by the system. A study with recommended mitigation is preferable to a blanket screening requirement for solar, which adds unnecessary upfront and ongoing expense.

Broccoli growing at the Alliant Energy Solar Farm at Iowa State University.

L. PRIME FARMLAND AND AGRIVOLTAICS

As the development of large-scale solar generation becomes more common, land taken out of production can increase concerns over the impact to prime farmland. While the placement of solar panels may limit agricultural uses for prime farmland, the construction and operation of a solar energy system typically has less impact than other forms of development such as residential or commercial development. Once a solar system has been decommissioned and removed, farmland can be returned to agricultural use with minimal reclamation. County officials should consider the potential for combining solar energy systems with other uses that may benefit agricultural operations, such as creating shade for livestock or habitat for pollinators and other wildlife.

Newer developments in solar technology also reduce the burden of utilizing prime farmland for utility-scale solar projects. Agrivoltaics, also sometimes referred to as agriphotovoltaics or dual-use solar, combines agriculture and solar power production on the same land. This approach combines crop production, livestock grazing, or other agricultural activities with solar panels to maximize land use efficiency and generate multiple types of benefits.

The effects of agrivoltaics are achieved by installing solar panels at elevated heights with enough spacing in-between to allow sunlight to reach crops or accommodate livestock below. The shade provided by the panels provides microclimate benefits through reducing heat stress on crops, conserving soil moisture, and helping mitigate the impacts of extreme weather conditions, such as droughts.

Installing agrivoltaic solar panels on prime farmland in Iowa can enable utility-scale solar projects by reducing the competition for land between farming and solar development. Agrivoltaics preserve agricultural productivity and addresses concerns about losing prime farmland to solar development. Such technology also provides economic opportunities for landowners, allowing for income streams to be diversified by leasing land for solar development while continuing to farm or graze livestock. Agrivoltaics offers a win-win approach, balancing the growing need for and interest in utility-scale solar development while also preserving prime farmland for traditional agricultural use.

Due to the benefits of agrivoltaics, county officials should avoid placing restrictions on the development of agrivoltaic projects. Not only should county officials leave open the possibility for agrivoltaics in their county, but they can also encourage the development of such projects through their ordinances.

Further details about varying agrivoltaic configurations, categories, and general considerations can be found in Appendix A.

CONSTRUCTION, OPERATION, MAINTENANCE, AND DECOMMISSIONING

A. INFRASTRUCTURE AND ROAD USE

Recommendation

- **Counties should put a process in place for assessing and repairing road infrastructure before construction begins.**

Solar construction crews will utilize roads in and out of a project site. Counties should have a lesser expectation of road impacts from solar development compared to wind development. To address potential impacts to public infrastructure, counties may adopt a road use plan.

We recommend establishing a process prior to construction that clarifies for all parties what specific impacts a developer will be held responsible for and what steps must be taken to mitigate potential damage to roads and other infrastructure. Other potential aspects of an ordinance that may regulate infrastructure include drainage infrastructure and communication infrastructure equipment.

B. SITE MAINTENANCE PLANNING

1. Recommendations

- **Counties should require a site maintenance plan designed to avoid negative impacts on the surrounding land, water, and neighbors.**
- **At a minimum, we encourage counties to consider requiring perennial vegetation to bolster wildlife, soil, and water quality benefits.**

Solar projects are expected to be in operation for at least several decades. To address both short-term and long-term maintenance of a project area, counties may require a site maintenance plan as part of the application process. Common elements for counties to address in their site maintenance plans include:

- Soil erosion and sediment control
- Stormwater management
- Ground cover and buffer areas
- Cleaning chemicals and solvents
- Maintenance, repair, or replacement of facility
- Emergency response plan

WINNESHIEK COUNTY[33]

Winneshiek County has adopted the following requirements for a road use agreement:

"Road use agreements: All routes on county roads that will be used for the construction and maintenance purposes shall be identified on the site plan. All routes for either ingress or egress shall be shown. The [community solar energy system] or [solar farm energy system] complete and provide a pre-construction baseline survey to determine existing road conditions for assessing potential future damage due to development-related traffic. The developer shall provide a road repair plan to ameliorate any and all damage, including installation or replacement of roads that might be required of the developer. The developer shall provide a letter of credit or surety bond in an amount and form approved by the appropriate highway authority official(s) when warranted. The provision of this subsection shall be subject to the approval of the Winneshiek County Engineer."

WINNESHIEK COUNTY [34]

Winneshiek County monitors compliance with maintenance requirements by authorizing access to a project site:

"In order to conduct an inspection to validate compliance with the building permit or conditional use permit, the Zoning Administrator shall make an appointment with the applicant to enter the property in question. The applicant may escort the Zoning Administrator and any other necessary personnel."

2. Cleaning Chemicals and Solvents

Counties may wish to address what cleaning chemicals and solvents are allowed at solar project sites. **We recommend counties do not spell out specifics but rather include a provision that project owner(s) and operator(s) comply with all federal and state regulations.**

3. Emergency Response Plan

Counties may wish to consider requiring an Emergency Response Plan, also called an Emergency Action Plan, at the time of application. When considering the key tenants of an Emergency Response Plan, it is important to define what emergency such a plan will cover. How will the emergency be defined? Will it differ from typical emergencies already covered by emergency service personnel? Answers to such questions will determine if there are unique considerations that must be accounted for in an Emergency Response Plan.

We recommend counties require owners and operators to file an Emergency Response Plan at the time of application that documents and specifies how emergencies will be dealt with. We recommend that counties and developers agree upon Emergency Response Plans prior to any construction on a solar installation begins.

C. DECOMMISSIONING AND SITE RESTORATION

Recommendations

- **Planning for the responsibility of discontinuation and decommissioning is a prudent step for a county ordinance. We recommend that counties require a decommissioning plan which defines the obligations of the owner/developer to remove the solar array and restore the land when the project will no longer be used.**
- **Counties should require the project developer/ owner to notify the county of their intent to stop using the facility and that should be the trigger for decommissioning to begin.**

CEDAR COUNTY [35]

"Emergency Services. The Applicant, Owner or Operator shall submit a copy of the site plan and Emergency Action Plan to the Cedar County Emergency Management Administrator. The Emergency Action plan must include 24-hour contact information for [utility-scale solar operations] US-SES Emergency Operations Personnel and shall be updated with Cedar County Emergency Management annually, or within 48 hours of changes to the emergency contact."

Solar ordinances often include a provision requiring the project owner to take responsibility for and bear the costs of decommissioning at the end of a solar project's life. These provisions ensure the county and landowners do not have to bear the cost of removing solar arrays. ordinance should include a notice requirement stating

Solar panels typically come with a 20-to-25-year warranty and could be useful for up to 40 years. Depending on the length of a landholder lease, or with a lease extension, projects could be refitted with new panels once panels have reached the end of their useful life. A county ordinance should include a notice requirement stating that once a developer/owner has determined that the facility will no longer be used, the developer/owner must notify the county of the intent to stop using the facility and decommission the facility in accordance with the agreed-upon decommissioning plan.

We recommend a utility-scale solar energy project be considered a discontinued use after one year without energy production, unless a plan is developed and submitted to the Zoning Administrator outlining the steps and schedule for returning the utility-scale solar energy project to service. Discontinued use does not apply to the pre-construction or construction periods and shall be measured from the initial commercial energy production and operation of the utility-scale solar energy project. All utility-scale solar energy projects and accessory facilities shall be removed to a depth of 4 feet below ground level within one year of discontinuation use.

We recommend each utility-scale solar energy project have a Decommissioning Plan outlining the anticipated means and cost of removing the utility-scale solar energy project. The cost estimates shall be made by a qualified, independent third-party professional. The plan shall also identify the financial resources that will be available to pay for the decommissioning and removal of the utility-scale solar energy project and accessory facilities. The County should reserve the right to verify that adequate decommissioning terms are contained in the landowner's lease or easement.

We also recommend that commencing on the starting date of commercial operation and annually thereafter for the remaining life of the utility-scale solar energy project, the operator continuously maintain a financial assurance mechanism(s) in the form of performance bond, letter of credit, and/or other security approved by the County. We recommend against counties requiring cash as a form of security.

Forms of security other than cash afford flexibility and do not discourage potential solar projects from coming to the county.

Further, we recommend that counties do not require owners and operators to deposit security with the county. It is important to recognize that utility-scale solar projects are typically brought forth by large utility companies that will not dissolve during the lifespan of the project. The amount of the security shall not exceed the total decommissioning cost, as determined by a qualified, independent third-party professional. If a bond is posted to meet this requirement, or if a letter of credit is issued to meet this requirement, the entity providing the assurance must be agreed upon by both the operator and the county.

CLAYTON COUNTY [36]

"Decommissioning Plan.

1. The application must include a decommissioning plan that describes the anticipated lifespan of the utility scale solar installation; the anticipated manner in which the project will be decommissioned; the anticipated site restoration actions; the estimated decommissioning costs in current dollars; and the method for ensuring that funds will be available for decommissioning and restoration.

2. The applicant shall provide the basis for estimates of net costs for decommissioning the site (decommissioning costs less salvage value). The costs basis shall include a mechanism for calculating adjusted costs over the life of the project.

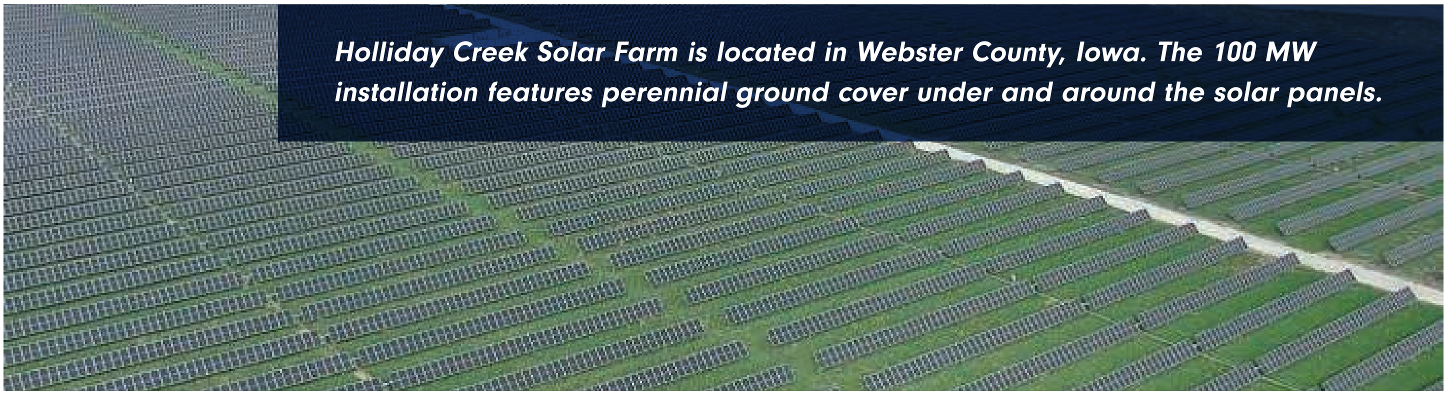
3. Restoration or reclamation activities shall include, but not limited to, the following:

    a. Restoration of the pre-construction surface grade and soil profile after removal of structures, equipment, graveled areas, and access roads.

    b. For any part of the energy project on leased property, the plan may incorporate agreements with the landowner regarding leaving access roads, fences, gates or repurposed buildings in place of regarding restoration of agricultural crops or forest resource land. Any use of remaining structures must be in conformance with the regulations in effect at that time.

4. Following a continuous one (1) year period in which no electricity is generated, or if substantial action on the project is discontinued for a period of one year, the permit holder will have one year to complete decommissioning of the utility scale solar installation. Decommissioning shall be completed in accordance with the approved decommissioning plan. The landowner or tenant must notify the county when the project is discontinued."

CONCLUSION



Holliday Creek Solar Farm is located in Webster County, Iowa. The 100 MW installation features perennial ground cover under and around the solar panels.

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APPENDIX A: AGRIVOLTAICS

Agrivoltaics presents an opportunity for farmland to retain its agricultural use while also being utilized for solar energy production. Understanding the technical aspects of agrivoltaics, along with the potential agricultural pairings, can help decisionmakers ensure that an agrivoltaics project will succeed in their county. Various configurations, categories, and considerations for success are briefly examined below. An ongoing agrivoltaics study at Iowa State University and lessons learned so far are also discussed.

Height and spacing between solar panels at the Alliant Energy Solar Farm at Iowa State University allows for plastic treatment to be laid with tractors.

CONFIGURATIONS

The adaptability of agrivoltaics presents an exciting opportunity for counties and solar developers alike as solar projects can be designed in a way to maximize the benefits provided for both agriculture and energy generation. Aspects that can be altered depending on needs include project capacity, panel height, racking system, panel spacing, row spacing, and PV technology. Though some overlap exists between the two, the main configuration styles for agrivoltaic installations are elevated and inter-row.

Elevated configurations consist of PV modules sited directly above vegetation and typically have heights greater than 6 feet (1.8 meters). Panels in elevated configurations can provide more substantial shading and reduce sunlight for vegetation below, but at the same time can serve as a protective barrier against inclement weather. Elevated systems are typically associated with higher-value crops, such as grapes, berries, delicate vegetables, and short-stature fruit trees.[37]

In inter-row configurations, vegetation is usually grown in-between rows of PV arrays rather than directly below them. Compared to elevated configurations, inter-row designs provide less physical protection against elements but allow for more sun to reach the vegetation. Lower-value crops, such as grasses, grains, and hardy vegetables, are more common to inter-row systems.[38]

CATEGORIES

Though not mutually exclusive, the primary categories of agriculture practices associated with agrivoltaics are crop and food production, livestock production and animal husbandry, ecosystem services, and solar greenhouses.

Crops can be grown directly underneath agrivoltaic systems or in-between rows of PV modules. Depending on design, the crops can be managed manually or with the assistance of mechanized equipment. Modifications to the infrastructure design can facilitate changes in sunlight/shading patterns and increase compatibility with farming operations.

Livestock can also be paired with agrivoltaics, allowing for grazing and management of animals underneath, around, as well as directly adjacent to the solar infrastructure. Most commonly sheep, cattle, poultry, honeybees, and rabbits have been paired with agrivoltaics, but other animal operations are also possible. The presence of animals within an agrivoltaics system can be year-round, seasonal, or on an as-needed basis. Relatedly, animals can be moved periodically to receive nutrition from off-site sources as a supplement if they do not receive all their nutrition from resources on-site.

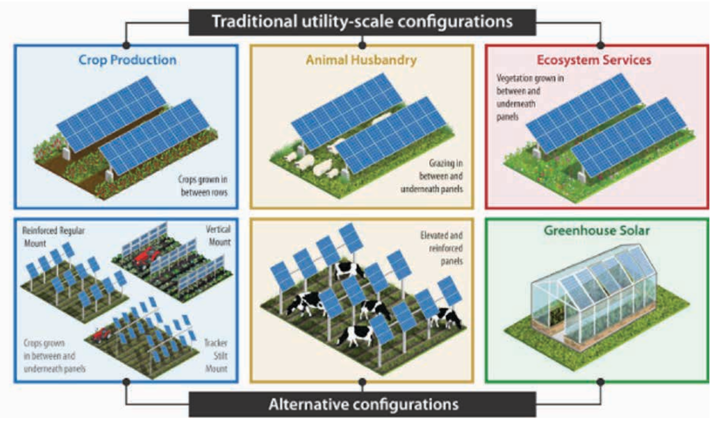

Figure 1. Types of agrivoltaics systems that have been deployed commercially.[39]

Agrivoltaic systems can also be designed to create or restore habitat, restore soil, and provide other ecosystem services through vegetation management. Such a pairing can support soil formation, photosynthesis, and biodiversity, as well as regulate carbon sequestration, flood control, and temperature. Vegetation management can also contribute to sociocultural services at the agrivoltaics installation by providing space for recreation, aesthetics, and spiritual benefits. PV technology can also be installed above or integrated with greenhouse infrastructures to provide partial shade and light modulation, encouraging vegetation growth and health.

CONSIDERATIONS FOR SUCCESS

Ensuring compatibility with agricultural activities and effective partnerships among stakeholders from different sectors is critical to a successful agrivoltaics project. According to a study by the National Renewable Energy Lab that examined agrivoltaic projects across the U.S., several factors will contribute to such compatibility and effective partnerships.[40]

A significant contributor to project compatibility and an effective partnership is project economics. Project economics must be viable for both solar operations and agricultural operations on the agrivoltaics site. Without clear economic value for both the solar and agricultural partners, projects are unlikely to even begin. As previously mentioned, the ability to modify aspects of agrivoltaic projects is a major asset, and when designed properly, can benefit all stakeholders. While modifications to the PV system aimed at accommodating agricultural activities can negatively impact solar infrastructure economics, the vice versa is also true. However, compromises and modifications can also increase the likelihood of successfully securing local permit approvals and expanding siting options for solar developers.

Clearly establishing the details of any Maintenance Plans and Vegetation Management Plans is also critical. Having clearly defined plans can affect the durability of the vegetation in agrivoltaic systems, particularly in ecosystem services projects if the procedures are not aligned with vegetation needs. Utilizing generic or overgeneralized contracts can also lead to poor results; generic contracts might specify mowing frequencies that are not suited to the specific groundcover species being grown and run counter to the initially stated project goals. Other activities covered by these plans (vegetation control, grazing, solar equipment maintenance, additional construction, etc.) can also affect vegetation depending on the location and timing of these activities (i.e., if they disrupt vegetation growth at crucial times such as flowering).

Similar to any maintenance plans, it is important that any agricultural or grazing equipment is compatible with the solar infrastructure design and that the equipment will not lead to solar infrastructure damage.

Overall, education and clear communication are key to addressing issues that might arise among partners and ensure the success of an agrivoltaics project. To date, most agrivoltaics in the U.S. have been driven by solar developers and not farmers' needs and preferences. As many farmers can be risk averse, considering and factoring in their needs should help a project succeed and benefit all stakeholders.

THE ALLIANT ENERGY SOLAR FARM AT IOWA STATE UNIVERSITY

In partnership with Alliant Energy, Iowa State University is studying agrivoltaics in Ames, Iowa through a DOE-funded project that includes 3,300 solar panels and 1.375 MW of capacity. The goal of The Alliant Energy Solar Farm at Iowa State is to determine if and under what conditions agrivoltaic practices in the Midwest can benefit local food production systems and what resources are needed to assist the many stakeholders involved.

Located on a 10-acre tract of land leased for 25 years, land that was previously used for corn-soybean production, this agrivoltaic project consists of both tracking and non-tracking panels at varying heights to identify possible impacts on energy generation, horticulture crops, and beekeeping production. The specific solar panel configurations are below.[41] While the study is ongoing, a few important lessons

Table 1: Solar panel configurations in the Alliant Energy Solar Farm at Iowa State University

AREA (m^2)	PANEL HEIGHT	TRACKING MECHINISM
1 (12402m^2)	1.52 M PIVOT HEIGHT (INDUSTRY STANDARD)	SINGLE AXIS TRACKING
2 (2464 m^2)	2.44 M	SINGLE AXIS TRACKING
3 (3150 m^2)	0.762 M LEADING EDGE	FIXED TILT
4 (6300 m^2)	1.68 M LEADING EDGE	FIXED TILT

The various treatments of vegetation being grown and studies within the project include:[42]

Table 2: Summary of treatments in the Alliant Energy Solar Farm at Iowa State University

#	TREATMENT	SPECIES/CULTIVAR DESCRIPTIONS
1	GRASS-CONTROL	GRASS AND CLOVER MIX PLANTED DURING CONSTRUCTION, REPRESENTING AN INDUSTRY STANDARD PRACTICE, AND SERVING AS A CONTROL TO COMPARE TO THE 7 TREATMENTS.
2	POLLINATOR MIX-REGIME 1	A MIX OF PERENNIAL FLOWERING PLANTS ESTABLISHED WITH AN INDUSTRY STANDARD MANAGEMENT PROTOCOL. (E.G . MOWED ONCE PER YEAR)
3	POLLINATOR MIX-REGIME 2	SAME MIX USED FOR REGIME 1 BUT ESTABLISHED AND MAINTAINED WITH MORE INTENSE AND FREQUENT MANAGEMENT. (E.G. WEEDING & MOWING)
4	VEGETABLE CROP 1	BROCCOLI
5	VEGETABLE CROP 2	SUMMER SQUASH
6	VEGETABLE CROP 3	BELL PEPPER
7	FRUIT CROP 1	THORNLESS RASPBERRY
8	FRUIT CROP 2	DAY-NEUTRAL STRAWBERRY

have been learned. First, leasing land to a company like Alliant Energy for an agrivoltaics system can present a new income stream for farmers without giving up land that could be used for crop production. This is especially true for those who grow fruits and vegetables alongside crops like corn and soybeans.[43]

Second, the microclimate under the solar panels is much cooler and moister than the microclimate outside and around the panels. These differences in microclimates bring both positives and negatives for agricultural practices. While the temperature and moisture can create more ideal conditions for grazing livestock and safer conditions for workers through shading, the increased humidity under the panels can also lead to increased fungi growth and presence of common pests such as squash bugs and cucumber beetles. However, fewer instances of Japanese beetles on grape and raspberry crops grown underneath the panels have also been observed.[44]

Summer squash growing at the Alliant Energy Solar Farm at Iowa State University.

APPENDIX ENDNOTES

[37] Macknick, Jordan, et al., "The 5 Cs of Agrivoltaic Success Factors in the United States: Lessons From the InSPIRE Research Study," *National Renewable Energy Laboratory*, August 2022, https://docs.nrel.gov/docs/fy22osti/83566.pdf.
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