Zero-Sum Environmentalism: Competing Tax Incentives for Solar Farms and Wildlife Conservation Land*

In a rush to woo solar companies into the state, North Carolina has enacted generous tax incentives for solar panels. While these tax incentives have resulted in North Carolina being among the vanguard of carbon-free energy producers, there are reasons to think that the generosity of these policies will ultimately do more harm than good to North Carolina's ecosystems. Large-scale solar farms now cover more than 35,000 acres in North Carolina. Every solar farm introduces toxic heavy metals to the environment, and many solar farms require heavy equipment to clear-cut vegetation and level the ground. Unlike other environmental tax incentives that influence how land in North Carolina is used and maintained, large-scale solar farms receive a tax break regardless of the amount of damage they do to ecosystems. To evaluate the ecological cost of solar farms in North Carolina, this Comment uses geographical information system data to explore trends in land being converted to solar farms. After demonstrating that solar farms are primarily built on land ideal for wildlife conservation, this Comment suggests how North Carolina could reform its solar panel tax incentives to reward the solar companies that take steps to decrease the ecological cost of solar farms.

INTRODUCTION

One of the preeminent responsibilities of any state is to protect the land within its borders; as the North Carolina Constitution makes clear, protecting land in modern America includes using the power of the state to preserve "forests, wetlands, . . . openlands, and places of beauty."[1] To achieve its environmental goals, North Carolina has zeroed in on carbon emissions from energy production and proven itself a national leader in the experiment of low-carbon energy production.[2] North Carolina has seen success, particularly in its efforts to increase solar energy generation, largely owing to its temporary (but very generous) Individual Tax Credit ("ITC") and its solar energy property tax exclusion.[3]

North Carolina also uses tax incentives—namely, the Present-Use Program ("PUP") and the Wildlife Conservation Land Program ("WCLP")—

1. N.C. CONST. art. XIV, § 5.

2. North Carolina is the only state to be ranked in the top five states in solar and nuclear generation. U.S. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2021, at 50 tbl.3.13, 58 tbl.3.21 (2022), https://www.eia.gov/electricity/annual/pdf/epa.pdf [https://perma.cc/NT92-RLD3]. North Carolina is the leading producer of hydroelectric energy in its region and is ranked ninth nationally. *Id.* at 51 tbl.3.14. North Carolina was the first state in the Southeast to develop a renewable energy portfolio. Press Release, N.C. Utils. Comm'n, North Carolina Utilities Commission Adopts Final Rules Implementing Session Law 2007-397 (Sente Bill 3)—"Promote Renewable Energy/Baseload Generation" (Feb. 29, 2008), https://starw1.ncuc.gov/ncuc/ViewFile.aspx?NET2022&Id=c1d0eb36-9979-4627-9a7a-566aa9385dba [https://perma.cc/ALT7-B4LC]. Additionally, North Carolina installed the first coastal wind farm in the Southeast. Chris Carnevale, *Amazon Wind Farm in North Carolina*, S. ALL. FOR CLEAN ENERGY (Aug. 14, 2020), https://www.cleanenergy.org/blog/amazon-wind-farm-north-carolina/ [https://perma.cc/B7YW-9YPA].

3. *See* Dani Glazer, *North Carolina's Investment Tax Credit Is Gone—Now What? Potential Solutions for Current and Prospective Solar Companies*, 26 DUKE ENV'T L. & POL'Y F. 299, 315–16 (2016).

in an attempt to directly preserve its various ecosystems.[4] North Carolina's success with preserving its ecosystems largely depends on influencing the choices of private citizens, as eighty percent of the state's thirty-one million acres are privately held.[5] So while North Carolina uses various measures to protect its land, the use of the tax system is crucial as tax incentives immediately influence citizens' decisions.[6]

North Carolina's efforts to minimize carbon emissions and preserve its ecosystems directly are often considered harmonious parts of the same environmental program: carbon emissions, it is argued, need to be lowered to prevent climate change from harming fragile ecosystems,[7] and the preservation of forests and plains results in carbon sequestration which decreases the amount of carbon in the air.[8] However, these two goals are not always served by the same policies—for example, preserving sand dunes might require keeping out a plant species that would contribute to carbon sequestration. Furthermore, considering the experimental nature of many of the energy policies adopted to reduce carbon emissions, there will likely be unforeseen consequences with tragic impacts on ecosystems.[9]

4. *See* N.C. GEN. STAT. § 105-277.2(6) (2024) (requiring land in the Present-Use Program ("PUP") to be under a "sound management program" to ensure the use is "consistent with its conservation"); *id.* § 105-277.15(b) (establishing special rules for the appraisal, assessment, and taxation of wildlife conservation land).

5. *Private Lands Management*, N.C. WILDLIFE RES. COMM'N, https://www.ncwildlife.gov/wildlife-habitat/private-lands-management [https://perma.cc/UHP7-LWB5] ("About 80 percent of North Carolina's land is privately owned."); *North Carolina*, U.S. CENSUS BUREAU, https://data.census.gov/profile/North_Carolina?g=040XX00US37 [https://perma.cc/8WSA-QGUX] ("North Carolina has a land area of 48,607.4 square miles.").

6. This effectiveness of tax at changing individuals' behaviors can be clearly seen in the successful use of tax to decrease tobacco or alcohol use. *See* Franco Sassi & Annalisa Belloni, *Fiscal Incentives, Behavior Change and Health Promotion: What Place in the Health-in-All-Policies Toolkit?*, 29 HEALTH PROMOTION INT'L i103, i103 (2014).

7. *See* K.R. Shivanna, *Climate Change and Its Impact on Biodiversity and Human Welfare*, 88 PROC. INDIAN NAT'L SCI. ACAD. 160, 164 (2022). Current predictions of harm to ecosystems rely on the theory that increased carbon in the atmosphere will increase global temperatures. *Id.* at 160. However, global temperatures are significantly impacted by cloud coverage, and the effect that rising carbon in the atmosphere will have on clouds remains a notable uncertainty that has been found problematic in climate models. *See* Johannes Mülmenstädt, Marc Salzmann, Jennifer E. Kay, Mark D. Zelinka, Po-Lun Ma, Christine Nam, Jan Kretzschmar, Sabine Hörnig & Johannes Quaas, *An Underestimated Negative Cloud Feedback from Cloud Lifetime Changes*, 11 NATURE CLIMATE CHANGE 508, 508 (2021).

8. *See* Ramesh Laungani & Johannes M.H. Knops, *The Impact of Co-Occurring Tree and Grassland Species on Carbon Sequestration and Potential Biofuel Production*, 1 GLOB. CHANGE BIOLOGY BIOENERGY 392, 392–93 (2009).

9. Many climate-change driven policies produce technologies that have had negative ecological impacts. For example, wind turbines are known to kill "significant numbers" of endangered birds like the golden eagle. Matthew Brown & Camille Fassett, *Criminal Cases for Killing Eagles Decline as Wind Turbine Dangers Grow*, AP NEWS (May 17, 2023, 5:06 PM), https://apnews.com/article/dead-eagles-wind-turbines-enforcement-biden-53ce35355433e18a27324f9254a2475a [https://perma.cc/5HBR-7VSC]. A more low-tech solar plant installed in a desert in California uses thousands of garage-sized

This Comment argues that the North Carolina tax policies favoring solar farms[10] are pushing citizens away from behaviors that contribute to the direct preservation of ecosystems. Specifically, this Comment considers the relationship between the solar equipment property tax exemption, PUP, and WCLP to understand their competing influences on land use. Part I provides background on the environmental costs of solar farms and the framework for the ITC, solar equipment property tax exemption, PUP, and WCLP. Part II presents original research using geographical information system ("GIS") data[11] to explore trends in land being converted to solar farms. That part will show that solar farms are built on land ideal for wildlife conservation and that these farms are likely harming ecosystems. Part III proposes two changes to the tax benefits for solar farms: (1) making the property tax exclusion for solar installations conditional on maintaining certain ecological standards similar to the standards required under the WCLP and (2) developing a graduated property tax exclusion that varies based on the ecological value[12] of the location determined using existing land data.

mirrors to concentrate sunlight into "boiler towers" to generate electricity, but the concentrated sunlight beams scorch any animal that flies through them, killing countless insects and an estimated 28,000 birds per year. Sebastian Anthony, *California's New Solar Power Plant Is Actually a Death Ray That's Incinerating Birds Mid-Flight*, EXTREME TECH (Aug. 20, 2014), https://www.extremetech.com/extreme/188328-californias-new-solar-power-plant-is-actually-a-death-ray-thats-incinerating-birds-mid-flight [https://perma.cc/BE5N-KJBG]. Additionally, damming rivers for hydro-electric power has resulted in substantial harm to freshwater fish because "[d]ams block fish migration routes, alter hydrological and water temperature regimes, and modify channel morphology." Qiuwen Chen, Qinyuan Li, Yuqing Lin, Jianyun Zhang, Jun Xia, Jinren Ni, Steven J. Cooke, Jim Best, Shufeng He, Tao Feng, Yuchen Chen, Daniele Tonina, Rohan Benjankar, Sebastian Birk, Ayan Santos Fleischmann, Hanlu Yan & Lei Tang, *River Damming Impacts on Fish Habitat and Associated Conservation Measures*, 60 REVS. GEOPHYSICS (2023), at 1.

10. For the purposes of this Comment, "solar farm" is used interchangeably with "utility-scale solar operations," which are solar operations with generating capacity above one megawatt. *See* DANIEL BROOKSHIRE, JERRY CAREY & DANIEL PARKER, N.C. SUSTAINABLE ENERGY ASS'N, NORTH CAROLINA SOLAR LAND USE AND AGRICULTURE 2022 UPDATE, at 3 (2022), https://energync.org/wp-content/uploads/2022/06/2022_Solar_Agv2.pdf [https://perma.cc/VR5N-ALFW] [hereinafter BROOKSHIRE ET AL., LAND USE AND AGRICULTURE].

11. A geographical information system ("GIS") is a system that "connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there)." *What Is GIS?*, ESRI, https://www.esri.com/en-us/what-is-gis/overview [https://perma.cc/AK2N-V9HP].

12. Others define "ecological value" as "the level of benefits that the space water, minerals, biota, and all other factors that make up natural ecosystems provide to support native life forms." H. KEN CORDELL, DANIELLE MURPHY, KURT RIITTERS & J.E. HARVARD III, THE MULTIPLE VALUES OF WILDERNESS 206 (2005). This Comment adopts that definition and takes the (well supported) assumption that "[e]cosystems contribute their greatest ecological value when they are in their most natural state." *See id.* As such, the greater that a use of land deviates from nature, the less ecological value that the land subject to the use will have. This Comment considers developed land or land with improvements—land altered from its natural state by construction or by installation of impervious surfaces (such as buildings, roads, or parking lots)—as land with the least ecological value. For

I. CONCEPTUAL AND LEGAL BACKGROUND

A. *The Environmental Costs of Solar Farms*

Utility-scale solar farms have two types of environmental costs that suggest the government should take an active role in influencing where they are built. First is the carbon cost.[13] While solar panels do not release any carbon when generating solar power, they still have a complicated and variable carbon footprint.[14] Carbon is released into the atmosphere from the mining, melting, slicing, and other manufacturing processes required to produce solar panels.[15] Additionally, it takes carbon to transport the panels; prepare the installation site; recycle the panels; and, if the land ceases being a solar farm, convert the land into some other use.[16] Considering the carbon emissions from the production of a single solar panel, researchers estimate that it takes three years for a panel to offset its carbon footprint.[17] Since a solar panel's useful life generally exceeds twenty years, solar panels will almost always offset more carbon than they produce.[18] However, their effectiveness at offsetting carbon is highly dependent on factors such as land use before solar installation—while a solar farm installed in a former airport might become carbon neutral within a few years, it will likely take significantly longer for a solar farm that required the cutting down of a small forest.[19]

Second, utility-scale solar farms have an ecosystem cost. A noteworthy example of the potential damage utility-scale solar installations can unleash on ecosystems was seen in 2022 when the Environmental Protection Agency charged four solar farm companies with violations of the Clean Water Act by failing to prepare for sediment runoff.[20] Solar farms are easier to install on level ground, which leads many companies to clear-cut all trees and vegetation before

undeveloped land, this Comment considers uses of land that frequently disturb the soil, introduce foreign chemicals into the soil, and result in single-species domination less ecologically valuable than uses that allow the soil to rest and permit biodiversity.

13. Nikolaos Stylos & Christopher Koroneos, *Carbon Footprint of Polycrystalline Photovoltaic Systems*, 64 J. CLEANER PROD. 639, 641 (2014).

14. *Id.*

15. *Id.*

16. Georgette Kilgore, *Why Is Solar Energy Bad? Solar Panels' Environmental Impact (Toxic, Dangerous)*, 8 BILLION TREES (Oct. 9, 2023), https://8billiontrees.com/solar-panels/why-is-solar-energy-bad/ [https://perma.cc/6G4C-LGMH].

17. *Carbon Footprint of Solar Panel Manufacturing*, COOL EFFECT (June 1, 2021), https://www.cooleffect.org/solar-carbon-footprint [https://perma.cc/2TS3-CVCX].

18. *Id.*

19. *See* Kilgore, *supra* note 16.

20. Zayne Syed, *The Hard Truth of Building Clean Solar Farms*, POPULAR SCI. (Dec. 15, 2022, 12:45 PM), https://www.popsci.com/environment/solar-farm-construction-epa-water-violations/ [https://perma.cc/8SBG-HRVS].

installing their panels.[21] Such practices destroy wildlife habitats and can result in soil erosion and sediment runoff which, if it travels into waterways, can deposit too much soil into bodies of water and devastate local ecosystems.[22] Solar farms also divide off massive sections of ecosystems due to the seven-foot-high barbed wire fences required by national electric and fire protection codes.[23] Additionally, there are concerns that the heavy metals used in the infrastructure, wiring, and panels of solar farms are toxic to plants and could leach into the soil, impacting the ecosystem for decades after the panels are removed.[24]

B. *Environmental Tax Programs in North Carolina*

While North Carolina has many tax programs to further certain environmental goals, the four that this Comment examines in depth are summarized in Table 1. The oldest of these programs is the Present-Use Program, which provides beneficial property tax treatment for millions of acres of land used for various agricultural-related purposes.[25] As discussed below, the PUP requires meeting a number of statutory requirements, including some minimal environmental management requirements designed to ensure the long-term productivity of the land.[26] A large trend in recent years is the transition of land out of the PUP.[27] To divert some of the former PUP land into uses that directly preserve ecosystems, the legislature created the Wildlife Conservation Land Program, which gives identical property tax benefits but has much more strict environmental requirements.[28] However, much of the land transitioning from the PUP that could qualify for the WCLP is instead being converted into solar farms, which receive significant property tax benefits but lack any similar environmental requirements.[29] This section details the specific requirements and legislative intent behind these property tax programs to better understand how these competing programs influence the use of land in North Carolina.

21. *Id.*

22. *Id.*

23. Frank Graff, *Making Solar Farms Wildlife Friendly*, PBS N.C., https://www.pbsnc.org/blogs/science/making-solar-farms-wildlife-friendly/ [https://perma.cc/X468-QGUQ] (last updated Feb. 16, 2024). However, solar installers can avoid some of the negative impact of the fences by creating passageways in the fence that allow animals to pass through. *Id.*

24. Mike Carroll, *Can Solar Energy Production Be Converted to Farmland?*, N.C. STATE UNIV., https://craven.ces.ncsu.edu/2021/10/can-solar-energy-production-be-converted-to-farmland/ [https://perma.cc/XLY3-FQPR] (last updated Mar. 25, 2024).

25. *See infra* Section I.B.3.

26. *See infra* Section I.B.3.

27. *See infra* note 59 and accompanying text.

28. *See infra* Section I.B.4.

29. *See infra* Sections I.B.2, II.B.

Table 1: Overview of Selected Environmental Tax Programs in North Carolina

Program	Purpose	Benefits	Requirements
Solar Equipment Investment Tax Credit (1999–2016) (Repealed)	To spur investment in solar energy property.	Income tax credit equal to 35% of the cost to construct, purchase, or lease renewable energy property.	Need only construct, purchase, or lease renewable energy property.
Solar Energy Property Tax Exclusion (2008–Present) N.C. GEN. STAT. § 105-275(45)	To encourage investment in solar energy property.	Excludes 80% to 100% of the appraised value of solar energy electric systems from property taxes.	Need only use systems that generate electricity through solar energy.
Present-Use Program (1974–Present) §§ 105-277.2–105-277.7	To encourage and ensure financial feasibility of agricultural and timber farming.	Favorable property tax valuation for commercially used: (1) agricultural land, (2) horticultural land, and (3) forestland.	Must meet specific ownership, size, use, income, and land-management requirements.
Wildlife Conservation Land Program (2008–Present)	To protect and encourage habitats important for wildlife.	Favorable property tax valuation for wildlife land used for: (1) protecting species, (2) protecting habitats, or (3) keeping a wildlife reserve.	Must meet specific ownership, size, use, and land-conservation requirements.

1. Solar Equipment Investment Tax Credit ("ITC")

Following the lead of Congress[30] (and then one-upping it), North Carolina established an investment tax credit in 1999 that permitted individual and corporate taxpayers to recover 35% of their investment in a "constructed, purchased, or leased renewable energy property."[31] This credit has rightly been called "one of the country's most generous tax subsidy bills," as it was added on top of the 30% credit provided by the federal government.[32] Because the ITC exceeded most other states' solar investment credits, the ITC spurred immense investment in North Carolina solar from both inside and outside the state.[33] However, after a shift in the political governance of the state and lobbying by Duke Energy, the ITC was given a sunset date of 2016.[34]

The ITC allowed taxpayers with renewable energy property that served a nonbusiness purpose to take the credit in the year it was placed into service, but taxpayers with property that served a business purpose had to distribute the credit over five years.[35] Since 2011, taxpayers have claimed more than $1.5 billion dollars of credits from the ITC, and, in every year since 2015, the ITC has been the most expensive credit reported on the North Carolina Department of Revenue's ("NCDOR") yearly economic incentives reports.[36]

2. Solar Energy System Property Tax Exclusion

Since 2008, North Carolina has made the appraised value of "solar energy electric system[s]" excludable from property taxes.[37] For purposes of the exclusion, "solar energy electric system means all equipment used directly and exclusively for the conversion of solar energy to electricity."[38] Solar equipment such as heat exchangers, which use solar energy to provide temperature control,

30. Congress first introduced a 10% tax credit for "business energy property and equipment using energy resources other than oil or natural gas" in 1978, which eventually became a permanent 10% credit for solar and geothermal in 1992. CONG. RSCH. SERV., THE ENERGY CREDIT OR ENERGY INVESTMENT TAX CREDIT (ITC) (Apr. 23, 2021), https://crsreports.congress.gov/product/pdf/IF/IF10479 [https://perma.cc/DQJ2-5QV5]. In 2006, Congress temporarily increased the solar credit to 30%, and the deadline for the 30% credit has been extended many times since. *See id.*

31. Act to Simplify and Modernize Tax Credits for Investing in Renewable Energy Sources, ch. 342, § 2, 1999 N.C. Sess. Laws 1295, 1297 (repealed).

32. *See* Glazer, *supra* note 3, at 301.

33. *Id.*

34. *Id.* at 303–04.

35. Act of April 9, 2015, ch. 6, § 2.6, 2015 N.C. Sess. Laws 35, 36–37 (repealed). Property serves a business purpose "if the useful energy generated by the property is offered for sale or is used on-site for a purpose other than providing energy to a residence." N.C. GEN. STAT. § 105-129.16A(c)(1) (2024).

36. *See, e.g.*, N.C. DEP'T OF REVENUE, 2023 ECONOMIC INCENTIVES REPORT, https://www.ncdor.gov/2023-economic-incentives-report [https://perma.cc/89Y6-BZN2] (reporting $92 million ITC credits were claimed in tax year 2022).

37. N.C. GEN. STAT. § 105-275(45) (2024).

38. *Id.*

are not subject to the tax exclusion.[39] The amount of a solar system's value that is excluded will vary because most nonbusiness property is excluded from property taxes;[40] thus, residential systems used only for personal use are 100% excludable, and systems used to generate income are 80% excludable.[41] In practice, very few systems qualify for the complete exclusion because selling any energy back to the utility company constitutes using the system to generate income.[42] Besides the distinction between personal and business use, however, there are no additional requirements a solar installation must meet to receive the exclusion.[43]

So while the property tax exclusion does not provide as much economic benefit as the ITC, it still presents significant tax savings for solar installations.[44] A report from 2013 concluded that a solar installation's property taxes in North Carolina would average $1.78 to $6.83 per megawatt-hour ("MWh")[45] over the first twenty years.[46] Without the exclusion, the average tax liability would be $8.90 to $34.15 per MWh[47]—a considerable cost when utility companies provide a credit worth between $100 and $220 per MWh for energy provided to the grid.[48]

3. Present-Use Program ("PUP")

Since the introduction of the PUP in 1974, it has been exceedingly successful, with more than sixteen million acres qualifying as farmland or

39. Memorandum from the N.C. Dep't of Revenue on Solar Energy Elec. Sys. to Cnty. Assessors (Feb. 11, 2011) (on file with the North Carolina Law Review) [hereinafter NCDOR Memorandum].

40. § 105-275(16).

41. § 105-275(45).

42. *See* NCDOR Memorandum, *supra* note 39.

43. *See* § 105-275(45).

44. *See* Glazer, *supra* note 3, at 316.

45. A watt-hour ("Wh") is a unit of energy equivalent to one watt of power generated over an hour, and a megawatt-hour ("MWh") is equal to 1,000,000 watt-hours. *Glossary*, N.C. SUSTAINABLE ENERGY ASS'N, https://energync.org/glossary/ [https://perma.cc/ZBL7-S64H].

46. JUSTIN BARNES, CHAD LAURENT, JAYSON UPPAL, CHELSEA BARNES & AMY HEINEMANN, U.S. DEP'T OF ENERGY, N.C. SOLAR CTR., MEISTER CONSULTANTS GRP., PROPERTY TAXES AND SOLAR PV SYSTEMS: POLICIES, PRACTICES, AND ISSUES 27 tbl.3 (2013), https://icma.org/sites/default/files/306462_Property%20Taxes%20and%20Solar%20PV%20Systems.pdf [https://perma.cc/K2SX-DZC4].

47. Since the average tax liability of $1.78 to $6.83 per megawatt-hour ("MWh") is under an 80% exclusion, *see id.*, the average tax liability without the exclusion is equal to five times the estimated average.

48. *See* Jamie Smith, *Everything North Carolina Residents Can Expect from Duke Energy's New Solar Net Metering Policy*, SOLARREVIEWS, https://www.solarreviews.com/news/duke-energy-new-net-metering-policy [https://perma.cc/M26N-KGW6] (last updated Mar. 2024) (explaining that the estimated time of use rate for electricity ranges from $0.10 to $0.22 per kWh).

commercial forestland under the program.[49] The program offers tax exemptions for the land necessary for the agriculture and agribusiness industry—consisting of the food, fiber, and forestry industries—which has become North Carolina's number one industry, accounting for almost 16% of the gross state product and a full 16% of its employees.[50]

The PUP is considered "the most beneficial tax program for owners of rural property."[51] Property taxes in North Carolina are usually assessed on land based on its market value, which is the value of the land when put to its highest and best use.[52] The PUP operates as an exemption meant to make farming a viable business in North Carolina. If farmland was taxed at the market value of the land, medium- and large-scale farm operations would be cost-prohibitive because the taxes on the acreage required to support those operations would likely result in a negative return on investment.[53] Further, it would be difficult for a long-term forestry crop to be worth the yearly property taxes since it does not realize income from sales until many years after planting.[54] The PUP taxes certain properties as if their highest and best use is for farming activities and their value is dependent on the income from those farming activities.[55] As the name of the program suggests, lands within the program are taxed at their present-use value rather than their market value, which generally provides

49. *See 2024 North Carolina Agricultural Overview*, U.S. DEP'T OF AGRIC., https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA [https://perma.cc/HS9K-TMG4] (showing that 8.1 million acres are dedicated to farm operations in North Carolina); *About Our Forests*, N.C. FOREST SERV., https://www.ncagr.gov/divisions/nc-forest-service/forest-health/about-our-forests [https://perma.cc/E48B-6U7Q] (last updated Jan. 1, 2025) (explaining that approximately 60% of North Carolina's more than 18.3 million acres of forest are commercial forestland).

50. Mike Walden, *Agriculture and Agribusiness: North Carolina's Number One Industry*, N.C. STATE UNIV. (2023), https://www.ces.ncsu.edu/wp-content/uploads/2024/01/N.C.-Agriculture-Industry-Economic-Impact-2023.pdf?fwd=no [https://perma.cc/YTQ9-VAJF]; *see also About Our Forests*, *supra* note 49 ("Forestry is the second largest industry in the state, contributing nearly $3.2 billion annually to the state's economy and providing 144,000 jobs for North Carolinians.").

51. Robert Branan & Rajan Parajuli, *Present Use Value: Transferring Property Enrolled in Present Use Value Property Taxation*, N.C. STATE EXTENSION (Jan. 10, 2022), https://content.ces.ncsu.edu/present-use-value-transferring-property-enrolled-in-present-use-value-property-taxation [https://perma.cc/DDM7-FB69].

52. The North Carolina Department of Revenue defines market value as the "estimated price at which property would change hands between a willing buyer and a willing seller, neither being under any compulsion to buy or sell, and both having reasonable knowledge of the various potential uses of the property." N.C. DEP'T OF REVENUE, PRESENT-USE VALUE PROGRAM GUIDE 3 (2023), https://www.ncdor.gov/2023-08-present-use-value-program-guidepdf/open [https://perma.cc/26M4-EA4H] [hereinafter NCDOR PROGRAM GUIDE].

53. Branan & Parajuli, *supra* note 51.

54. *Id.*

55. *See* NCDOR PROGRAM GUIDE, *supra* note 52, at 3.

substantial savings.[56] Thus, the program prevents successful farm operations from being displaced because of the rising market value of their property.

The PUP is essentially a tax deferral program, as the property's market value is considered each year and the difference between the taxes paid under the PUP and the taxes that would be owed if valued at the market value—along with any interest, penalties, or costs that may accrue—are a lien on the property and carried forward in the records as deferred taxes.[57] If the property is ever disqualified from the PUP, the owner will owe all the deferred property taxes for the previous three years.[58] This method of deferring taxes furthers the policy of promoting farm uses in North Carolina because taxpayers must pay a significant cost to exit the program and convert their land to some other use. However, North Carolina is among the states most quickly losing their farm and forestland to high-value developed uses, such as, solar farms and residential housing developments, which shows that the demand for these lands is too high for the deferred taxes to prevent the land from leaving the PUP.[59]

To qualify for the PUP, the land must fall into one of three categories: agricultural land, horticultural land, or forestland.[60] While each classification has specific requirements, there are also requirements common to each land class.[61] The most important common requirement is that the land must be

56. *Id.*; *see also* Branan & Parajuli, *supra* note 51 ("Th[e present-use] program offers up to 90% tax savings for private eligible landowners in NC.").

57. N.C. GEN. STAT. § 105-277.4(c) (2024).

58. *Id.*

59. *See* AM. FARMLAND TR., FARMS UNDER THREAT: NORTH CAROLINA 1–2 (2020), https://storage.googleapis.com/csp-fut.appspot.com/reports/spatial/North_Carolina_spatial.pdf [https://perma.cc/GV9D-9QQH] (finding that between 2001 and 2016, 387,500 acres of the best land in the country for long-term food production was converted to developed uses in North Carolina); MITCH HUNTER, ANN SORENSEN, THERESA NOGEIRE-MCRAE, SCOTT BECK, STACY SHUTTS & RYAN MURPHY, AM. FARMLAND TR., FARMS UNDER THREAT 2040: CHOOSING AN ABUNDANT FUTURE 22 tbl.2 (2022), https://farmlandinfo.org/wp-content/uploads/sites/2/2022/08/AFT_FUT_Abundant-Future-7_29_22-WEB.pdf [https://perma.cc/82TY-6QSB] (projecting that North Carolina will lose more than 1 million acres of agricultural land between 2016 and 2040); DANIEL BROOKSHIRE, HANNAH BUDDS & JERRY CAREY, DANIEL PARKER, N.C. SUSTAINABLE ENERGY ASS'N, INCREASED NORTH CAROLINA COUNTY TAX REVENUE FROM SOLAR DEVELOPMENT – 2022, at 4–5 (2022), https://energync.org/wp-content/uploads/2022/09/Sept2022v6-Increased-North-Carolina-County-Tax-Revenue-from-Solar-Development.pdf [https://perma.cc/V24C-8S3R] (finding more than eleven million dollars in property tax increase on solar farm installation sites after installation largely due to the payment of deferred taxes from the PUP).

60. *See* § 105-277.2.

61. For example, the land must be owned by either an individual, a trust, or an eligible business entity whose principal business is forestry or the farming of agricultural or horticultural land. *See id.* For a business entity to be eligible, it must not be publicly traded, and it must be owned directly or indirectly by individuals who are actively engaged in farming or "a relative of one of the individuals who is actively engaged." § 105-277.2(4)(b)(2)–(3). If the land is leased, all the entity's owners must be individuals and related. § 105-277.2(4)(b)(4). These ownership requirements can be a barrier to speculative developers seeking to enroll land prior to development. *See* Joshua Wilkins, Comment, *Clean & Green: Tidying Up the Farm Tax Subsidy*, 115 PENN. ST. L. REV. 473, 485 (2010).

actively used for its respective purpose.[62] Additionally, all land classification must be managed under a "sound management program," which is designed to maximize the net return from the land while being consistent with the land's "conservation and long-term improvement."[63] As discussed below, the requirement for a sound management program sets a low bar for land preservation.[64]

a. Agricultural Land

Agricultural land is "[l]and that is a part of a farm unit that is actively engaged in the commercial production or growing of crops, plants, or animals under a sound management program."[65] For a tract to qualify as agricultural land, it must meet specific size, income, and management requirements. First, the land must consist of at least ten acres in actual production.[66] The statute permits portions of enrolled parcels to be classified as "wasteland" or "woodland" under certain circumstances.[67] The land must also generate an average gross income of at least $1,000 per year over the previous three-year period.[68]

62. Unlike programs in other states, the PUP does not allow tax deferral for lands with the characteristics of forests or agricultural land that is not currently in production. *See, e.g.*, Wilkins, *supra* note 61, at 484 (discussing how North Carolina's tax deferral program lacks an analog to Pennsylvania's agricultural reserve or forest reserve classifications).

63. § 105-277.2(6).

64. *See infra* notes 68–72 and accompanying text.

65. § 105-277.2(1).

66. *Id.* § 105-277.3(a)(1). Under the statute, land with improvements on it for "the commercial production or growing of crops, plants, or animals" is included in the count of land in actual production. *See* § 105-277.2(1). According to the North Carolina Department of Revenue ("NCDOR"), such improvement could consist of "barns, sheds, or other outbuildings, along with a reasonable area of land around the building(s) which permits their convenient use." NCDOR PROGRAM GUIDE, *supra* note 52, at 31. Additionally, land used for farming aquatic species need only be five acres in actual production or "produce at least 20,000 pounds of aquatic species for commercial sale annually, regardless of acreage." § 105-277.3(a)(1).

67. NCDOR PROGRAM GUIDE, *supra* note 52, at 35. If the parcel consists of more than twenty acres of woodland, it must meet the requirements of the forestland-specific sound management plan—including the requirement for commercial growing of trees unless the land is shown to serve important agricultural purposes. *Id.* Woodlands serve important agricultural purposes if it is shown "that the highest and best use of the woodland is to diminish wind erosion of adjacent agricultural land, protect water quality of adjacent agricultural land, or serve as buffers for adjacent livestock or poultry operations." *See* § 105-277.2(1).

68. § 105-277.3(a)(1).

Finally, the land must be under a sound management plan.[69] An owner meets the sound management requirement if they can meet any of six tests.[70] These tests are simple to satisfy if the owner's farming revenue exceeds their expenses or if more than fifty percent of their income comes from farming operations.[71] Ultimately, the statute's requirement that the land be used "consistent with its conservation and long-term improvement" means no more than "that a legitimate farming operation will not seek to abuse the land and that the land should be farmed in a manner consistent with maintaining its long-term commercial productivity."[72] Unfortunately, as interpreted by the NCDOR, this standard permits unsustainable farming practices like the excessive use of chemical fertilizers that slowly deteriorate the soil.[73]

b. Horticultural Land

For land to qualify as horticultural land it must be "engaged in the commercial production or growing of fruits or vegetables or nursery or floral products."[74] Unlike agricultural land, horticultural land only requires five acres to be in actual production and can consist entirely of land with improvements.[75] This means it has the potential to be the PUP land classification with the lowest ecological value.[76] Similar to agricultural land, parcels of horticultural land can

69. § 105-277.2(1).

70. The tests consist of

> (1) Enrollment in and compliance with an agency-administered and approved farm management plan; (2) Compliance with a set of best management practices; (3) Compliance with a minimum gross income per acre test; (4) Evidence of net income from the farm operation; (5) Evidence that farming is the farm operator's principal source of income; [or] (6) Certification by a recognized agricultural or horticultural agency within the county that the land is operated under a sound management program.

§ 105-277.3(f).

71. NCDOR PROGRAM GUIDE, *supra* note 52, at 69. While some of the tests are simple, the NCDOR considers three of the tests to be "difficult . . . to administer and evaluate." *Id.* For example, the NCDOR does not know "which agencies and which programs were intended" by the first test, nor does it know of any agency that provides the required certification for the sixth test. *Id.*

72. *Id.* at 66.

73. As the NCDOR's discussion on fallow land makes clear, farmers in the program are typically wholly reliant on chemical fertilizers to artificially restore nutrients in the soil. *See id.* at 33. The combination of chemical fertilizers and constant tilling in modern agriculture together undermine the long-term health of the soil by killing the insects, fungi, and bacteria needed to naturally replenish the soil and prevent soil compaction. *See* Richard Schiffman, *Why It's Time to Stop Punishing Our Soils with Fertilizers*, YALE ENV'T 360 (May 3, 2017), https://e360.yale.edu/features/why-its-time-to-stop-punishing-our-soils-with-fertilizers-and-chemicals [https://perma.cc/RQA8-BHSD].

74. § 105-277.2(3).

75. § 105-277.3(a)(2).

76. *See* CORDELL ET AL., *supra* note 12, at 206 (defining "ecological value").

contain woodland.[77] Additionally, the income and sound management requirements for horticultural land are identical to those for agricultural land.[78]

c. Forestland

Land must be "actively engaged in the commercial growing of trees" to qualify as forestland.[79] While forestland may contain wasteland, it may not contain either of the other PUP land classes.[80] Forestland also does not have an income requirement.[81] For forestland to qualify for the PUP program, at least one tract must consist of twenty acres or more in actual production.[82]

According to the statute, an owner of forestland must be able to show that the land complies with a "written sound forest management plan for the production and sale of forest products."[83] The NCDOR states that a sound forest management plan should: (1) identify the owner's objectives; (2) give location information; (3) describe in detail the soil and trees on the land; (4) detail the harvest methods (such as clear-cutting the land or leaving mature seed-trees); and (5) detail the regeneration technique (such as planting or natural regeneration).[84] The plan may "include other objectives such as improving wildlife habitat," but such objectives are not permitted to "significantly detract" from the commercial production of timber.[85] Forestland can permit the most ecologically beneficial land use within the PUP since it is possible for management to largely mimic the natural environment: trees are only harvested every other decade, and the program permits the owner to leave some mature seed-trees and allow the trees to regenerate naturally. However, the flexibility of the sound management requirements—specifically, the authorizing of clear-cutting and replanting—allows for practices that can be harmful to the land and wildlife.[86]

77. Woodland needs to conform to the requirements for forestland if the woodland exceeds twenty acres and unless the woodland's highest and best use is to "diminish wind erosion of adjacent horticultural land or protect water quality of adjacent horticultural land." § 105-277.2(3).

78. § 105-277.3(a)(2), (f). However, if the horticultural use is for growing Christmas trees, the land must meet the sound management requirements for forestland in any growing years and have at least $1,500 of income per acre (or $2,000 per acre in the mountains) in any harvest years. NCDOR PROGRAM GUIDE, *supra* note 52, at 73–74.

79. § 105-277.2(2).

80. *Id.*

81. NCDOR PROGRAM GUIDE, *supra* note 52, at 52. An income requirement for forestland would not be feasible since it only produces income from infrequent harvests. *Id.*

82. § 105-277.3(a)(3).

83. § 105-277.3(g).

84. NCDOR PROGRAM GUIDE, *supra* note 52, at 67.

85. *Id.*

86. *See About Clearcutting*, SIERRA CLUB, https://www.sierraclub.org/grassroots-network/stop-clearcutting-ca/about-clearcutting [https://perma.cc/ZVU2-UTG2] (arguing that clear cutting leads to negative environmental results such as accelerating climate change, degrading water, and threatening

4. Wildlife Conservation Land Program ("WCLP")

In 2008, North Carolina created a program complementary to the PUP that is designed to protect land important to wildlife.[87] In recognition of the special status given to wildlife conservation land under the North Carolina Constitution,[88] the General Statutes of North Carolina require that conservation land be appraised, assessed, and taxed under the WCLP using the same tax deferral system as the PUP.[89] Similarly, the rollback penalties for losing eligibility for the WCLP are identical to those for the PUP.[90] The legislative intent behind the WCLP is to use tax-based incentives to encourage the preservation of wildlife, and the commission in charge of administering the rules for this program—the North Carolina Wildlife Resources Commission ("WRC")—promulgates rules to balance the cost of required management activities with potential tax savings.[91]

To take advantage of the WCLP, an owner must satisfy certain size, ownership, and use requirements.[92] To meet the ownership requirement, a person must have at least one qualifying tract of land that consists of twenty contiguous acres in the same county.[93] Once an owner has a qualifying tract, they can then have up to two hundred acres in the same county (or up to eight hundred acres if the land is used as a wildlife reserve).[94]

The core of the WCLP program is seen in the use requirements. There are three land uses that qualify for wildlife conservation land: wildlife species protection, wildlife habitat protection, and land used as a wildlife reserve.[95] All

wildlife). *But see* N.C. FOREST SERV., CLEARCUTTING . . . FACTS AND MYTHS (2020), https://www.ncagr.gov/divisions/nc-forest-service/FM0313/download?attachment [https://perma.cc/ASZ8-39XB (staff-uploaded archive)] ("Clearcutting today is not like it was 100 years ago. It is an important tool for managing forests and stimulating new growth.").

87. N.C. WILDLIFE RES. COMM'N, FISCAL NOTE FOR PROPOSED WILDLIFE CONSERVATION LAND PROGRAM RULES FOR THE WILDLIFE RESOURCES COMMISSION 3 (2019) [hereinafter FISCAL NOTE], https://files.nc.gov/ncosbm/documents/files/WRC_2020-02-19.pdf [https://perma.cc/75GQ-6PNU].

88. *See* N.C. CONST. art. V, § 2(2).

89. *See* N.C. GEN. STAT. § 105-277.15(e).

90. § 105-277.15(h) (referencing section 105-277.5, which subjects PUPs to penalties).

91. *See* FISCAL NOTE, *supra* note 87, at 4.

92. § 105-227.15(a)(6).

93. § 105-277.15(c1). Generally, the land must also have been owned by the same owner for at least four years and that owner must be either an individual, a family trust, or a family business entity. § 105-277.15(c2). An owner can get around the four-year requirement if the land is the owner's residence, the land is adjacent to land that is already in the Wildlife Conservation Land Program ("WCLP") program, there was a transfer of land already in the WCLP program, or there is some continuity of ownership for at least one of the owners in a family trust of business. § 105-277.15(c2)(1)–(7).

94. § 105-277.15(d)(1).

95. § 105-277.15(c3)(1)–(3).

three uses require that the land be managed "under a written wildlife habitat conservation agreement" with the WRC.[96]

a. Wildlife Species Protection

The most straightforward use requirements are for land used for wildlife species protection. This land is treated as if it were forestland under the present-use value system for tax purposes.[97] Wildlife species protection consists of "protect[ing] an animal species that lives on the land" and is recorded on a "North Carolina protected animal list."[98] The North Carolina Administrative Code clarifies that eligible species are those designated as "endangered, threatened, or special concern."[99] For land to qualify for this use, at least one eligible species must be identified on the land and the owner must manage the land using "established strategies" identified in the conservation agreement.[100]

b. Wildlife Habitat Protection

The WCLP identifies six "priority animal wildlife habitats: longleaf pine forest, early successional habitat, small wetland community, stream and riparian zone, rock outcrop, [and] bat cave."[101] According to the North Carolina Administrative Code, land can meet the use requirement for the WCLP if at least one of these priority wildlife habitats is "identified on the land or *planned for establishment*" and there are "management strategies planned for or in place for the continued existence of the priority habitat."[102] Similar to land used for wildlife species protection, land that qualifies is treated as if it were forestland under the present-use value system for tax purposes.[103]

While all of the enumerated habitats are essential for North Carolina wildlife to thrive, two in particular are notable as on-ramps for cropland, forestland, and pastureland transitioning from the PUP to the WCLP.[104] First, early successional habitats are habitats dominated by native plants without woody stems and are important habitats for forty-nine different species that are

96. § 105-277.15(c3).
97. § 105-277.15(b)(1).
98. § 105-277.15(c3)(1).
99. 15A N.C. ADMIN. CODE 10L.0102(a) (2020).
100. 15A N.C. ADMIN. CODE 10L.0102(b) (2020).
101. § 105-277.15(c3)(2).
102. 15A N.C. ADMIN. CODE 10L.0103(b)(1)–(2) (2020) (emphasis added).
103. § 105-277.15(b)(2).
104. This can be seen in the standard Wildlife Habitat Conservation Agreement published by the North Carolina Wildlife Resources Commission ("WRC"), which provides instructions and a checkbox for cropland transitioning to either early successional habitat or longleaf pine forest. *Wildlife Habitat Conservation Agreement*, N.C. WILDLIFE RES. COMM'N 7–8 (Apr. 2024), https://www.ncwildlife.org/media/1269/download?attachment [https://perma.cc/K2EG-7YNU].

considered "of Greatest Conservation Need."[105] Typical early successional habitats include clear-cut forests, field borders, abandoned fields, and meadows.[106] While grazing pastures and crop fields can be converted into early successional habitat, the turf grasses typical of pastures and fields do not benefit wildlife and thus must be controlled so that native grasses that grow in clumps can take over.[107] The key to maintaining an early successional habitat is periodic disturbances, such as burning or mowing to prevent woody plants from taking over.[108] Since early successional habitats are easy to establish and maintain, accepting this much-needed habitat under the WCLP incentivizes landowners to repurpose their forest, pasture, or cropland for the benefit of the local ecosystem.

Second, a longleaf pine forest offers an alternative to PUP land. Longleaf pine forests once covered ninety-one million acres in the United States, but now have a range of only three million acres.[109] These forests have been lost to development and increased commercial plantings of fast-growing pines like the loblolly pine.[110] In North Carolina, thirty-five priority wildlife species are associated with this habitat.[111] A landowner with mixed pines can qualify for the WCLP as long as longleaf pine is established on the land and management is used to promote the trees' restoration.[112] Establishment of this habitat—by planting three hundred trees per acre and doing a controlled burning in the first two years of planting—also can qualify for the WCLP, making this another viable option for former pastureland or cropland.[113]

c. Wildlife Reserve

The broadest and most recent category of acceptable land use is the wildlife reserve category.[114] This requires a landowner to create the reserve and "actively and regularly" use it for "hunting, fishing, shooting, wildlife observation, or wildlife activities."[115] Additionally, the owner must engage in

105. *Wildlife Conservation Land Program Priority Habitat Management Guidelines: Early Successional Habitat*, N.C. WILDLIFE RES. COMM'N (May 2023), https://www.ncwildlife.org/Portals/0/Early_Succession_May_2023.pdf [https://perma.cc/YN4T-SS7P (staff-uploaded archive)].

106. *Id.*

107. *Id.*

108. *Id.*

109. *Wildlife Conservation Land Program Priority Habitat Management Guidelines: Longleaf Pine Forest*, N.C. WILDLIFE RES. COMM'N (May 2023), https://www.ncwildlife.org/Portals/0/Longleaf_WCLP_May_2023.pdf [https://perma.cc/S4TT-TL39 (staff-uploaded archive)].

110. *Id.*

111. *Id.*

112. *Id.*

113. *Id.*

114. The wildlife-preserves land-use category became effective on July 1, 2019, and it constitutes a large statutory expansion of the type of land that can qualify for the program which provided a benefit to private citizens. *See* FISCAL NOTE, *supra* note 87, at 3–5.

115. N.C. GEN. STAT. § 105-277.15(c3)(3) (2024).

three of seven enumerated activities that promote the "breeding, migrating, or wintering" of native animals for human use such as "food, medicine, or recreation."[116] The land is inspected by a certified wildlife biologist every five years to ensure these activities are taking place.[117] Land that qualifies as a wildlife reserve receives the same tax treatment as forestland under the present-use system.[118]

While the wildlife reserve category differs from the other WCLP land uses in that it contemplates conservation for human enjoyment of wildlife, it is notable that the North Carolina Administrative Code excludes from the program any land that is "managed and maintained primarily for human uses" and specifically names solar energy as one such forbidden use.[119] This exclusion makes sense considering the goal of the WCLP to promote wildlife conservation because human uses that are more than periodic are largely incompatible with wildlife.

C. *Solar Industry Competitiveness Allows for Less Lenient Tax Incentives*

When compared to the extensive use, ownership, and management requirements of the PUP or WCLP, the lack of requirements to receive a tax break for solar equipment is striking. All three tax incentives are grounded in the policy of environmental preservation, and all apply to behaviors that impact how millions of acres of land are used across North Carolina.[120] And, as discussed above, although the legislature established the WCLP to try and transition land enrolled in the PUP into uses that preserve wildlife conservation land,[121] PUP land is being frequently developed into solar farms.[122]

However, the difference in requirements makes sense considering the urgent need for investments in solar technology when the solar incentives were

116. *Id.* The first three activities are providing "supplemental" food, water, and shelter. § 105-277.15(c3)(3)(a)–(c). In interpreting this language, the WRC determined that the term "supplemental" meant adding to the natural resources of the land in a manner that provides lasting benefit to the conservation. FISCAL NOTE, *supra* note 87, at 5. As such, providing "supplemental food" means planning annual or perennial noninvasive food sources rather than putting out a deer feeder, and providing "supplemental water" means creating a water feature or source. 15A N.C. ADMIN. CODE 10L.0104(b)(1)–(2) (2020). Other activities include implementing practices to maintain "habitat control," implementing some form of "erosion control," implementing "predator control" (which may consist of removing invasive species), and conducting or participating in animal population surveys. 15A N.C. ADMIN. CODE 10L.0104(b)(4)–(7) (2020).

117. § 105-277.15(c3)(3).

118. § 105-277.15(b)(3).

119. 15A N.C. ADMIN. CODE 10L.0104(a) (2020). In addition to solar energy, the North Carolina Administrative Code also lists the following as types of property that shall not qualify as wildlife reserve land: "large lawns, golf courses, horse pastures, production agricultural fields, monoculture hayfields, . . . and commercial timber stands." *Id.*

120. *See supra* notes 49, 59 and accompanying text.

121. *See supra* text accompanying notes 87, 104, 113.

122. *See supra* note 59 and accompanying text.

enacted. These incentives have been crucial for the research and development necessary to make solar energy production a competitively viable energy source.[123] As such, it makes sense that these exemptions were written to be as broad as possible to encourage private investment in all places and at all scales, and thus the statute provides the same tax benefits to the panels on a solar farm as panels on a residential rooftop even if the former have a much higher carbon and ecological cost than the latter.[124] Overall, solar panel tax incentives have been the great success of American environmental energy policies, as solar farms can now compete with other energy sources irrespective of the tax benefits.[125] Additionally, there has been a dramatic rise of ethical investing in the last decade and a half, such that as of 2019, institutional investors managing more than $80 trillion in assets committed to investing in companies that promote environmental, social, and governance ("ESG") goals.[126] This trend led many companies to invest in solar companies to achieve their ESG investment goals, which resulted in solar investments outpacing oil investments for the first time in 2023.[127]

Since tax incentives are no longer as necessary for the solar industry to receive investments, it is a good time to consider if the solar property tax incentive should have more requirements to lower the environmental cost of solar farms.

II. STUDY ON THE LAND USE OF SOLAR FARMS IN NORTH CAROLINA

Since the introduction of the PUP, the North Carolina General Assembly has been successfully using the property tax system to encourage and promote land uses it believes are important.[128] In recent years, North Carolina has used this same method to achieve its goals of preserving the natural resources of the state more directly by encouraging solar farms and the conservation of wildlife conservation land.[129] However, these two more recent programs, though enacted

123. Matthew E. Parker, Let the Sun In: The Effect of Investment Tax Credits on Solar Energy Generation Across the United States 6 (Apr. 4, 2023) (M.A. thesis, Georgetown University) (on file with the North Carolina Law Review).

124. *See supra* notes 30–36 and accompanying text.

125. *See supra* notes 30–36 and accompanying text; *see also Renewable Electricity Levelized Cost of Energy Already Cheaper than Fossil Fuels, and Prices Keep Plunging*, ENERGY INNOVATION (Jan. 22, 2018), https://energyinnovation.org/2018/01/22/renewable-energy-levelized-cost-of-energy-already-cheaper-than-fossil-fuels-and-prices-keep-plunging/ [https://perma.cc/7S8L-K8AR].

126. Betsy Atkins, *Demystifying ESG: Its History & Current Status*, FORBES (Apr. 14, 2022, 2:06 PM), https://www.forbes.com/sites/betsyatkins/2020/06/08/demystifying-esgits-history--current-status/ [https://perma.cc/AJ5W-ZPNH (staff-uploaded archive)].

127. Mark Segel, *Global Investment in Solar Outpacing Oil for First Time Ever: IEA*, ESG TODAY (May 25, 2023), https://www.esgtoday.com/global-investment-in-solar-capacity-outpacing-oil-for-first-time-ever-iea/ [https://perma.cc/R4QB-7R6A].

128. *See* BARNES ET AL., *supra* note 46, at 26–28.

129. *See supra* notes 37, 87 and accompanying text.

for similar reasons, are largely incompatible, as solar farms have significant land requirements with potentially high ecological costs.[130] Thus, to understand the extent to which the legislature is rewarding behaviors that further its land use goals, and to better assess the benefit (and cost) of North Carolina's investment in solar, it is necessary to know whether these programs are competing for the same tracts of lands and how the land surrounding solar farms is used.

A. *Methodology*

1. Data

This analysis utilizes the interactive map provided by the North Carolina Sustainable Energy Commission ("NCSEA") to locate utility-scale solar farms.[131] NCSEA uses data from its Renewable Energy Database, "a statewide clearinghouse of installed renewable energy systems," to identify solar operations and their generating capacities.[132] This analysis also makes use of the latest NC OneMap orthoimagery, which is a source of geospatial data containing high-resolution imagery of the surface of North Carolina.[133]

Finally, data from a land cover GIS file created by the National Land Cover Dataset ("NLCD") is used.[134] The NLCD divides the United States into thirty-square-meter portions, each assigned to one of sixteen land cover classes.[135] The land is classified based on its usage and contents including open water, different types of vegetated lands (such as deciduous forests, evergreen

130. *See supra* Section I.A.

131. *Interactive Maps*, N.C. SUSTAINABLE ENERGY ASS'N, https://energync.org/maps/ [https://perma.cc/A7EN-YPM8] (using the map of North Carolina Solar, click "Filter By County" to zoom into a specific county, click "Utility-Scale" to highlight all utility-scale solar operations, and hover the mouse over a red dot to receive information about the solar installation).

132. BROOKSHIRE ET AL., LAND USE AND AGRICULTURE, *supra* note 10, at 8. The source of the Renewable Energy Database's information is the North Carolina Utilities Commission which is claimed to be "the most comprehensive source of renewable energy system information in North Carolina." *Id.*

133. *NC Orthoimagery*, NC ONEMAP, https://www.nconemap.gov/pages/imagery [https://perma.cc/9U27-B558]. Orthoimagery is an aerial photograph without all the distortions of terrain relief and cameral tilts. *Id.* The NC Orthoimagery Program collects and produces 6-inch (15cm) orthoimagery on a four-year cycle by flying over approximately a quarter of the state each year. *Id.*

134. MULTI-RESOLUTION LAND CHARACTERISTICS CONSORTIUM, https://www.mrlc.gov/ [https://perma.cc/GEZ7-RFDA]. This data is provided by the Multi-Resolution Land Characteristics Consortium ("MRLC"), "a group of federal agencies that coordinate and generate consistent and relevant land cover information at the national scale" and are trusted as a definitive source of United States land cover. *Id.* The MRLC has created the National Land Cover Dataset ("NLCD") by mapping the lower forty-eight states, Hawai'i, Alaska, and Puerto Rico "from decadal Landsat satellite imagery and other supplementary datasets." *Id.*

135. *Id.*

forests, grasslands, and pastures), and different levels of developed land.[136] The dataset contains land-use classifications going back to 2001.[137]

While most of the NLCD classifications are easy to understand, it is important to know how the classifications around development are defined. The lowest development classification is "Developed, Open Space," which consists of areas where impervious surfaces[138] account for less than 20% of the total surface and vegetation consists mainly of lawn grasses.[139] Next, "Developed, Low Intensity" describes areas where "[i]mpervious surfaces account for 20% to 49% of total cover."[140] "Developed, Medium Intensity" describes areas where "[i]mpervious surfaces account for 50% to 79% of the total cover."[141] "Developed High Intensity" means areas where "[i]mpervious surfaces account for 80% to 100% of the total cover."[142] The classification "Barren Land" is given to areas with an accumulation of earthen material where "vegetation accounts for less than 15% of total cover."[143]

2. Method

NCSEA has conducted multiple analyses of the classification of land converted to solar farms by examining the footprints of utility-scale solar operations.[144] This Comment's analysis differed from any analysis conducted by the NCSEA in three significant ways. First, this analysis was limited to utility-scale solar operations that are built on land that could have qualified for the WCLP, while NCSEA analyses considered all utility-scale solar farms.[145] Second, the footprints of solar farms in this analysis were captured based on the fence line of the solar operation to include land beyond the area covered by the

136. *Id.*

137. *Id.*

138. As defined by the MRLC, an impervious surface is "any man-made material that impedes or prevents the natural infiltration of water into the soil," with such surfaces including "building roofs, patios, sidewalks, concrete or asphalt streets, parking lots, and gravel roads." *See EVA Tool*, MULTI-RESOLUTION LAND CHARACTERISTICS CONSORTIUM, https://www.mrlc.gov/eva/?c=48339&fr=2001&r=county&s=48&t=2&to=2019 [https://perma.cc/KY7G-3NNH] (click on "view legend"). The amount of impervious surfaces matter because it is an indicator of development and "[w]hen impervious surfaces cover areas where water naturally seeps into underground water sources, or aquifers, they reduce the amount of water available to recharge wells and springs. . . . As impervious surfaces increase, so do stormwater runoff volumes, the velocity of stormwater flows, and pollutant levels in runoff." *Id.*

139. *National Land Cover Database Class Legend and Description*, MULTI-RESOLUTION LAND CHARACTERISTICS CONSORTIUM, https://www.mrlc.gov/data/legends/national-land-cover-database-class-legend-and-description [https://perma.cc/B4DA-QSYT].

140. *Id.*

141. *Id.*

142. *Id.*

143. *Id.*

144. BROOKSHIRE ET AL., LAND USE AND AGRICULTURE, *supra* note 10, at 3.

145. *See id.* at 4.

panels.[146] Third, this analysis utilized the NLCD data for all available years after 2008 to analyze the change over time, unlike the NCSEA analyses which only examined the land use categories as of 2008.[147]

This research analysis consisted of four steps. First, it was necessary to determine which solar farms could potentially meet the requirements of the WCLP. The NCSEA map was used to locate the approximate location of the utility-scale solar systems. The aerial imagery from OneMap and the GIS measuring tool were then used to determine if, before the installation of the solar system, the land could meet the twenty-contiguous-acre requirement. Next, older aerial imagery from OneMap was used to confirm that, before solar installation, the land consisted of sufficient pastureland, forestland, cropland, or some other land type that could potentially satisfy one of the WCLP land uses.

The second step was to create GIS data footprints of all the solar farms in North Carolina that were built on land that could have qualified for the WCLP before installation. Once the solar farms were located, footprints were created by using the aerial imagery from OneMap as a basemap and creating a layer of polygons outlining all the identified solar farms that met the criteria. The solar farms were outlined to capture the fence line surrounding the solar site to capture the impact on the adjacent land from the solar installation. Appendix A provides simplified examples of this and the succeeding steps.

Third, these footprints were used to extract land use data from the NLCD dataset. The first utility-scale solar systems in North Carolina were installed in 2009,[148] thus land use data analysis began in 2008. The NLCD data was set to one specific year, and the solar farm footprints were then used to extract the NLCD land use classifications for the area identified as eventual solar farms. This process was then repeated using NLCD data from 2011, 2013, 2016, 2019, and 2021. The NLCD dataset did not successfully capture every transition in land coverage for every solar farm in North Carolina. If there was no change in the land cover classification before and after the installation of the solar farm, that solar farm was excluded from this analysis.

Finally, the extracted land use data was compared year-over-year to see the change in land use classifications for the footprints over time. Different land-use classifications were grouped to analyze this data. In Figure 1, four categories of land classifications were created to show the general trends in terms of land uses compatible and incompatible with the WCLP. First, the category labeled "Developed / Barren" groups together all the surfaces that would be ineligible for the WCLP program: open, low-intensity, medium-

146. *See id.* at 8.
147. *See id.*
148. *Id.*

intensity, high-intensity development, and barren land. Second, the category "Herbaceous Plants" groups together grasslands/herbaceous and emergent herbaceous wetlands. Third, the category "Woody Plants" represents all the forest types (deciduous, evergreen, and mixed) as well as shrub/scrub and woody wetlands. Fourth, "Pasture / Crop" consists of pasture/hay and cultivated crops.

Figure 2 is a stacked percentage chart that shows changes in more specific land uses. This figure separates cultivated crops, pasture/hay, grass/herbaceous, and shrub/scrub into distinct categories. The "Forest" category consists of all forests and wetlands. The "Developed" category contains low-, medium-, and high-intensity development—all classifications with impervious surfaces. Finally, the "Barren" category is comprised of barren land and developed open spaces.

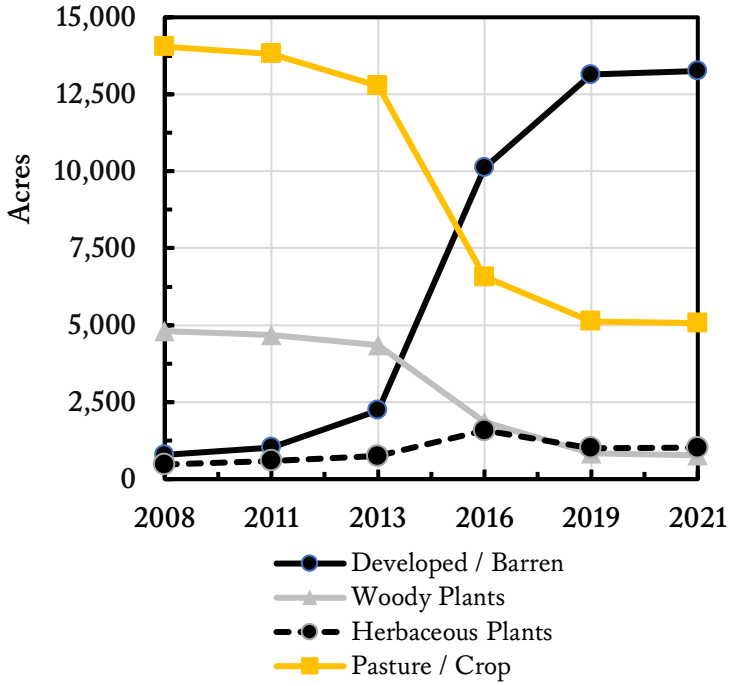
B. *North Carolina Solar Farms Have a High Ecological Cost*

After excluding all solar farm sites that did not have the potential to be converted into the WCLP as of 2008, a total of 34,973 acres were identified.[149] However, 14,858 acres did not have their land cover classification transition post solar installation captured by the NLCD dataset, so this analysis was conducted on a sample of 20,115 acres.[150]

149. All relevant research materials and data for this Recent Development's studies are available through UNC's open data repository at Nathaniel Swigart, *Data & Code for Nathaniel Swigart, Zero-Sum Environmentalism: Competing Tax Incentives for Solar Farms and Wildlife Conservation Land, 103 N.C. L. Rev. 803 (2024)*, UNC DATAVERSE (Apr. 5, 2025), https://doi.org/10.15139/S3/UETOIZ [https://perma.cc/8F5F-L59C] [hereinafter Swigart, *Data & Code*].

150. Swigart, *Data & Code*, *supra* note 149. For reasons unknown to the author, the NLCD data did not capture many conversions of solar farms installed after 2020.

Figure 1: Trends in Solar Site Land Categories Suitable for WCLP over Time



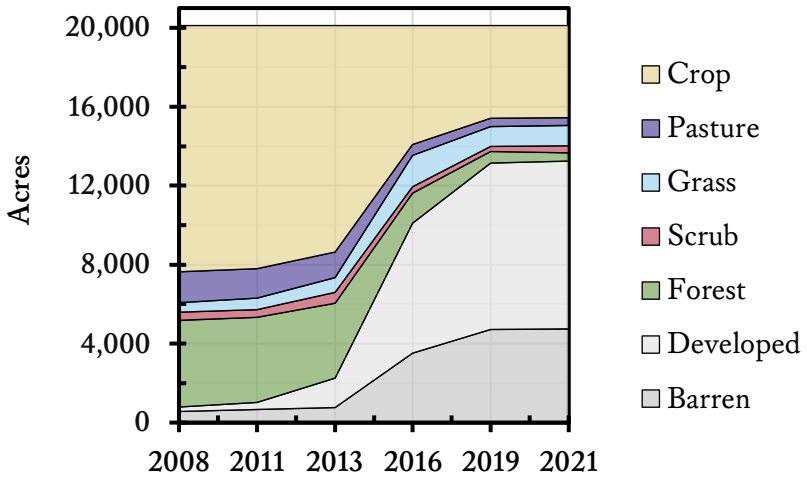
In Figure 1, the low prevalence of developed and barren land in 2008 makes it clear that solar panels are frequently being built on land that likely was within the PUP and could have qualified for the WCLP, resulting in substantial development of this land. Since 2008, 13,000 acres—or 65% of the land analyzed—have become classified as developed or barren due to utility-scale solar installations; assuming the sample analyzed is representative of the total 35,000 acres,[151] more than 22,000 acres have become developed due to solar farms. The bulk of the land has been converted from pasture and cropland as seen in the decrease of approximately 10,000 acres. However, as of 2021, pasture

151. In conducting this analysis, the author examined satellite images of every solar farm in North Carolina before and after the solar farm was installed. While the NLCD data did not capture a number of conversions, there was no clear difference between the solar farms that were successfully captured and those that were not, other than the year of installation. Thus, this sample of the majority of solar sites in North Carolina is likely representative of all solar sites in North Carolina.

and cropland were more prevalent on solar farm sites than either woody or herbaceous plants, suggesting that these farming uses are somewhat compatible with large-scale solar farms. Woody plants were the most displaced by the solar installations, and herbaceous plants increased because of the installation of solar farms. This finding can be explained by the common practice of solar farm installers to first clear-cut the land to remove any woody plants that could shade out the panels resulting in the smaller herbaceous plants taking their place.[152]

More than 4,000 acres of woody plants in this sample have been lost to solar developments, which is almost equal to the total amount of land enrolled in the WCLP in the first five years of the program's existence.[153] Assuming this sample is representative, 7,000 acres of woody plants have been lost. For perspective, this estimated amount of woody plant coverage lost would have been sufficient to cover the total area of the largest state park in Orange County, Eno River State Park, one and a half times.[154]

Figure 2: Stacked Percentage of Solar Site Land Classifications over Time



152. *See supra* note 21 and accompanying text.

153. *See* Kelly Douglass, Forest Stewardship Biologist, N.C. Wildlife Res. Comm'n, Wildlife Conservation Lands Program Presentation (2015) (reporting that 4,041.5 acres qualified in the WCLP from 2009–2013).

154. *See Eno River State Park*, ENO RIVER ASS'N, https://www.enoriver.org/features/eno-river-state-park/ [https://perma.cc/D6Z7-2M52] (stating that Eno River State Park covers more than 4,500 acres).

Figure 2 provides greater insight into what is being done with the land within the margins between the solar panels and the fence line. While developed land was essentially nonexistent in 2008, it was the largest category by far by 2021 and reflects the extent to which the panels themselves cover the land that is dedicated to solar farms. The remainder of the land categories shows what is being done with the land in the margins of the solar farms.

After Developed, the two most prevalent land types are Barren and Crop, each consisting of more than 4,000 acres. The presence of cropland is likely due to many farmers choosing to farm around solar panels placed in the center of their fields, which is a commonly occurring layout. This arrangement generally results in the solar fields taking up the vast majority of the parcel, making it unlikely that it will retain the ability to meet the twenty-contiguous-acre requirement of the WCLP. As discussed earlier, cropland does very little to support wildlife;[155] thus, the solar installations' retention of cropland essentially locks this land out from participation in the WCLP and removes the associated incentives to convert it into land with more ecological benefits.

Figure 2 suggests that the land in the margins of the solar farms is not being used to its ecological potential. This figure shows a large quantity of barren land and a comparatively small quantity of grassland. Unlike trees, grasses and other small perennial plants are very compatible with solar farms, as they do not present the same issues with shading out the panels and can support important wildlife such as pollinators.[156] For this reason, conservation experts believe that North Carolina solar farms can play an important role in creating the necessary habitat to support native grasslands offsetting the habitat decline that threatens many insect species listed as "Species of Greatest Conservation Need."[157] While this idea is excellent in theory, the high quantity of barren land and the minuscule amount of grassland suggests that few, if any, solar farms have adopted this practice. Further, the clear decrease of pastureland suggests that solar farms are also not engaging in a practice called "solar grazing" in which a solar farm is used symbiotically with livestock to prevent vegetation from overtaking the panels without the need to expend fossil fuels or chemicals to control the plants.[158]

155. *See supra* note 107 and accompanying text.

156. N.C. POLLINATOR CONSERVATION ALL., NORTH CAROLINA TECHNICAL GUIDANCE FOR NATIVE PLANTINGS ON SOLAR SITES 2 (2018), https://ncpollinatoralliance.org/wp-content/uploads/2018/10/NC-Solar-Technical-Guidance-Oct-2018.pdf [https://perma.cc/T4AL-PA64].

157. *Id.*

158. *What Is Solar Grazing and How Does It Work?*, AM. SOLAR GRAZING ASS'N, https://solargrazing.org/wp-content/uploads/2019/06/Solar-Grazing-Brochure.pdf [https://perma.cc/6QRS-7VGM].

III. IMPROVING THE TAX INCENTIVES FOR SOLAR FARMS

North Carolinians should be proud of the steps taken to preserve the natural resources of this state for future generations. In the face of rapid population growth and demand for development, North Carolina has shown itself to be a leader among modern governments in enacting prudent legislation to meet the environmental challenges of this century.

Much of North Carolina's success has come from the willingness to experiment and correct shortcomings. Though not perfect, North Carolina's PUP has ensured for decades that farming operations in the state take some measures to avoid abusing the land. To provide for greater protection of wildlife, North Carolina used what it learned from the PUP and established the WCLP, which uses the power of the property tax system to incentivize long-term conservation of key habitats. While North Carolina's experiments with incentivizing solar have been tremendously successful at spurring solar investment in the state, this Comment has explored how the program's openness has resulted in a significant cost to ecosystems because solar farms are being built on land ideal for wildlife conservation. Additionally, the solar tax exemption is likely missing easy opportunities to push citizens towards behaviors that contribute to the direct preservation of ecosystems.

North Carolina should make either of two changes to its solar property tax exemption that would likely significantly decrease the ecological cost of solar panels.

A. *Conditioning Solar Property Benefits on Habitat Cultivation and Conservation*

First, the property tax exclusion for solar installations could become a deferral program that is conditioned on maintaining certain ecological standards like the standards required in the WCLP. While solar farms are incompatible with most key ecosystems currently protected by the WCLP, that does not mean that they cannot play an important role in protecting species. As discussed above, solar farms can serve as excellent habitats for dozens of endangered pollinating insects by planting native grasses and wildflowers around the panels and within the fence line.[159] Since this habitat mainly supports flying insects like bees and butterflies, it is compatible with the tall fences required for solar farms. While there are organizations dedicated to encouraging solar farm owners to adopt such practices, this Comment's analysis of land classifications within solar farm fence lines suggests that currently very few (if any) solar farms are voluntarily making such efforts.

Like the WCLP, the statute could require that solar farms follow certain habitat management plans that detail what native plants will be introduced into

159. *See supra* note 156 and accompanying text.

the solar farm and how the ecosystem will be maintained. Like lands in the WCLP, solar farms would be subject to inspection every few years to ensure compliance with the management plan, and failure to conform would result in owing the taxes deferred for some number of previous years. The experience North Carolina agencies have had in enforcing the WCLP shows that this proposal is feasible. The following table provides statutory language to establish this tax program.

Table 2: Proposed Statute Incentivizing Habitat Conservation for Solar Farms

(a) Definitions.	The following definitions apply in this section: (1) Solar energy electric system: All equipment used directly and exclusively for the conversion of solar energy to electricity. (2) Utility-scale solar operation: A tract of land containing solar energy electric systems with a combined generating capacity above one megawatt. For purposes of this definition, a tract of land consists of any parcels of land that were under common ownership within five years prior to the installation of any solar energy electric systems. (3) Exempt solar utility: A utility-scale solar operation meeting the use requirements of this section.
(b) Classification.	Solar energy electric systems are designated a special class of property under Article V, Section 2(2) of the North Carolina Constitution and must be taxed as follows: (1) Eighty percent (80%) of the appraised value of a solar energy electric system shall be excluded from taxation. (2) Subsection (b)(1) shall not apply to any utility-scale solar operation unless it is an exempt solar utility.
(c) Use.	The land must be managed under a written wildlife habitat conservation agreement with the North Carolina Wildlife Resources Commission that is in

	effect as of January 1 of the year for which the benefit of this section is claimed and that requires the owner to create and conserve either of the following priority animal wildlife habitats: early successional habitat or native planting pollinator habitat.
(d) Deferred Taxes.	The difference between the taxes that are due on solar energy electric systems within an exempt solar utility classified under this section and that would be due if the land were taxed as a utility-scale solar operation is a lien on the property. The difference in taxes must be carried forward in the records of each taxing unit as deferred taxes. The deferred taxes for the preceding three fiscal years are due and payable in accordance with section 105-277.1F(b) of the General Statutes of North Carolina when the land loses its eligibility for deferral as a result of a disqualifying event. A disqualifying event occurs when a utility-scale solar operation no longer qualifies as an exempt solar utility.
(e) Administration.	An owner who applies for the classification allowed under this section must attach a copy of the owner's written wildlife habitat agreement required under subsection (c) of this section. An owner who fails to notify the county assessor when land classified under this section loses its eligibility for classification is subject to a penalty of ten percent (10%) of the total amount of the deferred taxes and interest thereon for each year for which the failure to report continues.

Subsection (a) of the proposed statute in Table 2 uses the existing definition for a "solar energy electric system" in the General Statutes of North Carolina.[160] Since this definition includes solar installations with very little ecological costs (for example, rooftop residential systems), the proposed statute also defines "utility-scale solar operations" to separate the solar installations that cause the bulk of the ecological harm from those that are nearly harmless. This definition follows the same criteria used in this Comment for the term "solar farm"[161] and would capture all the solar installations examined in Part II. Subsection (a) also defines all utility-scale solar operations that meet the

160. *See* N.C. GEN. STAT. § 105-275(45) (2024).

161. *See supra* note 10 and accompanying text.

proposed statute's use requirements as "exempt solar utility" to separate the utility-scale solar operations that comply with the stated ecological requirements from those that do not (providing the exemption to the former and precluding the latter).

Under subsection (b), the same eighty percent tax exclusion already in place would apply to all solar energy electric systems, unless they are utility-scale operations.[162] This ensures that smaller solar systems, like residential systems, need not do anything different to continue receiving the benefit of the exclusion. Utility-scale systems only receive the exclusion if they can show that they are an exempt solar utility because they meet the use requirements of subsection (c), which is modeled after the WCLP statute.[163] The utility would first have to work with the WRC to establish a wildlife habitat conservation agreement requiring the solar installations to be designed, developed, and maintained in a manner compatible with early successional habitat (like in the WCLP) or in a new native planting pollinator habitat. As discussed above, both habitats are critical for supporting priority animals, and both are compatible with solar installations.[164] Similar to management agreements under the WCLP, agreements under the proposed statute would require periodic inspection by the WRC to ensure compliance with the agreement.

Just like the PUP and WCLP,[165] subsection (d) designates this proposed program as a tax deferral program, such that if any exempt solar utility fails to meet the use requirements of this program, the taxes deferred by the exclusion for the past three years are due and payable according to the statute laying out the uniform provisions for payment of deferred taxes. Subsection (e) provides for the same interest penalty as the PUP and WCLP for a failure to notify the county assessor when an exempt solar utility no longer meets the use requirements of subsection (c).[166] Given the significant economic benefit the property tax exemption offers solar farm installations,[167] this proposed statute would give existing and newly constructed solar farms a clear economic reason to lessen their ecological impact in meaningful ways.

B. *Graduating Tax Benefits for Solar Farms Based on Prior Land Use*

Second, North Carolina could develop a graduated property tax exclusion that varies based on the ecological value of the location as determined by using existing land classifications. While the proposed statute above would encourage solar farms to be more compatible with wildlife, this proposal would discourage

162. *See* § 105-275(45).
163. *See id.* § 105-277.15(c3).
164. *See supra* note 156 and accompanying text.
165. *See* § 105-277.4(c); § 105-277.15(e).
166. *See* § 105-277.5; § 105-277.15(h).
167. *See supra* notes 37–47 and accompanying text.

solar farms from disrupting important ecosystems in the first place. As this Comment's analysis has shown, solar farms are being developed on land that is important for wildlife conservation. Only a handful of solar farms in North Carolina are built upon previously developed land. Given that environmental protection is the policy rationale for incentivizing solar panels, it is strange that a solar farm created by clear-cutting an old-growth forest would receive the same tax benefits as a solar farm created on an abandoned runway or parking lot. To remedy this oddity, the solar property tax incentive could be crafted to provide a full exemption for property built on developed land and a decreasing percentage of the exemption for solar farms built upon land with higher ecological potential.

A statute to accomplish this purpose could look similar to the proposed statute in Table 2, with the difference that this would not be a tax deferral program; rather, the extent of the exemption would depend on historic land use rather than meeting an existing use requirement. For example, an effective statute would provide that if a utility-scale solar farm was built on land enrolled in the WCLP within the last five years, it would not receive any tax exclusion. If the land was enrolled in the PUP within the last five years, it would receive an exclusion based on the ecological value of the specific land use. Thus, there would be a 20% exclusion for forestland, 40% for cropland, and 60% for horticulture land. Finally, if the solar farm was built on land that had been developed for the previous five years, then it would receive a 100% exclusion. For determining the historic land use, it would be important for the statute to look back multiple years to prevent potential abuse. If the statute only considered the land categorization immediately before the solar installation, it might create an incentive to develop the land shortly before construction of the solar farm. By requiring the land to have been developed for five years before the solar installation to receive the full exclusion, there would be no realistic incentive to develop.

Additionally, the policy goals of this statute—to encourage the construction of solar farms on developed land and discourage solar farms on land important for ecosystems—would potentially be reinforced by private investment. Since the extent of the exclusion is based on the ecological cost of the solar farm, simply knowing the extent of the exemption would provide private companies looking to meet ESG investment goals with an easy way to assess the ecological cost of any solar farm. And because the exact property tax exclusion would be essential to knowing the basic financials of the investment, it is likely that any company looking to invest in solar farms would know the exclusion a given farm is expected to receive. As such, this program would provide beneficial information to the private sector, enabling companies truly committed to furthering environmentalism with key information needed to invest ethically. If the amount of the exclusion thus became a signal for the

environmental impact of the solar farm, it is likely that when competing for investments, solar companies would strive to show that their solar farms do minimal ecological damage. Thus, this proposal could have a significant impact on shifting solar farm development away from ecologically important land.

CONCLUSION

North Carolina tax policies favoring solar farms are pushing citizens away from behaviors that contribute to the direct preservation of ecosystems. Solar farms are built on land ideal for wildlife conservation, and there is currently no requirement that they be constructed and maintained in a manner that would decrease their environmental costs. North Carolina could significantly decrease the ecological costs of solar panels by making the property tax exclusion for solar property conditional on maintaining ecological standards like the WCLP, or by creating a graduated property tax exclusion that varies based on the ecological value of the location as determined by existing land classifications. Either of these proposals would make it clear that if North Carolina has a carbon-free future, it should not come at the expense of the ecosystems it is trying to protect.

NATHANIEL SWIGART[**]

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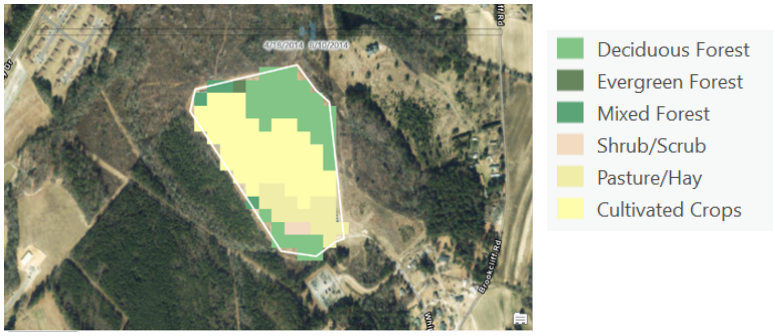
APPENDIX A. SIMPLIFIED RESEARCH STEPS EXAMPLE

1. Locate Solar Farm (this is a twenty-five-acre solar farm in Lee County).

2. Create a shapefile by tracing the fence line of the solar farm to create a footprint.

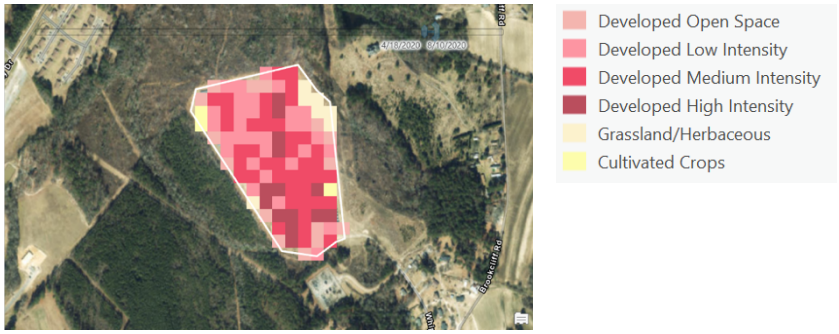
3. Use the footprint to extract land use data from the National Land Cover Dataset.

i. 2014 (a few years pre-installation)



ii. 2017 (shortly before installation)

iii. 2020 (post-installation)



4. Export data.

Year	Land Surface Type	Acres
2014	Deciduous Forest	8.22
2014	Evergreen Forest	0.22
2014	Mixed Forest	0.89
2014	Shrub/Scrub	0.44
2014	Pasture/Hay	3.56
2014	Cultivated Crops	11.56
2017	Grassland/Herbaceous	9.78
2017	Pasture/Hay	3.56
2017	Cultivated Crops	11.56
2020	Developed Open Space	3.33
2020	Developed Low Intensity	6.89
2020	Developed Medium Intensity	9.36
2020	Developed High Intensity	3.11
2020	Grassland/Herbaceous	1.55
2020	Cultivated Crops	0.66