Champaign County
Department of
PLANNING &
ZONING

Brookens Administrative Center
1776 E. Washington Street
Urbana, Illinois 61802

(217) 384-3708
zoningdept@co.champaign.il.us
www.co.champaign.il.us/zoning

CASE NO. 895-AT-18

SUPPLEMENTAL MEMORANDUM #2
March 1, 2018

Petitioner: Zoning Administrator

Request: Amend the Champaign County Zoning Ordinance to add "Solar Farm" as a new principal use under the category "Industrial Uses: Electric Power Generating Facilities" and indicate that Solar Farm may be authorized by a County Board Special Use Permit in the AG-1 Zoning District and the AG-2 Zoning District; add requirements and fees for "Solar Farm"; add any required definitions; and make certain other revisions are made to the Ordinance as detailed in the full legal description in Attachment A.

Location: Unincorporated Champaign County

Time Schedule for Development: As soon as possible

Prepared by: **Susan Burgstrom**
Senior Planner

John Hall
Zoning Administrator

STATUS

An email from Ted Hartke received by John Hall on May 9, 2017, was overlooked when providing Mr. Hartke's previous emails in Supplemental Memo #1 dated February 23, 2018. The email and its attachment, "Example Template Solar Energy Facility Ordinance (North Carolina)" by the Alliance for Wise Energy Decisions, can be found in Attachment B.

On February 26, 2018, John Hall received an email from Patrick Brown of BayWa r.e. Solar Projects LLC with the following attached documents (see Attachment C):

- "Health and Safety Impacts of Solar Photovoltaics" by the NC Clean Energy Technology Center and NC State University
- Presentation: "Solar Photovoltaic (PV) Health & Safety" by the NC Clean Energy Technology Center

On February 27, 2018, John Hall received an email from Patrick Brown of BayWa r.e. Solar Projects LLC with comments and recommended revisions on the proposed text amendment (see Attachment D).

P&Z Staff created a comparison table of several solar ordinances from Illinois. The comparison includes two North Carolina documents, one submitted by Ted Hartke, and the other from the NC Sustainable Energy Center and NC Clean Energy Technology Center. There is also a column showing recommendations from the Illinois Solar Energy Association.

ATTACHMENTS

A Legal advertisement

B Email from Ted Hartke received May 9, 2017, with attachment: "Example Template Solar Energy Facility Ordinance (North Carolina)" by the Alliance for Wise Energy Decisions

C Email from Patrick Brown received February 26, 2018, with attachments:
- "Health and Safety Impacts of Solar Photovoltaics" by the NC Clean Energy Technology Center and NC State University
- Presentation: "Solar Photovoltaic (PV) Health & Safety" by the NC Clean Energy Technology Center

D Email from Patrick Brown received February 27, 2018 with comments on proposed text amendment

E Ordinances Comparison Table created by P&Z Staff dated March 1, 2018

LEGAL PUBLICATION: WEDNESDAY, FEBRUARY 14, 2018 CASE: 895-AT-18

NOTICE OF PUBLIC HEARING REGARDING A PROPOSED AMENDMENT TO THE CHAMPAIGN COUNTY ZONING ORDINANCE.

CASE: 895-AT-18

The Champaign County Zoning Administrator, 1776 East Washington Street, Urbana, has filed a petition to change the text of the Champaign County Zoning Ordinance. The petition is on file in the office of the Champaign County Department of Planning and Zoning, 1776 East Washington Street, Urbana, IL.

A public hearing will be held **Thursday, March 1, 2018, at 6:30 p.m.** prevailing time in the Lyle Shields Meeting Room, Brookens Administrative Center, 1776 East Washington Street, Urbana, IL, at which time and place the Champaign County Zoning Board of Appeals will consider a petition to:

Amend the Champaign County Zoning Ordinance as follows:

Part A. Amend Section 3 by adding definitions including but not limited to "NOXIOUS WEEDS" and "SOLAR FARM".

Part B. Add paragraph 4.2.1 C.5. to indicate that SOLAR FARM may be authorized by County Board SPECIAL USE permit as a second PRINCIPAL USE on a LOT in the AG-1 DISTRICT or the AG-2 DISTRICT.

Part C. Amend Section 4.3.1 to exempt SOLAR FARM from the height regulations except as height regulations are required as a standard condition in new Section 6.1.5.

Part D. Amend subsection 4.3.4 A. to exempt WIND FARM LOT and SOLAR FARM LOT from the minimum LOT requirements of Section 5.3 and paragraph 4.3.4 B. except as minimum LOT requirements are required as a standard condition in Section 6.1.4 and new Section 6.1.5.

Part E. Amend subsection 4.3.4 H.4. to exempt SOLAR FARM from the Pipeline Impact Radius regulations except as Pipeline Impact Radius regulations are required as a standard condition in new Section 6.1.5.

Part F. Amend Section 5.2 by adding "SOLAR FARM" as a new PRINCIPAL USE under the category "Industrial Uses: Electric Power Generating Facilities" and indicate that SOLAR FARM may be authorized by a County Board SPECIAL USE Permit in the AG-1 Zoning DISTRICT and the AG-2 Zoning DISTRICT and add new footnote 15. to exempt a SOLAR FARM LOT from the minimum LOT requirements of Section 5.3 and paragraph 4.3.4 B. except as minimum LOT requirements are required as a standard condition in new Section 6.1.5.

Part G. Add new paragraph 5.4.3 F. that prohibits the Rural Residential OVERLAY DISTRICT from being established inside a SOLAR FARM County Board SPECIAL USE Permit.

Part H. Amend Subsection 6.1.1 A. as follows:

1. Add SOLAR FARM as a NON-ADAPTABLE STRUCTURE and add references to the new Section 6.1.5 where there are existing references to existing Section 6.1.4.
2. Revise subparagraph 6.1.1 A.11.c. by deleting reference to Section 6.1.1A. and add reference to Section 6.1.1A.2.

Part I. Add new subsection 6.1.5 SOLAR FARM County Board SPECIAL USE Permit with new standard conditions for SOLAR FARM.

Part J. Add new subsection 9.3.1 J. to add application fees for a SOLAR FARM zoning use permit.

Part K. Add new subparagraph 9.3.3 B.8.to add application fees for a SOLAR FARM County Board SPECIAL USE permit.

All persons interested are invited to attend said hearing and be heard. The hearing may be continued and reconvened at a later time.

Catherine Capel, Chair
Champaign County Zoning Board of Appeals

TO BE PUBLISHED: WEDNESDAY, FEBRUARY 14, 2018 ONLY

Send bill and one copy to: Champaign County Planning and Zoning Dept.
Brookens Administrative Center
1776 E. Washington Street
Urbana, IL 61802
Phone: 384-3708

John Hall

From: Connie Berry
Sent: Tuesday, May 9, 2017 9:53 AM
To: John Hall
Subject: FW: Example Solar Energy Facility Ordinance and Hartke concerns.
Attachments: Model Solar Ordinance.docx

FYI

From: Ted Hartke [mailto:tedhartke@hartke.pro]
Sent: Tuesday, May 09, 2017 9:51 AM
To: zoningdept <zoningdept@co.champaign.il.us>
Subject: Example Solar Energy Facility Ordinance and Hartke concerns.

Dear John,

Greetings! First of all, thank you for all the work you do for our community. Overall, I think you've done a good job in relation to resource protection and applying regulations countywide which protect us from flooding, etc.

I have a concern about a new development in my township. As a rural resident near Sidney Illinois where a solar energy company wishes to install solar panels, I have concerns about our county not having some minimum standards.

My highest concern is the loss of productive farmland being turned into a blanket-covered industrial use. In this county, we have taken careful steps to preserve farmland by restricting rural lots down to only three acres maximum lot size. Although some variances are allowed on case-by-case basis, it has worked reasonably well.

Now being approached with a huge solar energy facility, it seems we are abandoning our productive farmland preservation ideals and allowing a sudden and vast amount of sprawl which is a disservice to the surrounding communities. Sidney is a very rural and natural area and nearly void of industrial facilities outside of the Frito Lay grain storage rail load-out facility. Also, the huge substation and overhead transmission lines cause that corridor to be the "utility closet" for Champaign County, and perhaps adding the solar array will further erode the lands.

I attached a model solar ordinance in case you only received an ordinance from others which was born from the installation industry. I am certain their goals our different from ours, but I think this attachment is rather fair to protect our existing citizens.

I have not made my own suggestions, but I would prefer the solar panels be NOT VISIBLE from standing or driving on adjacent parcels. The side view of solar panels is a personal taste, HOWEVER MOST people would rather not enjoy the viewshed of the side edge seeing all of the posts and wires and utilitarian usage of land which was previously used for growing crops or open area. All projects should have berms and/or trees and security fence surrounding the facility to buffer adjacent land. We do the same for recycling yards and material stockpiling and industrial areas near residents, and this should be treated no differently.

Glare and erosion control are the next highest concerns I have. The solar project near Indianapolis was relocated from its original position because of the glare issue it would cause for approaching aircraft to land at

the airport. Please keep these solar arrays away from existing airports and landing strips. Of course the panels will likely shade the ground below, and cause less plant growth ground cover. No panels should be allowed to be installed over hilly terrain or through drainage swales. If these panels are allowed to be installed, there is a need to address erosion issues.

Minimize use of concrete. On the solar array near Univ of Illinois, all posts were screwed into the ground. There was no concrete used for any footings or foundations or supports for the panels. I suggest the screw anchor posts be used for all solar projects in Champaign County. The only concrete which should be allowed should be for transformer pads and the perimeter fence. Minimizing buried concrete will make it easier to reclaim the land and return it into productive farmland after the solar panels are removed.

Please see this attachment.....hopefully may make your job a bit easier, and also help us avoid becoming the "utility closet" for companies who benefit from huge tax subsidies which cause these projects to happen.

Best regards,

Ted Hartke

Special message: **My email was hacked Dec 30, 2016.** If you received a message that looks like it came from me and it asks you to click a link to share files, DO NOT CLICK ON LINKS OR ICONS. I will never send you a link or ask you to download anything unless I include a detailed project-specific correspondence. To protect yourself, never attempt to download files or click links which seem random or out of the ordinary.

Theodore P. Hartke, PE, PLS
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EXAMPLE TEMPLATE SOLAR ENERGY FACILITY ORDINANCE (NORTH CAROLINA)

Source: Alliance for Wise Energy Decisions
http://wiseenergy.org/Energy/NCSolar/NC_Model_Solar_Law.pdf

{Note: this sample law uses North Carolina as the state where XYZ County is located.

SECTION 1. LOCAL LAW REPEALED
Local Law No. __ of the year ____, is hereby repealed in its entirety and replaced with this Local Law.
{Note: this would be applicable if there's an existing solar law that this ordinance will replace.}

SECTION 2. TITLE
This Local Law may be cited as the "Solar Energy Facilities" law of XYZ County, North Carolina.

SECTION 3. PURPOSE
The County Commissioners of XYZ County adopt this Local Law to regulate the placement of industrial Solar Energy Facilities (SEFs) to protect the public health, safety and welfare of its citizens and visitors; to minimize the adverse impacts on the County's character and economy; to minimize negative impacts on the unique scenic resources including, but not limited to adjacent lands and waterways; to minimize the adverse impacts on property values of nearby citizens; to minimize the adverse impacts on the County's farming communities; and to minimize the adverse impacts on the County's environment and ecosystems.

This law is not addressing residential solar use, or a small solar array that is on a farm or other business, exclusively for onsite energy usage. This ordinance is not intended to abridge safety, health or environmental requirements contained in other applicable codes, standards, or ordinances. The provisions of this ordinance shall not be deemed to nullify any provisions of any state or federal law.

SECTION 4. AUTHORITY AND REFERENCES
The County Commissioners of XYZ County, North Carolina enact this ordinance establishing comprehensive regulations for Solar Energy Facilities in XYZ County, providing for the administration, enforcement, and amendment thereof, in accordance with the provisions of:

4-1 The applicable parts of the North Carolina State Constitution
4-2 The applicable parts of the North Carolina General Statutes (esp. §14 - Criminal Law; §22B-20 - Solar Collectors; §62 - Public Utilities; §105 - Taxation; §106 - Agriculture; §113 - Conservation and Development; §113A - Pollution Control and Environment; §130A - Public Health; §150B - Administrative Procedure; §153A - Counties; §159 - Local Government Finance; §160A - Cities and Towns).
4-3 The applicable parts of North Carolina State Building Codes.
4-4 North Carolina State Session Law 2007-397, Senate Bill 3.
4-5 NC Dept of Insurance: Fire Fighter Safety & Renewable Energy Systems Module.
4-6 US DoD Instruction: Air Installation Compatible Use Zones (AICUZ).

SECTION 5. FINDINGS
The County Commissioners of XYZ County find and declare that:

5-1 The North Carolina State General Statutes (e.g. §153A-340, §160A-381) give local legislators the power to write zoning and regulation ordinances "for the purpose of promoting the health, safety, or general welfare" of their community.
5-2 While solar energy is a semi-renewable energy resource of electricity generation, and under some circumstances it may reduce the use of nonrenewable energy sources, the possible benefits must be balanced against potential negative impacts to local citizens, local economy, and local ecosystems.

5-3 Regulation of the siting and installation of solar arrays is necessary for protecting the health, safety, and well-being of neighboring property owners, the general public, the local economy and local ecosystems.

5-4 Several independent legal and economic experts have concluded that there can be legal and economic downsides for landowners entering into the secretive, complicated and one-sided lease/easement contracts written by industrial solar energy developers.

5-5 Large-scale industrial solar energy facilities represent potential negative aesthetic impacts because of their size.

5-6 Installation of large-scale industrial solar energy facilities can create drainage problems through erosion and lack of sediment control of facility and access road sites, and harm farmlands through construction methods utilized.

5-7 There is evidence from independent appraisers that industrial solar energy facilities can reduce property values of nearby property owners. Said property value reductions will reduce the County's tax base, resulting in a tax rate increase on all County property owners.

5-8 In certain circumstances, industrial solar energy facilities can cause electromagnetic interference with some types of communications.

5-9 Independent experts (e.g. ornithologists) have concluded that solar arrays can kill birds. It is especially troublesome if raptors that are destroyed. XYZ County is located on a migration route for many species of birds, and is habitat for many species, both year-round and seasonal.

5-10 XYZ County has many scenic view sheds, and some of these would be negatively impacted by industrial solar energy facilities.

5-11 Significant public and private dollars have been invested in infrastructure within XYZ County to enhance and promote an important local industry, tourism. It stands to reason that nearby industrial solar energy facilities may have a negative economic impact on tourism sensitive communities.

5-12 XYZ County and its citizens desire to maintain the pastoral, rural nature of this region. An industrial solar energy facility is in conflict with the culture and character of this community.

5-13 Due to the unusually broad array of potentially problematic Findings (and lack of scientifically proven net benefits), the Precautionary Principle dictates that the County be particularly conservative and cautionary in its regulation of industrial solar energy.

5-14 XYZ County has regulated solar energy facilities for the past decade through local laws. This Local Law represents an updating of said regulations.

5-15 In formulating this Local Law, studies have been reviewed — and those written by independent experts were given the greatest consideration. (See WiseEnergy.org for good examples of such reports.) Experiences of other communities with industrial solar energy have been studied. An ad hoc Committee was appointed to make recommendations regarding industrial solar energy regulation. Some of its conclusions were incorporated into this Local Law.

SECTION 6. PERMIT REQUIRED

Large solar energy facilities shall be permitted within XYZ County only in an Agricultural District designated as such. Such facilities shall be subject to the requirements and permitting process of this Local Law, in addition to other applicable local, state and federal laws.

This Local Law shall apply to all areas of XYZ County.

SECTION 7. DEFINITIONS

As used in this chapter, the following terms shall have the meanings indicated. Words not defined in this Local Law shall be given their ordinary and common meaning:

Accessory building: A building that is located on the Solar Energy Facility (SEF) property.

Accessory Equipment: Any equipment serving or being used in conjunction with a SEF. The term includes utility or transmission equipment, power supplies, generators, batteries, equipment buildings, and storage sheds, shelters or similar structures.
Administrative Approval: Approval that the Planning Board is authorized to grant after Administrative Review.
Board of Appeals: The Board of Appeals is comprised of the members of the Zoning Board of Appeals that is established by the Local Zoning Law.
Completed Application: An application that contains all information and/or data required and requested, to enable an informed decision to be made with respect to that application.
Concentrated Solar Power (CSP): See Thermal Solar Conversion.
Conservation Area: Such areas include natural areas protected by law, such as wetlands that meet the definition in the Clean Water Act 33 USC Sec. 1251 et seq.; shore land areas; water bodies; riparian buffers; populations of endangered or threatened species, or habitat for such species; archaeological sites, cemeteries, and burial grounds; important historic sites; other significant natural features and scenic viewsheds; and existing trails or corridors that connect the tract to neighboring areas.
Electrical Transmission Tower: An electrical transmission structure used to support high voltage overhead power lines. The term shall not include any utility pole.
FAA: The Federal Aviation Administration or successor agency.
Maintenance: The cleaning, painting, repair, or replacement of defective parts (including plumbing, electrical, or mechanical work that might require a building permit) in a manner that does not alter the basic design or composition of a structure, such as a solar array.
Modification or Modify: Any change, addition, removal, swap-out, exchange, and the like that does not qualify as "Repairs and/or Maintenance" as defined herein is a Modification. Also included is any change, addition, swap-out, exchange, and the like that requires or results in changes and/or upgrades to the structural integrity of a solar array.
Necessary: What is technologically required for the equipment to function as designed by the manufacturer. Anything less will restrict or inhibit the provision of service as intended and described in the Application. Necessary does not mean what may be desired or preferred technically.
Ordinary Maintenance: Actions that ensure that the SEF is kept in good operating condition. Ordinary Maintenance includes inspections, testing and modifications that maintain functional capacity and structural integrity. Ordinary Maintenance does not include Modifications.
Person: An individual, trustee, executor, receiver, other fiduciary, corporation, firm, partnership, association, organization, club, etc. acting as an entity.
Photovoltaic Solar Conversion (PV): An active solar energy system that directly converts sunlight into electricity by what is known as the photovoltaic process.
Repair: The replacement of existing work with the same kind of material used in the existing work, not including additional work that would change the structural safety of the structure or that would affect or change required existing facilities, a vital element of an elevator, plumbing, gas piping, wiring, or heating installations, or that would be in violation of a provision of law or this Local Law. The term "Repair" or "Repairs" shall not apply to any change in construction.
Residential Zoning Districts: The RA, R-35, {fill these in} … zoning districts.
Solar Array: An active solar energy system that converts sunlight into electricity using either Thermal or Photovoltaic methods. Such a system has multiple solar collectors, and might include transformers, generators, batteries, and other appurtenant structures and/or facilities.
Solar Collector: A device that converts sunlight into electricity using either Thermal or Photovoltaic methods.
Solar Energy: There are two general ways sunlight is converted into useful energy: passive and active. Passive refers to such actions as opening a window shade to let sunlight in to heat a room. Active uses mechanical devices to collect, convert, store and distribute solar energy. The two most common Active conversions of sunlight into electricity are Thermal and Photovoltaic.

Solar Energy Facility (SEF): A commercial electricity-generating facility (PV or CSP), whose primary purpose is to supply electricity. This consists of one or more solar arrays and other accessory structures and buildings, including substations, electrical infrastructure, generators, transmission lines, and other appurtenant structures and/or facilities.
Solar Farm: A marketing term for a SEF.
State: The State of North Carolina.
Temporary: Something intended to exist or does exist for fewer than 180 days.
Thermal Solar Conversion: An active solar energy system that converts sunlight into electricity by collecting and concentrating heat to drive a conventional steam generator. For a commercial application this is called Concentrated Solar Power (CSP).
Utility Pole: A structure owned and/or operated by a public utility, municipality, electric membership corporation, or rural electric cooperative that is designed specifically for and used to carry lines, cables, or wires for telephone, cable television, or electricity, or to provide lighting.

SECTION 8. PERMIT REQUIREMENTS

8-1 General: Before a building permit may be submitted for a SEF, a Solar Energy Permit Application must first be approved by the Planning Board.

8-2 Permit Application: Throughout the permit process, the Applicant shall promptly notify the Planning Board of any changes to the information contained in the permit application. Changes that do not materially alter the initial site plan may be administratively accepted. The application for a SEF shall consist of an electronic (digital) filing that contains at least the following:

8-2.1 Summary: A narrative overview of the SEF, including its generating capacity.

8-2.2 Inventory: A tabulation describing the:
- A. Number and type of each proposed solar array, including their generating capacity.
- B. Dimensions and respective manufacturers.
- C. Appurtenant structures and/or facilities.

8-2.3 Vicinity map: Identification of the property on which the proposed SEF will be located.

8-2.4 Site Plan: A plan showing the:
- A. Planned location of each solar array.
- B. All property lines within 1000 feet of the property lines of the proposed site.
- C. Each array's setback distance from the closest SEF boundary.
- D. Access road and turnout locations.
- E. Substation(s) and ancillary equipment, buildings, and structures.
- F. Electrical cabling from the SEF to the substation(s), and from the substation(s) to where the electricity will leave the site, and associated transmission lines.
- G. Conservation Areas, including natural areas protected by law, such as wetlands that meet the definition in the Clean Water Act; shore land areas; water bodies; riparian buffers; populations of endangered or threatened species (federal or state), or habitat for such species; flyways; archaeological sites, cemeteries, and burial grounds; important local historic sites; existing healthy, native forests consisting of at least one acre of contiguous area; individual existing healthy trees that are at least 100 years old; other significant natural features and scenic view sheds; existing trails or corridors that connect the tract to neighboring areas.
- H. A landscaping plan that shows proposed screening and buffering of all arrays, buildings and other non-array structures on the site or sites.

8-2.5 Misc: The Applicant shall provide the following information to the Planning Board:
- A. Certification that the proposal is for an International Electrical Congress (IEC) solar array that is designed to meet all NC Building Codes.
- B. A Stand-down Plan for high wind conditions.

C. Signed copies of all original leases/easements and agreements for this SEF.
D. Any other materials needed to satisfy the requirements of this permit.

8-2.6 Economic Impact Study: The County will hire independent experts (paid for from the Escrow Account: see ¶ 8-4) who will do a thorough, conservative assessment of the SEF's net economic impact on the community. This will include possible tourism reduction, property devaluations (and the commensurate loss in tax base), cost to community due to possible adverse health effects, higher cost of electricity, etc. This will be compared to any guaranteed incomes from the SEF.

8-2.7 Environmental Impact Study: An Environmental Impact Study (EIS) shall be conducted that includes review comments from citizens in the County, independent experts, as well as all applicable state and federal agencies, including (as a minimum) the:

A. NC Department of Environmental Quality,
B. NC Department of Health,
C. NC Department of Transportation,
D. US Fish and Wildlife Service, and
E. US Army Corps of Engineers.

The EIS shall include, at a minimum, the potential impacts on the human population, as well as the animal populations, migratory areas used by waterfowl, land, and water (including impacts on groundwater resources due to foundations, pilings, etc.), and air. The study area shall include within the confines of the proposed SEF, as well as the area at least one (1) mile surrounding the proposed SEF.

All costs and expenses incurred related to the Environmental tests for the SEF shall be paid from the Escrow Account (see ¶ 8-4). The County shall use the Escrow Account funds to hire independent qualified experts, as needed, to do the following:

1. The Applicant must provide a written report from all appropriate state and federal agencies detailing their evaluation of the proposed SEF.
2. Provide a complete list of all materials that will be used in the solar array, highlighting any materials that are known to be carcinogenic (e.g. cadmium).
3. At least ten representative soil samples to generate a reasonable baseline as to what the pre-SEF soils consist of.
4. Provide the location and full description of any of the following: open drainage courses, streams, vernal pools, wetlands, and other important natural areas and site features, including, but not limited to, floodplains, deer wintering areas, Essential Wildlife Habitats, Significant Wildlife Habitats, livestock, Scenic or Special Resources, habitat of rare and endangered plants and animals, natural communities of endangered species (federal or state), unique natural areas, sand and gravel aquifers, wells, and historic and/or archaeological resources.
5. The Applicant must demonstrate, to the satisfaction of the County, that the proposed SEF will not have undue hydro-geological consequences (e.g. with surface or subterranean water resources, and storm water runoff), or adverse effects on geological stability, rare, threatened, or endangered wildlife, Significant Wildlife Habitat, Essential Wildlife Habitat, Raptor Habitat, livestock, threatened or endangered plants, and rare or exemplary natural plant communities and ecosystems.
6. The Applicant must provide a cumulative-impact assessment of their SEF in the context of any other SEFs within five (5) miles, including migratory bird, bat and large mammal corridors, and demonstrate that the SEF is not located in an area that will result in degradation of important wildlife corridors or flyways.
7. Pre-construction and post-construction field studies shall be conducted using the most advanced techniques available. If the pre-construction field studies demonstrate significant adverse effect to birds, bats, game animals, water resources, habitat fragmentation or other

ecosystem degradation, the SEF Applicant shall propose a remediation plan, subject to the County's approval. The Applicant accepts that some environmental impacts cannot be satisfactorily resolved, and that such situations will be factored into the County's decision regarding the net benefits of the SEF.

8. In determining the nature and effectiveness of such remediation plans, the County will be guided by inputs of its citizens, its own consultants, the appropriate state & federal agencies, and applicable state and federal laws and regulations. The SEF Applicant will be responsible for the full cost of implementing any approved remediation plan, under the supervision of the County and its designated agents.
9. After implementation of any remediation plan, the County will review the situation to determine its effectiveness. Should the County find the remediation efforts inadequate, the SEF Applicant will be given sixty (60) days from that finding, to resolve the deficiencies. In the absence of a successful resolution, the County (at its sole discretion) shall have the right to deny the SEF Permit.

8-2.8 SEF Airspace Impacts: If any portion of a SEF will be located within five (5) miles of any civilian or military airport runway, or heliport, the Applicant shall provide a copy of the FAA determination resulting from the filing of FAA Form 7460-1. The Applicant shall also demonstrate compliance with all Local, State and Federal airport related laws.

If requested by the County Planning Board, the SEF Applicant shall use the latest version of the Solar Glare Hazard Analysis Tool (SGHAT), per its user's manual to evaluate the solar glare aviation hazard, as indicated in D (i) and D (ii). The full report for each flight path and observation point, as well as the contact information for the zoning administrator, shall be sent to the appropriate authority at least 30 days prior to site plan approval. Proof of delivery of notification and date of delivery shall be submitted with permit application.

8-2.9 Visual Impacts: The Applicant shall furnish a visual impact assessment to the Planning Board, which shall include:

A. Pictorial representations of "before and after" views from 360 degree viewpoints within 1000 feet of the proposed SEF boundaries. These will include major roads; state and local parks; other public lands; historic districts; preserves and historic sites. The Applicant shall provide a map showing the locations of where the pictures were taken and the distance of each location from the proposed SEF.
B. If any portion of a proposed SEF will be located within 1000 feet of the right-of-way of a Federal or State-designated Scenic Route/By-way, the Applicant shall describe the proposed measures to be taken to minimize the visual impact of the proposed SEF upon a Scenic Route/By-way.
C. A computer-generated "zone of visibility map" (covering at least a one [1] mile radius from the proposed SEF) shall be created to illustrate locations from which the proposed installation may be seen, with and without foliage.

8-2.10 Maintenance Plan: The Applicant shall detail storm follow-up, and other actions that will be taken to keep the SEF operating quietly, efficiently, and not polluting land, water, or air. The Applicant shall conduct preventive maintenance inspections at least once every year, and after any wind event defined as a tropical storm or Category 1 (or higher) hurricane.

Each inspection shall look for such things as metal fatigue, nut loosening, and other potential failures that might impact the public health and safety. Such inspection reports shall be provided to the Planning Board within thirty (30) days of the inspection.

8-2.11 Decommissioning Plan: A description of how the structural and array materials will be disposed of, how the site will be restored, as well as:

A. Anticipated life of the SEF.

B. Estimated decommissioning costs including contingency costs of at least 20% (in current dollars), as provided by an appropriately experienced licensed engineer.
C. A verifiable means of determining if the decommissioning plan needs to be activated due to cessation of use, such as a letter from the electric utility stating that it will notify the Planning Department within ten (10) business days if electricity is not received from any array within the SEF for any thirty (30) consecutive days.
D. The Applicant's plan to dispose of all hazardous waste contained in the SEF.
E. Method for ensuring that funds will be available for decommissioning and restoration as set forth in ¶ 9-6.

8-2.12 Ancillary Materials: Other relevant studies, reports, certifications, and approvals as may be reasonably requested by the County to ensure compliance with this Local Law, or to protect the health, safety and well-being of the County's citizens, or local ecosystems. The inputs of local citizens will be solicited in at least one (1) public hearing on this application.

8-2.13 Testament: The Applicant will sign a document that Applicant (and successive assigns) agree to all the provisions of this Local Law, without reservation or qualification.

8-2.14 Planning Board Decision: The approval by the Planning Board shall be valid for a period of one (1) year. Prior to the expiration of such approval, the Owner of the SEF may submit one (1) approval extension application for up to an additional one (1) year. Such approval extension application shall be accompanied by a renewal application fee (¶ 8-9), as well as a letter explaining the reasons that would justify an approval extension.

8-3 Installation and Design:

8-3.1 Setbacks: To provide for at least minimal operational safety for persons and property located outside of a SEF, all SEFs shall comply with the following: two hundred fifty (250) feet from property lines*, and maximum height of twenty (20) feet**.

* Such minimum setback for a SEF shall be measured from its outermost extension that is nearest the SEF property line, public or private right-of-way, and access easement.

** Height is measured from the lowest adjacent grade to the highest point of the structure, including any attachments (such as a lightening protection device).

8-3.2 Power Collection: The electrical connection system from the solar arrays to a substation shall, to the maximum extent possible, be placed underground. The power from that substation may use overhead transmission lines, if approved by the Planning Board.

8-3.3 Road Analysis: The Applicant shall agree, in writing, to the conditions of ¶ 9-3.

8-3.4 The SEF shall:

A. Be a non-obtrusive color that blends with the surrounding foliage, as determined by the Planning Board.
B. Not be artificially lighted, except as approved by the Planning Board.
C. Not contain any signs or other advertising (including flags, streamers or decorative items or any identification of the array manufacturer, SEF owner and operator). This does not include any identification plaques that might be required by the electric utility or a governmental agency.
D. Have a minimum landscape buffer of 25 feet on sides where neighboring homes can see into the SEF. The buffer shall contain evergreen trees or bushes planted no more than 8 feet apart and at least 4 feet tall at time of planting. The buffer shall obtain a height of 10 feet within 3 growing seasons. The trees or bushes may be trimmed but no lower than a height of 10 feet.
E. Have a continuous opaque, unperforated barrier (inside the buffer tree line) extending from the surface of the ground to a uniform height of not less than six (6) feet from the ground at any given point, constructed of dirt, wood, stone, steel, or other metal, or any substance of a similar nature and strength which will hide the SEF.
F. Be sited and operated so as to not interfere with television, Internet service, telephone (including cellular and digital), microwave, satellite (dish), navigational, or radio reception in

neighboring areas. The Applicant and/or operator of the SEF shall be responsible for the full cost of any remediation necessary to correct any problems or provide equivalent alternate service, within thirty (30) days of being given notice. This includes relocation or removal of a problematic array, or any other equipment, transmission lines, transformers, and other components related thereto.

G. The design and construction of the SEF shall not produce light emissions, either direct or indirect (reflective), that would interfere with pilot vision and/or traffic control operations as stated in section 3.2.2 of the DoD AICUZ report.

H. Prepare an incident response plan that ensures that local emergency responders have the necessary equipment and training to effectively handle emergencies such as fires, structural damage (or collapse) of equipment, including access to equipment needed for rescue of trapped personnel. The Escrow Fund will be used to reimburse all local emergency responders for any necessary equipment or training required by a SEF.

8-3.5 Security: The Applicant shall submit design plans to verify that the SEF is:

A. Located, fenced, or otherwise secured so as to prevent unauthorized access.

B. Installed in such a manner that they are accessible only to persons authorized to operate or service them, and inaccessible to non-authorized individuals.

8-4 SEF Escrow Account: The Applicant shall pay to the County a non-refundable Application Fee (see ¶ 8-9). The County Commissioners and/or County Planning Board reserve the right to obtain engineering, economic impact, environmental impact, or other professional services to aid it in the review of any submitted SEF application. These costs (and other expenses incurred by the County) are reimbursable only from the Escrow Account, not the Application Fee.

8-4.1 The Applicant shall reimburse the County for all oversight expenses incurred relating to the SEF, from application through decommissioning.

8-4.2 These SEF-related oversight expenses include (but are not limited to) amounts required for Building Permits, Licensing, Re-Licensing, and Decommissioning — e.g. administration, engineering, expert health and wildlife evaluations, handling complaints, legal, etc. “Legal” includes reasonable attorney fees for the County if the County has to sue the Applicant.

8-4.3 Any Escrow Account interest shall stay with the account and be considered new principle.

8-4.4 This Escrow Account will be setup by the Applicant at the time of the SEF permit Application. This Escrow Account will be at a financial institution approved by the County, solely in the name of the County, to be managed by the County Treasurer (or designee).

The Applicant will make an initial deposit of $10,000. A SEF Permit Application will not be processed until the Applicant has provided proof of deposit. A SEF Permit Application determination will not be made until all costs incurred by the County to date, have been reimbursed by the Applicant.

8-4.5 If the SEF Application is denied, all Escrow Account funds will be returned to the Applicant, less related expenses incurred by the County. The money will be returned, along with a statement as to these costs, within 30 days of the Application being formally denied, or receipt of a Letter of Withdrawal. Permit Fees are non-refundable.

8-4.6 This Escrow Account will be funded during the life of the SEF by the Applicant/Owner/Operator. The Applicant/Owner/Operator will replenish any Escrow funds used by the County within 14 days of being sent written notification (and explanation) of said withdrawals. Failure to maintain the Escrow Account at $10,000 (within 30 days of being given notice) shall be cause for revocation (or denial of renewal) of the SEF Permit.

8-4.7 Once the Owner believes that they have satisfactorily complied with the decommissioning conditions specified herein, they will send the County written notification. The County then has sixty (60) days to verify to their satisfaction that all decommissioning conditions have been complied with. If there is material non-compliance, the County will so notify the Owner and the process starts

over. Otherwise the County will return all Escrow Account funds to the Owner, less related expenses incurred by the County, along with an explanatory statement.

8-5 SEF Real Property Value Protection Plan:
The SEF Applicant shall assure the County that there will be no loss in real property value for any property within 1000 feet of the SEF. To legally support this claim, the Applicant shall consent in writing to a Real Property Value Protection Agreement ("Agreement": see ¶ 9-4) as a condition of approval for the SEF. This Agreement shall provide assurance to non-participating real property owners (i.e. those with no solar facilities on their property) near the SEF, that they have some protection from SEF-related real property values losses.

8-6 SEF Surety for Removal, when Decommissioned:
The Applicant shall place with the County an acceptable letter-of-credit, bond, or other form of security that is sufficient to cover the cost of removal at the end of each SEF array's useful life, as detailed in the decommissioning plan. Such surety shall be at least $10,000 for each acre of a solar array. The Planning Board may approve a reduced surety amount that is not less than 150% of a cost estimate that is certified by an Engineer, salvage company, or other expert acceptable to the Planning Board. This calculation will not take into account any estimated salvage values.

The County shall use this surety to assure the faithful performance of the decommissioning terms and conditions of the Applicant's plan and this law. The full amount of the bond or security shall remain in full force and effect until all necessary site restoration is completed to return the site to a condition comparable to what is was prior to the SEF, as determined by the Planning Board (see ¶ 9-6). The Applicant will be responsible for assuring that any subsequent Assigns of the SEF, will provide acceptable surety to the County, prior to any transfer of ownership.

8-7 SEF Liability Insurance:

8-7.1 The holder of a permit for a SEF shall agree to secure and maintain for the duration of the permit public liability insurance, as follows:

A. Commercial general liability covering personal injuries, death and property damage: $5,000,000 per occurrence ($10,000,000 aggregate), which shall specifically include the County and its officers, councils, employees, committee members, attorneys, agents and consultants as additional named insureds.

B. Umbrella coverage: $10,000,000.

8-7.2 The insurance policies shall be issued by an agent or representative of an insurance company licensed to do business in the State and with at least a Best's rating of "A".

8-7.3 The insurance policies shall contain an endorsement obligating the insurance company to furnish the County with at least 30 days prior written notice in advance of a cancellation.

8-7.4 Renewal or replacement policies shall be delivered to the County at least 15 days before the expiration of the insurance that such policies are to renew or replace.

8-7.5 No more than 15 days after the grant of the permit and before construction is initiated, the permit holder shall deliver to the County a copy of each of the policies or certificates representing the insurance in the required amounts.

8-7.6 A certificate of insurance that states that it is for informational purposes only and does not confer sufficient rights upon the County, shall not be deemed to comply with this Law.

8-8 SEF Indemnification:
Any application for a SEF within the County shall contain an indemnification provision. The provision shall require the Applicant to at all times defend, indemnify, protect, save, hold harmless, and exempt the County, and its officers, councils, employees, committee members, attorneys, agents, and consultants from any and all penalties, damages, costs, or charges arising out of any and all claims, suits, demands, causes of action, or award

of damages, whether compensatory or punitive, or expenses arising therefrom, either at law or in equity, which might arise out of, or are caused by, the placement, construction, erection, modification, location, equipment's performance, use, operation, maintenance, repair, installation, replacement, removal, or restoration of said SEF, excepting, however, any portion of such claims, suits, demands, causes of action or award of damages as may be attributable to the negligent or intentional acts or omissions of the County, or its employees or agents. With respect to the penalties, damages, or charges referenced herein, reasonable attorneys' fees, consultants' fees, and expert witness fees are included in those costs that are recoverable by the County.

8-9 SEF Permit Fees.

The non-refundable Permit Application Fee shall be $500 per megawatt (MW) of rated maximum capacity. A renewal Permit Application Fee shall be $250 per megawatt (MW) of rated maximum capacity.

8-10 Standards for Planning Board's SEF Permit Application Decision:

The Planning Board may disapprove a SEF Permit Application for a variety of legal reasons, including but not limited to, the following:

A. Conflict with safety and safety-related codes and requirements.
B. The use or construction of a SEF that is contrary to an already-stated purpose of a specific zoning or land use designation.
C. The operation of a SEF would be a net economic liability to the community.
D. The operation of a SEF would create unacceptable health risks to the public.
E. The placement and operation of a SEF that would create unacceptable risks to wildlife and/or regional ecosystems.
F. The placement and location of a SEF would result in a conflict with, or compromise or change in, the nature or character of the surrounding area.
G. The operation of a SEF would create unacceptable interference with any type of military operation.
H. Conflicts with any provisions of this Local Law.

SECTION 9. SEF POST-PERMIT APPROVAL REQUIREMENTS

9-1 SEF Certification

Prior to operation of any approved and constructed SEF, the Applicant must provide a certification that the project complies with applicable codes, industry practices and conditions of approval (where applicable).

9-2 Reservation of Authority to Inspect SEF

In order to verify that the holder of a permit for a SEF and any and all lessees, renters, and/or licensees of it, have placed and constructed such facilities in accordance with all applicable technical, safety, fire, building, and zoning codes, laws, Local Laws and regulations and other applicable requirements, the County may inspect all facets of said permit holder's, renter's, lessee's or licensee's placement, construction, and maintenance of such facilities, including all solar arrays, buildings, and other structures constructed or located on the site.

9-2.1 Solar Energy Facilities shall not begin operation until all approvals required under this Local Law shall have been obtained, and all required certifications are provided.

9-2.2 Following the issuance of any approval required under this Local Law, the Planning Board or its designee shall have the right to enter onto the Site upon which a SEF has been placed, at reasonable times in order to inspect such SEF and its compliance with this Law.

9-3.3 After undertaking such inspection, the Planning Board or its designated representative shall provide notice of any non-compliance with the terms of this Local Law or the conditions of approval of any permit issued hereunder, and shall provide the owner or Applicant with a reasonable time frame to cure such violation, such time frame to be determined based upon the seriousness of the violation, its actual and/or potential impact upon public safety, and the actual and/or potential impact of the violation upon County residents and/or local ecosystems.

9-3 SEF Construction Related Damage

The owner of any permitted SEF shall, to the extent practicable, repair or replace all real or personal property, public or private, damaged during the SEF construction. The Applicant shall reimburse the NC DOT and/or County (as appropriate) for any and all repairs and reconstruction to roads that are necessary due to the construction or decommissioning of the SEF. A qualified independent third party or other qualified person, agreed to by the NC DOT and/or County (as appropriate) and the Applicant, shall be hired to pre-inspect the roadways to be used during construction and/or decommissioning. This third party shall be hired to evaluate, document, and rate the roads condition prior to construction or decommissioning of the SEF, and again 30 days after the SEF is completed or removed.

A. Any road damage during construction that is done by the Applicant and/or one or more of its subcontractors that is identified by this third party shall be repaired or reconstructed to the satisfaction of NC DOT and/or County (as appropriate) at the Applicant's expense, prior to the final inspection. In addition, the Applicant shall pay for all costs related to this third party pre-inspection work prior to receipt of the final inspection.
B. The surety for removal of a decommissioned SEF shall not be released until the Planning Board is satisfied that any road damage that is identified by this third party during and after decommissioning that is done by the Applicant and/or one or more of its contractors or subcontractors has been repaired or reconstructed to the satisfaction of the NC DOT and/or County at the Applicant's expense. In addition, the Applicant shall pay for all costs related to work of this third party's inspection prior to receipt of the release of the surety.

9-4 SEF Real Property Value Protection Plan:

The Applicant guarantees that there will be no loss in real property value within 1000 feet of the SEF, due to the SEF. Any real property owner(s) included in that area who believe that their property may have been devalued due to the SEF, may elect to exercise the following option:

9-4.1 All appraiser costs are paid by the Applicant, from the Escrow Account. Applicant and the property owner shall each select a licensed appraiser. Each appraiser shall provide a detailed written explanation of the reduction, if any, in value to the real property ("Diminution Value"), caused by the proximity to the SEF. This shall be determined by calculating the difference between the current Fair Market Value (FMV) of the real property and what the FMV would have been at the time of exercising this option, assuming no SEF was proposed or constructed.

A. If the higher of the Diminution Valuations submitted is equal to or less than 25% more than the other, the two values shall be averaged ("Average Diminution Value": ADV).
B. If the higher of the Diminution Valuations submitted is more than 25% higher than the other, then the two appraisers will select a third licensed appraiser, who shall present to Applicant and property owner a written appraisal report as to the Diminution Value for the real property. The parties agree that the resulting average of the two highest Diminution Valuations shall constitute the ADV.
C. In either case, the property owner may elect to receive payment from Applicant of the ADV. Applicant is required to make this payment within 60 days of receiving said written election from property owner.

9-4.2 Other Agreement Conditions:

A. If a property owner wants to exercise this option, they must do so within 10 years of the SEF receiving final approval from the County.
B. A property owner may elect to exercise this option only once.
C. The Applicant and the property owner may accept mutually agreeable modifications of this Agreement, although the Applicant is not allowed to put other conditions on a financial settlement (e.g. confidentiality). If the property owner accepts some payment for property value loss based on an alternative method, that that acceptance and payment shall be considered an exercise of this option.

D. This Agreement applies to the property owner of record as of the date of the SEF approval, and is not transferrable to subsequent owners.
E. The property owner of record as of the date of the SEF approval must reasonably maintain the property from that time, until they choose to elect this option.
F. The property owner must permit full access to the property by the appraisers, as needed to perform the appraisals.
G. The property owner must inform the appraisers of all known defects of the property as may be required by law, as well as all consequential modifications or changes to the property subsequent to the date of the SEF application.
H. This Agreement will be guaranteed by the Applicant (and all its successors and assigns), for 10 years following the SEF receiving final approval from the County, by providing a bond (or other surety) to the County, in an amount determined to be acceptable by the County. This surety account will ensure execution of all aspects of this Agreement (including compensation of eligible property owners in the case of default by Applicant). Failure to maintain this surety account shall be cause for revocation (or denial of renewal) of the SEF Permit.
I. Payment by the Applicant not made within sixty (60) days will accrue an interest penalty. This will be twelve percent (12%) annually, from the date of the written election from property owner.
J. For any litigation regarding this Agreement, all reasonable legal fees and court costs will be paid by the Applicant.

9-5 SEF Environmental Monitoring:
The Applicant will permit post-construction environmental studies deemed appropriate by the County Planning Board, which will be funded by the Escrow Account (¶ 8-4). The Applicant is responsible to see that the County has a current written list of all chemicals used for maintenance, etc. of the SEF (e.g. pesticides, herbicides, cleaners). This list shall include quantity and frequency of application of each of these chemicals. At any time if this information is out of date, the Applicant will be subject to a fine per ¶ 10-2.2.

Post-construction field studies will include scientific assessments of regional nesting failures, and territory abandonment of special status species within one (1) mile of the SEF. When these assessments are being done, only researchers involved with these studies will be legally allowed to touch carcasses. SEF personnel who move carcasses without written County approval will be subject to a fine per ¶ 10-2.2, as solar arrays do kill endangered and other highly protected species. During the life of the project every bird or bat carcass, or crippled bird or bat found anywhere within the SEF must be reported to the County by the Applicant within seven (7) days.

9-6 SEF Decommissioning:
The County Planning Board will review the projected Decommissioning costs (¶ 8-2.11) every five (5) years. The SEF owner will adjust their security to any changes from the original calculation.

If the County Building Codes official condemns any portion of a SEF, or if no electricity is generated from any solar array for three (3) consecutive months, the SEF owner and/or property owner shall have three (3) months to remedy the safety issues or complete the decommissioning of the SEF, according to the approved plan.

9-6.1 The Planning Board may grant extensions of time for repair and/or maintenance, for good cause, such as the need to back-order parts that are not currently available from the supplier or the need to repair a SEF damaged by a storm.
9-6.2 Decommissioning shall include the complete removal of solar arrays, buildings, electrical components, cabling, roads, and any other associated facilities and/or structures, including below-ground items (e.g. foundations), to a depth of four (4) feet below grade.

9-6.3 Disturbed earth shall be graded and re-seeded, unless the landowner requests in writing that the access roads or other land surface areas not be restored.

9-6.4 The Planning Board shall pay (from the Escrow Account) for at least ten representative soil sample tests, to assure that no new contaminants are left behind (ref ¶ 8-2.7 (3)). If evidence of new contaminants is found, the SEF owner is obligated to remedy the situation to the County Planning Board's satisfaction.

9-7 SEF Complaints:

The County shall set up a procedure for filing and handling SEF complaints. The SEF owner shall initially be given a reasonable opportunity to resolve all complaints. The cost of such resolution shall be borne by the SEF owner. If resolution is not made in a reasonable time (as determined by the County), the County may utilize its Escrow Account to attempt to resolve any SEF issues. The County may establish a monitoring committee to oversee resolution of complaints regarding SEFs.

SECTION 10. MISCELLANEOUS

10-1 SEF Tax Exemption

The County reserves the right to opt out of the Tax Exemption provisions of Real Property Tax Law. Further, the County reserves the right to assess any and all parts of the SEF at their full current market value. That value will be determined by the documented construction cost, less any applicable depreciation.

10-2 Enforcement; Penalties and Remedies for Violations

10-2.1 The County Commissioners and/or Planning Board shall appoint such County staff or outside consultants as it sees fit to enforce and implement this Local Law.

10-2.2 Any person owning, controlling or managing any building, structure or land related to a SEF, shall be legally and financially responsible for any and all violations of this Local Law. Such violations would include noncompliance with the terms and conditions of the permit herein, or any order of the enforcement officer. Any person who is responsible for so doing, shall be guilty of an offense and subject to a fine of not more than $1000 per incident, and/or any other penalties provided by local, state, or federal law. Every such person shall be deemed guilty of a separate offense for each week such violation shall continue. The County may institute a civil proceeding to collect civil penalties in the amount of $1000 for each violation, and each week said violation continues shall be deemed a separate violation.

10-2.3 In case of any violation (or threatened violation) of any of the provisions of this Local Law, including the terms and conditions imposed by any permit issued pursuant to this Local Law, in addition to other remedies and penalties herein provided, the County may institute any appropriate legal action or proceeding to prevent such unlawful erection, structural alteration, reconstruction, operation, moving and/or use, and to restrain, correct or abate such violation, to prevent the illegal act.

10-3 Fiscal Responsibility

10-3.1 The Planning Board may, at its discretion, request the most recent annual audited financial report of the permittee prepared by a duly licensed Certified Public Accountant, during the review process. If such report does not exist, the Planning Board may, in its sole discretion, require a suitable alternative to demonstrate the financial responsibility of the Applicant and its ability to comply with the requirements of this Local Law.

10-3.2 No transfer or sale of any SEF, including the sale of more than 30% of the stock of such entity (not counting sale of shares on a public exchange) shall occur without written acceptance by such entity of the obligations of the permittee under this Local Law. Any such transfer shall not eliminate the liability of any entity for any act occurring during its ownership or status as permittee.

SECTION 11. APPLICABILITY

The requirements of this Local Law shall apply to all SEFs proposed, operated, modified or constructed after the effective date of this Local Law.

SECTION 12. SEVERABILITY

Should any provision of this Local Law be declared by any Court, administrative body, or board, or any other government body or board, to be unconstitutional, invalid, preempted, void, or otherwise inapplicable for any reason, such decision shall not affect the validity of this Local Law as a whole or any part thereof other than the part so decided to be unconstitutional, invalid, preempted, void, or otherwise inapplicable.

Susan Burgstrom

From: John Hall
Sent: Monday, February 26, 2018 1:36 PM
To: Susan Burgstrom
Subject: FW: Zoning Board of Appeals Hearing: NC State Safety Memo
Attachments: Health and Safety Impacts of Solar Photovoltaics-2017_white paper.pdf; Solar on Farms Eckerlin.pdf; Solar PV Health & Safety 180103.pdf

From: Patrick Brown [mailto:Patrick.Brown@baywa-re.com]
Sent: Monday, February 26, 2018 11:40 AM
To: John Hall <jhall@co.champaign.il.us>
Subject: Zoning Board of Appeals Hearing: NC State Safety Memo

Hello John,

BayWa-re would like to officially submit the attached documents from NC State University, NC Clean Energy. The White Paper covers Health and Safety Impacts of Solar Photovoltaics and is written by Dr. Eckerlin with NC State University. There is also a slide presentation on health and safety issues surrounding PV Solar Technology written by Isaac Panzeralla, Professional Engineer with NC Clean Energy.

RECEIVED
FEB 2 6 2018
CHAMPAIGN CO. P & Z DEPARTMENT

Patrick Brown
Director of Development

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NC CLEAN ENERGY TECHNOLOGY CENTER

NC STATE UNIVERSITY

Health and Safety Impacts of Solar Photovoltaics

The increasing presence of utility-scale solar photovoltaic (PV) systems (sometimes referred to as solar farms) is a rather new development in North Carolina's landscape. Due to the new and unknown nature of this technology, it is natural for communities near such developments to be concerned about health and safety impacts. Unfortunately, the quick emergence of utility-scale solar has cultivated fertile grounds for myths and half-truths about the health impacts of this technology, which can lead to unnecessary fear and conflict.

Photovoltaic (PV) technologies and solar inverters are not known to pose any significant health dangers to their neighbors. The most important dangers posed are increased highway traffic during the relative short construction period and dangers posed to trespassers of contact with high voltage equipment. This latter risk is mitigated by signage and the security measures that industry uses to deter trespassing. As will be discussed in more detail below, risks of site contamination are much less than for most other industrial uses because PV technologies employ few toxic chemicals and those used are used in very small quantities. Due to the reduction in the pollution from fossil-fuel-fired electric generators, the overall impact of solar development on human health is overwhelmingly positive. This pollution reduction results from a partial replacement of fossil-fuel fired generation by emission-free PV-generated electricity, which reduces harmful sulfur dioxide (SO_2), nitrogen oxides (NO_x), and fine particulate matter ($PM_{2.5}$). Analysis from the National Renewable Energy Laboratory and the Lawrence Berkeley National Laboratory, both affiliates of the U.S. Department of Energy, estimates the health-related air quality benefits to the southeast region from solar PV generators to be worth 8.0 ¢ per kilowatt-hour of solar generation.[1] This is in addition to the value of the electricity and suggests that the air quality benefits of solar are worth more than the electricity itself.

Even though we have only recently seen large-scale installation of PV technologies, the technology and its potential impacts have been studied since the 1950s. A combination of this solar-specific research and general scientific research has led to the scientific community having a good understanding of the science behind potential health and safety impacts of solar energy. This paper utilizes the latest scientific literature and knowledge of solar practices in N.C. to address the health and safety risks associated with solar PV technology. These risks are extremely small, far less than those associated with common activities such as driving a car, and vastly outweighed by health benefits of the generation of clean electricity.

This paper addresses the potential health and safety impacts of solar PV development in North Carolina, organized into the following four categories:

(1) Hazardous Materials
(2) Electromagnetic Fields (EMF)
(3) Electric Shock and Arc Flash
(4) Fire Safety

1. Hazardous Materials

One of the more common concerns towards solar is that the panels (referred to as "modules" in the solar industry) consist of toxic materials that endanger public health. However, as shown in this section, solar energy systems may contain small amounts of toxic materials, but these materials do not endanger public health. To understand potential toxic hazards coming from a solar project, one must understand system installation, materials used, the panel end-of-life protocols, and system operation. This section will examine these aspects of a solar farm and the potential for toxicity impacts in the following subsections:

(1.2) Project Installation/Construction
(1.2) System Components
- 1.2.1 Solar Panels: Construction and Durability
- 1.2.2 Photovoltaic technologies
  - (a) Crystalline Silicon
  - (b) Cadmium Telluride (CdTe)
  - (c) CIS/CIGS
- 1.2.3 Panel End of Life Management
- 1.2.4 Non-panel System Components

(1.3) Operations and Maintenance

1.1 Project Installation/Construction

The system installation, or construction, process does not require toxic chemicals or processes. The site is mechanically cleared of large vegetation, fences are constructed, and the land is surveyed to layout exact installation locations. Trenches for underground wiring are dug and support posts are driven into the ground. The solar panels are bolted to steel and aluminum support structures and wired together. Inverter pads are installed, and an inverter and transformer are installed on each pad. Once everything is connected, the system is tested, and only then turned on.

Figure 1: Utility-scale solar facility (5 MW_{AC}) located in Catawba County. Source: Strata Solar

1.2 System Components

1.2.1 Solar Panels: Construction and Durability

Solar PV panels typically consist of glass, polymer, aluminum, copper, and semiconductor materials that can be recovered and recycled at the end of their useful life.[2] Today there are two PV technologies used in PV panels at utility-scale solar facilities, silicon, and thin film. As of 2016, all thin film used in North Carolina solar facilities are cadmium telluride (CdTe) panels from the US manufacturer First Solar, but there are other thin film PV panels available on the market, such as Solar Frontier's CIGS panels. Crystalline silicon technology consists of silicon wafers which are made into cells and assembled into panels, thin film technologies consist of thin layers of semiconductor material deposited onto glass, polymer or metal substrates. While there are differences in the components and manufacturing processes of these two types of solar technologies, many aspects of their PV panel construction are very similar. Specifics about each type of PV chemistry as it relates to toxicity are covered in subsections a, b, and c in section 1.2.2; on crystalline silicon, cadmium telluride, and CIS/CIGS respectively. The rest of this section applies equally to both silicon and thin film panels.

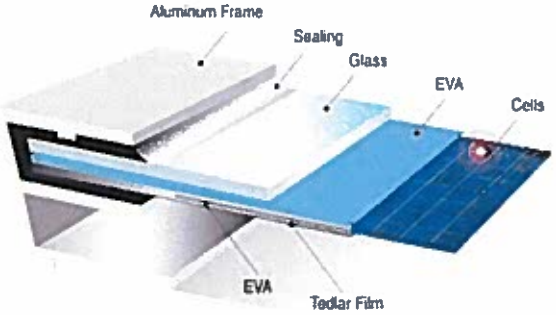

Figure 2: Components of crystalline silicon panels. The vast majority of silicon panels consist of a glass sheet on the topside with an aluminum frame providing structural support. Image Source: www.riteksolar.com.tw

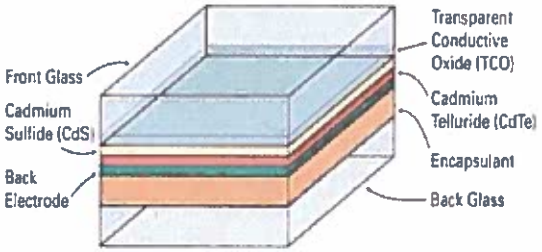

Figure 3: Layers of a common frameless thin-film panel (CdTe). Many thin film panels are frameless, including the most common thin-film panels, First Solar's CdTe. Frameless panels have protective glass on both the front and back of the panel. Layer thicknesses not to scale. Image Source: www.homepower.com

To provide decades of corrosion-free operation, PV cells in PV panels are encapsulated from air and moisture between two layers of plastic. The encapsulation layers are protected on the top with a layer of tempered glass and on the backside with a polymer sheet. Frameless modules include a protective layer of glass on the rear of the panel, which may also be tempered. The plastic ethylene-vinyl acetate (EVA) commonly provides the cell encapsulation. For decades, this same material has been used between layers of tempered glass to give car windshields and hurricane windows their great strength. In the same way that a car windshield cracks but stays intact, the EVA layers in PV panels keep broken panels intact (see Figure 4). Thus, a damaged module does not generally create small pieces of debris; instead, it largely remains together as one piece.

Figure 4: The mangled PV panels in this picture illustrate the nature of broken solar panels; the glass cracks but the panel is still in one piece. Image Source: http://img.alibaba.com/photo/115259576/broken_solar_panel.jpg

PV panels constructed with the same basic components as modern panels have been installed across the globe for well over thirty years.[3] The long-term durability and performance demonstrated over these decades, as well as the results of accelerated lifetime testing, helped lead to an industry-standard 25-year power production warranty for PV panels. These power warranties warrant a PV panel to produce at least 80% of their original nameplate production after 25 years of use. A recent SolarCity and DNV GL study reported that today's quality PV panels should be expected to reliably and efficiently produce power for thirty-five years.[4]

Local building codes require all structures, including ground mounted solar arrays, to be engineered to withstand anticipated wind speeds, as defined by the local wind speed requirements. Many racking products are available in versions engineered for wind speeds of up to 150 miles per hour, which is significantly higher than the wind speed requirement anywhere in North Carolina. The strength of PV mounting structures were demonstrated during Hurricane Sandy in 2012 and again during Hurricane Matthew in 2016. During Hurricane Sandy, the many large-scale solar facilities in New Jersey and New York at that time suffered only minor damage.[5] In the fall of 2016, the US and Caribbean experienced destructive winds and torrential rains from Hurricane Matthew, yet one leading solar tracker manufacturer reported that their numerous systems in the impacted area received zero damage from wind or flooding.[6]

In the event of a catastrophic event capable of damaging solar equipment, such as a tornado, the system will almost certainly have property insurance that will cover the cost to cleanup and repair the project. It is in the best interest of the system owner to protect their investment against such risks. It is also in their interest to get the project repaired and producing full power as soon as possible. Therefore, the investment in adequate insurance is a wise business practice for the system owner. For the same

reasons, adequate insurance coverage is also generally a requirement of the bank or firm providing financing for the project.

1.2.2 Photovoltaic (PV) Technologies

a. Crystalline Silicon

This subsection explores the toxicity of silicon-based PV panels and concludes that they do not pose a material risk of toxicity to public health and safety. Modern crystalline silicon PV panels, which account for over 90% of solar PV panels installed today, are, more or less, a commodity product. The overwhelming majority of panels installed in North Carolina are crystalline silicon panels that are informally classified as Tier I panels. Tier I panels are from well-respected manufacturers that have a good chance of being able to honor warranty claims. Tier I panels are understood to be of high quality, with predictable performance, durability, and content. Well over 80% (by weight) of the content of a PV panel is the tempered glass front and the aluminum frame, both of which are common building materials. Most of the remaining portion are common plastics, including polyethylene terephthalate in the backsheet, EVA encapsulation of the PV cells, polyphenyl ether in the junction box, and polyethylene insulation on the wire leads. The active, working components of the system are the silicon photovoltaic cells, the small electrical leads connecting them together, and to the wires coming out of the back of the panel. The electricity generating and conducting components makeup less than 5% of the weight of most panels. The PV cell itself is nearly 100% silicon, and silicon is the second most common element in the Earth's crust. The silicon for PV cells is obtained by high-temperature processing of quartz sand (SiO_2) that removes its oxygen molecules. The refined silicon is converted to a PV cell by adding extremely small amounts of boron and phosphorus, both of which are common and of very low toxicity.

The other minor components of the PV cell are also generally benign; however, some contain lead, which is a human toxicant that is particularly harmful to young children. The minor components include an extremely thin antireflective coating (silicon nitride or titanium dioxide), a thin layer of aluminum on the rear, and thin strips of silver alloy that are screen-printed on the front and rear of cell.[7] In order for the front and rear electrodes to make effective electrical contact with the proper layer of the PV cell, other materials (called glass frit) are mixed with the silver alloy and then heated to etch the metals into the cell. This glass frit historically contains a small amount of lead (Pb) in the form of lead oxide. The 60 or 72 PV cells in a PV panel are connected by soldering thin solder-covered copper tabs from the back of one cell to the front of the next cell. Traditionally a tin-based solder containing some lead (Pb) is used, but some manufacturers have switched to lead-free solder. The glass frit and/or the solder may contain trace amounts of other metals, potentially including some with human toxicity such as cadmium. However, testing to simulate the potential for leaching from broken panels, which is discussed in more detail below, did not find a potential toxicity threat from these trace elements. Therefore, the tiny amount of lead in the grass frit and the solder is the only part of silicon PV panels with a potential to create a negative health impact. However, as described below, the very limited amount of lead involved and its strong physical and chemical attachment to other components of the PV panel means that even in worst-case scenarios the health hazard it poses is insignificant.

As with many electronic industries, the solder in silicon PV panels has historically been a lead-based solder, often 36% lead, due to the superior properties of such solder. However, recent advances in lead-free solders have spurred a trend among PV panel manufacturers to reduce or remove the lead in their panels. According to the 2015 Solar Scorecard from the Silicon Valley Toxics Coalition, a group that tracks environmental responsibility of photovoltaic panel manufacturers, fourteen companies (increased from twelve companies in 2014) manufacture PV panels certified to meet the European Restriction of

Hazardous Substances (RoHS) standard. This means that the amount of cadmium and lead in the panels they manufacture fall below the RoHS thresholds, which are set by the European Union and serve as the world's de facto standard for hazardous substances in manufactured goods.[8] The Restriction of Hazardous Substances (RoHS) standard requires that the maximum concentration found in any homogenous material in a produce is less than 0.01% cadmium and less than 0.10% lead, therefore, any solder can be no more than 0.10% lead.[9]

While some manufacturers are producing PV panels that meet the RoHS standard, there is no requirement that they do so because the RoHS Directive explicitly states that the directive does not apply to photovoltaic panels.[10] The justification for this is provided in item 17 of the current RoHS Directive: "The development of renewable forms of energy is one of the Union's key objectives, and the contribution made by renewable energy sources to environmental and climate objectives is crucial. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (4) recalls that there should be coherence between those objectives and other Union environmental legislation. Consequently, this Directive should not prevent the development of renewable energy technologies that have no negative impact on health and the environment and that are sustainable and economically viable."

The use of lead is common in our modern economy. However, only about 0.5% of the annual lead consumption in the U.S. is for electronic solder for all uses; PV solder makes up only a tiny portion of this 0.5%. Close to 90% of lead consumption in the US is in batteries, which do not encapsulate the pounds of lead contained in each typical automotive battery. This puts the lead in batteries at great risk of leaching into the environment. Estimates for the lead in a single PV panel with lead-based solder range from 1.6 to 24 grams of lead, with 13g (less than half of an ounce) per panel seen most often in the literature.[11] At 13 g/panel[12], each panel contains one-half of the lead in a typical 12-gauge shotgun shell. This amount equates to roughly 1/750th of the lead in a single car battery. In a panel, it is all durably encapsulated from air or water for the full life of the panel.[14]

As indicated by their 20 to 30-year power warranty, PV modules are designed for a long service life, generally over 25 years. For a panel to comply with its 25-year power warranty, its internal components, including lead, must be sealed from any moisture. Otherwise, they would corrode and the panel's output would fall below power warranty levels. Thus, the lead in operating PV modules is not at risk of release to the environment during their service lifetime. In extreme experiments, researchers have shown that lead can leach from crushed or pulverized panels.[15, 16] However, more real-world tests designed to represent typical trash compaction that are used to classify waste as hazardous or non-hazardous show no danger from leaching.[17, 18] For more information about PV panel end-of-life, see the Panel Disposal section.

As illustrated throughout this section, silicon-based PV panels do not pose a material threat to public health and safety. The only aspect of the panels with potential toxicity concerns is the very small amount of lead in some panels. However, any lead in a panel is well sealed from environmental exposure for the operating lifetime of the solar panel and thus not at risk of release into the environment.

b. Cadmium Telluride (CdTe) PV Panels

This subsection examines the components of a cadmium telluride (CdTe) PV panel. Research demonstrates that they pose negligible toxicity risk to public health and safety while significantly reducing the public's exposure to cadmium by reducing coal emissions. As of mid-2016, a few hundred MWs of

cadmium telluride (CdTe) panels, all manufactured by the U.S. company First Solar, have been installed in North Carolina.

Questions about the potential health and environmental impacts from the use of this PV technology are related to the concern that these panels contain cadmium, a toxic heavy metal. However, scientific studies have shown that cadmium telluride differs from cadmium due to its high chemical and thermal stability.[19] Research has shown that the tiny amount of cadmium in these panels does not pose a health or safety risk.[20] Further, there are very compelling reasons to welcome its adoption due to reductions in unhealthy pollution associated with burning coal. Every GWh of electricity generated by burning coal produces about 4 grams of cadmium air emissions.[21] Even though North Carolina produces a significant fraction of our electricity from coal, electricity from solar offsets much more natural gas than coal due to natural gas plants being able to adjust their rate of production more easily and quickly. If solar electricity offsets 90% natural gas and 10% coal, each 5-megawatt (5 MW_{AC}, which is generally 7 MW_{DC}) CdTe solar facility in North Carolina keeps about 157 grams, or about a third of a pound, of cadmium *out of* our environment.[22, 23]

Cadmium is toxic, but all the approximately 7 grams of cadmium in one CdTe panel is in the form of a chemical compound cadmium telluride,[24] which has 1/100th the toxicity of free cadmium.[25] Cadmium telluride is a very stable compound that is non-volatile and non-soluble in water. Even in the case of a fire, research shows that less than 0.1% of the cadmium is released when a CdTe panel is exposed to fire. The fire melts the glass and encapsulates over 99.9% of the cadmium in the molten glass.[27]

It is important to understand the source of the cadmium used to manufacture CdTe PV panels. The cadmium is a byproduct of zinc and lead refining. The element is collected from emissions and waste streams during the production of these metals and combined with tellurium to create the CdTe used in PV panels. If the cadmium were not collected for use in the PV panels or other products, it would otherwise either be stockpiled for future use, cemented and buried, or disposed of.[28] Nearly all the cadmium in old or broken panels can be recycled which can eventually serve as the primary source of cadmium for new PV panels.[29]

Similar to silicon-based PV panels, CdTe panels are constructed of a tempered glass front, one instead of two clear plastic encapsulation layers, and a rear heat strengthened glass backing (together >98% by weight). The final product is built to withstand exposure to the elements without significant damage for over 25 years. While not representative of damage that may occur in the field or even at a landfill, laboratory evidence has illustrated that when panels are ground into a fine powder, very acidic water is able to leach portions of the cadmium and tellurium,[30] similar to the process used to recycle CdTe panels. Like many silicon-based panels, CdTe panels are reported (as far back ask 1998[31]) to pass the EPA's Toxic Characteristic Leaching Procedure (TCLP) test, which tests the potential for crushed panels in a landfill to leach hazardous substances into groundwater.[32] Passing this test means that they are classified as non-hazardous waste and can be deposited in landfills.[33, 34] For more information about PV panel end-of-life, see the Panel Disposal section.

There is also concern of environmental impact resulting from potential catastrophic events involving CdTe PV panels. An analysis of worst-case scenarios for environmental impact from CdTe PV panels, including earthquakes, fires, and floods, was conducted by the University of Tokyo in 2013. After reviewing the extensive international body of research on CdTe PV technology, their report concluded, "Even in the worst-case scenarios, it is unlikely that the Cd concentrations in air and sea water will exceed the environmental regulation values."[35] In a worst-case scenario of damaged panels abandoned on the ground, insignificant amounts of cadmium will leach from the panels. This is because this scenario is

much less conducive (larger module pieces, less acidity) to leaching than the conditions of the EPA's TCLP test used to simulate landfill conditions, which CdTe panels pass.[36]

First Solar, a U.S. company, and the only significant supplier of CdTe panels, has a robust panel take-back and recycling program that has been operating commercially since 2005.[37] The company states that it is "committed to providing a commercially attractive recycling solution for photovoltaic (PV) power plant and module owners to help them meet their module (end of life) EOL obligation simply, cost-effectively and responsibly." First Solar global recycling services to their customers to collect and recycle panels once they reach the end of productive life whether due to age or damage. These recycling service agreements are structured to be financially attractive to both First Solar and the solar panel owner. For First Solar, the contract provides the company with an affordable source of raw materials needed for new panels and presumably a diminished risk of undesired release of Cd. The contract also benefits the solar panel owner by allowing them to avoid tipping fees at a waste disposal site. The legal contract helps provide peace of mind by ensuring compliance by both parties when considering the continuing trend of rising disposal costs and increasing regulatory requirements.

c. CIS/CIGS and other PV technologies

Copper indium gallium selenide PV technology, often referred to as CIGS, is the second most common type of thin-film PV panel but a distant second behind CdTe. CIGS cells are composed of a thin layer of copper, indium, gallium, and selenium on a glass or plastic backing. None of these elements are very toxic, although selenium is a regulated metal under the Federal Resource Conservation and Recovery Act (RCRA).[38] The cells often also have an extremely thin layer of cadmium sulfide that contains a tiny amount of cadmium, which is toxic. The promise of high efficiency CIGS panels drove heavy investment in this technology in the past. However, researchers have struggled to transfer high efficiency success in the lab to low-cost full-scale panels in the field.[39] Recently, a CIGS manufacturer based in Japan, Solar Frontier, has achieved some market success with a rigid, glass-faced CIGS module that competes with silicon panels. Solar Frontier produces the majority of CIS panels on the market today.[40] Notably, these panels are RoHS compliant,[41] thus meeting the rigorous toxicity standard adopted by the European Union even thought this directive exempts PV panels. The authors are unaware of any completed or proposed utility-scale system in North Carolina using CIS/CIGS panels.

1.2.3 Panel End-of-Life Management

Concerns about the volume, disposal, toxicity, and recycling of PV panels are addressed in this subsection. To put the volume of PV waste into perspective, consider that by 2050, when PV systems installed in 2020 will reach the end of their lives, it is estimated that the global annual PV panel waste tonnage will be 10% of the 2014 global e-waste tonnage.[42] In the U.S., end-of-life disposal of solar products is governed by the Federal Resource Conservation and Recovery Act (RCRA), as well as state policies in some situations. RCRA separates waste into hazardous (not accepted at ordinary landfill) and solid waste (generally accepted at ordinary landfill) based on a series of rules. According to RCRA, the way to determine if a PV panel is classified as hazardous waste is the Toxic Characteristic Leaching Procedure (TCLP) test. This EPA test is designed to simulate landfill disposal and determine the risk of hazardous substances leaching out of the landfill.[43,44,45] Multiple sources report that most modern PV panels (both crystalline silicon and cadmium telluride) pass the TCLP test.[46,47] Some studies found that some older (1990s) crystalline silicon panels, and perhaps some newer crystalline silicon panels (specifics are not given about vintage of panels tested), do not pass the lead (Pb) leachate limits in the TCLP test.[48,49]

The test begins with the crushing of a panel into centimeter-sized pieces. The pieces are then mixed in an acid bath. After tumbling for eighteen hours, the fluid is tested for forty hazardous substances that all must be below specific threshold levels to pass the test. Research comparing TCLP conditions to conditions of damaged panels in the field found that simulated landfill conditions provide overly conservative estimates of leaching for field-damaged panels.[50] Additionally, research in Japan has found no detectable Cd leaching from cracked CdTe panels when exposed to simulated acid rain.[51]

Although modern panels can generally be landfilled, they can also be recycled. Even though recent waste volume has not been adequate to support significant PV-specific recycling infrastructure, the existing recycling industry in North Carolina reports that it recycles much of the current small volume of broken PV panels. In an informal survey conducted by the NC Clean Energy Technology Center survey in early 2016, seven of the eight large active North Carolina utility-scale solar developers surveyed reported that they send damaged panels back to the manufacturer and/or to a local recycler. Only one developer reported sending damaged panels to the landfill.

The developers reported at that time that they are usually paid a small amount per panel by local recycling firms. In early 2017, a PV developer reported that a local recycler was charging a small fee per panel to recycle damaged PV panels. The local recycling firm known to authors to accept PV panels described their current PV panel recycling practice as of early 2016 as removing the aluminum frame for local recycling and removing the wire leads for local copper recycling. The remainder of the panel is sent to a facility for processing the non-metallic portions of crushed vehicles, referred to as "fluff" in the recycling industry.[52] This processing within existing general recycling plants allows for significant material recovery of major components, including glass which is 80% of the module weight, but at lower yields than PV-specific recycling plants. Notably almost half of the material value in a PV panel is in the few grams of silver contained in almost every PV panel produced today. In the long-term, dedicated PV panel recycling plants can increase treatment capacities and maximize revenues resulting in better output quality and the ability to recover a greater fraction of the useful materials.[53] PV-specific panel recycling technologies have been researched and implemented to some extent for the past decade, and have been shown to be able to recover over 95% of PV material (semiconductor) and over 90% of the glass in a PV panel.[54]

A look at global PV recycling trends hints at the future possibilities of the practice in our country. Europe installed MW-scale volumes of PV years before the U.S. In 2007, a public-private partnership between the European Union and the solar industry set up a voluntary collection and recycling system called PV CYCLE. This arrangement was later made mandatory under the EU's WEEE directive, a program for waste electrical and electronic equipment.[55] Its member companies (PV panel producers) fully finance the association. This makes it possible for end-users to return the member companies' defective panels for recycling at any of the over 300 collection points around Europe without added costs. Additionally, PV CYCLE will pick up batches of 40 or more used panels at no cost to the user. This arrangement has been very successful, collecting and recycling over 13,000 tons by the end of 2015.[56]

In 2012, the WEEE Directive added the end-of-life collection and recycling of PV panels to its scope.[57] This directive is based on the principle of extended-producer-responsibility. It has a global impact because producers that want to sell into the EU market are legally responsible for end-of-life management. Starting in 2018, this directive targets that 85% of PV products "put in the market" in Europe are recovered and 80% is prepared for reuse and recycling.

The success of the PV panel collection and recycling practices in Europe provides promise for the future of recycling in the U.S. In mid-2016, the US Solar Energy Industry Association (SEIA) announced that they are starting a national solar panel recycling program with the guidance and support of many

leading PV panel producers.[58] The program will aggregate the services offered by recycling vendors and PV manufacturers, which will make it easier for consumers to select a cost-effective and environmentally responsible end-of-life management solution for their PV products. According to SEIA, they are planning the program in an effort to make the entire industry landfill-free. In addition to the national recycling network program, the program will provide a portal for system owners and consumers with information on how to responsibly recycle their PV systems.

While a cautious approach toward the potential for negative environmental and/or health impacts from retired PV panels is fully warranted, this section has shown that the positive health impacts of reduced emissions from fossil fuel combustion from PV systems more than outweighs any potential risk. Testing shows that silicon and CdTe panels are both safe to dispose of in landfills, and are also safe in worst case conditions of abandonment or damage in a disaster. Additionally, analysis by local engineers has found that the current salvage value of the equipment in a utility scale PV facility generally exceeds general contractor estimates for the cost to remove the entire PV system.[59, 60, 61]

1.2.4 Non-Panel System Components (racking, wiring, inverter, transformer)

While previous toxicity subsections discussed PV panels, this subsection describes the non-panel components of utility-scale PV systems and investigates any potential public health and safety concerns. The most significant non-panel component of a ground-mounted PV system is the mounting structure of the rows of panels, commonly referred to as "racking". The vertical post portion of the racking is galvanized steel and the remaining above-ground racking components are either galvanized steel or aluminum, which are both extremely common and benign building materials. The inverters that make the solar generated electricity ready to send to the grid have weather-proof steel enclosures that protect the working components from the elements. The only fluids that they might contain are associated with their cooling systems, which are not unlike the cooling system in a computer. Many inverters today are RoHS compliant.

The electrical transformers (to boost the inverter output voltage to the voltage of the utility connection point) do contain a liquid cooling oil. However, the fluid used for that function is either a non-toxic mineral oil or a biodegradable non-toxic vegetable oil, such as BIOTEMP from ABB. These vegetable transformer oils have the additional advantage of being much less flammable than traditional mineral oils. Significant health hazards are associated with old transformers containing cooling oil with toxic PCBs. Transfers with PCB-containing oil were common before PCBs were outlawed in the U.S. in 1979. PCBs still exist in older transformers in the field across the country.

Other than a few utility research sites, there are no batteries on- or off-site associated with utility-scale solar energy facilities in North Carolina, avoiding any potential health or safety concerns related to battery technologies. However, as battery technologies continue to improve and prices continue to decline we are likely to start seeing some batteries at solar facilities. Lithium ion batteries currently dominate the world utility-scale battery market, which are not very toxic. No non-panel system components were found to pose any health or environmental dangers.

1.4 Operations and Maintenance – Panel Washing and Vegetation Control

Throughout the eastern U.S., the climate provides frequent and heavy enough rain to keep panels adequately clean. This dependable weather pattern eliminates the need to wash the panels on a regular basis. Some system owners may choose to wash panels as often as once a year to increase production, but most in N.C. do not regularly wash any PV panels. Dirt build up over time may justify panel washing a few times over the panels' lifetime; however, nothing more than soap and water are required for this activity.

The maintenance of ground-mounted PV facilities requires that vegetation be kept low, both for aesthetics and to avoid shading of the PV panels. Several approaches are used to maintain vegetation at NC solar facilities, including planting of limited-height species, mowing, weed-eating, herbicides, and grazing livestock (sheep). The following descriptions of vegetation maintenance practices are based on interviews with several solar developers as well as with three maintenance firms that together are contracted to maintain well over 100 of the solar facilities in N.C. The majority of solar facilities in North Carolina maintain vegetation primarily by mowing. Each row of panels has a single row of supports, allowing sickle mowers to mow under the panels. The sites usually require mowing about once a month during the growing season. Some sites employ sheep to graze the site, which greatly reduces the human effort required to maintain the vegetation and produces high quality lamb meat.[62]

In addition to mowing and weed eating, solar facilities often use some herbicides. Solar facilities generally do not spray herbicides over the entire acreage; rather they apply them only in strategic locations such as at the base of the perimeter fence, around exterior vegetative buffer, on interior dirt roads, and near the panel support posts. Also unlike many row crop operations, solar facilities generally use only general use herbicides, which are available over the counter, as opposed to restricted use herbicides commonly used in commercial agriculture that require a special restricted use license. The herbicides used at solar facilities are primarily 2-4-D and glyphosate (Round-up®), which are two of the most common herbicides used in lawns, parks, and agriculture across the country. One maintenance firm that was interviewed sprays the grass with a class of herbicide known as a growth regulator in order to slow the growth of grass so that mowing is only required twice a year. Growth regulators are commonly used on highway roadsides and golf courses for the same purpose. A commercial pesticide applicator license is required for anyone other than the landowner to apply herbicides, which helps ensure that all applicators are adequately educated about proper herbicide use and application. The license must be renewed annually and requires passing of a certification exam appropriate to the area in which the applicator wishes to work. Based on the limited data available, it appears that solar facilities in N.C. generally use significantly less herbicides per acre than most commercial agriculture or lawn maintenance services.

2. Electromagnetic Fields (EMF)

PV systems do not emit any material during their operation; however, they do generate electromagnetic fields (EMF), sometimes referred to as radiation. EMF produced by electricity is non-ionizing radiation, meaning the radiation has enough energy to move atoms in a molecule around (experienced as heat), but not enough energy to remove electrons from an atom or molecule (ionize) or to damage DNA. As shown below, modern humans are all exposed to EMF throughout our daily lives without negative health impact. Someone outside of the fenced perimeter of a solar facility is not exposed to significant EMF from the solar facility. Therefore, there is no negative health impact from the EMF

produced in a solar farm. The following paragraphs provide some additional background and detail to support this conclusion.

Since the 1970s, some have expressed concern over potential health consequences of EMF from electricity, but no studies have ever shown this EMF to cause health problems.[63] These concerns are based on some epidemiological studies that found a slight increase in childhood leukemia associated with average exposure to residential power-frequency magnetic fields above 0.3 to 0.4 μT (microteslas) (equal to 3.0 to 4.0 mG (milligauss)). μT and mG are both units used to measure magnetic field strength. For comparison, the average exposure for people in the U.S. is one mG or 0.1 μT, with about 1% of the population with an average exposure in excess of 0.4 μT (or 4 mG).[64] These epidemiological studies, which found an association but not a causal relationship, led the World Health Organization's International Agency for Research on Cancer (IARC) to classify ELF magnetic fields as "possibly carcinogenic to humans". Coffee also has this classification. This classification means there is limited evidence but not enough evidence to designate as either a "probable carcinogen" or "human carcinogen". Overall, there is very little concern that ELF EMF damages public health. The only concern that does exist is for long-term exposure above 0.4 μT (4 mG) that may have some connection to increased cases of childhood leukemia. In 1997, the National Academies of Science were directed by Congress to examine this concern and concluded:

> "Based on a comprehensive evaluation of published studies relating to the effects of power-frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects."[65]

There are two aspects to electromagnetic fields, an electric field and a magnetic field. The electric field is generated by voltage and the magnetic field is generated by electric current, i.e., moving electrons. A task group of scientific experts convened by the World Health Organization (WHO) in 2005 concluded that there were no substantive health issues related to *electric* fields (0 to 100,000 Hz) at levels generally encountered by members of the public.[66] The relatively low voltages in a solar facility and the fact that electric fields are easily shielded (i.e., blocked) by common materials, such as plastic, metal, or soil means that there is no concern of negative health impacts from the electric fields generated by a solar facility. Thus, the remainder of this section addresses magnetic fields. Magnetic fields are not shielded by most common materials and thus can easily pass through them. Both types of fields are strongest close to the source of electric generation and weaken quickly with distance from the source.

The direct current (DC) electricity produced by PV panels produce stationary (0 Hz) electric and magnetic fields. Because of minimal concern about potential risks of stationary fields, little scientific research has examined stationary fields' impact on human health.[67] In even the largest PV facilities, the DC voltages and currents are not very high. One can illustrate the weakness of the EMF generated by a PV panel by placing a compass on an operating solar panel and observing that the needle still points north.

While the electricity throughout the majority of a solar site is DC electricity, the inverters convert this DC electricity to alternating current (AC) electricity matching the 60 Hz frequency of the grid. Therefore, the inverters and the wires delivering this power to the grid are producing non-stationary EMF, known as extremely low frequency (ELF) EMF, normally oscillating with a frequency of 60 Hz. This frequency is at the low-energy end of the electromagnetic spectrum. Therefore, it has less energy than

other commonly encountered types of non-ionizing radiation like radio waves, infrared radiation, and visible light.

The wide use of electricity results in background levels of ELF EMFs in nearly all locations where people spend time – homes, workplaces, schools, cars, the supermarket, etc. A person's average exposure depends upon the sources they encounter, how close they are to them, and the amount of time they spend there.[68] As stated above, the average exposure to magnetic fields in the U.S. is estimated to be around one mG or 0.1 μT, but can vary considerably depending on a person's exposure to EMF from electrical devices and wiring.[69] At times we are often exposed to much higher ELF magnetic fields, for example when standing three feet from a refrigerator the ELF magnetic field is 6 mG and when standing three feet from a microwave oven the field is about 50 mG.[70] The strength of these fields diminish quickly with distance from the source, but when surrounded by electricity in our homes and other buildings moving away from one source moves you closer to another. However, unless you are inside of the fence at a utility-scale solar facility or electrical substation it is impossible to get very close to the EMF sources. Because of this, EMF levels at the fence of electrical substations containing high voltages and currents are considered "generally negligible".[71, 72]

The strength of ELF-EMF present at the perimeter of a solar facility or near a PV system in a commercial or residential building is significantly lower than the typical American's average EMF exposure.[73, 74] Researchers in Massachusetts measured magnetic fields at PV projects and found the magnetic fields dropped to very low levels of 0.5 mG or less, and in many cases to less than background levels (0.2 mG), at distances of no more than nine feet from the residential inverters and 150 feet from the utility-scale inverters.[75] Even when measured within a few feet of the utility-scale inverter, the ELF magnetic fields were well below the International Commission on Non-Ionizing Radiation Protection's recommended magnetic field level exposure limit for the general public of 2,000 mG.[76] It is typical that utility scale designs locate large inverters central to the PV panels that feed them because this minimizes the length of wire required and shields neighbors from the sound of the inverter's cooling fans. Thus, it is rare for a large PV inverter to be within 150 feet of the project's security fence.

Anyone relying on a medical device such as pacemaker or other implanted device to maintain proper heart rhythm may have concern about the potential for a solar project to interfere with the operation of his or her device. However, there is no reason for concern because the EMF outside of the solar facility's fence is less than 1/1000 of the level at which manufacturers test for ELF EMF interference, which is 1,000 mG.[77] Manufacturers of potentially affected implanted devices often provide advice on electromagnetic interference that includes avoiding letting the implanted device get too close to certain sources of fields such as some household appliances, some walkie-talkies, and similar transmitting devices. Some manufacturers' literature does not mention high-voltage power lines, some say that exposure in public areas should not give interference, and some advise not spending extended periods of time close to power lines.[78]

3. Electric Shock and Arc Flash Hazards

There is a real danger of electric shock to anyone entering any of the electrical cabinets such as combiner boxes, disconnect switches, inverters, or transformers; or otherwise coming in contact with voltages over 50 Volts.[79] Another electrical hazard is an arc flash, which is an explosion of energy that can occur in a short circuit situation. This explosive release of energy causes a flash of heat and a shockwave, both of which can cause serious injury or death. Properly trained and equipped technicians and electricians know how to safely install, test, and repair PV systems, but there is always some risk of

injury when hazardous voltages and/or currents are present. Untrained individuals should not attempt to inspect, test, or repair any aspect of a PV system due to the potential for injury or death due to electric shock and arc flash, The National Electric Code (NEC) requires appropriate levels of warning signs on all electrical components based on the level of danger determined by the voltages and current potentials. The national electric code also requires the site to be secured from unauthorized visitors with either a six-foot chain link fence with three strands of barbed wire or an eight-foot fence, both with adequate hazard warning signs.

4. Fire Safety

The possibility of fires resulting from or intensified by PV systems may trigger concern among the general public as well as among firefighters. However, concern over solar fire hazards should be limited because only a small portion of materials in the panels are flammable, and those components cannot self-support a significant fire. Flammable components of PV panels include the thin layers of polymer encapsulates surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes on rear of panel, and insulation on wiring. The rest of the panel is composed of non-flammable components, notably including one or two layers of protective glass that make up over three quarters of the panel's weight.

Heat from a small flame is not adequate to ignite a PV panel, but heat from a more intense fire or energy from an electrical fault can ignite a PV panel.[80] One real-world example of this occurred during July 2015 in an arid area of California. Three acres of grass under a thin film PV facility burned without igniting the panels mounted on fixed-tilt racks just above the grass.[81] While it is possible for electrical faults in PV systems on homes or commercial buildings to start a fire, this is extremely rare.[82] Improving understanding of the PV-specific risks, safer system designs, and updated fire-related codes and standards will continue to reduce the risk of fire caused by PV systems.

PV systems on buildings can affect firefighters in two primary ways, 1) impact their methods of fighting the fire, and 2) pose safety hazard to the firefighters. One of the most important techniques that firefighters use to suppress fire is ventilation of a building's roof. This technique allows superheated toxic gases to quickly exit the building. By doing so, the firefighters gain easier and safer access to the building, Ventilation of the roof also makes the challenge of putting out the fire easier. However, the placement of rooftop PV panels may interfere with ventilating the roof by limiting access to desired venting locations.

New solar-specific building code requirements are working to minimize these concerns. Also, the latest National Electric Code has added requirements that make it easier for first responders to safely and effectively turn off a PV system. Concern for firefighting a building with PV can be reduced with proper fire fighter training, system design, and installation. Numerous organizations have studied fire fighter safety related to PV. Many organizations have published valuable guides and training programs. Some notable examples are listed below.

- The International Association of Fire Fighters (IAFF) and International Renewable Energy Council (IREC) partnered to create an online training course that is far beyond the PowerPoint click-and-view model. The self-paced online course, "Solar PV Safety for Fire Fighters," features rich video content and simulated environments so fire fighters can practice the knowledge they've learned. www.iaff.org/pvsafetytraining
- Photovoltaic Systems and the Fire Code: Office of NC Fire Marshal
- Fire Service Training, Underwriter's Laboratory

- Firefighter Safety and Response for Solar Power Systems, National Fire Protection Research Foundation
- Bridging the Gap: Fire Safety & Green Buildings, National Association of State Fire Marshalls
- Guidelines for Fire Safety Elements of Solar Photovoltaic Systems, Orange County Fire Chiefs Association
- Solar Photovoltaic Installation Guidelines, California Department of Forestry & Fire Protection, Office of the State Fire Marshall
- PV Safety & Firefighting, Matthew Paiss, Homepower Magazine
- PV Safety and Code Development: Matthew Paiss, Cooperative Research Network

Summary

The purpose of this paper is to address and alleviate concerns of public health and safety for utility-scale solar PV projects. Concerns of public health and safety were divided and discussed in the four following sections: (1) Toxicity, (2) Electromagnetic Fields, (3) Electric Shock and Arc Flash, and (4) Fire. In each of these sections, the negative health and safety impacts of utility-scale PV development were shown to be negligible, while the public health and safety benefits of installing these facilities are significant and far outweigh any negative impacts.

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Office of Research, Innovation and Economic Development
Office of the Vice Chancellor

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MEMORANDUM

FROM: Alan H. Rebar
Vice Chancellor of Research, Innovation and Economic Development

SUBJECT: Solar on Farms & Clean Energy Development Information

DATE: May 2, 2017

The University has been made aware of the recent activities on the part of Dr. Herb Eckerlin, a retired faculty member from the College of Engineering at NC State, on the issue of solar development in North Carolina. While Dr. Eckerlin's statements and opinions are representative of a specific position on the issues surrounding solar development, his position and opinions are his own and he is not speaking on behalf of NC State University.

As part of its land-grant mission, NC State seeks to provide education, research, and community engagement for both the renewable energy and agriculture industries alike. The University is committed to its NC Clean Energy Technology Center, and the advancement of a sustainable energy economy by educating, demonstrating and providing support for clean energy technologies, practices, and policies. Dr. Eckerlin's viewpoint is representative of one side of a sensitive issue, and we encourage all groups, farmers, landowners, and communities, to continue the study and evaluation of facts and information related to solar energy in order to make reasoned and well-informed decisions and choices for themselves.

AHR/mh

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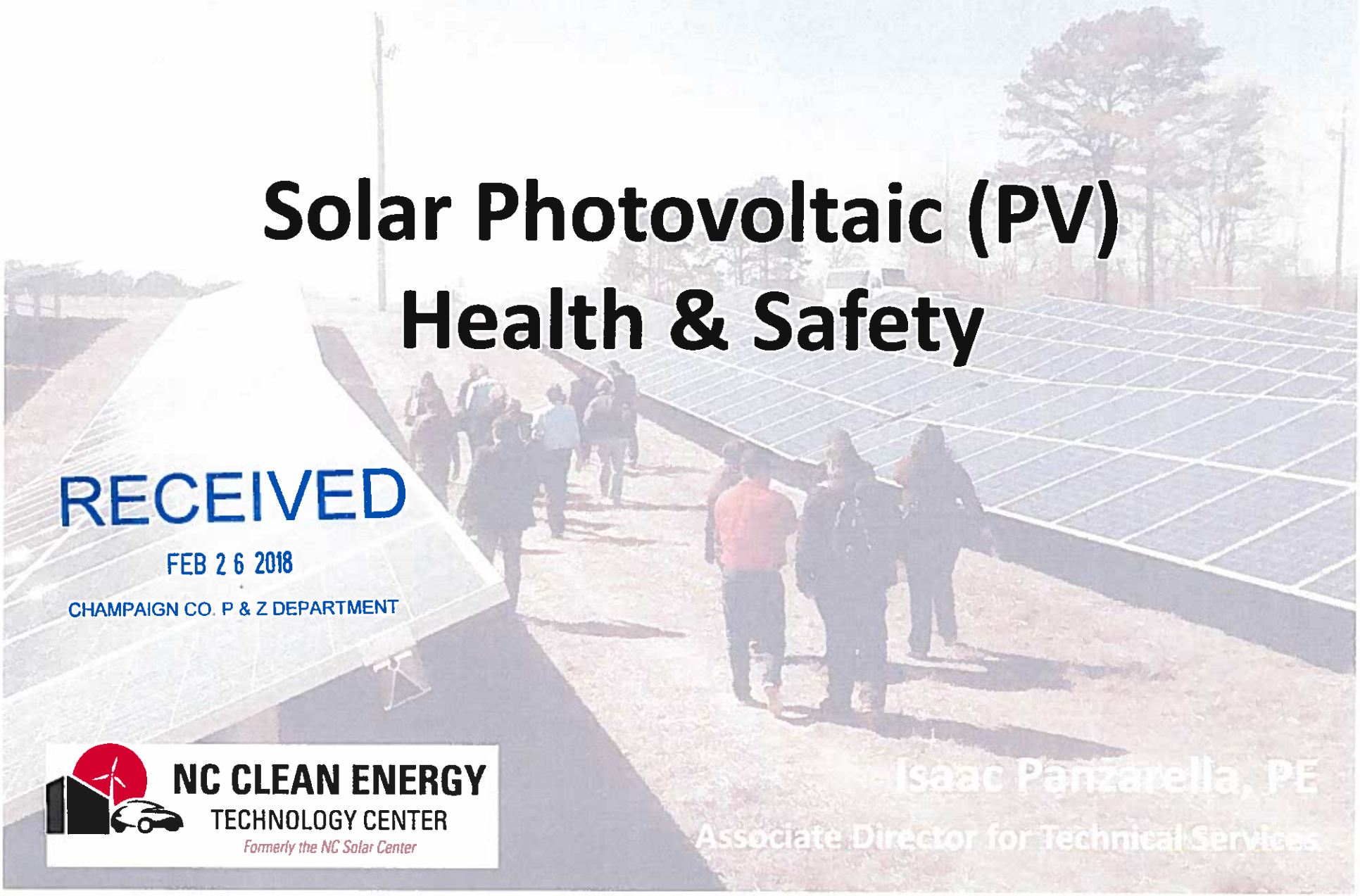
Solar Photovoltaic (PV) Health & Safety



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Formerly the NC Solar Center

Isaac Panzarella, PE
Associate Director for Technical Services

NC STATE UNIVERSITY

N.C. Clean Energy Technology Center (formerly the NC Solar Center) Overview

- Created in 1988 as a resource for renewable energy programs and information, training, technical assistance and applied research
- Operated under the College of Engineering at N.C. State University
- Funded by the state appropriation through the N.C. Department of Natural Resources (DENR), federal and state grants, and fee-for-service

Major Program Areas:

- Renewable Energy
- Clean Power & Efficiency
- Clean Transportation
- Economic Development
- Energy Policy
- Workforce Development
- Education & Outreach

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AGENDA

- Experience with Solar PV Technology in NC
- Positive Impacts of Solar PV
- Commonly Expressed Concerns about PV
- Specific Concerns
  - Material Hazard Concerns; Installation, System Components, Operations & Maintenance
  - EMF
  - Electric Shock & Arc Flash
  - Fire Fighting Safety

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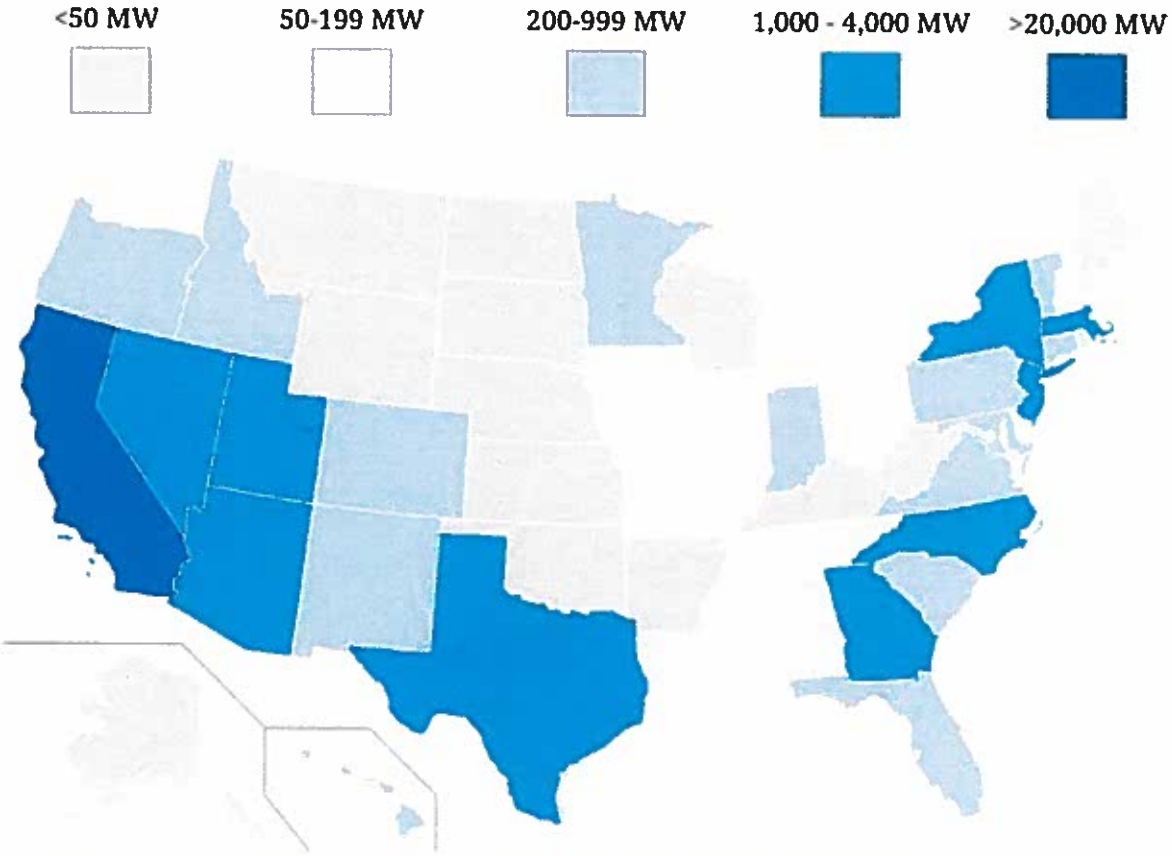
TOP 10 STATES

1. CA: 20,163 MW
2. NC: 3,785 MW
3. AZ: 3,336 MW
4. NV: 2,585 MW
5. NJ: 2,234 MW
6. MA: 1,898 MW
7. TX: 1,847 MW
8. UT: 1,566 MW
9. GA: 1,505 MW
10. NY: 1,176 MW

Cumulative Solar Capacity by State, through Q3 2017



2017

gtmresearch SEIA

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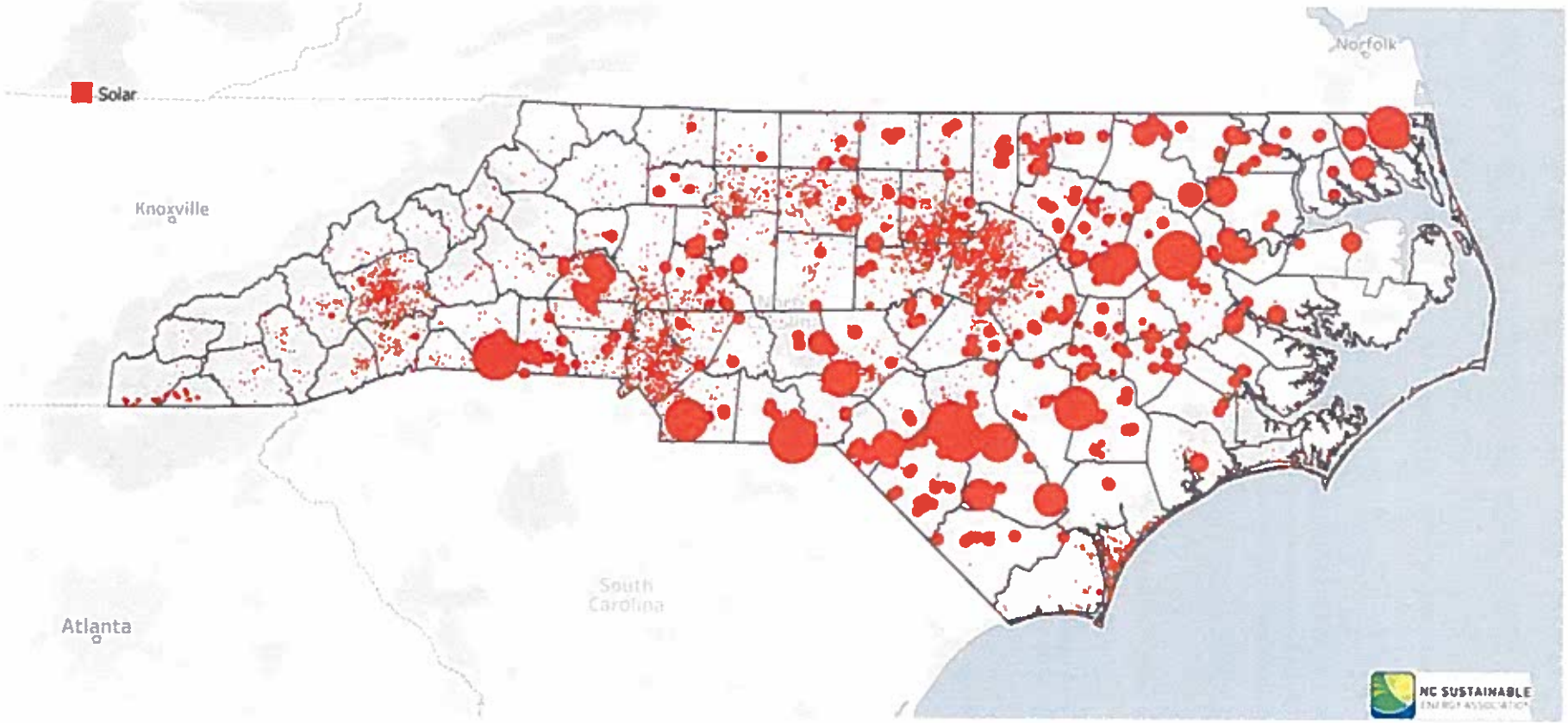
NC Installed Solar PV Systems



General System Type	Capacity (MW)	Number of Systems
Solar	3,194.08	5,896
Grand Total	3,194.08	5,896

General System Type

- Biomass
- Hydroelectric
- Solar

County

All

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Positive Impacts of PV

- Cleaner Air & Water → Public health improvement ($0.08/kWh in Southeast in DOE study)
- Local power generation – no mining, shipping, purchasing of fuels
- Less expensive than power from new traditional power plants
- Reduces environmental risk of fossil fuels – mining, SOx, NOx, particulates, greenhouse gases, etc.
- Improves energy security – distributed assets, no fuel needs
- Reduces electricity lost during transport (line losses)
- Increased local property tax income with ~no additional services
- Economic development (jobs & spending): 1 FTE per 2.8 acres during development, 1 full-time O&M per ~20 MW ~120 acres)

Commonly Expressed Concerns
"Don't Like the Look"

- In flat territory, the PV panels can be easily blocked from view with existing tree cover and/or a planted vegetative buffer
- The more topography, the more difficult to screen from view

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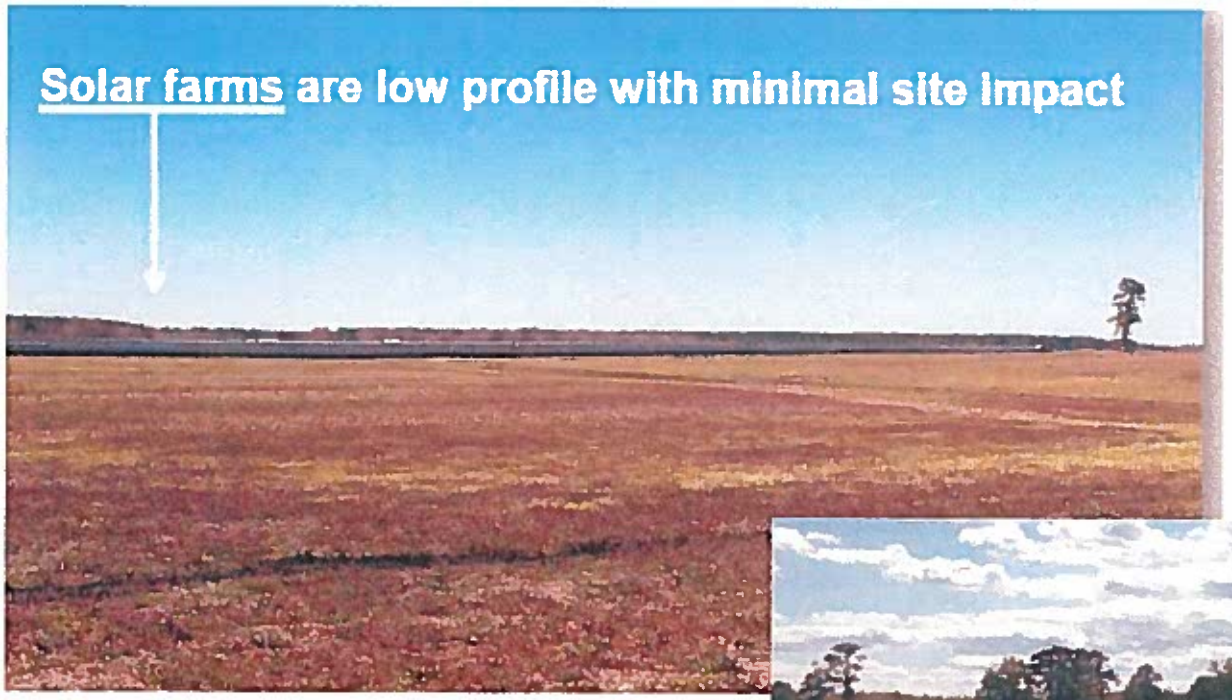
Visual Impacts

Solar Farm at 500 feet



Animal Houses at 500 feet

Source: Blue Green Energy

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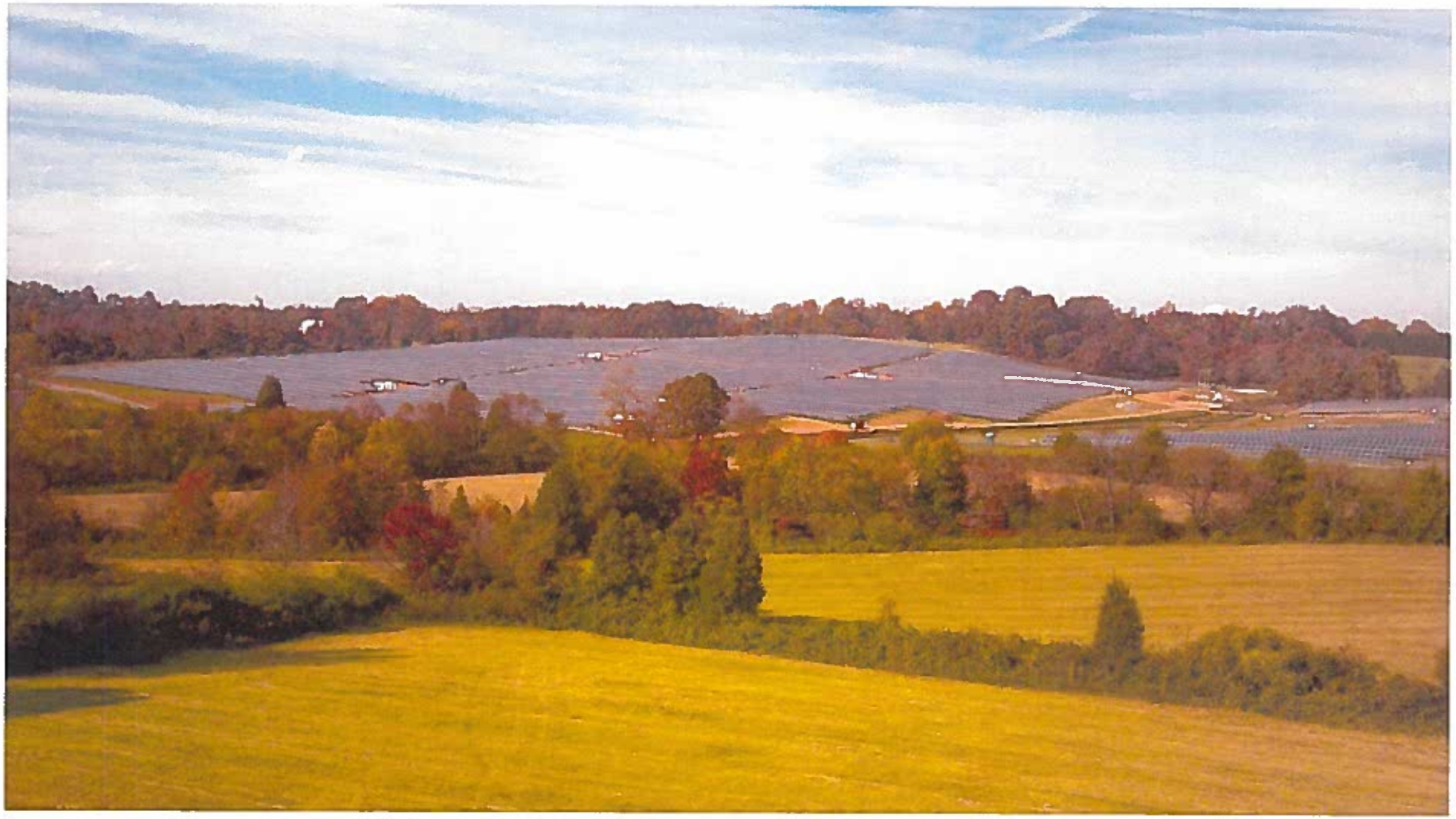

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Sound

- Primary sound is from the inverters during daylight hours. Very mild humming from transformers.
- Electrical humming sound and sometimes cooling fan
- Similar to a residential air conditioner outdoor unit
- Sound dissipates quickly and can be screened, generally no louder than existing (quiet) rural background noises at solar site fence

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Glare

- PV modules are designed to absorb, and therefore not reflect, as much sunlight as possible, over 95%
- At a glancing angle the panels are moderately reflective, similar to water or other glass
- Sandia/FAA provide SGHAT software for aviation
- At the location experiencing glare, one must look in the direction of the sun to 'see' the glare

COURTESY THINKSTOCK

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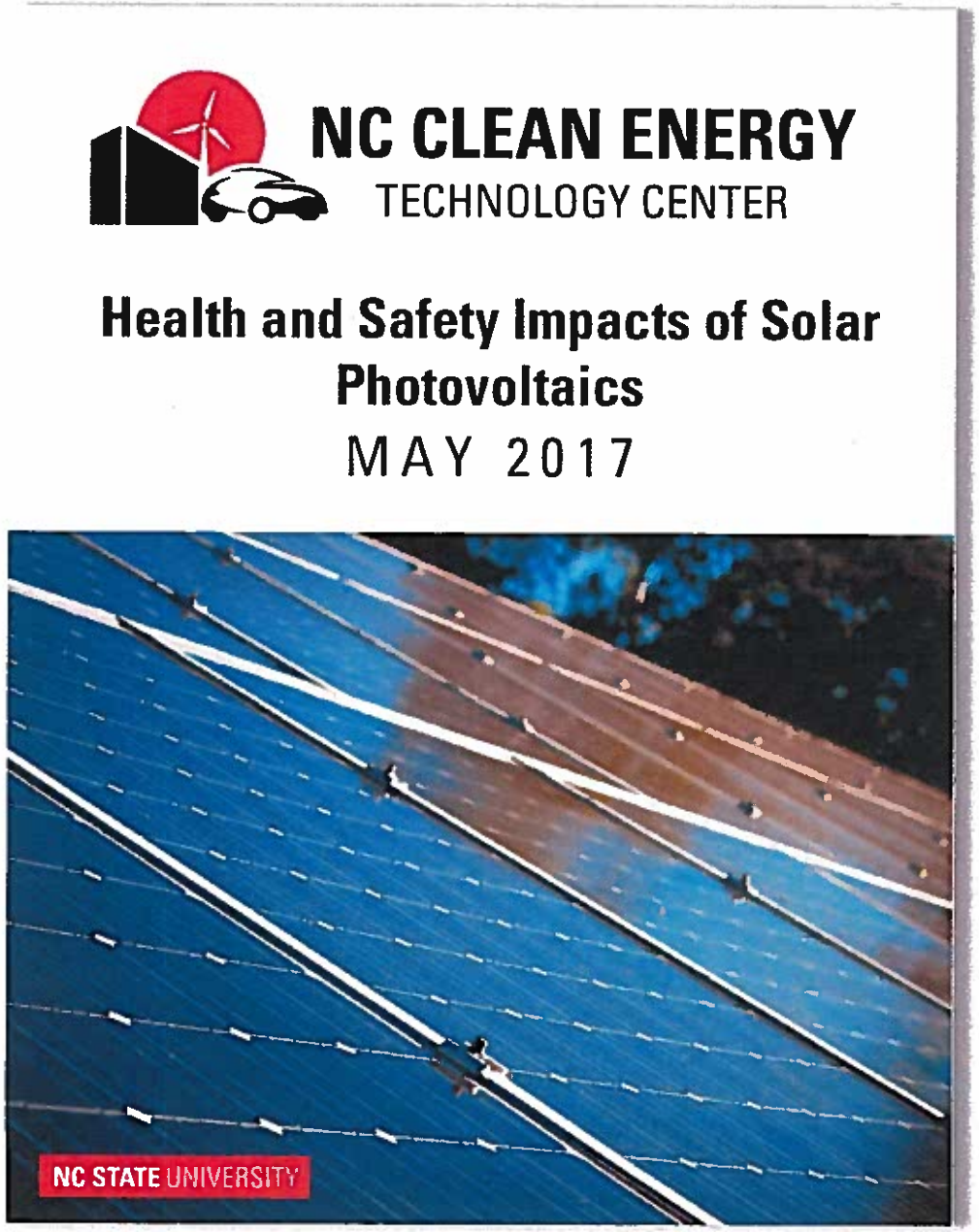

2017 whitepaper addresses:

- Material Hazard Concerns
  - Installation
  - System Components
  - Operations & Maintenance
- EMF
- Electric Shock & Arc Flash
- Fire Safety

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Material Hazard Concerns

- Installation
- System Components
  - Modules
  - Inverters, Transformers
  - Mounting Structure & Hardware
- Operations & Maintenance

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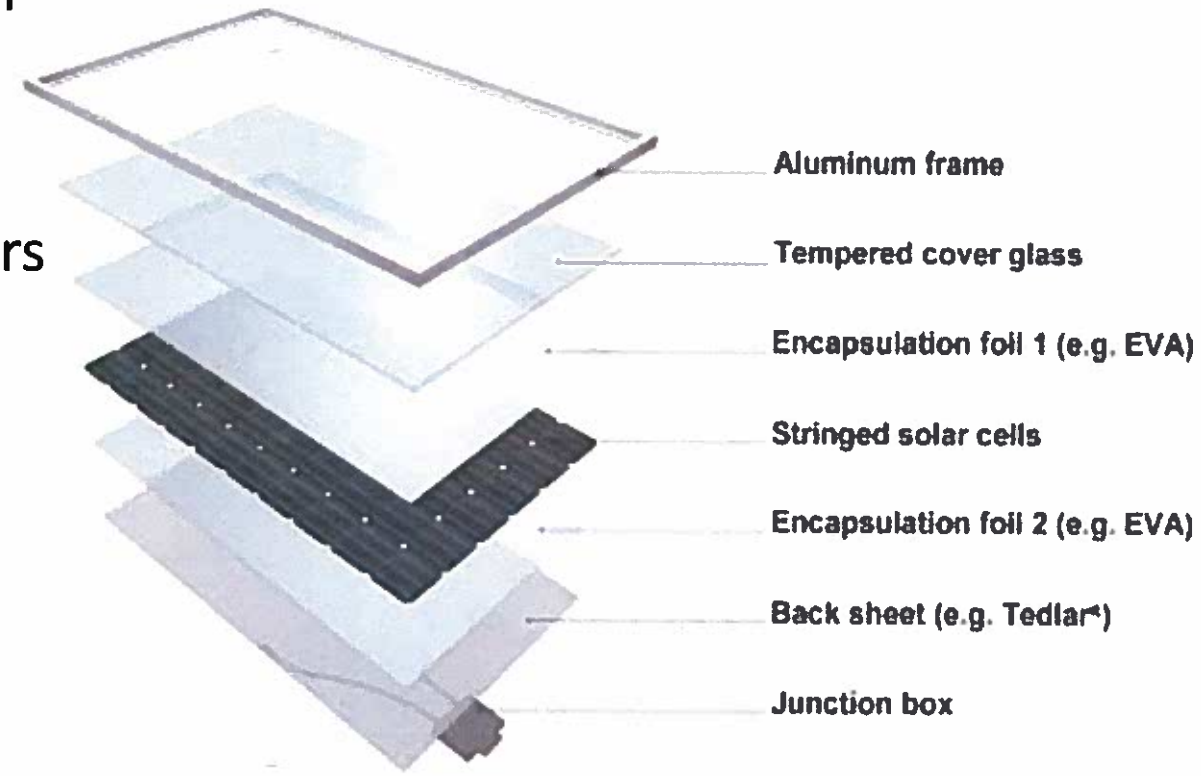
Crystalline Silicon PV Modules

- Over 90% of PV industry
- 250 to 350 Watts each
- 14% to 22% efficient
- Warranty for 80% of rated power in 25 years
- Embodied energy payback in 1.5 years
- Highly Recyclable



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No Toxicity Danger

- No operational air, water, or ground emissions
- PV modules pass EPA Toxicity Characteristic Leaching Protocol test, so non-hazardous and landfill allowed
  - Silicon cells are non-toxic, some modules contain tiny amount of lead in solder
  - Cadmium Telluride (First Solar) contain cadmium, but in stable CdTe form safe from release, even in fire
- Inverters are RoHS compliant
- Transformers use non-toxic mineral or vegetable oil
- No batteries

Site Maintenance & Operations

- Southeast annual rainfall is adequate to eliminate need for washing of solar PV arrays
- To avoid shading and aesthetic concerns, vegetation must be kept low, either by:
  - Planting species that are naturally low in height
  - Mowing at regular intervals
  - Use of grazing livestock
  - Application of herbicides in strategic areas
  - Controlling growth with a regulator commonly applied on roadways and golf courses
- Licensed professionals are engaged to maintain site

End of Life / Decommissioning

- PV owner responsible, per land lease
- 25-year PV module power warranty
- 5 to 25 year inverter warranty
- Modules over 90% recyclable, including semiconductor
- Significant salvage value, widely estimated to be higher than labor to remove
- Land returned to pre-solar condition
  - Break up an compaction and addition of lime and fertilizer to return to production

EMF/Radiation

- All electricity generates Electromagnetic Fields (EMF), it is all around us all day
- Primary EMF emitter in solar farm is the AC side of the inverter
  - Levels diminish very rapidly with distance
  - At site perimeter (>100 ft), EMF is generally no higher than background levels

Fire Safety

- PV modules are made mostly of nonflammable materials, and do not ignite easily
- Building mounted PV has specific considerations
- Firefighter associations and fire protection research agencies, as well as code authorities offer guidance, training and permitting guidelines for solar PV systems; eg firefighter access to PV system disconnects

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Thank you for your attention!

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Susan Burgstrom

From: John Hall
Sent: Wednesday, February 28, 2018 8:44 AM
To: Susan Burgstrom
Subject: FW: Revised Solar Ordinance Comments

Follow Up Flag: Follow up
Flag Status: Flagged

From: John Hall
Sent: Tuesday, February 27, 2018 3:31 PM
To: 'Patrick Brown' <Patrick.Brown@baywa-re.com>
Subject: RE: Revised Solar Ordinance Comments

Patrick, see my replies below.

John Hall

From: Patrick Brown [mailto:Patrick.Brown@baywa-re.com]
Sent: Tuesday, February 27, 2018 2:37 PM
To: John Hall <jhall@co.champaign.il.us>
Subject: Revised Solar Ordinance Comments

Hello John,

Please find my comments on the revised ordinance. I appreciate your effort to accommodate the changes I recommended. I only have a few comments that we should discuss in detail.

Section 6.1.5.A.2.c This is a bit tricky because you do not get crossing agreements until you have the project 100% engineered. We do not start 100% engineering until after we get the CUP because it's expensive. Crossing agreements are really a financing issue and must be secured when you get the title policy for the land. If you do not the title company won't insure the crossing and will put an exception in the title policy, which will make it unfinanceable. HALL: The SUP can anticipate crossing agreements that are documented at the time of construction approval.

Section 6.1.5.F.f-i I am a bit confused if this is relevant to the actual construction of the project itself or is this for the haul route to get to the project location? HALL: I believe this is relevant to any work in the right of way

Section 6.1.5.L.2 Let's discuss how to implement this when I come on Thursday and we review the site plan in the field. HALL: OK

Section 6.1.5.O.1.a Do you really want this? We will give it to you, but you may not want it (Extra Work). I propose you qualify it to say upon request by the ZA and or the ELUC annual reports shall be provided. This gives you the ability to obtain them if you want them, but doesn't put an obligation to file them every year. HALL: This was based on the wind farm requirement and I suppose it was required for the wind farm because of the physical danger posed by the turbine towers. The ZBA may not see that being a problem with a

solar farm. At a minimum this would have to be provided when requested by the Zoning Administrator.

Section 6.1.5.P.d.2 This is fair, but can we cap it at 3% of CPI? Open ended items like this make financers take the most stringent and conservative approach. This way they cap it at 3% and not discount the project purchase price of project on a fictitious CPI that may never happen. HALL: This requirement now only applies to the time period between updates of the financial assurance so it may not be necessary at all.

Section 6.1.5.P.4.e This is problematic. This is backwards because the project has the highest value years 1-20. Have you thought of maybe setting this up like a mining reclamation plan? We should discuss this because it places security as the mine gets deeper and removes security as the hole is reclaimed. In our case we should start funding the decommissioning as the project gets older maybe year 13 post the bond. Also replacing security with cash is super expensive. Why can't there be a letter of credit the entire time? HALL: As was discussed at ELUC, this was a requirement specifically required by the County Board during the writing of the wind farm requirements. You are welcome to convince the County Board that it is too expensive.

Section 9.3.1 J We should talk about this. We want to pay all of your time and do not have a problem funding a deposit trust account and providing additional deposits as required. This fee as proposed will be $270,000. See proposed language. HALL: This fee is identical to the fee per megawatt that is paid by a wind farm. Why should the fee be less for a solar farm? I will gather data on fees paid by wind farms in other counties and let you know what I find but as I recall, our wind farm fees are similar to other Illinois counties

Section 9.3.3.B.2 This is more reasonable. I am ok with this approach verses a deposit account.

Patrick Brown | +1 619 733 2649 | patrick.brown@baywa-re.com

Snapshot of Solar Farm Ordinance Comparison Table

Comparison Counties: Champaign, Christian, Fulton, Kankakee, Knox, Tazewell, Whiteside

- PERMITS: All counties require a Conditional/Special Use Permit for solar farms
- LOT SIZE: All but Champaign and Fulton counties have a 5 acre minimum lot size for solar farms; Champaign County has no minimum or maximum
- HEIGHT: Champaign County is the only one that does not establish a maximum height requirement for solar farm equipment in the ordinance.
- SETBACKS:
  - Separation from adjacent residential use or district in a residential area is at least 50 feet for all counties, with some requiring up to 500 feet
  - Champaign and Christian counties are the least restrictive at 50 feet except Fulton County, which can have as little as 2 feet side or rear yard.
- FENCING: 6-8 feet for all counties except Fulton, which does not require fencing; Champaign is 7 feet.
- AIRPORTS: Projects developed near airports are subject to approval from the FAA. Champaign County has the only commercial service, and has the most stringent analysis/reporting requirements. Restricted Landing Area (RLA) and Residential Airports also have 500 feet separation requirement unless the applicant provides a glare analysis.
- GROUND COVER/BUFFER AREAS: Champaign County is only one to require a visual screen (within 1,000 feet of a dwelling or residential district)
- WEED/GRASS CONTROL PLAN: required in most counties, including Champaign
- FINE FOR MAINTAINING FENCE, WEED/GRASS CONTROL: some require fines only as they pertain to their Nuisance Ordinance; most do not mention fines
- ENVIRONMENTAL REVIEW:
  - Champaign and 3 other counties require an IDNR EcoCat review
  - 3 counties do not require environmental review
  - Hartke's North Carolina model recommends full Environmental Impact Statement
- ECONOMIC IMPACT STUDY:
  - None of the counties requires a study, but Hartke's North Carolina model requires one to be submitted with the building permit application.
- CODE COMPLIANCE: all counties require compliance with local, state and federal codes, which includes applicable building and electrical codes, and others such as Champaign County SWMEC and Illinois NPDES.
- FIRE PROTECTION PLAN: most counties do not require one, but Champaign County requires one if the FPD requests it. Hartke's North Carolina model recommends an Incidence Response Plan for all emergency responders
- POWER AND COMMUNICATION LINES:
  - most counties do not specify line location (buried or overhead)

Snapshot of Solar Farm Ordinance Comparison Table

  - Champaign County is only one that requires consideration of ag drainage tiles if they are to be buried

- GLARE: most counties require minimizing glare onto adjacent properties

- NOISE:
  - most counties do not set limit on noise from solar farms
  - Champaign County requires compliance with applicable Illinois Pollution Control Board (IPCB) regulations regarding noise
  - Kankakee establishes 50 decibels maximum

- INSPECTIONS: all counties allow inspections, typically to verify building permit compliance

- LIABILITY INSURANCE:
  - Champaign and Tazewell Counties require liability insurance
  - Other counties do not require it

- AGRICULTURAL PROTECTION:
  - Champaign County requires that applicants repair any broken ag drainage tiles, and that applicants must have Agricultural Impact Mitigation Agreement with the IL Dept of Agriculture for tile repairs, soil compaction, underground wiring, land leveling, and topsoil placement
  - Christian County stipulates repairing any broken ag drainage tiles
  - Knox and Whiteside counties require compliance with LESA

- ROAD USE AGREEMENT:
  - Champaign, Christian, Kankakee and Tazewell require a Road Use Agreement
  - Champaign County is only one that requires it prior to the close of the ZBA public hearing
  - Champaign County allows a waiver of this for a Community Solar Farm if approved by relevant highway authority

- DECOMMISSIONING:
  - Decommissioning plan required in all counties except Fulton
  - All counties except Champaign require a 12-month period of inactivity that triggers decommissioning; Champaign does not have a time frame.
  - Time allowed for decommissioning ranges from 90 days to 12 months for those that have a limit; Champaign County does not stipulate a time frame.

- FEES (not including any additional review fees):
  - The permit cost for a 2 MW system based on each county's fee schedule ranges from $500 in Fulton County to $11,000 in Christian County
  - Champaign County fee for a 2 MW system would be $6,240
  - Champaign County building permit fee is $1,800 per MW; Special Use Permit fee varies on MW - less than 7 MW is $1,320 per MW, 8 to 112 MW is $9,240 plus $102 for each MW over 7, more than 112 MW $173 per MW

Solar Farm Ordinances Comparison

	Champaign (draft dated 2/22/18)	Christian	Fulton	Kankakee	Knox	Tazewell	Whiteside	IL Solar Energy Association (Specific Recommendations)	North Carolina Model (Hartke version of Alliance for Wise Energy Decisions model)	North Carolina Model (NC Sustainable Energy Assoc/NC Clean Energy Tech Center)
Adoption date	-	11/21/2017	10/10/2017	May 2017	8/23/2017	5/31/2017	4/18/2017	8/30/2017	draft received 5/9/17	version 1.4 10/6/2016
Utility scale solar facility description	Community Solar Farm, Solar Farm	Solar Energy Facility	Commercial/Large Scale Solar Farm (SES)	Solar Farm, Solar Power Plant, Solar Energy Generation Facility	Solar Garden, Solar Farm	Community Solar Garden, Commercial/Large Scale Solar Farm (SES)	Solar Garden, Solar Farm	Utility Scale Solar	Solar Energy Facility (SEF)	Solar Energy System (SES)
Zoning Districts	AG-1 or AG-2 districts with a County Board Special Use Permit	can only be located in areas that are zoned AG-1 Agriculture or I-2 Industrial with special use and building permits	all AG, CR and I districts with a Cond. Use Permit	A1 Agriculture district with County Board Special Use Permit	C Conservation, A Agriculture, M, and M-2 Industrial districts with a Conditional Use Permit	all AG, CR and I districts with Special Use Permit	AG districts with Special Use Permit	Solar should be permitted in all zones (accessory use for behind-the meter systems and principle use for other systems) as "by-right" if it meets certain requirements	only in Agricultural districts	Agricultural, Residential Commercial, Office/Institutional with Special Use Permit, Development Standards required for Industrial districts
Min Lot Size	No	5 acres	not in solar ordinance	5 acres	5 acres	5 acres	5 acres	no limits if they meet other requirements and conform to project size	not specified	varies per district
Height	max height of all above ground structures shall be identified in the application and as approved in the Special Use permit	same as principal structure in zoning district	same as principal structure in zoning district	30 feet	20 feet	same as principal structure in zoning district	20 feet	20 feet	20 feet	20 feet
Setbacks	per street centerline required setback in Zoning Ordinance; 100 feet from any existing dwelling or principal building, not less than 50 feet from property line; 500 feet separation from airport facilities	Improved areas shall be at least 100 feet from any residence or church, measured from the principle building in a non-residential area. Improved areas shall be 50 feet from a residence or church, measured from the property line in a residential area	must meet all applicable setback requirements for an accessory structure in the zoning district	100 feet front setback, and 50 feet from all other property lines except 100 feet from neighboring properties in residential use or district	must meet all applicable setback requirements in the zoning district, 500 feet from a residence that is not part of the permit	50 feet from all property lines, and solar panels shall be kept at least five hundred (500) feet from a residence that is not part the Special Use permit	50 feet from all property lines, and solar panels shall be kept at least five hundred (500) feet from a residence that is not part the Special Use permit	subject to the same setbacks as other standard structures in the same zone or twenty-five (25) feet, whichever is less; waivers ok	two hundred fifty (250) feet from property lines	Generally 30 feet front setback, 15 feet side, and 25 feet rear. Low density residential districts have 50 feet setback on all sides. 100 feet setback to any residential dwelling unit in all districts.
Perimeter Fencing	7 feet	at least 6 feet	not in Solar Farm or Zoning Ordinance	8 feet	8 feet max	8 feet	not in Solar Farm ordinance	8 feet, waivers ok	continuous opaque, unperforated barrier minimum 6 feet, made of dirt, wood, stone, steel, or other metal, or any substance of a similar nature and strength which will hide the SEF	examples provided in appendix

Solar Farm Ordinances Comparison

	Champaign (draft dated 2/22/18)	Christian	Fulton	Kankakee	Knox	Tazewell	Whiteside	IL Solar Energy Association (Specific Recommendations)	North Carolina Model (Hartke version of Alliance for Wise Energy Decisions model)	North Carolina Model (NC Sustainable Energy Assoc/NC Clean Energy Tech Center)
Airports	500 feet separation for any airport or its approach zone; same for legal restricted landing area or residential airport that had a Special Use Permit application received by April 22, 2010 or complete and provide results from the Solar Glare Hazard Analysis Tool	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	max height limits established by the requirements of the Airport Zoning Resolution for the City of Galesburg for buildings near the municipal airport	if there is solar within 500 feet of any airport or its approach zones, applicant must complete and provide results from Solar Glare Hazard Analysis Tool	if there is solar within 500 feet of any airport or its approach zones, applicant must complete and provide results from Solar Glare Hazard Analysis Tool	Projects developed near airports are subject to approval from the FAA. Any additional regulation at the local level is unnecessary.	within five (5) miles of any civilian or military airport runway, or heliport, the Applicant shall provide a copy of the FAA determination resulting from the filing of FAA Form 7460-1. The Applicant shall also demonstrate compliance with all Local, State and Federal airport related laws	for farms greater than 0.5 acre, must do map analysis, consider potential impacts to military flight paths, and applicant must complete and provide results from Solar Glare Hazard Analysis Tool
Ground cover and buffer areas	visual screen required if within 1,000 feet of a dwelling or residential district	not in Solar Farm or Zoning Ordinance	not in Solar Farm Ordinance	when required by CB, must be 3 feet tall when planted, with hedge growing to at least 8 feet within 3 years. If buffer is to be part of solar farm, a landscape plan should be submitted	Solar Farms shall be located in a manner to reasonably minimize the view of the system from surrounding properties	not in Solar Farm ordinance	Soils shall be planted to and maintained in perennial vegetation to prevent erosion, manage run off and build soil	native vegetation is typical, and mowing maintenance is common	minimum landscape buffer of 25 feet on sides where neighboring homes can see into the SEF. The buffer shall contain evergreen trees or bushes planted no more than 8 feet apart and at least 4 feet tall at time of planting. The buffer shall obtain a height of 10 feet within 3 growing seasons	SESs shall be constructed with buffering as required by the applicable zoning district or development standards
Weed/Grass Control Plan required	Yes	Yes	not in Solar Farm Ordinance	Yes	not in Solar Farm Ordinance	Yes	Soils shall be planted to and maintained in perennial vegetation to prevent erosion, manage run off and build soil.	No	Yes	No
Fine for maintaining fence, weed/grass control	per Nuisance Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	Yes	not in Solar Farm Ordinance	Yes	not in Solar Farm ordinance	No	only if there is local ordinance for it	No
EcoCat natural resource review or other environmental review required	EcoCat required	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	Yes	Yes	Yes	Yes	post-construction Environmental Impact Statement if requested by County	links to information on resource mapping in appendix
Economic Impact Study required	No	No	No	No	No	No	No	No	Economic Impact Study required as part of permit application	No
Compliance with building code, electric code and all Federal/State requirements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Solar Farm Ordinances Comparison

	Champaign (draft dated 2/22/18)	Christian	Fulton	Kankakee	Knox	Tazewell	Whiteside	IL Solar Energy Association (Specific Recommendations)	North Carolina Model (Hartke version of Alliance for Wise Energy Decisions model)	North Carolina Model (NC Sustainable Energy Assoc/NC Clean Energy Tech Center)
Fire Protection Plan required	upon request by local fire protection district	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	Yes	not in Solar Farm ordinance	not in recommendations	incident response plan for all emergency responders	No; links to information on fire safety in appendix
Power and communication lines	All underground wiring or cabling shall be at least 5 feet below grade or deeper to maintain a minimum one foot of clearance between the wire or cable and any ag drainage tile or a lesser depth if so authorized by the Agricultural Impact Mitigation Agreement with the IL Dept of Agriculture. Burying power and communication wiring underground shall be minimized consistent with best management practice regarding solar farm construction and minimizing impacts on agricultural drainage tile.	underground	not in Solar Farm Ordinance	underground	not in Solar Farm Ordinance	not in Solar Farm ordinance	underground, except with variance	underground is typical, but not necessary	underground	links to information on wildlife friendly power lines in appendix
Glare	standard condition to minimize glare	not in Solar Farm Ordinance	a solar collection device or combination of devices will be designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard	not in Solar Farm Ordinance	reflection angles for solar collectors shall be oriented such that they do not project glare onto adjacent properties	reflection angles for solar collectors shall be oriented such that they do not project glare onto adjacent properties	solar energy systems using a reflector to enhance solar production shall minimize glare from the reflector affecting adjacent or nearby properties	majority of panel technology is antireflective, so glare risk is minimal to non-existent. If the authority wants to include glare guidance, it should be minimal. Per federal regulations, projects around airports need approval from the FAA	design and construction of the SEF shall not produce light emissions, either direct or indirect (reflective), that would interfere with pilot vision and/or traffic control operations as stated in section 3.2.2 of the DoD AICUZ report	glare considered only in relation to airport operations within 5 miles of a SES
Noise	must comply with the applicable Illinois Pollution Control Board (IPCB) regulations (35 Illinois Administrative Code Subtitle H: Noise Parts 900, 901, 910)	not in Solar Farm Ordinance	not in Solar Farm Ordinance	50 decibels max at the property line when located adjacent to an existing residence or residential district	not in Solar Farm Ordinance	not in Solar Farm ordinance	not in Solar Farm Ordinance	not in recommendations	not in ordinance model	not in ordinance model

Solar Farm Ordinances Comparison

	Champaign (draft dated 2/22/18)	Christian	Fulton	Kankakee	Knox	Tazewell	Whiteside	IL Solar Energy Association (Specific Recommendations)	North Carolina Model (Hartke version of Alliance for Wise Energy Decisions model)	North Carolina Model (NC Sustainable Energy Assoc/NC Clean Energy Tech Center)
Inspection by Zoning Department	building permit compliance	building permit compliance	building permit compliance	building permit compliance	building permit compliance	yearly	building permit compliance	not in recommendations	County can inspect, and applicant must do yearly inspection and report to the Planning Board within 30 days	not in ordinance model
General liability insurance required	$5 million/event $5 million/aggregate	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm Ordinance	not in Solar Farm ordinance	$2 million/event $5 million/aggregate, deductible <$5,000	not in Solar Farm ordinance	not in recommendations	$5 million/event $10 million/aggregate, deductible <$5,000	not in ordinance model
Agricultural protection	agriculture tiles must be repaired by the applicant, and must have Agricultural Impact Mitigation Agreement with the IL Dept of Ag regarding tile repairs, soil compaction, underground wiring, land leveling, topsoil placement	must repair drainage tiles if broken during construction	not in Solar Farm Ordinance	not in Solar Farm Ordinance	compliance with LESA	not in Solar Farm Ordinance	compliance with LESA	If LESA evaluation is required, it should be clear how county will use the LESA score	not in ordinance model	example finding: installation of large-scale industrial solar energy facilities can create drainage problems through erosion and lack of sediment control of facility and access road sites, and harm farmlands through construction methods utilized, but no specific language in the ordinance
Road use agreement required	Prior to the close of the ZBA public hearing, the Applicant shall enter into a Roadway Upgrade and Maintenance agreement approved by the County Engineer and State's Attorney; or Township Highway Commissioner; or municipality except for any COMMUNITY SOLAR FARM for which the relevant highway authority has agreed in writing to waive the requirements of subparagraphs 6.1.5 F. 1., 2., and 3.	Each SEF shall have a written agreement with County Engineer & Township Highway Commissioner(s) re: use of road, bridges and right-of-way. Performance/surety bonds may be required before a building permit can be issued	not in Solar Farm Ordinance	Prior to the issuance of a building permit, the applicant shall submit an executed agreement between the solar power plant owner/operator and all road district authorities with infrastructure affected by the solar power plant to the county	not in Solar Farm ordinance	Routing for construction and maintenance shall be approved subject to the approval of the County Highway Engineer in coordination with the Township Road Commissioners. Road repair plan and letter of credit when warranted.	not in Solar Farm ordinance	No	Applicant shall reimburse the NC DOT and/or County for any and all repairs and reconstruction to roads that are necessary due to construction or decommissioning	not in ordinance model
Decommissioning plan required	Yes	Yes	not in Solar Farm Ordinance	Yes	Yes	Yes	Yes	No	County reviews projected decommissioning costs every 5 years	Yes

Solar Farm Ordinances Comparison

	Champaign (draft dated 2/22/18)	Christian	Fulton	Kankakee	Knox	Tazewell	Whiteside	IL Solar Energy Association (Specific Recommendations)	North Carolina Model (Hartke version of Alliance for Wise Energy Decisions model)	North Carolina Model (NC Sustainable Energy Assoc/NC Clean Energy Tech Center)
Time period for requiring decommission due to farm being out of service/ not producing electrical energy	can require decommissioning in as little as 6 months per 6.1.5P.5.(e).	12 months	12 months	12 months	12 months	12 months	12 months	established by each county	3 months	established by each county
Time allowed for decommission	not in Solar Farm ordinance	12 months	90 days	not in Solar Farm ordinance	not in Solar Farm ordinance	6 months	not in Solar Farm ordinance	established by each county	3 months to decommission or mitigate safety issues	established by each county
Fees	Building permit fee is $1,800 per MW; Special Use Permit fee varies on MW - less than 7 MW is $1,320 per MW, 8 to 112 MW is $9,240 plus $102 for each MW over 7, more than 112 MW $173 per MW	Building permit fee is $10,000 for first 2 MW and $1,000 per additional MW + $1,000 for Special Use hearing	Conditional Use Permit fee is $500 per application (not solar specific)	Building permit fee is $6,526 for first $1 million in value plus $1 per each additional thousand dollars in value after that; Special Use Permit fee is $5,000 per application	Building Permit fee depends on kilowatts; 1 to 2 MW is $5,000; no fee shown for CUP	Building Permit fee depends on kilowatts; 1 to 2 MW is $5,000; Special Use Permit starts at $300 based on acreage	$500/MW + $750 per public hearing + court stenographer + $75 LESA eval	If the authority requires a fee for permit application, the industry prefers a clear delineation of such fees.	$10,000 escrow per application for use by local dept from application to decommission; permit fee is $500 per MW for new, $250 per MW renewal	not in ordinance model