The National Agricultural Law Center

nationalaglawcenter.org | nataglaw@uark.edu | @nataglaw

Land Use Conflicts Between Wind and Solar Renewable Energy and Agricultural Uses

By

Peggy Kirk Hall

Ohio State University Agricultural & Resource Law Program

&

Whitney Morgan and Jesse Richardson

West Virginia University College of Law

This material is based upon work supported by the National Agricultural Library, Agricultural Research Service, U.S. Department of Agriculture

USDA National Agricultural Library
UNITED STATES DEPARTMENT OF AGRICULTURE

Land Use Conflicts Between Wind and Solar Renewable Energy and Agricultural Uses

Peggy Kirk Hall

Ohio State University Agricultural & Resource Law Program

Whitney Morgan and Jesse Richardson

West Virginia University College of Law

I. Introduction

The terms "solar farm" and "wind farm"[1] could not more perfectly demonstrate the inevitable pairing of renewable energy and agriculture as uses of land. At the same time, harvesting the sun and wind and converting both to energy forms usable to mankind are far from traditional agricultural practices.

Many states have renewable energy policies, goals, or even mandates that encourage the development of large utility-scale renewable energy facilities.[2] Utility-scale facilities are those that produce energy to sell directly to the electrical power grid—these may have size requirements based on acreage or power production capacity.[3] These renewable energy efforts raise the question of where to put the renewable facilities, particularly facilities that take up considerably more land or surface area than traditional sources of energy, at least initially.[4]

---

[1] Energy Farms, U.S. Department of Agriculture, https://www.nal.usda.gov/afsic/energy-1.
[2] State Renewable Portfolio Standards and Goals, National Conference of State Legislatures, https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.
[3] *See e.g.*, Governor's Task Force on Renewable Energy Development and Siting, State of Maryland, at 11 (2020), https://governor.maryland.gov/wp-content/uploads/2020/09/REDS-Final-Report.pdf; Model Solar Ordinance for Indiana Local Governments, Indiana University Environmental Resilience Institute and Great Plains Institute, at 6 (Dec. 2020), https://eri.iu.edu/documents/in-solar-ordinance-2020-december.pdf; Planning and Zoning for Solar Energy, American Planning Association, at 770 (2014) https://planning-org-uploaded-media.s3.amazonaws.com/document/product_EIP_E_IP30.pdf.
[4] See *infra* Section II.a.

Although siting renewable facilities on farmland can supplement the landowner's income and allow agricultural production to occur where such production otherwise would not be feasible, [5] more often the loss of farmland and increased land competition set renewable energy policies at odds with farmland protection policies. That is, policies that aim to reduce the conversion of agricultural land to non-agricultural uses directly compete with policies that encourage increased production of renewable energy.[6] The friction forces a policy decision on whether to prohibit or limit wind and solar development on farmland in the face of mandates and incentives for renewable energy.

By way of example, one particularly complex clash occurs in California between the Williamson Act, originally adopted to combat suburban development,[7] and siting renewables. Under the Act, counties may enter into contracts with landowners to dedicate land to agricultural use in exchange for tax benefits, with the counties also holding the authority to determine whether green energy development is compatible with a Williamson Act contract.[8] Most local governments have found that green development is not compatible.[9] However, three counties have allowed solar development on non-prime farmland soils.[10] In the majority of cases, the Williamson Act contracts have had to be cancelled.[11]

Land use is typically under local purview. Thus, tensions escalating between renewables and agriculture are being exacerbated by the age-old tension between state and local control.[12] Notably, local regulation runs the full gamut

---

[5] In the Matter of Twigg, 2019 WL 1375206, 3 (Ct. Spec. App. Md. 2019) (The Court of Special Appeals of Maryland recognized this concept, opining that allowing solar arrays on 10 acres of a 40-acre parcel would allow the remaining to return to agricultural production).

[6] American Farmland Trust, To Combat Climate Change: Encourage Solar Energy That Doesn't Sacrifice Agricultural Land, https://farmland.org/encourage-solar-energy-that-doesnt-sacrifice-agricultural-land/.

[7] Comment, Growing Energy: Amending the Williamson Act to Protect Prime Farmland and Support California's Solar Future, 21 San Joaquin Agric. L. Rev. 321, 322 (2011-2012).

[8] *Id.* at 322.

[9] *Id.* at 323.

[10] *Id*.

[11] *Id*.

[12] Two-thirds of Illinois Counties Oppose SB 1602, National Wind Watch (May 21, 2021), https://www.wind-watch.org/news/2021/05/21/two-thirds-of-illinois-counties-oppose-sb1602-limiting-local-zoning-laws/; Illinois Bill Proposes Statewide Standards for Solar, Wind Farm Energy Facilities (May 3, 2021), https://www.natlawreview.com/article/illinois-bill-proposes-statewide-standards-solar-wind-farm-energy-facilities.

from total exclusion[13] to equating solar and wind facilities to traditional agricultural practices.[14]

The U.S. Census of Agriculture began tracking on-farm energy produced by wind turbines, solar panels, and methane digesters in 2009.[15] In the 2012 Census of Agriculture, the survey identified "renewable energy systems" that also included geothermal/geoexchange systems, small hydro systems, biodiesel, and ethanol in addition to solar panels, wind turbines, and methane digesters.[16] Most data show only the number of systems and not whether systems provide energy only to the farm itself or to the grid.[17]

The number of farms with renewable energy producing systems has grown exponentially, particularly solar panels. In 2009, a total of 9,509 farms in the U.S. had renewable energy producing systems.[18] That number rose to 57,299 in 2012 and more than doubled in five years to 133,176 in 2017.[19] Similarly, the number of farms with solar panel systems grew from 7,968 in 2009 to 36,331 in 2012, and to 90,142 in 2017. A total of 1,420 farms reported wind turbines in 2009, of which only 14 are considered "large wind" (greater than 100 kW).[20] By 2017, a total of 14,136 farms had wind turbines.[21]

This paper first, in Section II, reviews the issues arising between renewable energy and agriculture when siting the two uses, in terms of land consumption,

---

[13] *Id.*
[14] *Id.*
[15] U. S. Dept. of Agriculture, National Agricultural Statistics Service, 2007 Census of Agriculture: On-farm Energy Production Survey (2009), https://www.nass.usda.gov/Publications/AgCensus/2007/Online_Highlights/On-Farm_Energy_Production/index.php, (hereinafter 2009 Survey). Note that the 2007 data were collected differently than subsequent years, contain more detail, and were collected in a 2009 survey.
[16] U. S. Dept. of Agriculture, National Agricultural Statistics Service, 2012 Census of Agriculture History (2017) at 197, https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/History/2012%20History%20Final%203.14.17.pdf. Although the other renewable energy systems are significant in number and generally increasing, the land consumption issue focuses on wind and solar, so this paper also focuses on those two types of systems.
[17] 2009 Survey, *supra* note 16. Note that the 2009 data show more detail than the other years.
[18] *Id.*
[19] Table 49, Renewable Energy: 2017 and 2012, in U.S. Dept. of Agriculture, National Agricultural Statistics Service, 2012 Census of Agriculture (2017), https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf (hereinafter 2012 Census Table 49).
[20] Table 1, Farms Reporting Wind Turbines, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009, in 2009 Survey, *supra* note16.
[21] 2012 Census Table 49, s*upra* note 19.

local opposition, and co-location. Section III then highlights results of our research on the status of state laws in place that weigh the interests of renewables and use of agricultural lands and summarizes the range of local regulation. At present, few states have detailed regulation as to how to navigate siting renewable energy facilities on agricultural lands.[22] In Section IV, the paper compiles recommendations from existing laws, recent state bills, as well as leading resources on siting renewables on agricultural lands, including model code language. The paper concludes with several issues for future research in Section V and a full list of recommended resources on siting renewables and agricultural uses in Section VI.

II. The Issues: Renewables and Agriculture

Agricultural lands can play an important role in meeting energy demands in the United States. One prediction is that 11% of the country's cropland could satisfy U.S. electricity production needs if converted to producing renewable energy.[23] Most Americans support expanding wind and solar energy over continued investments in other energy sources such as coal, nuclear, and oil and gas.[24] Even so, locating utility-scale wind and solar facilities in agricultural areas raises recurring issues centered on land consumption and its implications, opposition to individual wind and solar projects at the local level, and co-locating multiple land uses.

a. *Land Consumption*

Concerns commonly surface about the amount of acreage consumed by a utility-scale solar or wind project.[25] Much of the attention focuses on farmland

---

[22] The research for this paper included a state-by-state review of current local ordinances to identify provisions addressing the siting of renewable energy facilities on agricultural lands. *See infra* Section III.
[23] Rebecca R. Hernandez et al, Environmental Impacts of Utility-scale Solar Energy, 29 Renewable and Sustainable Energy Reviews 766, at 775 (2014).
[24] Cary Funk and Brian Kennedy, The Politics of Climate, Pew Research Center, at 16 (Oct. 4, 2016), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2016/10/PS_2016.10.04_Politics-of-Climate_FINAL.pdf.
[25] *See, e.g.*, Christopher Joyce, Renewable Energy Needs Land, Lots of Land, National Public Radio (Aug. 28, 2009), https://www.npr.org/templates/story/story.php?storyId=112323643; Dave Merrill, The U.S. Will Need a lot of Land for a Zero-Carbon Economy, Bloomberg Green (Apr. 29, 2021), https://www.bloomberg.com/graphics/2021-energy-land-use-economy/; Tux Turkel, Unprecedented Wave of Solar Development Spurs Land Rush in Maine, Press Herald (Jan. 4, 2021).

loss.[26] The land consumption issue in turn raises implications for land competition, prime soils, and farmland protection policies. Possible alternative sites for renewable energy facility development include state lands, landfills, brownfields and industrial lands, and rooftops.[27] However, like most development, renewable energy facilities can generally be developed less expensively on agricultural land and forestland than previously developed land or land that may be contaminated.[28] At the same time, solar and wind development may not encroach on farmlands to the same detrimental degree as housing or commercial development.[29]

The initial physical footprint of wind or solar energy undoubtedly differs from those of extractive sources such as coal and gas, with wind and solar having a greater direct footprint at the onset of a project.[30] The lower "power density" of wind and solar energy contributes to this difference, as more land is arguably necessary to produce a set amount of energy from wind and solar than from extractive energy sources.[31] The result is that wind and solar energy can require at least ten times the amount of land per unit of power as coal and gas energy.[32]

A counter to apprehensions over land consumption is the "time to land use equivalency" theory, which argues that land consumption comparisons between energy sources should be made over time.[33] Wind and solar facilities use the same land year after year for decades, while fossil-based energy continuously requires new land, that may or may not be capable of being

---

[26] *See, e.g.*, Donnelle Eller, Solar Energy Projects Surge in Iowa, Farmland Loss a Concern, Des Moines Register, (Apr. 22, 2021); Ally Lanasa, A Third Solar Farm Eyes County, Marysville Journal-Tribune (Aug. 4, 2021) https://www.marysvillejt.com/news/a-third-solar-farm-eyes-county; Matthew Weaver, NW Solar, Wind Developments Could Impact Vast Swaths of Ag Land, Capital Press (May 5, 2021).
[27] Energy Sprawl in Connecticut: Why Farmland and Forests are Being Developed for Electricity Production; Recommendations for Better Siting, A Special Report of the Council on Environmental Quality, at 7-9 (Feb. 3, 2017).
[28] *Id.* at 4.
[29] Grow Solar: Local Government Solar Toolkit for Planning, Zoning, and Permitting, Brian Ross and Abby Finis, Great Plains Institute, at 11 (Jun. 2017), https://ilcounty.org/file/195/IllinoisSolarToolkit_June2017.pdf (Agricultural Protection If the community has ordinances that protect agricultural soils, this provision applies those same standards to solar development. Counties should understand, however, that solar farms do not pose the same level or type of risk to agricultural practices as does housing or commercial development.).
[30] Anne M. Trainor et al, Energy Sprawl is the Largest Driver of Land Use Change in United States, PLoS ONE 11(9), at 9 (Sept. 8, 2016), https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0162269.
[31] Samantha Gross, Renewables, Land Use and Local Opposition in the United States, Brookings Institute, at 4 (Jan. 2020) https://www.brookings.edu/wp-content/uploads/2020/01/FP_20200113_renewables_land_use_local_opposition_gross.pdf.
[32] *Id.* at 11.
[33] Trainor, *supra* note 30, at 2, 6.

reverted to an alternate use. Applying "time to land use equivalency" theory, land consumption for extraction-based energy eventually catches up to the larger initial needs of renewable energy, and the land use impacts of each is about the same over the lifetime of an energy project.[34]

Land conversion data helps explain the concerns about initial losses of agricultural land to utility-scale wind and solar energy development. One study concluded that by 2015, almost 30% of utility-scale solar projects in the U.S. were sited on croplands and pastures.[35] Over 27,000 acres of solar projects at that time were in California's Central Valley, a highly productive agricultural area.[36] More recently, approved or pending utility-scale wind and solar projects in Ohio today total more than 73,000 acres of land, primarily agricultural, with an average size of 1,027 acres per solar facility.[37] Meanwhile, wind farms can occupy thousands of acres in agricultural areas, such as the 70,000-acre Roscoe Wind Farm in Texas, the 41,632-acre Grand Meadow Wind Farm in Minnesota, and the 40,000-acre Whispering Willow Wind Farm in Iowa.[38] As another example, Connecticut adopted laws to encourage renewable energy development as early as 2005. By 2016, solar photovoltaic facilities constituted the primary type of development consuming agricultural and forest land in the state.[39]

The loss of farmland to wind and solar facilities also raises the issue of increased competition for land. Additional demands for renewable energy intensify land competition between energy and agricultural production.[40] Heightened competition for farmland can alter the nature of economic activities in rural

[34] *Id.*
[35] Rebecca R. Hernandez et al, Solar Energy Development Impacts on Land Cover Change and Protected Areas, Proceedings of the National Academy of Sciences of the United States of America, Vol. 112, No. 44, 13579, at 13582 (Nov. 3, 2015), https://doi.org/10.1073/pnas.1517656112.
[36] *Id.*
[37] Ohio Power Siting Board, Wind Farm Map and Statistics and Solar Farm Map and Statistics, https://opsb.ohio.gov/wps/portal/gov/opsb/.
[38] Paul Denholm et al, Land-use Requirements of Modern Wind Power Plants in the United States, National Renewable Energy Laboratory, Technical Report NREL/TP-6A2-45834, Appendix (Aug. 2009), https://www.nrel.gov/docs/fy09osti/45834.pdf.
[39] *Id.* at 2.
[40] Anuj Krishnamurthy and Oscar Serpell, Harvesting the Sun, On-Farm Opportunities and Challenges for Solar Development, Kleinman Center for Energy Policy, U. of Pennsylvania, at 1 (July 2021), https://kleinmanenergy.upenn.edu/research/publications/harvesting-the-sun-on-farm-opportunities-and-challenges-for-solar-development/.

areas.[41] More specifically, for the 39% of U.S. farmland being rented,[42] tenant operators at risk of losing land to wind and solar development can be forced to compete for other land and see increases in per-acre rental costs.[43] In Maryland, for example, farmers lease crop or pastureland for between $25.50 per acre and $175 per acre, while lease rates offered by solar companies can range from $800 to $1,200 per acre.[44]

At the core of the land competition conflict is the reduction of "prime farmland," land that is highly suited for food and fiber production due to its physical and chemical characteristics.[45] However, the same flat, unshaded, well-drained lands that contain productive soils are also optimal for wind and solar development, particularly if located near transmission access and infrastructure.[46] Consuming prime farmland for renewable energy facilities rather than agricultural production naturally leads to conflict in the farm communities where facilities locate.[47]

---

[41] Craig Schultz et al, Renewable Energy Trends, Options, and Potentials for Agriculture, Forestry, and Rural America, U.S. Dept. of Agriculture Office of the Chief Economist, at 43 (March 2021), https://www.usda.gov/sites/default/files/documents/renewable-energy-trends-2020.pdf.
[42] Daniel Bigelo, Allison Borchers and Todd Hubbs, U.S. Farmland Ownership, Tenure and Transfer, EOB-161, U.S. Dept. of Agriculture, Economic Research Service (Aug. 2016), https://www.ers.usda.gov/webdocs/publications/74672/eib-161.pdf?v=5301.6.
[43] Travis Grout and Jennifer Ifft, Approaches to Balancing Solar Expansion and Farmland Preservation: A Comparison Across Selected States, Cornell University Charles H. Dyson School of Applied Economics and Management EB 2018-04, at 3 (May 2018).
[44] Dru Schmidt-Perkins, An Opportunity to Get Solar Siting Right, Abell Foundation, at 5 (Sept. 2019), https://abell.org/sites/default/files/files/Solar%20Siting%20Report%209_10_19.pdf. In addition, consider the following: "Land is more valuable if building a solar farm is less expensive to construct. Ideally, land would be: flat (less than 5 degrees of slope; more is acceptable if it slopes to the south), clear of trees, structures, or other obstacles, free of ponds, streams, creeks, etc., and bordered by a road that will provide easy access to construction crews. These conditions are typically found on prime agricultural farmland. Simple rule of thumb is that 1MW solar power should require about 7.9 acres. Depending on the specific technology, a utility-scale solar power plant may require between 5 and 10 acres per megawatt (MW) of generating capacity." Alison F. Davis, Considerations for Future Utility Scale Solar Farm Developments, University of Kentucky (Sept. 2020), https://agecon.ca.uky.edu/files/considerations_for_future_utility_scale_solar_farm_developments_aec_staff_paper_498_davis_sept2020.pdf.
[45] U.S. Dept. of Agriculture, Handbook No. 18 (Oct. 1993), excerpt available at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs143_014052.
[46] Grout, *supra* note 43, at 3. *See e.g.*, Solar Land Lease, What do Solar Developers Look for in a Property?, https://www.solarlandlease.com/what-do-solar-developers-look-for-in-a-property.
[47] Grout, *supra* note 40; Ellen Rosen, As Demand for Green Energy Grows, Solar Farms Face Local Resistance, New York Times (Nov. 2, 2021), https://www.nytimes.com/2021/11/02/business/solar-farms-resistance.html.

b. *Local Opposition*

Strong public support exists in the U.S. for wind and solar power and policies that increase the use of renewable energy for producing electricity.[48] Eighty-nine percent of citizens favor expanding solar power and 83% approve of wind power expansion, significantly higher than support for fossil fuels or nuclear energy.[49] High approval numbers for renewable energy often do not play out at the local level, however, and negative or "Not in My Backyard (NIMBY)" reactions to utility-scale wind or solar development are common.[50] Experts offer divergent reasons for strong local opposition to renewable energy development across the country. Those who support renewable energy in the abstract can reverse that opinion if they believe a development will cause economic or health problems or if the project raises aesthetics issues.[51] In fact, renewable energy proposals often prompt the pairing of strange bedfellows, as well as conflicts within given coalitions. For example, in the Flint Hills of Kansas proponents of a proposed wind project included the developers of the project, environmentalists focused on green energy, and landowners (mostly farmers) seeking to derive income from leasing their land to the developers for placement of turbines.[52] Opponents also included farmers, but those that wanted to maintain the landscape in its present condition, and environmentalists who were instead focused on aesthetics and ecology.[53]

More generally, proximity of a renewable energy facility to residences and different land types may also be a factor in NIMBYism.[54] Both the higher land use requirements and the siting of projects in areas where people have not

[48] Abel Gustafson, Republicans and Democrats Differ in Why They Support Renewable Energy, Energy Policy 141, 111448 (June 2020), https://doi.org/10.1016/j.enpol.2020.111448.
[49] Funk, *supra* note 24.
[50] *See, e.g.*, David R. Baker and Millicent Dent, NIMBYs Shoot Down Green Projects Next Door While Planet Burns, Bloomberg Green (Sept. 17, 2019), https://www.bloomberg.com/news/features/2019-09-17/nimbys-shoot-down-green-projects-next-door-while-planet-burns; Jan Ellen Spiegel, New Farmland Harvest—Solar Energy—Creating Political Sparks, Ct Mirror (Feb. 21, 2017), https://ctmirror.org/2017/02/21/new-farmland-harvest-solar-energy-creating-political-sparks/; Madeline Wells, SF Bay Area NIMBYs Reportedly in Favor of Green Energy Oppose Solar Farm in Their Backyard, SF Gate (Oct. 1, 2020), https://www.sfgate.com/home/article/About-SFGATE-15613713.php.
[51] Gross, *supra* note 31, at 9.
[52] Comment, Turbines v. Tallgrass: Law, Policy, and a New Solution to Conflict Over Windfarms in the Kansas Flint Hills, 54 U. Kan. L. Rev. 1131, 1135 (2006).
[53] *Id.*
[54] Juliet E. Carlisle, Utility-scale Solar and Public Attitudes Toward Siting: A Critical Examination of Proximity, Land Use Policy 58, at 491 (2016).

customarily encountered energy development can affect acceptance of wind and solar projects locally.[55] Environmental impacts, harm to wildlife, noise and nuisance interferences, and effects on property values are additional reasons people oppose wind development.[56] Some argue that opposition to energy projects is rational and understandable, usually driven by a concern for property values, sense of place, local environment, or distrust in energy companies.[57]

c. *Co-location of Renewables and Agricultural Uses*

Another topic increasingly raised in conjunction with utility-scale renewable energy concerns is "co-location," the intentional co-existence of different land uses on a parcel. Advocates of co-location claim that an "either/or" mentality drives policy and development decisions around utility-scale renewable energy installations.[58] Conventional land use approaches can force renewable energy to compete in a "zero-sum-game" with agriculture, while co-location is a more integrated approach that can maintain and improve both energy and food production security.[59]

In the agricultural context, co-location or "dual-use" deliberately locates agriculture within wind and solar installations.[60] Wind turbines can fit into an agricultural landscape with little disruption or displacement of the agricultural activities around them.[61] Because a farmer can engage in crop and livestock production beneath and up to the base of a wind turbine, agriculture co-locates easily with wind energy.[62] More difficult is the integration of agriculture on a solar installation site, an evolving area of research referred to as

[55] Gross, *supra* note 31, at 8.
[56] K.K. DuViver and Thomas Witt, NIMBY to NOPE—or YESS?, 38 Cardozo L. Rev. 1453, 1459-62 (2018).
[57] Sanya Carley and David Konisky, Will NIMBYs Sink New Clean Energy Projects? The Conversation (Aug. 11, 2021), https://theconversation.com/will-nimbys-sink-new-clean-energy-projects-the-evidence-says-no-if-developers-listen-to-local-concerns-164052.
[58] Greg A. Barron-Gafford, et al, Agrivoltaics Provide Mutual Benefits Across the Food-Energy-Water Nexis in Drylands, Nature Sustainability 2(9), at 1 (Sept. 2019), DOI:10.1038/s41893-019-0364-5, https://www.nature.com/articles/s41893-019-0364-5.
[59] *Id.*
[60] *Id.*
[61] *Id.*; Colin Tiernan, Idaho's Largest Wind Farm Planned Near Shoshone, Times-News (Mar. 20, 2020), https://magicvalley.com/news/local/idahos-largest-wind-farm-planned-near-shoshone/article_23864dbd-7660-54cd-869f-3a2b1ee351df.htm.
[62] Benjamin Retik, The Mutual Benefits of Wind and Energy and Agriculture, Guidehouse Insights (May 11, 2021), https://guidehouseinsights.com/news-and-views/the-mutual-benefits-of-wind-energy-and-agriculture.

"agrivoltaics."[63] Agrivoltaics involves raising and spacing solar panels to allow agricultural production around and beneath the panels.[64]

Co-location, particularly agrivoltaics, is offered as a strategy for overcoming the separation of food and energy production that occurs in the land use arena.[65] Research concludes that agrivoltaics can reduce land use competition[66] and increase land productivity.[67] Agrivoltaics may also affect the social acceptance of utility-scale renewable energy.[68] Solar industry officials believe local communities are more likely to support solar energy projects that involve agrivoltaics due to the multiple local benefits that "projects with personality" can provide a community.[69] Finally, combining solar power generation with agriculture could provide additional revenue to farmers, helping to protect farmland and keep food costs down.[70]

On the other hand, agrivoltaics presents concerns among the agricultural sector, including challenges with the adoption and integration of new technologies and uncertain market potential. Some accept the challenge with a willingness to help farmers determine how to continue to work solar facility lands for agriculture. States like New York and Maine advocate co-location and provide informational and technical assistance for farmers. [71] Like farmers, energy developers must also be willing to engage in co-location opportunities.

---

[63] Model Solar Ordinance, *supra* note 3, at 6 (Agrivoltaics – A solar energy system co-located on the same parcel of land as agricultural production, including crop production, grazing, apiaries, or other agricultural products or services.)
[64] *Id.*
[65] Alexis S. Pascaris et al, Integrating Solar Energy with Agriculture: Industry perspectives on the Market, Community, and Socio-political Dimensions of Agrivoltaics, Energy Research & Social Science 75, at 1 (2021).
[66] Elnaz H. Adeh et al, Solar PV Power Potential is Greatest over Croplands. Scientific Reports, 9(1) (2019).
[67] Axel Weselek et al, Agrophotovoltaic Systems: Applications, Challenges, and Opportunities, a Review, Agronomy for Sustainable Development, 39(4) (2019), https://link.springer.com/content/pdf/10.1007/s13593-019-0581-3.pdf.
[68] Pascaris, *supra* note 65, at 5.4 page 10.; Lisa Prevost, Connecticut Solar Developers Enlist Sheep to Cut Grass and Ease Tensions, Energy News Network (Mar. 3, 2021) https://energynews.us/2021/03/03/connecticut-solar-developers-enlist-sheep-to-cut-grass-and-ease-tensions/.
[69] *Id.*
[70] Gross, *supra* note 28, at 13
[71] *See e.g.*, Harrison Dreves, Beneath Solar Panels, the Seeds of Opportunity Sprout, National Renewable Energy Laboratory, https://www.nrel.gov/news/features/2019/beneath-solar-panels-the-seeds-of-opportunity-sprout.html; Dual-Use of (Agrivoltaic) Solar Installations, Maine Dept. of Agriculture Conservation & Forestry (Dec. 2020), https://www.maine.gov/dacf/ard/resources/docs/dual-use-factsheet.pdf.

III. State-Local Tensions

Locating uses within a community is most often a matter of local concern addressed through zoning laws. In some instances, states preempt local zoning authority for siting certain uses for public policy reasons.[72] As siting renewable energy has often proven to be a NIMBY issue[73] squarely at odds with state mandates on reaching renewable energy source standards,[74] some states have begun to remove local authority to regulate the siting of renewable energy. In doing so, however, few states have detailed legislation to navigate the overlap between siting renewable energy and the use of agricultural lands, a clash with which local regulators may have more intimate knowledge. On the other hand, deference to local knowledge and likely other reasons leads some states to maintain local regulation for the siting of renewables.
Local regulation of renewable energy projects typically varies widely, even within relatively small geographic areas.[75] For example, the Flint Hills in Kansas contains 12 counties.[76] Two of the counties have no zoning and, hence, no local regulation of renewable energy projects.[77] One county completely bans commercial wind farms.[78] The remaining nine counties regulate wind turbines in a wide range of ways.[79]

Local zoning authority granted by states not surprisingly often seeks to both preserve agriculture and promote renewables,[80] but rarely details how to balance these two goals when at odds with each other. Notably, of the few states that specifically address the overlap between siting renewables and the effect on agricultural lands, most merely require that siting or permitting authorities

---

[72] CLOSUP: Center for Local State and Urban Policy, Appendix State-by-State Chart (Feb. 2021), http://closup.umich.edu/sites/closup.umich.edu/files/working-papers/closup-wp-50-Essa-Solar-Siting-Authority-Across-the-United-States.pdf; State Approaches to Wind Facility Siting, National Conference of State Legislatures (Sept. 2, 2020), https://www.ncsl.org/research/energy/state-wind-energy-siting.aspx.
[73] See *supra* Section II.b.
[74] *See, e.g.*, State Renewable Portfolio Standards and Goals, *supra* note 2.
[75] EZ Policies for Maryland, OpenEI, https://openei.org/wiki/Maryland/EZ_Policies.
[76] Turbines v. Tallgrass, *supra* note 52, at 1140.
[77] *Id.*
[78] *Id.*
[79] *Id.* at 1140-41,
[80] *See e.g.*, N.H. Rev. Stat. Ann. § 672:1 (West) (Neighboring sections of zoning authority show that renewables and ag are "important" and shouldn't be unreasonably affected, but doesn't account for when renewables and agriculture are in competition with each other); 53 Pa. Stat. Ann. § 10105 (West).

consult with the particular state's department of agriculture[81] or have a policy to consider effects[82] on agriculture with little detail. Several states have created state energy plans,[83] advisory councils, or similar projects with the purpose of understanding how to promote renewables with some level of consideration on the impacts to agriculture[84] or to promote cooperation with the agricultural community.[85] Other states have failed to include representatives from the agricultural community in these advisory groups.[86] One state specifically has a program for the protection of agricultural lands from development, but that development excludes wind energy facilities.[87] A few states have provisions to encourage pollinator habitats[88] or generally promote renewables to the agricultural community.[89] Meanwhile, a small handful of states have gone so far as to specifically consider siting renewables on agricultural lands based on soil quality,[90] or require an impact mitigation agreement[91] or environmental assessment[92] that includes agriculture.

Interestingly, far more states than those currently with legislation on the books have recently considered bills that squarely deal with the intersection between agriculture and siting renewables, indicating this conflict is thoroughly ripe. Given how many of these bills have failed, the conflict is also proving to be a contentious one. Interestingly, the content of these bills gives considerable insight into potential mechanisms for addressing issues arising from siting renewables on agricultural lands, much of which is included with Section IV's summary of recommended practices.

---

[81] *See, e.g.*, Minn. Stat. Ann. §216B.243 (West); W.S.A. 101.175 (In Wisconsin, installation of renewables must involve consultation with department of agriculture).
[82] *See, e.g.*, Mont. Code Ann. §90-4-1001 (West); N.J. Stat. Ann. §4:1C-32.6 (West).
[83] *See, e.g.*, 30 V.S.A. §202b.
[84] N.D.C.C. §54-63-01, -03; 4 Pa. Code §6.232. Interestingly, at least one state has the Department of Agriculture administering its grant and subsidized loan program for renewables. S.C. Code §46-3-260.
[85] Va. Code Ann. §45.1-391 (West) (Solar Energy Center promotes cooperation with agriculture).
[86] *Id.* §45.2-1710 (new energy plan does not mention agriculture).
[87] Ohio Rev. Code Ann. §931.02 (West).
[88] Mo. Ann. Stat. §261.500 (West).
[89] Miss. Code. Ann. §69-46-5 (West); N.D.C.C. § 54-63-01, -03; Va. Code Ann. §45.1-39 (West).
[90] H.R.S §205-2.
[91] 55 ILCS 5/5-12020.
[92] Tenn. Code Ann. §65-17-105 (West).

IV. Summary of Recommended Practices

A review of existing laws and pending bills reveals several strategies. Recognizing the need to better anticipate how renewables can be brought onto agricultural lands while *minimizing conflicts*,[93] numerous manuals, handbooks, toolkits, and factsheets have been created by a range of entities—agricultural interest groups, renewable energy interest groups, universities, state task forces, and more. The Connecticut Department of Environmental Quality refers to the "balance trap," arguing that balancing two conflicting goals results in "diminishment of both pursuits."[94] Integration or harmonization of goals provides a better solution,[95] with an example being the enlistment of sheep to cut grass below solar panels and ease tensions between solar development and local opinion.[96] Co-location integrates and harmonizes. The intentional combining of uses through agrivoltaics is proactive and planned, not reactive.

From the birds' eye view, renewable siting regulation to minimize conflict with agriculture has manifested in several forms: primarily state-level regulation, primarily local-level regulation, and hybrid approaches.[97] Between all of these, numerous concerns come up repeatedly:

- protecting quality soils,
- involving agricultural leaders in decision-making,
- planning through mapping,
- the benefits of dual-use or agrivoltaics, and
- planning for decommissioning.[98]

First, renewable energy and agriculture policymakers must be brought together to create cohesive policy that clearly defines state and local control with regard to the placement of wind and solar facilities and the protection of agricultural lands. The resulting policies will likely involve protection of quality soils. For the

[93] OR. H 2520 (2021) (would fund the creation of rules specifically for this purpose).
[94] Energy Sprawl in Connecticut, *supra* note 27, at 9.
[95] *Id.*
[96] Prevost, *supra* note 68.
[97] *See, e.g.*, State Approaches to Wind Facility Siting, *supra* note 72.
[98] More complex efforts to preserve agricultural lands through land use have included to exempt portions of agricultural lands with renewables from participating in the trade of development rights, or to require an equivalent amount of agricultural land that is used for renewables to be placed under deed restriction limiting it to traditional agricultural use. MA S 2174/H 3346 (2021).

most protected soils, involving state-level agricultural boards or departments[99] in decision-making during the siting process or even requiring that such entity issue a letter of attestation as a pre-requisite to a power purchase agreement[100] may enable better navigation of renewable-agriculture conflicts. More generally, whether imposed at the state level or local level, maintaining quality soils in agricultural production appears to be a recurring concern, and often soil quality is determined by federal definitions.[101]

Second, comprehensive mapping should be developed to inform both state and local decision-making on the siting of renewables, detailing categories of agricultural lands, including prime farmlands and other soil categories; current placement of wind and solar installations, both on-farm and utility-scale; wind energy potential; solar energy potential; transmission lines and other utility infrastructure; and areas experiencing increasing drought or otherwise experiencing decreasing arability.

At the state level, preserving agricultural lands may be rooted in concerns over food security, desires to preserve the aesthetics of the countryside, or an interest in protecting the "small farmer,"[102] all of which are squarely at odds with state measures for meeting renewable energy goals.[103] From this perspective, renewable-agriculture conflicts may be lessened through requirements that comprehensive plans and their required land use maps consider the placement of renewables within local communities.[104] State-level mapping of current placement of renewables, existing energy infrastructure, agricultural lands and their various levels of quality, and renewable potential placement may inform

---

99 CT. H 5175 (2021).
100 HI. S 942 (2021).
101 *See* 7 C.F.R. § 657.5. "The protection of prime soils and prime farmland should be prioritized. Other farmland and marginal farmland should be pursued for standard ground-mounted solar array, dual-use should also be considered, if possible (AFT, 2020).5 If solar projects are still proposed on prime soils, they should be agricultural dual-use projects, ensuring continued production is prioritized. Dual-use projects will be a challenge for lands that have been used for crop and livestock production but would be better suited for small animal grazing, i.e., sheep (but not goats)." Solar Siting Guidelines for Farmland, American Farmland Trust New England, Northampton, MA: American Farmland Trust, (Jan. 2020), https://s30428.pcdn.co/wp-content/uploads/2020/01/AFT-solar-siting-guidelines-Jan-2020.pdf.

102 Schmidt-Perkins, *supra* note 44, at 5.
103 State Renewable Portfolio Standards and Goals, *supra* note 2.
104 Farmland Solar Policy Design Toolkit, Solar Energy Initiative, at 8 (2020), https://farmandenergyinitiative.org/wp-content/uploads/2020/08/Final-FSPP-Toolkit-Report.pdf.

this decision-making as well.[105] And, as renewable development occurs, states may consider maintaining a database or mapping to catalog the actual transition of agricultural lands to renewable energy production,[106] something the USDA does at the national level.[107] The mapping can both direct renewable energy facilities to certain areas and determine areas for possible co-location.

Co-location or dual use with livestock, crops, and pollinator habitats shows promise and should be encouraged. Where renewables are allowed, agrivoltaics,[108] also known as co-location or dual-use, [109] can deploy renewable facilities so that some level of agriculture may continue. Agrivoltaics ranges from traditional crop production or livestock pasturing beneath solar panels or wind turbines all the way to simply requiring pollinator friendly ground cover[110] and buffer areas.

Another strategy is creating a distinction in regulation between renewables utilized exclusively for on-farm use (accessory renewables[111]), which can be considerable given, for example, the cost of pumping irrigation water,[112] and

---

105 Schmidt-Perkins, *supra* note 44, at 6. ("But perhaps the biggest obstacle to striking a balance between maintaining prime land for agriculture and developing plots to achieve renewable energy targets is that there is no statewide mapping of 'preferred' land."). *See, e.g.*, Renewable EnerGIS, Hawaii State Energy Office, http://geodata.hawaii.gov/energis; Zoning for Renewable Energy Database, Michigan Department of Environment, Great Lakes, and Energy, https://www.michigan.gov/climateandenergy/0,4580,7-364-85453_85461-519951--,00.html; Liam Neimeyer, As solar power moves in, a Kentucky farm community wonders about its future, Hoptown Chronicle (Feb. 22, 2021), https://hoptownchronicle.org/as-solar-power-moves-in-a-kentucky-farm-community-wonders-about-is-future/ (combining farmland data from the USDA and solar power data from PJM Interconnection to generate mapping).

106 VA. H 2023 (2021).

107 *See supra* notes 16—21.

108 *See supra* Section I.c.

109 N.J. S 3484 (2021) (incentivizes dual-use).

110 Grow Solar, *supra* note 29, at 10 (Ground Cover Standards Perennial grasses and wildflowers planted under the panels, between arrays, and in setback or buffer areas will substantially mitigate the stormwater risks associated with solar arrays, and result in less runoff than typically seen from many types of agriculture. Moreover, establishing and maintaining native ground cover can have important co-benefits to the community or the property owner. Native grasses can be harvested for forage and wildflowers and blooming plants can create pollinator and bird habitat, and maintaining the site in native vegetation will build soils that can be turned back into agriculture at the end of the solar farm's life.); Model Solar Ordinance, *supra* note 3, at 12 (If appropriately established, these ground cover standards also likely reduce maintenance costs and limit the need for chemical weed management, which also improves water quality outcomes.); *Id.* at 14 (The groundcover at solar farms will protect agricultural soil, build nutrients, prevent erosion, and improve topsoil quality at the site.).

111 NHSEA Model Solar Zoning Ordinance (2018), https://docs.wixstatic.com/ugd/c6c29c_c3f6d0279dfe4037bfb95bfa28b041e5.pdf.

112 Co-locating Renewable Energy Resources and Agricultural Operations: Challenges and Opportunities, TomKat Center for Sustainable Energy, Stanford University, at 17 (Aug. 2019), https://stanford.app.box.com/s/fk6n5ymzp2qk3uszqql6g2m26if3u0xw.

utility-scale renewable facilities.[113] In delineating a threshold between various renewable facility sizes, protecting agricultural land may be best served by definitions based on land use footprint, i.e. acreage, rather than or in conjunction with array capacity, electrical load, or consumer type.[114] In avoiding prime farmlands, areas experiencing increasing drought may be appropriate for transitioning farmlands no longer able to produce to solar farms.[115]

Lastly, planning for the decommissioning of wind and solar facilities to revert to agricultural use is an important consideration. A commitment to revert solar or wind "farms" back to agricultural lands at the end of the facilities' lifespan is a common requirement of land use regulation of renewable energy facilities.[116]

Additional recommended practices by developers, while not formalized in state or local land use laws, may help reduce local opposition and the NIMBY impacts of wind and solar facility development. For instance, in New York, a developer reduced the size of a proposed facility from 500 to 245 acres in response to local resident concerns that the project would have too large an impact on the pastoral setting.[117] Some developers have learned that offering to screen developments from view and incorporate pollinator habitats and agrivoltaics can also win community support.[118] And in a recent mediation ordered by the Hawaii Public Utilities Commission, Kahana Solar agreed to a legally enforceable "community benefits" package that will provide $55,000 per year over a 25-year period in funding for community groups and a pledge to hire local workers at an agreed upon prevailing wage in the West Maui community where the solar facility would locate on former pineapple fields.[119] While the result of an intervention in the utilities approval process by the West Maui Preservation

113 Farmland Solar Policy Design Toolkit, *supra* note 104, at 9.
114 *Id.* at 15-16.
115 Sammy Roth, California Farmers are Planting Solar Panels as Water Supplies Dry Up, Los Angeles Times (Jul. 31, 2019), https://www.latimes.com/business/la-fi-agriculture-farmlands-solar-power-20190703-story.html.
116 Planning and Zoning for Solar Energy, *supra* note 3.
117 Rosen, *supra* note 44.
118 *Id.*; John Flesher and Tammy Webber, Bees, sheep, crops: Solar developers tout multiple benefits, AP News, Nov. 4, 2021.
119 Report of Parties and Participants on Mediation, *In the Matter of the Application of Maui Electric Company, Limited*, Public Utilities Commission of the State of Hawaii, No. 2020-0141 (Oct. 15, 2021), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21J15B01424A01661. *See also* Brittany Lyte, How a Maui Solar Farm Reached An 'Unprecedented' Deal With Neighbors, Honolulu Civil Beat (Nov. 21, 2021), https://www.civilbeat.org/2021/11/how-a-maui-solar-farm-reached-an-unprecedented-deal-with-neighbors/.

Association, the case offers insight into mediated and voluntary approaches that can remedy local opposition to facility development while also addressing land consumption and co-location issues.

V. Remaining Issues

Siting renewables on agricultural lands has consequences well beyond that not-so-simple act, consequences with the potential to be both positive[120] and negative. From a land use perspective, rural communities are going to be significantly impacted by changes to the landscape, community character, the local economy, and the numerous domino effects from what promises to be an imminent and significant change in agricultural America. Much more research is needed to understand the full range of land use issues and mitigate adverse impact during this transition.

VI. List of Key Resources for Wind and Solar Energy and Agricultural Land Uses

An Opportunity for Maryland to Get Solar Siting Right, Dru Schmidt-Perkins, Abell Foundation (Sept. 2017), https://abell.org/sites/default/files/files/Solar%20Siting%20Report%209__10__19.pdf.

Clean Energy in Agriculture: A Colorado Study, Center for the New Energy Economy, Colorado State University (Apr. 2018), http://ruralenergy.colostate.edu/wp-content/uploads/2020/04/CNEE-Report-on-Clean-Energy-in-Agriculture-Colorado-April-2018-1.pdf.

---

[120] Mapping may also include preferred locations in “wellhead protection area[s] for the purpose of removing agricultural uses from high-risk recharge areas.” Model Solar Ordinance, *supra* note 3, at 14. Also consider the potential for renewable development in the floodplain. *Id.* at 16. "In 2018, researchers at the Department of Energy's Argonne National Laboratory found that stable pollinator populations facilitated by pollinator-friendly solar farms allowed nearby agricultural land to be pollinated and, ultimately, boosted crop yields. Planting pollinator-friendly vegetation in solar farms provides multiple ecological and economic benefits to stakeholders. Using native plants as ground cover can help recharge groundwater, reduce erosion, and improve soil carbon sequestration.” Abby Neal, Pollinator-Friendly Solar Installations Benefit Wildlife, Farmers, Climate, Environmental and Energy Study Institute (Mar. 2020), https://www.eesi.org/articles/view/pollinator-friendly-solar-installations-benefit-wildlife-farmers-climate.

Co-Locating Renewable Energy Resources and Agricultural Operations: Challenges and Opportunities, Brown et al., TomKat Center for Sustainable Energy, Stanford University (Aug. 2019), https://stanford.app.box.com/s/fk6n5ymzp2qk3uszqql6g2m26if3u0xw.

Considerations for Future Utility Scale Solar Farm Developments, Alison Davis, Department of Agricultural Economics, University of Kentucky (Sept. 2020), https://agecon.ca.uky.edu/files/considerations_for_future_utility_scale_solar_farm_developments_aec_staff_paper_498_davis_sept2020.pdf.

Dual-use (or Agrivoltaic) Solar Installations, Fact Sheets, Maine Department of Agriculture, Conservation, and Forestry (Dec. 2020), https://www.maine.gov/dacf/ard/resources/docs/dual-use-factsheet.pdf.

Energy Sprawl in Connecticut, Connecticut Council on Environmental Quality (2017), EnergySprawlinConnecticutpdf.pdf.

Farmland Solar Policy Design Toolkit, Genevieve Byrne, Farm and Energy Initiative (May 2020), https://farmandenergyinitiative.org/wp-content/uploads/2020/08/Final-FSPP-Toolkit-Report.pdf.

Governor's Task Force on Renewable Energy Development and Siting, Final Report (Aug. 2020), https://governor.maryland.gov/wp-content/uploads/2020/09/REDS-Final-Report.pdf.

Grow Solar: Local Government Solar Toolkit for Planning, Zoning, and Permitting, Brian Ross and Abby Finis, Great Plains Institute (Jun. 2017), https://ilcounty.org/file/195/IllinoisSolarToolkit_June2017.pdf.

Innovative Site Preparation and Impact Reductions on the Environment Project (InSPIRE), U.S. Department of Energy National Renewable Energy Laboratory (Oct. 2021), https://openei.org/wiki/InSPIRE.

Model Solar Ordinance for Indiana Local Governments, Great Plains Institute (Dec. 2020), https://eri.iu.edu/documents/in-solar-ordinance-2020-december.pdf.

Planning and Zoning for Solar Energy, American Planning Association (2014), https://planning-org-uploaded-media.s3.amazonaws.com/document/product_EIP_E_IP30.pdf (with model ordinances, permitting applications, and decommissioning plan).

Renewables, Land use, and Local Opposition in the United States, Samantha Gross, Brookings Institution (Jan. 2020), https://www.brookings.edu/wp-content/uploads/2020/01/FP_20200113_renewables_land_use_local_opposition_gross.pdf.

Technical Guidance for Utility-scale Solar Installation and Development on Agricultural, Forested, and Natural Lands (Jan. 2021), https://www.maine.gov/dacf/ard/resources/docs/dacf-solar-guidance-182021.pdf.