

Article

Competition for Land: Equity and Renewable Energy in Farmlands

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Abstract: The development of renewable energy in agricultural landscapes has led to new debates about siting solar, wind, and other energy projects. Concerns for protecting food production and prime agricultural soils are often leading points of resistance to renewable energy projects. This resistance has grown, even as the urgency of transitioning away from fossil fuels has increased. The economic stakes are high, particularly for farmers seeking to diversify and stabilize farm income with renewables, but few studies have examined the likely magnitude of effects, either on food production or on farm incomes, implied by expanding renewables. How extensively are hosting communities likely to be impacted, and what do farmers stand to gain, or lose, in these debates? Focusing on a portion of New York State (NYS), with its aggressive solar development goals, we evaluated the effects of state solar targets on farmland and the economic potential for farmers leasing land. In comparison to current income from leading crops, land leasing alone would imply an increase of \$42 million per year in local revenue, while affecting less than 12 percent of non-food producing, non-prime soils within the study area. The areal impacts are larger in our imaginations than in the real landscapes, and the debate has far-reaching implications for policy beyond farming areas.

Keywords: agricultural landscapes; energy privilege; farm income; renewable energy; solar energy



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1. Introduction

Widespread development of renewable energy production, such as solar or wind power, is essential for reducing dependence on fossil fuels and for reducing the rate of climate warming [1]. This development represents a fundamental reorganization of the ways wealthier regions source their energy. For roughly a century, most of the United States, for example, has acquired fuel for heating, transportation, and electric power production from remote oil-, gas-, or coal-producing regions. Energy-producing regions, for example in Louisiana, Texas, West Virginia, and Pennsylvania, gain significant wealth but also absorb substantial environmental and social costs [2]. Energy consumers in other regions, for example in New York State, which produces little of its own fuel, have thus been able to externalize the environmental and social costs of their oil, gas, and coal consumption [3]. Among these externalized costs are those of carbon emissions, which include global incidence of drought, storms, land loss, and other impacts [4].

Implementation of renewables provides an opportunity to reduce these externalized environmental and social costs. In New York State (NYS), for example, the 2019 Climate Leadership and Community Protection Act (CLCPA) [5], calls for 10 GW of distributed solar capacity by 2030, among other targets, and aims for a zero-carbon electricity system by 2040. Justifications for these goals, in addition to climate benefits, include improved environmental health for communities near fossil-fuel combustion plants and economic opportunity, in the form of lowered energy costs or even income from renewables, for communities with persistent economic disadvantages.

Photovoltaic (PV) solar power plants, the focus of the present study, cause minimal environmental and social harms compared to fossil fuel extraction, processing, and combustion. However, solar plants are widely distributed across the landscape, often in communities that have not traditionally identified as energy producers. These communities can include exurban or agricultural areas with open, level land [6]. The cumulative footprint of solar PV installations can be expansive: A general estimate is that each megawatt of installed solar capacity occupies roughly 2 ha (5 ac) of land [7,8], and the expansion of these projects has met widespread resistance [9,10], including opposition to specific projects and changes to zoning laws that restrict or effectively block solar development, e.g., [10] (pp. 126, 129, 130).

Partly as a result of local opposition, it is unclear whether NYS can meet its CLCPA climate goals. As of March 2024, some 78 percent of large-scale solar permit applications reported by the NYS Energy Research and Development Authority (NYSERDA) had been cancelled [11]. There are many reasons for cancellation, including rising interest rates and changing project costs and financing, and local resistance is not ubiquitous. It is clear, however, that the rate of implementation remains modest for CLCPA ambitions, and that local resistance is a factor.

1.1. Farmland Protection and Rural Economies

Two themes are commonly emphasized in legal [12,13] and zoning restrictions on solar, e.g., [10] (p. 125), [14,15]: One is protection of agricultural lands [16–18], whose open, largely level terrain is well suited to solar projects. Another is food production [16,19,20], which is seen to be at risk from expansive solar installations, especially in regions identified as food-producing landscapes. While some studies have quantified the total amount of land needed for solar [6], few studies have calculated the actual magnitudes of solar policy impacts on farmland soils and food production, that is, how severe the threat is to food and to farming.

The cumulative economic impact of solar development for farmers, similarly, has received little systematic attention. While there is increasingly broad agreement that solar projects can provide important income for landowners, [12,13,17,19], few studies have quantified the cumulative impact of solar buildout on farm incomes.

In this study, we examine these two related issues regarding the costs and benefits of an aggressive solar policy: Taking NYS as a representative of the many regions with ongoing debates about renewable energy development, we asked first, what is the magnitude of the threat that a solar buildout poses to food and prime farmland, in terms of the extent of land available and the land needed for solar? Second, we asked, what is the potential value of this buildout, compared to current farm income sources, for rural economies?

We take NYS as a representative case, but we note that a growing number of regions globally are implementing ambitious renewable energy targets and facing increased debates about how to site those resources [21–23].

1.2. Resistance and Equity

While legal challenges often rest on food and soil protection, resistance involves a variety of additional themes, particularly in terms of attitudes toward renewables. Opponents of solar projects have cited, for example, the importance of protecting the iconic agricultural landscapes in rural farming communities [12,13,18]. (It is worth noting that other forms of development, such as residential or commercial activities, often do not face these challenges, or they are protected by zoning codes favoring dispersed residential development.) Some disputes involve popular fictions, such as electromagnetic field emissions from solar panels, e.g., [10] (pp. 82, 193), [14]. Other resistance involves concerns about ensuring community review and control of new projects, as with other novel land uses [9,22].

A number of studies have explored factors behind this resistance. Some resistance has been attributed to community members who have moved to a farming community for its bucolic setting and whose employment is in nearby cities, or who have second homes in the

community where solar projects have been proposed [13,21]. Some studies have observed that it is often a minority of residents who pose objections [22], but when a small group is well organized, it can succeed in derailing projects [22,24,25]. In some cases, outside funding sources have been found to motivate opposition [26]. Real estate values are another concern, although empirical studies have found this impact is negligible in general [27,28].

An important question regarding interests and equity in renewables is that of rural income inequality [19]. Many rural communities face persistent economic stresses, and farming in the US is often a precarious business, with high expenses and thin profit margins. The United States Department of Agriculture reports, for example, that NYS lost 4887 farms, 14 percent of the total number, between 2012 and 2022 [29]. The income from leasing some farmland for renewables can offer a lifeline for farming operations [16,19,30,31].

In a study of attitudes toward renewables, Stokes et al. (2023) [24] found that opposition to wind projects in the US and Canada tended to occur in communities with a larger white population, lower populations of color, lower residential density, and (in Canada) higher median income compared to communities that did not oppose projects. They found only slight differences in opposition along liberal/conservative political lines. Cranmer et al. [32] similarly found that both coal and solar plants in the US tended to be located in communities of color, with lower income. Stokes et al. used the term “energy privilege” to describe patterns of renewables rejection, in which legal challenges and changes to zoning laws were used to exclude renewable development in communities of higher socioeconomic status. These practices thus force other communities, often lower-income ones, to bear the burdens of energy production. They also reduce potential income for community members whose income rests on farming. Stokes et al. further observed that rates of opposition to renewables have increased over time, raising concerns for larger climate action (and environmental justice) targets.

2. Materials and Methods

To evaluate the impact of solar expansion on food production and on prime farmland soils, we calculated the extent of non-food producing, non-prime farmland soils that occurred in proximity to existing transmission lines for an area in upstate New York State. We then compared that extent to the acreage needed to meet CLCPA solar targets for 2030 (10 GW of installed solar). To assess the economic impact of those CLCPA solar targets, we calculated the difference between the economic potential of crops and of renewables; for context, we also evaluated current agricultural income using data from the US Department of Agriculture and the US Census American Community Survey.

2.1. Grid Proximity

In this assessment, we restricted analysis to lands in proximity to powerlines that reported available hosting capacity (ability to accept input electricity) at the time of analysis. Hosting capacity is an increasing concern in siting renewable energy resources. Hosting capacity is a fluid measure, dependent on constantly changing system parameters, power loads, grid management, and other considerations [33]. Thus, the National Renewable Energy Lab (NREL) notes that hosting capacity does not represent a hard limit on the amount of power that can be added to the distribution system [34]. However, a snapshot of hosting capacity can provide some approximation of grid capacity, which represents less than the total grid extent.

Electric utilities publish hosting capacity data in different formats; among these operators, New York State Electric and Gas (NYSEG) provides more consistent hosting capacity data in usable formats, compared the other major system operators in the state [35]. We therefore restricted our study area to the NYSEG service territory (Figure 1).

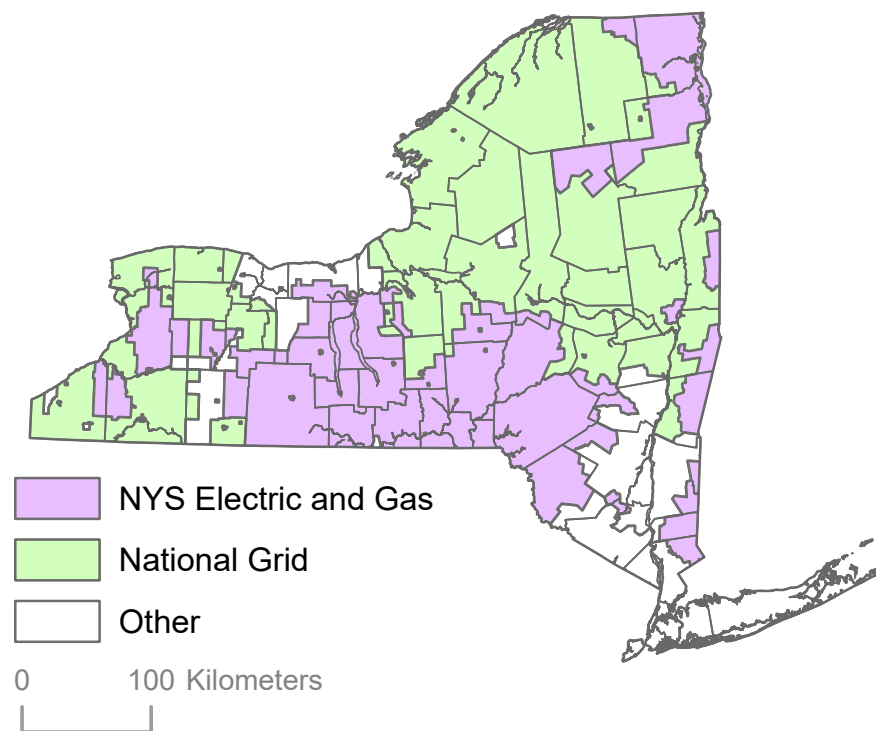


Figure 1. New York State, with area analyzed, the NYS Electric and Gas (NYSEG) utility service territory, shown in purple.

Within the study area, we delineated a buffer of 1.6 km (1 mile) around all NYSEG transmission lines whose hosting capacity was greater than 0. This distance was equal to or less than the distances used in other studies (see Katkar et al. [6], Table 4). We separately evaluated the powerlines with low (>0 and <0.3 MW) capacity, medium (0.3–1.0 MW) capacity, or high (1–26 MW) capacity. All spatial analysis was carried out in ArcGIS Pro v. 3.2.2 [36]. Output buffer polygons overlapped at powerline intersections, and hosting capacity often differed at these intersections. We used the update function to flatten overlapping buffers, retaining the higher hosting capacity values where differences occurred.

2.2. Soil Classes

Within the 1.6-km buffer distance around transmission lines, we evaluated the extent of soil classes and agricultural land uses. For soil classifications, we used Soil Survey Geography (SSURGO) polygon data from the USDA Natural Resources Conservation Service (NRCS). The SSURGO soils classes consisted of Prime, Not Prime, and Prime If Drained. We used the pairwise intersect function to calculate the extent of each farmland soil class within the 1.6-km buffers [37].

2.3. Land Use Classes

For the intersected buffer and soils polygons, we then tabulated the area of crops and non-crop land uses, using the USDA Cropland Data Layer (CDL) for 2021 [38]. This dataset provides 30-m resolution raster classes for crops and other land use classes, including developed, forest, water, and wetlands. As a layer interpreted from remotely sensed data, the CDL is suitable for moderate-scale and regional analysis. Forested areas and water/wetland areas were excluded from analysis.

Because protection of food crops is a central theme in debates over renewables siting [10], we followed the approach of Brown et. al. (2014) [39] and reclassified CDL classes to differentiate food crops, those directly consumed by people, in contrast to non-food crops, including those used for ethanol, other industrial products, or livestock feed. Food crops included fruits, vegetables, orchard fruits, and edible grains. We classified corn (*Zea*

mays) and soybeans (*Glycine max*) as “non-food”, because they are predominantly used for fuel, feed, or industrial products: of the US corn crop, 88 percent is used for ethanol (primarily for transportation) and livestock feed; the remaining 12 percent is used for “other food, seed, and industrial use” [40]. Grass and hay crops were also classified as non-food. Also retained in reclassification, for comparison of extent, were “developed” land uses (urban and partially developed urban).

The tabulated output, representing a 1.6-km buffer around powerlines, and including variables for hosting capacity, soil class, and food/non-food production, was re-joined to SSURGO polygon data for mapping as well as exported for analysis.

2.4. Agricultural Income

To assess the economic value of solar production for farming communities, we compared the value per hectare of solar and of two regionally dominant crops, field corn and soybeans. These two commodity crops make up nearly all non-food, non-hay cropland in NYS and are among the highest value crops in the state [38,41]. To provide context for agricultural earnings, we acquired data from the US Census Bureau American Community Survey (ACS), income by earnings (table B24031) for NYS subdivisions within the study area [42] and NYS median income [43], as well as farm income data from the USDA Census of Agriculture [29].

Income and production data for corn and soybeans, for northeastern states, were acquired from the US Department of Agriculture (USDA) Economic Research Services (ERS) [44]. The ERS reports net operating costs as income per acre minus operating costs (seed, fertilizer, chemicals, etc.) and allocated overhead (labor, machine capital, etc.) per acre. Income and cost calculations excluded government payments (commodity supports, crop insurance, and other subsidies).

2.5. Rent Rates

Renting farmland is a common practice for siting solar projects. Rent rates paid to landowners are generally confidential, and rates vary widely, but in Ohio, Pham and Bone (2023) [45] found an average rent rate of \$1338 per acre (\$3306/ha). A similar study by the Penn State Center for Economic and Community Development [46], using data earlier than 2020, estimated an average rent rate of \$700 to \$1000 per acre in Pennsylvania, with higher rent rates expected near transmission lines. For New York State, a commercial solar land leasing website [47] estimates rent rates in NYS between \$1000 and \$1500 per acre. For the present analysis, we used a rent rate of \$1000 per acre, or \$2470 per hectare, to represent a rent rate for areas near power transmission lines.

When figuring the amount of land needed for 1 MW of solar capacity, we assumed a widely used figure of 2 ha/MW (5 ac/MW). Actual area varies, with recent assessments finding values lower than this [7,8], so we consider 2 ha/MW a reasonable figure.

3. Results

3.1. Area of Land Uses

The area of the buffers around NYSEG powerlines with available hosting capacity was 12.4 million ha. Of this area, 67 percent was forested, 9 percent was wetlands or water, 11 percent was developed, 12 percent was in non-food agriculture, and 1 percent was in food production. Of the 2.7 million ha that was not wooded or wetlands, 51 percent of soils were not prime, 29 percent were prime soils, and 20 percent were prime if drained (Figure 2).

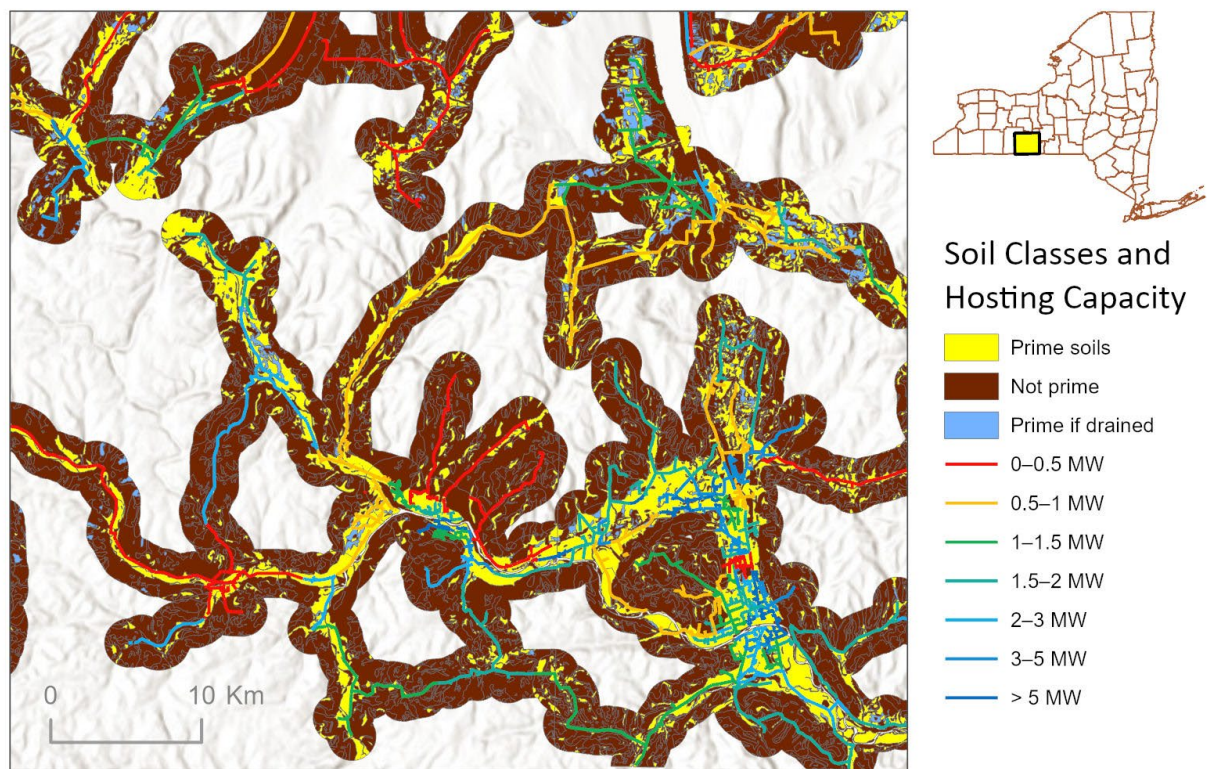


Figure 2. Example of study area extent and variables: Soils (classified by prime soil classes) and agricultural land uses were clipped by buffers of power lines, which retained attributes of available hosting capacity. The location of the example area is indicated by the yellow rectangle in the state index map. Data are summarized in Figure 3.

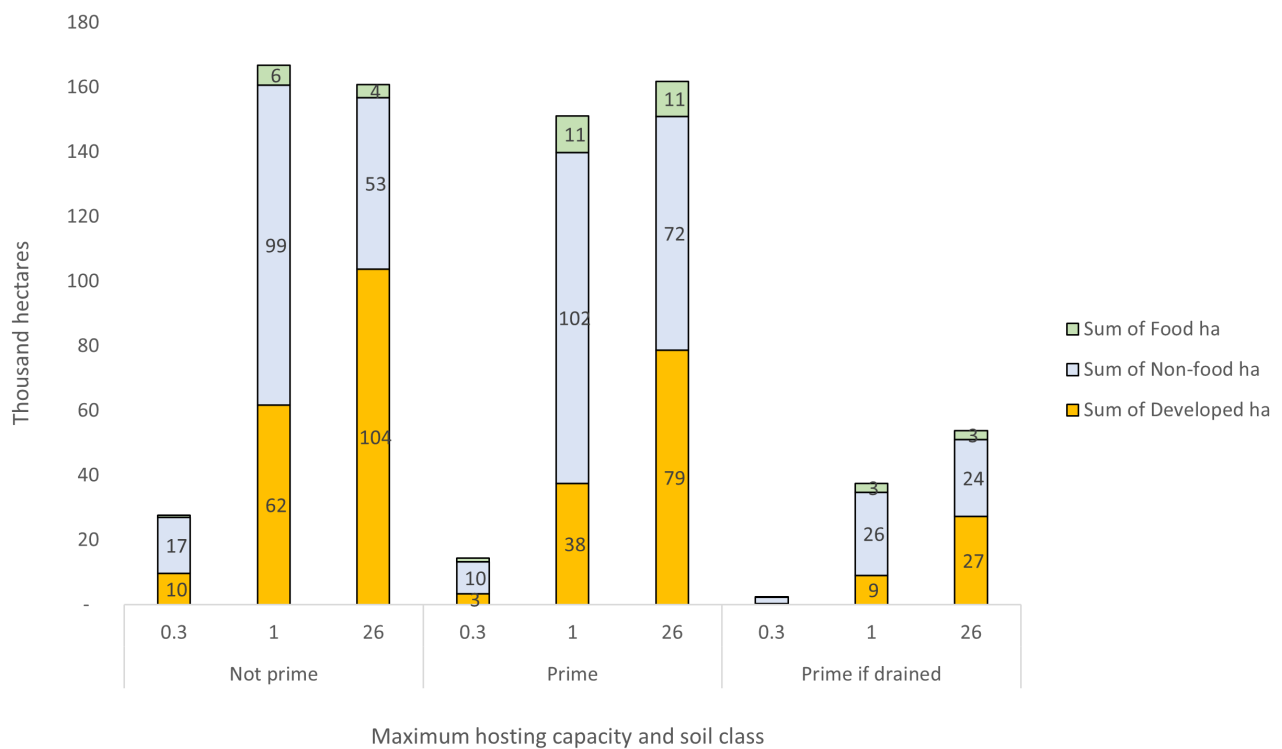


Figure 3. Number of hectares in soil categories (not prime, prime, and prime if drained) and land use (food, non-food, and developed), quantified by hosting capacity (0–0.3 MW, 0.3–1 MW, 1–26 MW) of powerlines within 1.6 km of a soil polygon. Forested areas were excluded from analysis.

Within the 1.6-km powerline buffers, and within the not-prime soil polygons, a majority of land was in developed classes, followed by non-food (Figure 3, left three bars). Food production on all soil types (green segments of bars) was dramatically lower than non-food agricultural production (blue segments). More non-prime soils were in developed land use classes, that is, urban, low-density urban, or industrial (yellow segments). Prime soils had predominantly non-food agricultural production, followed by developed land uses (center three bars). A minority of the area analyzed was in “prime if drained” soil classes, but the landcover distribution within those soil types was similar to that of the other soil types.

Roughly half of the area analyzed was proximate to powerlines with 1–26 MW of available hosting capacity (rightmost bar for each soil type). The extent of area near lowest hosting capacity (0–0.3 MW) was small for all three soil types.

The land use classes that should have the least competition for food production should be areas with non-prime soils and non-food production. The amount of area in non-prime soils and non-food production was 169,345 ha (418,000 ac), slightly less than the 175,000 ha of developed land (433,000 ac, Table 1). This area was 21.8 percent of the total area analyzed.

Table 1. Hectares of land (and percentage of total) by agricultural category and soil class. The area designated as non-food crops in not-prime soil classes is shown in bold text.

Agricultural Category	Not Prime	Prime	Prime if Drained	Sum
Food Crops	10,928 (1.4)	23,219 (3.0)	5691 (0.7)	39,838 (5.1)
Non-food	169,345 (21.8)	184,491 (23.8)	51,258 (6.6)	405,095 (52.2)
Developed	175,060 (22.6)	119,510 (15.4)	36,732 (4.7)	331,302 (42.7)
Sum	355,333 (45.8)	327,220 (42.2)	93,681 (12.1)	776,291 (100)

Assuming that solar PV occupies approximately 2 ha/MW [7,8], the state’s CLCPA goal of 10 GW installed solar (10,000 MW) should occupy about 20,000 ha. This amount represents 11.8 percent of the 169,345 ha of non-food, non-prime area within the buffered area around the subset of powerlines analyzed.

3.2. Solar Extent and Farm Incomes

Farm income is relatively low in NYS (Figure 4). The US Census Bureau ranks agriculture and forestry among the lowest industries by earnings, with median earnings in 2022 of \$32,831 ($\pm$ \$1564), using 1-year estimates for NYS from the American Community Survey. (This dataset did not differentiate classes of work for any of the industries reported.) This income level was 63 percent of the median for all employment classes (\$51,533).

The USDA National Agricultural Statistics service reported, in the 2022 Census of Agriculture, that NYS had 30,650 farms, down from 35,537 a decade earlier (Table 2). Of these farms, in 2022, 40 percent reported net gains, 60 percent reported net losses, and 16 percent reported net income of \$50,000 or greater. For comparison, the ACS-reported median NYS household income in 2022 was \$79,557.

This low income reflects modest net income from crop production, as reported by the USDA Economic Research Service (Table 3). On average, farmers earned \$2673/ha for corn production in 2022, of which \$2283 (85%) was used for operating expenses and overhead costs. For soybean production, farmers earned \$1800/ha, minus production and overhead costs of \$1497 (83%). The net return was \$390/ha for corn and \$304/ha for soybeans.

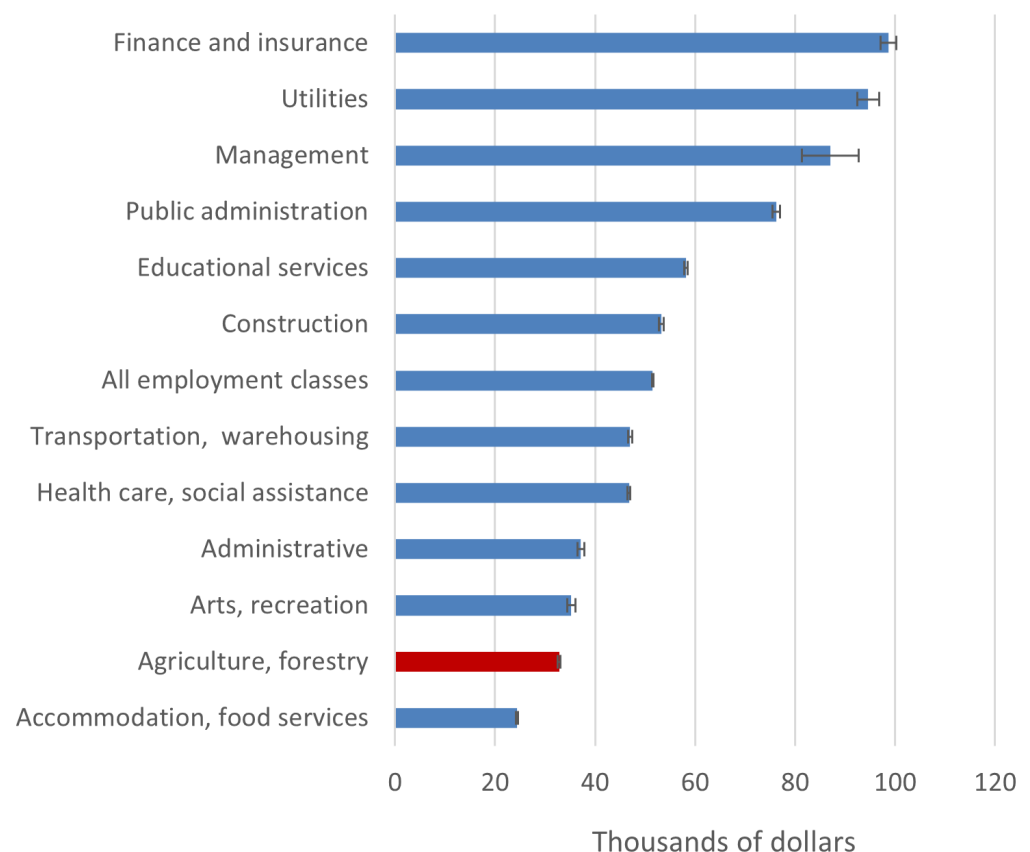


Figure 4. Median earnings by industry, 2017–2022 5-year estimates, for New York State, with median agriculture and forestry income highlighted in red. Error bars show reported margins of error for estimated means. Source: American Community Survey, 2024.

Table 2. Number of farms and income ranges. Source: USDA Census of Agriculture, 2022, 2017.

Number of Farms	2022	2017	2012
Number of farms in NYS (number)	30,650	33,438	35,537
Farms with net gains (number) (percent)	12,353 (40)	14,973 (45)	15,693 (44)
Farms with net losses (number) (percent)	18,297 (60)	18,465 (55)	19,844 (56)
Farms with income $\geq$ \$50,000 (percent)	4986 (16)	5547 (17)	5623 (16)

Potential income per hectare for solar, assuming \$2470/ha (\$1000/ac), would exceed corn income by around \$2080/ha (Table 3 row 5). Potential income for solar, at the same rate, would exceed soybean income by around \$2166/ha.

For a utility-scale, 5-MW solar PV system, assuming an average area of 2 ha/MW (~5 acres/MW) or 10 ha total, one could expect land lease income of over \$20,000 per year for solar (Table 3, row 6).

As noted earlier, achieving CLCPA solar goals of 10 GW, should require just over 20,000 ha. The income difference for converting 20,243 ha of corn or soybeans to solar, using the assumptions here, would be over \$42 million per year. This would represent funds reinvested into farm communities, rather than exported out of state.

Table 3. Income and costs per hectare for corn and soybeans, compared to an assumed average rent income (\$2470/ha, or \$1000/ac) for solar land leases. An area of 10 ha (row 6) is assumed to approximate a solar installation of 5 MW.

Measure	Corn	Soybeans
Gross value	\$2673	\$1800
Production costs	\$2283	\$1497
Net crop income/ha	\$390	\$304
Solar rent (per ha *)	\$2470	\$2470
Difference (solar–crop, per ha **)	\$2080	\$2166
Difference (solar–crop, per 10 ha)	\$20,797	\$21,662
CLCPA goal, ha	20,243	20,243
Difference, \$ million ***	\$42.10	\$43.85

* Assumed solar rent rate, based on available information (see text). Actual rent rates vary dramatically according to land conditions, situation, and local markets. ** Difference = solar rent–net crop income (2022). Source: USDA NASS. *** Difference in income for 20,243 ha of solar, assumed to be the amount needed to meet NYS CLCPA goals.

4. Discussion

The cumulative amount of territory needed for solar development has garnered substantial public debate, but that territory is relatively modest in terms of overall state land use. CLCPA goals could be met with a small proportion of non-food producing, non-prime soils. The NYS CLCPA aims for 10 GW of distributed solar, or roughly 20,000 ha (50,000 ac), which represents just 12 percent of current non-prime, non-food cropland that occurs within 1.6 km of NYSEG powerlines with hosting capacity and within the portion of the state evaluated here. Compared to statewide farmland, the 20,000 ha needed for solar represents just 8 percent of NYS corn acreage or 14 percent of soybean acreage. This low proportion suggests that aggressive buildout of solar is unlikely to dramatically reduce feed supplies for NYS dairies and livestock producers.

The extent of actual grid connection capacity is a larger question than this paper can address, but the low amount of lands needed suggests that there is abundant statewide capacity for solar development. Sward et al. (2019) [48] similarly found that NYS has abundant land, proximate to electric substations, to meet state solar targets.

Given the moderate footprint of state solar goals, it follows that worries about the impact of a solar buildout on farmland are misplaced. The effects on food supplies will be vanishingly small. Effects on prime farmlands will be dramatically smaller than conventional forms of development. (In our study area, nearly half of prime farmland soils had been converted to developed uses such as exurban residential subdivisions, commercial uses, and transportation infrastructure).

At the same time, solar developers could accelerate progress by avoiding “energy privileged” areas of the state—those that are whiter and wealthier, for example—and focusing on communities that are more eager to garner the economic benefits of solar energy production [12].

4.1. Rural Economies and Their Implications

There are clear economic incentives for farmers to supplement income with renewable energy. The economic value of renewables is increasingly well recognized by landowners, and in a time of continued farm foreclosures, the additional revenue stream is widely understood to be important for farming families and for rural communities [16,19,30].

The solar costing approach used here assumes that landowners are renting acreage to solar developers. Revenue could be greater if landowners had more ownership stake in the solar project, rather than simply renting land to a third party that owns the solar plant. Our

relative revenue estimates may also be conservative, as they rest on commodity prices in 2022, when global crop prices were unusually high, due to the war in Ukraine.

This study does not address the challenge of land access for farm operators who rent land in order to expand their production. In an agricultural system with very thin profit margins (see Table 3), it can be necessary for farmers to cultivate vast areas to make a living. On the other hand, farmers who lack sufficient acreage to make a living on conventional crops could gain financial stability by putting some land in solar (or wind), if local zoning laws do not disallow these land uses. That new income stream could reduce the necessity of renting land to extend production.

Economic stability has political implications. Chronic economic stress [41–43] has long contributed to populist or reactionary political trends: Caudill (1962) [49], for example, discussed the persistent relationship between economic insecurity and authoritarian politics. Farmer resistance has emerged as an important obstacle to environmental and climate policy [50,51], in part because rural communities have few economic options. Alternative economic opportunities can, by implication, lead to broader support for climate policy.

4.2. *Natural Landscapes of Agricultural Production?*

Arguments against converting agricultural land to renewables often rest on the assumption that agricultural production is environmentally positive. Corn and soybean production, however, are associated with a variety of environmental issues, such as biodiversity loss, soil erosion, herbicide and pesticide applications, water contamination, and fuel consumption in crop production and processing [52]. The ontological interpretation of a landscape of commodity agriculture is therefore in the eye of the beholder. To an ecologist, these areas are ecological deserts; to Indigenous communities, they represent settler colonialism. To critics of corn ethanol production, they represent disproportionate impacts on water and energy consumption [51–55], making them green in color but not in impacts.

It is also important to recognize that corn- and soy-producing landscapes are already energy landscapes. These crops dominate much of our study area, and the USDA reports that nearly all of US corn and soybeans are used for fuel, industrial fluids, or industrial-scale livestock feed [38]. The carbon intensity of ethanol has been estimated as 24 percent greater than that of gasoline [52], and statistician Hannah Ritchie has argued that the US could power its electric vehicles with solar on a fraction of the land currently used for ethanol fuel [53].

4.3. *Visual Landscapes*

This study does not evaluate the question of visual landscapes, in part because aesthetics are a judgement of the beholder, and in part because perspectives can shift over space and time and with individual viewpoints and priorities [18,54]. A great many studies have explored responses to visual impacts of renewables, e.g., [9,18,56], in some cases arguing that some cultures have higher regard for their landscapes than others do [18]. Attitudes toward renewables, and resistance to their presence, can also depend on the scale and structure of the rewards a local community receives: Where communities perceive that outside entities control development and retain revenue, they are more likely to object to the presence of renewables in the landscape; where communities gain revenue from renewables, objections are uncommon [21,22].

One empirical approach to understanding the value that people attach to visual landscapes has been to assess real estate pricing. In a comparison of home values with proximity to wind turbines, which are more visible than solar fields, Brunner et al. (2024) [28] found that property prices near wind farms fell after project announcement but recovered after a project was completed, implying that the idea of wind farms was perceived more negatively than the fact of their presence in the landscape. Guo et al. (2023) [27] similarly found a 1 percent decline in home prices near turbines, but that this difference dissipated over time.

It is worth noting that preserving agricultural landscapes also requires the persistence of working farms. Where farm incomes are unstable, farmland is a greater risk of conversion to other forms of development.

Concerns from host communities are important to acknowledge and address. Renewable energy sources have expanded rapidly in many areas, and it is not unreasonable that communities want their concerns recognized in the development process. Local planning and zoning boards can also require some time to adapt policies to land use changes. In some cases, renewable energy development companies are learning to anticipate community concerns, and to incorporate community benefits [21,22], possibly reducing the rate of opposition in some areas [23,24].

4.4. *Energy Privilege: Thinking Locally and Acting Globally*

The concept of energy privilege is helpful in articulating a relationship between energy producing regions and energy consuming regions, both under historical energy regimes [24] and increasingly in renewable energy debates [10,12,13]. Historically, this relationship has involved fossil fuel production, with producing regions bearing the burdens of extraction and processing. For fossil fuels, with highly capitalized, multinational control of resources that are toxic and carcinogenic, these burdens have been generational and devastating. Watts (2004) [57], for instance, documented the global impacts of corruption resulting from oil industry control of the Niger Delta. He showed the direct links between petrostate colonialism and authoritarian governments, poverty, and chronic political instability, which produce volatile breeding grounds of militants and of armed conflict. Bullard and others [2,3,58] have shown that systemic racism often underlies extractive energy systems in a fossil fuel regime. The extractive costs of fossil fuel extraction, engineered by wealthy urban interests, run deep, as discussed by Caudill [49].

A transition to renewables offers an opportunity to ameliorate this relationship, as energy-consuming regions use fewer fossil fuels and more renewable power. Renewables, with environmental and social costs far lower than those of fossil energy, also present an opportunity to understand energy production as a net benefit to host communities. In this case, the justice aspects of energy production can imply opportunities, rather than burdens. The opportunity to produce and to sell clean power, especially when ownership of power production is locally controlled or distributed widely, can be transformative. Restrictions on renewables, such as solar moratoria or bans on commercial production [10], on the other hand, serve to perpetuate economic and environmental inequities, both locally and abroad.

This aspect of energy privilege, as discussed by Stokes et al. [24] is an important concern. The right to reject renewable projects has been defended by community members (often vocal minorities [20,21]) resistant to wind and solar projects. Laws precluding the sale (e.g., production greater than consumed onsite) or production (e.g., through strongly restrictive zoning codes) of local energy serve to embed privilege in county and local statutes [10]. While impacts on visual landscapes are important, renewables have lower environmental, health, and social impacts than do the processes of fossil energy production, even excluding the overarching issue of climate change [2–4].

A reorganization of energy production systems clearly poses a fundamental challenge to communities that have not historically taken responsibility for energy production. Giving up energy privilege is deeply challenging. However, a reorganization of the relationships of production represents a step toward environmental justice. Embedded in CLCPA plans are strategies to improve equity and representation for all New Yorkers [5]. This implies some redistribution of how we allocate space, as well as other resources, among communities. How to negotiate this redistribution is a matter of rights, justice, and equity that energy scholars and landscape scholars should engage going forward.

4.5. *Gaps and Uncertainties*

We finally note several general gaps in this study. Most obviously, data regarding powerline hosting capacity in NYS was limited, and the actual proportion of land needed

to support a solar buildout would be far smaller than the proportion of the area assessed here. Hosting capacity is also a changeable quantity, especially with rapidly evolving grid management systems, so capacity estimates are both uncertain and subject to change. Detailed land and crop price values (and their variation) was similarly unavailable, which necessitated assumptions about income and costs. Despite these shortcomings, assessments like this one are useful for interrogating widely invoked concerns about protecting food and farmland, and widely disregarded attention to stability of farm economies. In this generalized model, the assumptions noted allowed us to provide a preliminary estimate of the economic balance. Further studies informed by “insider” data from the solar industry would provide stronger conclusions.

5. Conclusions

The transition to renewable energy and the elimination of carbon emissions face many challenges. Among these challenges, siting of new renewables has become an increasingly contested matter, as communities unaccustomed to hosting energy infrastructure consider widely distributed solar, wind, or other systems. While there are important concerns in host communities, debates can also be evaluated in terms of energy privilege, a relationship in which energy consumers resist energy production in their landscapes and their communities. This resistance is widely framed in terms of protecting food production and the prime farmland soils that produce food.

Our assessment indicates that there is far more available non-food producing, non-prime farmlands than is needed to meet NYS goals for solar energy development. These non-food, non-prime lands, near to a subset of the state’s powerlines with available hosting capacity, represent nearly 22 percent of lands analyzed (over 169,000 ha). A complete solar buildout would occupy about 20,000 ha, or 11.8 percent of the non-food producing, non-prime soils just within the area analyzed here. We conclude that concerns about threats to food production and to prime farmland soils are misplaced.

Resistance to renewables also disregards the real economic needs of farmers and farming communities, for whom income from distributed solar projects could be a lifeline. The economic value of solar to the state’s farmers would be substantial. While the dominant crop, corn, produces a net income of around \$390 per hectare per year, we estimate that solar rent should exceed \$2000 per hectare per year. The net difference statewide, from meeting solar targets, would be over \$40 million per year greater, compared to corn production. These funds would accrue to community members, rather than leaving the community, as payments for fossil fuels currently do.

Resistance to siting renewables in energy-privileged areas precludes an opportunity to mitigate long-standing injustices embedded in current energy production systems. This includes an opportunity to address economic insecurity for farmers, as well as more global impacts.

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