# The Land Use and Land Value Impacts of Solar Developments

**Wendong Zhang**

Assistant Professor, Dyson School of Applied Economics and Management, Cornell University;

wendongz@cornell.edu

(607) 254-3231

https://wendongzhang.weebly.com/

CCE Agriculture, Food & Environmental Systems In-Service, November 8, 2023

Dyson
Cornell
SC Johnson College of Business

# Research & Extension Program Themes

- **Theme I: Agriculture & the Environment**
- **Theme II: Land Value, Land Ownership, Land Tenure, Land Use**
- **Theme III: Chinese Agriculture & its Global Trade Implications**
- Other Useful information:

  Appointment: 50% Research & 50% Extension

  Joined Cornell Dyson School & CCE in July 2022

  Faculty Affiliate, Cornell Institute for China Economic Research (CICER)

  Faculty Fellow, Cornell Atkinson Center for a Sustainable Future

  Assistant and Associate Professor at Iowa State 2015-2022

  Led Iowa land value survey; co-founded the ISU China Ag Center

**https://wendongzhang.weebly.com/**

# Recent Publications

Land 41. Lu, Qinan, Nieyan Cheng, **Wendong Zhang**, and Pengfei Liu. 2023. **Disamenity or Premium: Do Electricity Transmission Lines Affect Farmland Values and Housing Prices Differently?** **Forthcoming** at ***Journal of Housing Economics*** **(Corresponding Author)**

L 40. Mykel R. Taylor, **Wendong Zhang**, and Festus Attah. 2023. "**Foreign Interests in U.S. Agricultural Lands: The Missing Conversations about Leasing**." Forthcoming at **Choices**

C 39. Xiong, Tao, **Wendong Zhang**, and Fangxiao Zhao. 2023. "**When China Strikes: Quantifying Australian Companies' Stock Price Responses to China's Trade Restrictions**", **forthcoming** at ***Australian Journal of Agricultural and Resource Economics (Corresponding Author)*** (**published version**)

C 38. Li, Minghao, and Xi He, **Wendong Zhang**, Lulu Rodriguez, James M Gbeda, Shuyang Qu. 2023. **Farmers' Reactions to the US-China Trade War: Perceptions Versus Behaviors**. **Forthcoming** at ***Journal of AAEA (Corresponding Author) (published version)***

L 37. Lee, Jun Yeong, Grant Durbahn, Peter F. Orazem, and **Wendong Zhang**. 2023. "**The Roles of Risk Preferences, Selection, and Uncertain Returns on Land Contracts**", **Forthcoming** at ***Agricultural Economics (published version)***

E 36. Howard, Gregory, **Wendong Zhang**, Adriana Valcu-Lisman, and Philip Gassman. 2023. **Evaluating the Tradeoff between Cost-Effectiveness and Participation in Agricultural Conservation Programs**, **Forthcoming** at ***American Journal of Agricultural Economics (Corresponding Author) (published version)***

L 35. Maule, Beatrice, **Wendong Zhang**, and Qing Liu, 2023. **Of Women and Land: How Gender Affects Successions and Transfers of Iowa Farms**. **Forthcoming** at ***Applied Economic Policy and Perspectives (Corresponding Author)*** (Winner of the 2021 AAEA Undergraduate Paper Competition)

E 29 Mei, Yingdan, Li Gao, **Wendong Zhang**, and Feng-an Yang. 2021. **Will Homeowners Benefit When Coal-fired Power Plants Switch to Natural Gas? Evidence from Beijing, China**. **Journal of Environmental Economics and Management**, 110:102566. (**published version**)

C 28. Xiong, Tao, **Wendong Zhang**, and Chen-Ti Chen. August 2021. **A Fortune from Misfortune: Evidence from Hog Firms' Stock Price Responses to China's African Swine Fever**. **Food Policy**, 105: 102150 (**published version**)

CHOICES

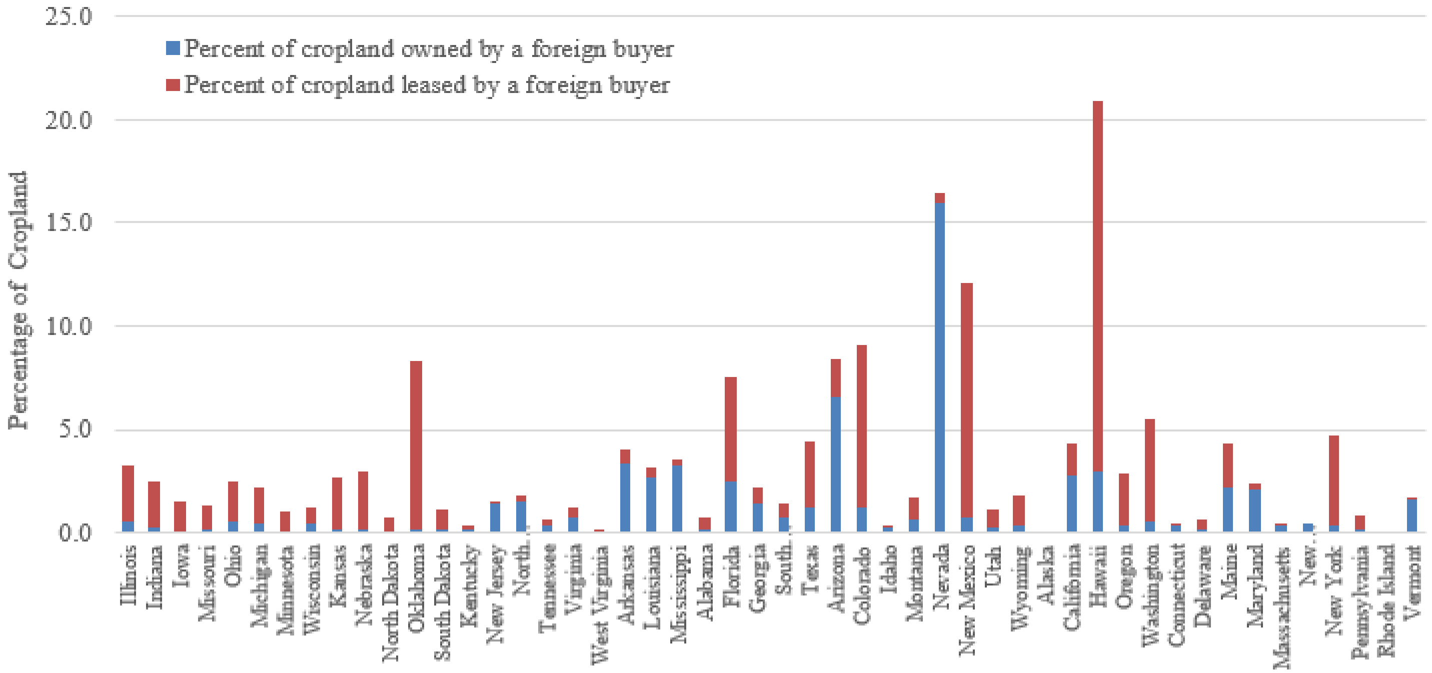
AAEA Agricultural & Applied Economics Association

Volume 38. Quarter 4

# Foreign Interests in U.S. Agricultural Lands: The Missing Conversations about Leasing

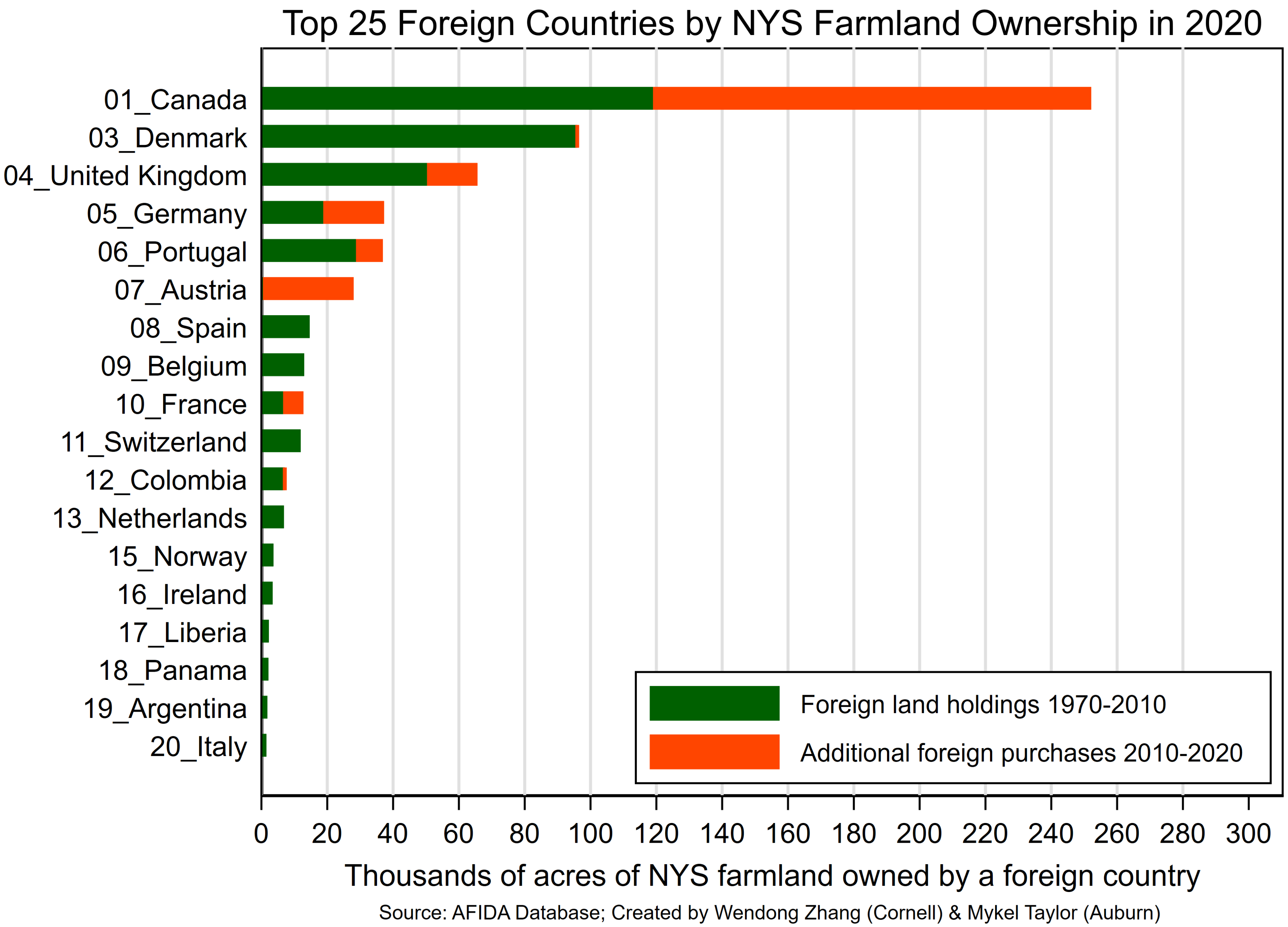
Mykel R. Taylor, Wendong Zhang, and Festus Attah

*JEL Classifications: Q15, Q18*
*Keywords: Foreign investment, Land, Policy, Lease*




*(b) Foreign Interest in U.S. Cropland*

*Note: Author calculations based on AFIDA database via a 2020 FOIA request with USDA Farm Service Agency. State-level total privately-held farmland is from USDA (2021) and the state-level cropland acres is based on 2017 U.S. Census of Agriculture.*


Top 25 Foreign Countries by NYS Farmland Ownership in 2020
01_Canada
03_Denmark
04_United Kingdom
05_Germany
06_Portugal
07_Austria
08_Spain
09_Belgium
10_France
11_Switzerland
12_Colombia
13_Netherlands
15_Norway
16_Ireland
17_Liberia
18_Panama
19_Argentina
20_Italy
Foreign land holdings 1970-2010
Additional foreign purchases 2010-2020
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Thousands of acres of NYS farmland owned by a foreign country
Source: AFIDA Database; Created by Wendong Zhang (Cornell) & Mykel Taylor (Auburn)

# Mapping and Contextualizing Foreign Ownership and Leasing of US Farmland

**Fangyao Wang, Wendong Zhang, Mykel Taylor**

**Submitted to *Journal of American Society of Farm Managers and Rural Appraisers***

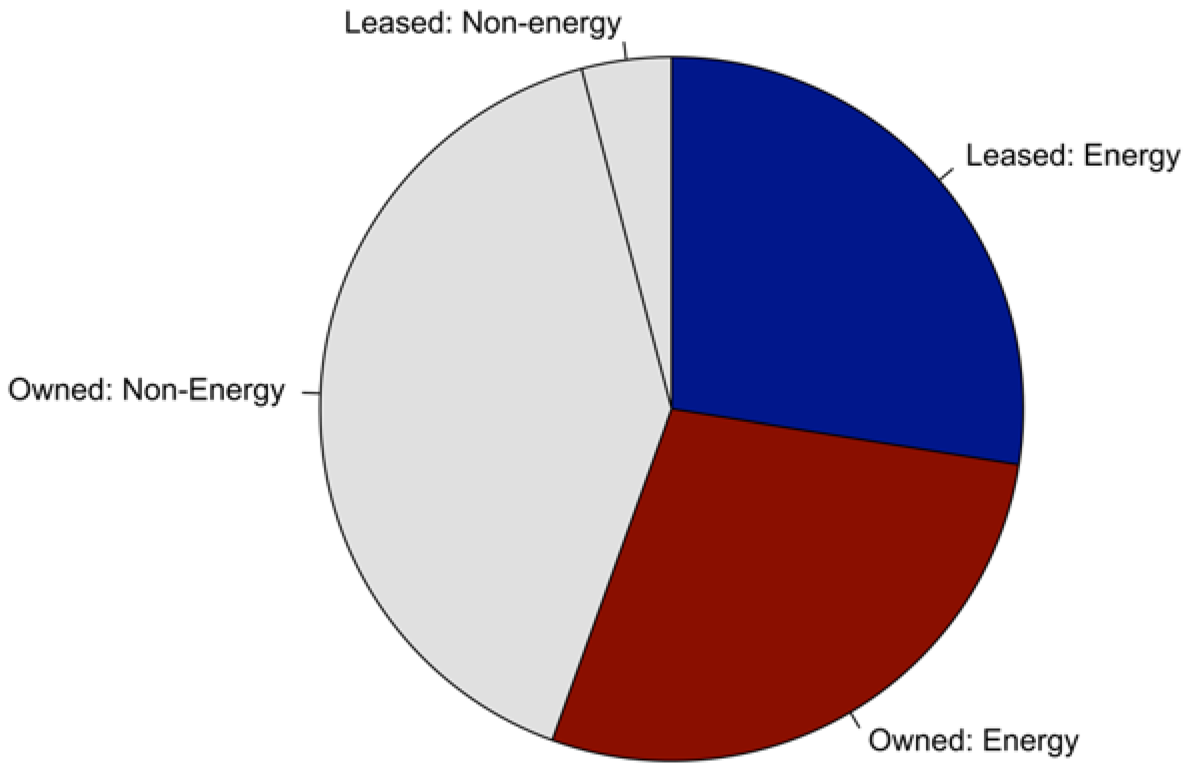
## Abstract

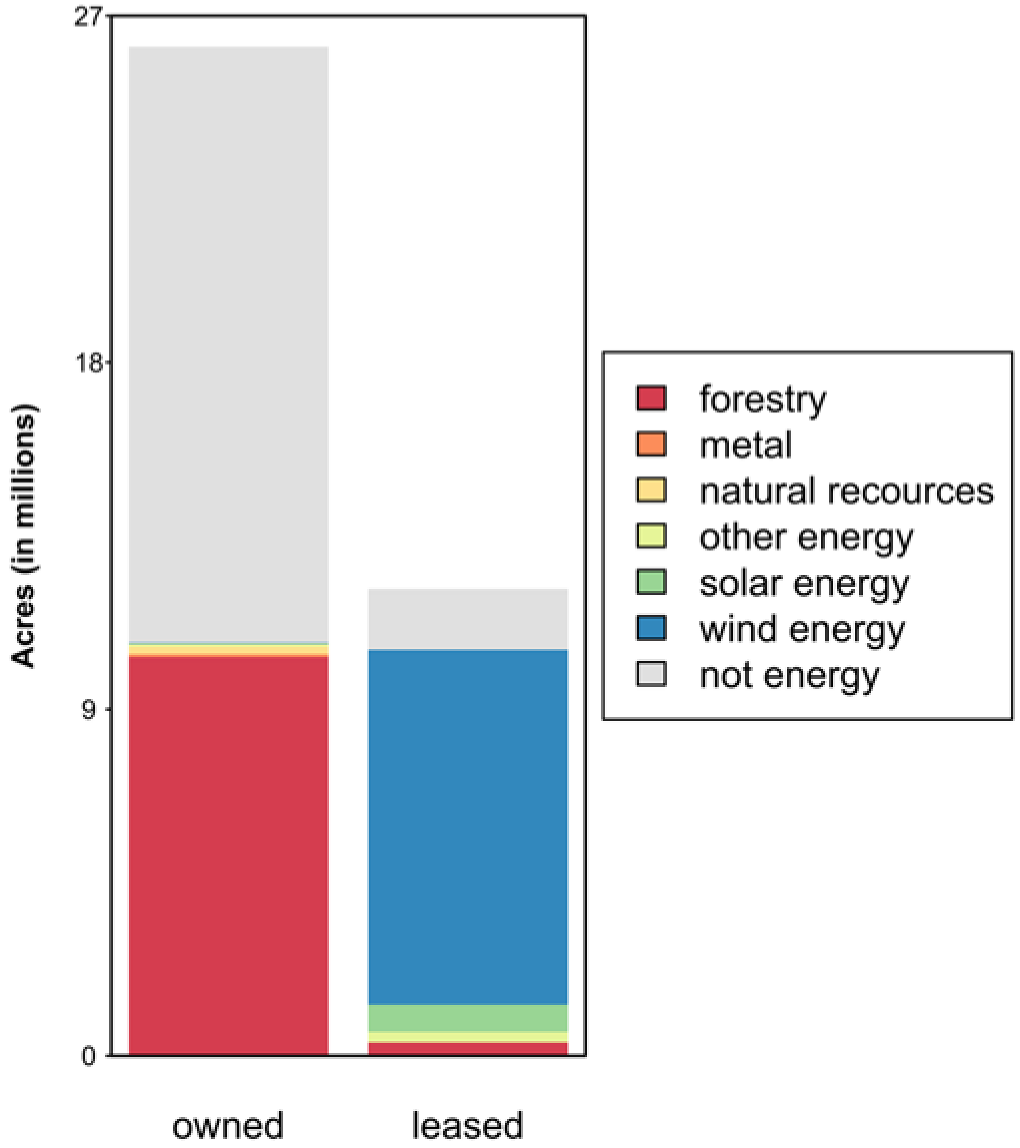
Foreign ownership of US farmland has recently attracted growing interest from the public as well as the federal and state policy makers. Using all reported AFIDA transactions, this article provides a comprehensive analysis on the structure of foreign land ownership in the US. We find that: (1) long-term leasing is the main driver of the increasing foreign interests of US farmland in the recent 20 years; (2) a considerable number of foreign transactions are related to wind and solar energy development, especially for entities holding long-term lease; (3) the "adversary" countries like China take only 1% of all the foreign-owned agricultural land.

## Keywords

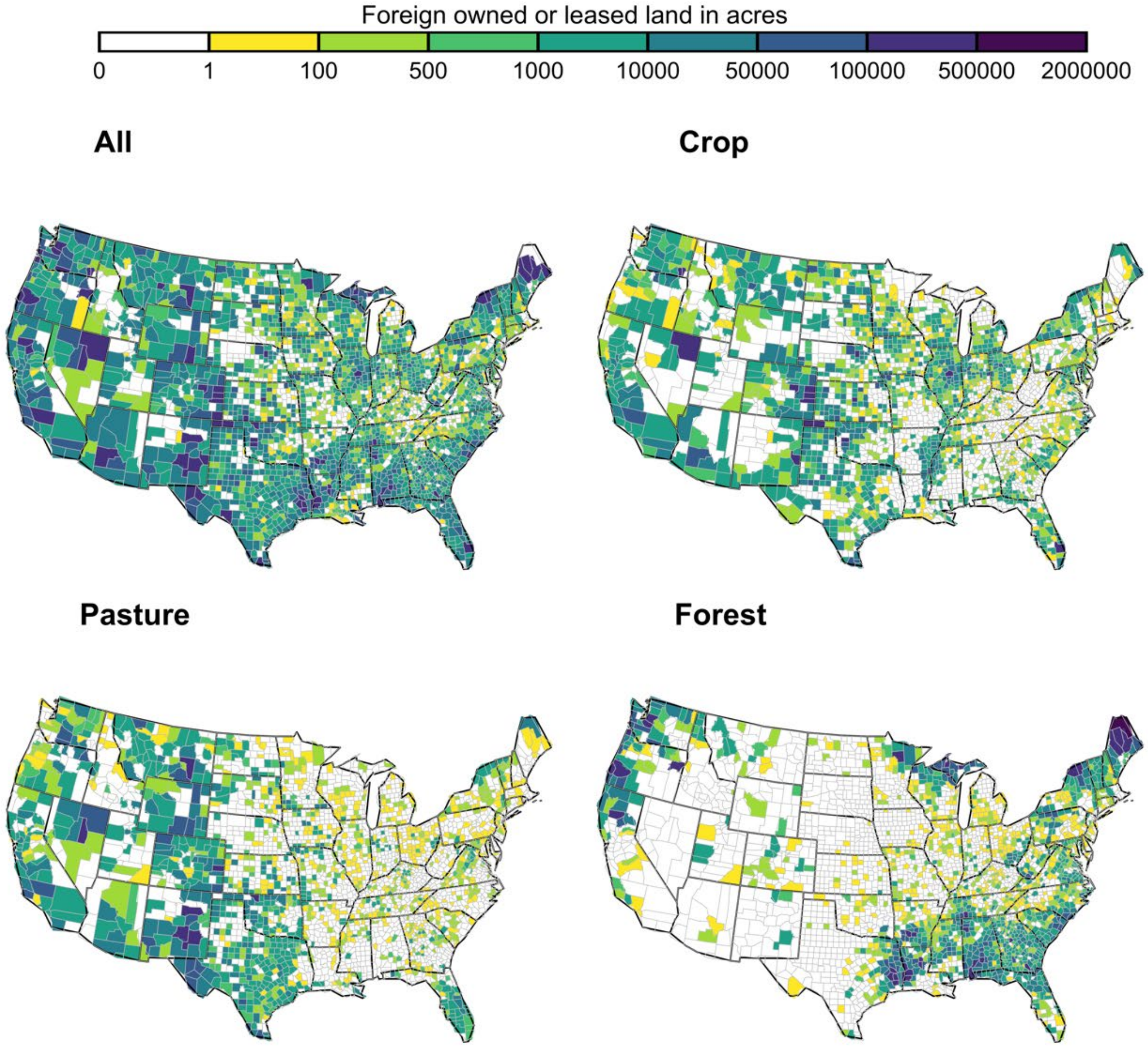
Foreign Investment, Farmland Ownership, Lease, China, Wind, Solar, AFIDA

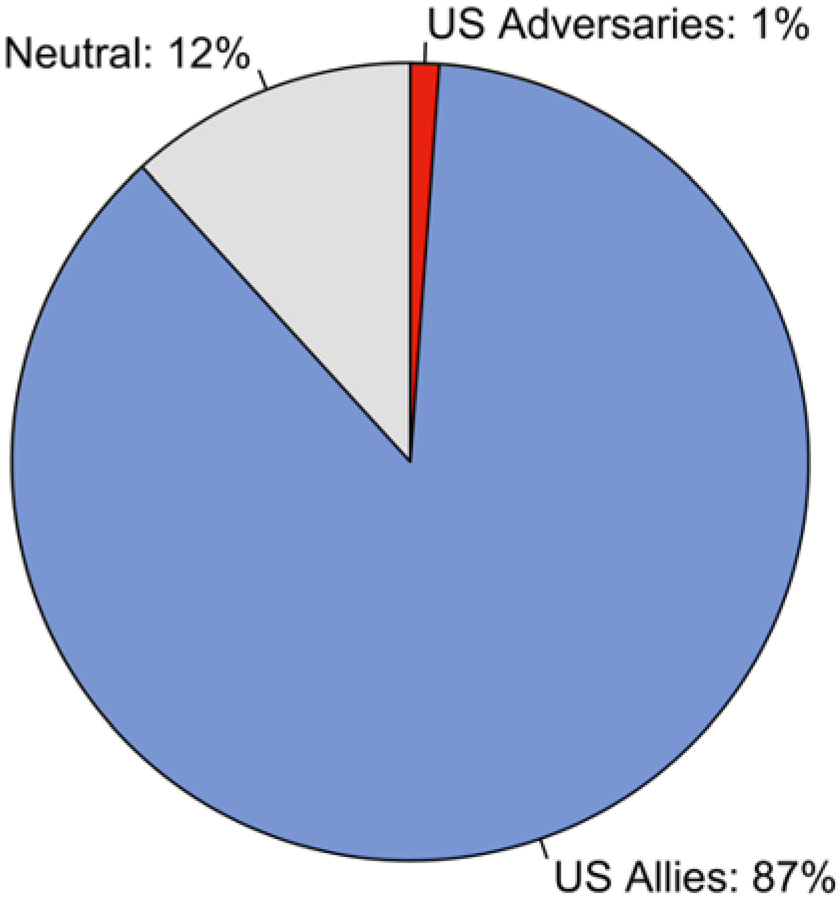
# Energy represents a significant share of foreign interests, especially for leased land



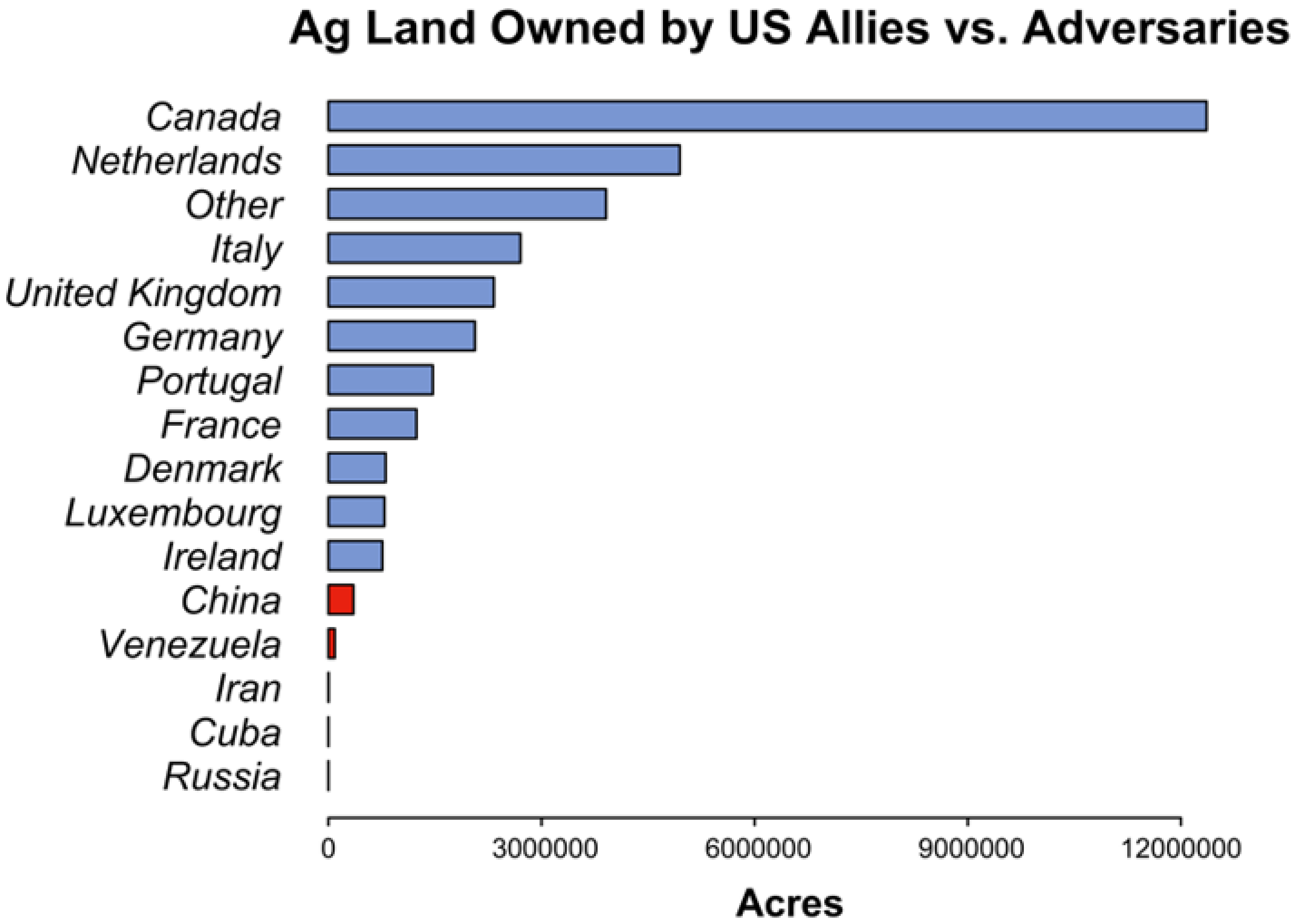



Total land with foreign interests: 38.3 million acres, 2.9% of all US farmland.





Neutral: 12%
US Adversaries: 1%
US Allies: 87%

Ag Land Owned by US Allies vs. Adversaries
Canada
Netherlands
Other
Italy
United Kingdom
Germany
Portugal
France
Denmark
Luxembourg
Ireland
China
Venezuela
Iran
Cuba
Russia
0
3000000
6000000
9000000
12000000
Acres

| | US Allies | | | | | 'Adversaries' | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Canada | Netherlands | Italy | United Kingdom | Germany | China | Russia | Venezuela | Iran | Cuba |
| Appalachia | 163963 | 472156 | 59859 | 127847 | 84247 | 63294 | 11 | 2380 | 428 | 0 |
| Corn Belt | 514078 | 116262 | 602967 | 134904 | 271725 | 43936 | 0 | 14247 | 457 | 0 |
| Delta | 685229 | 1077146 | 65926 | 183777 | 163106 | 108 | 0 | 0 | 0 | 0 |
| Lake | 482086 | 467284 | 187721 | 113301 | 48866 | 0 | 0 | 0 | 0 | 0 |
| Mountain | 1586880 | 199151 | 319202 | 528149 | 445635 | 47770 | 0 | 20835 | 0 | 0 |
| Northeast | 3313311 | 358519 | 4771 | 137428 | 100562 | 2936 | 761 | 3513 | 788 | 0 |
| Northern Plains | 981433 | 23483 | 697491 | 118329 | 64605 | 0 | 0 | 0 | 169 | 0 |
| Pacific | 1258951 | 357190 | 12496 | 658770 | 125353 | 13589 | 40 | 1500 | 1507 | 0 |
| Southeast | 627414 | 1432449 | 23032 | 160097 | 395669 | 16729 | 0 | 46006 | 11 | 10 |
| Southern Plains | 2477418 | 403923 | 729406 | 164102 | 353102 | 163288 | 10 | 1137 | 964 | 838 |
| Total | 12090763 | 4907565 | 2702871 | 2326704 | 2052870 | 351651 | 822 | 89618 | 4324 | 848 |

*Note:*

USDA Farm Production Regions (Cooter et al., 2012)

[1] Available at: https://www.researchgate.net/figure/USDA-Farm-Production-Regions_fig2_235609824

# *Quantifying the Property Value and Land Use Impacts of Utility-Scale Solar Farms in New York State*

**Wendong Zhang**, Assistant Professor, Applied Economics and Management
**Richard Stedman**, Professor, Natural Resources and the Environment
**David Kay**, Sr. Extension Associate, Global Development

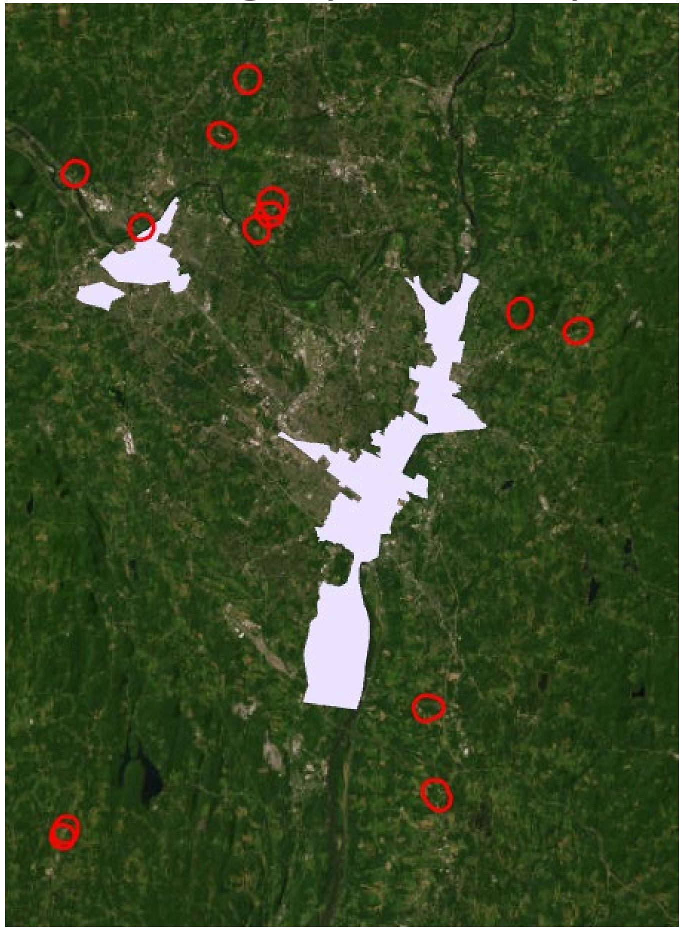
Large solar facilities are critical to meet the New York State's ambitious climate and energy goals. This research will evaluate the monetary impacts of large solar farms on nearby farmland sales prices, and assess land use and crop choice changes following solar farm constructions using satellite data.

CORNELL CENTER for SOCIAL SCIENCES

# Map Visualization using Google Earth Engine
- Justin Li (Dyson undergrad; jcl386)

Dark Basemap


Imagery Basemap



Polygon

AgSolarMapDraft1b

Open in Map \

Layers

Get started

You can explore maps, add layers, and more without signing in. To save your work, sign in before creating your map.

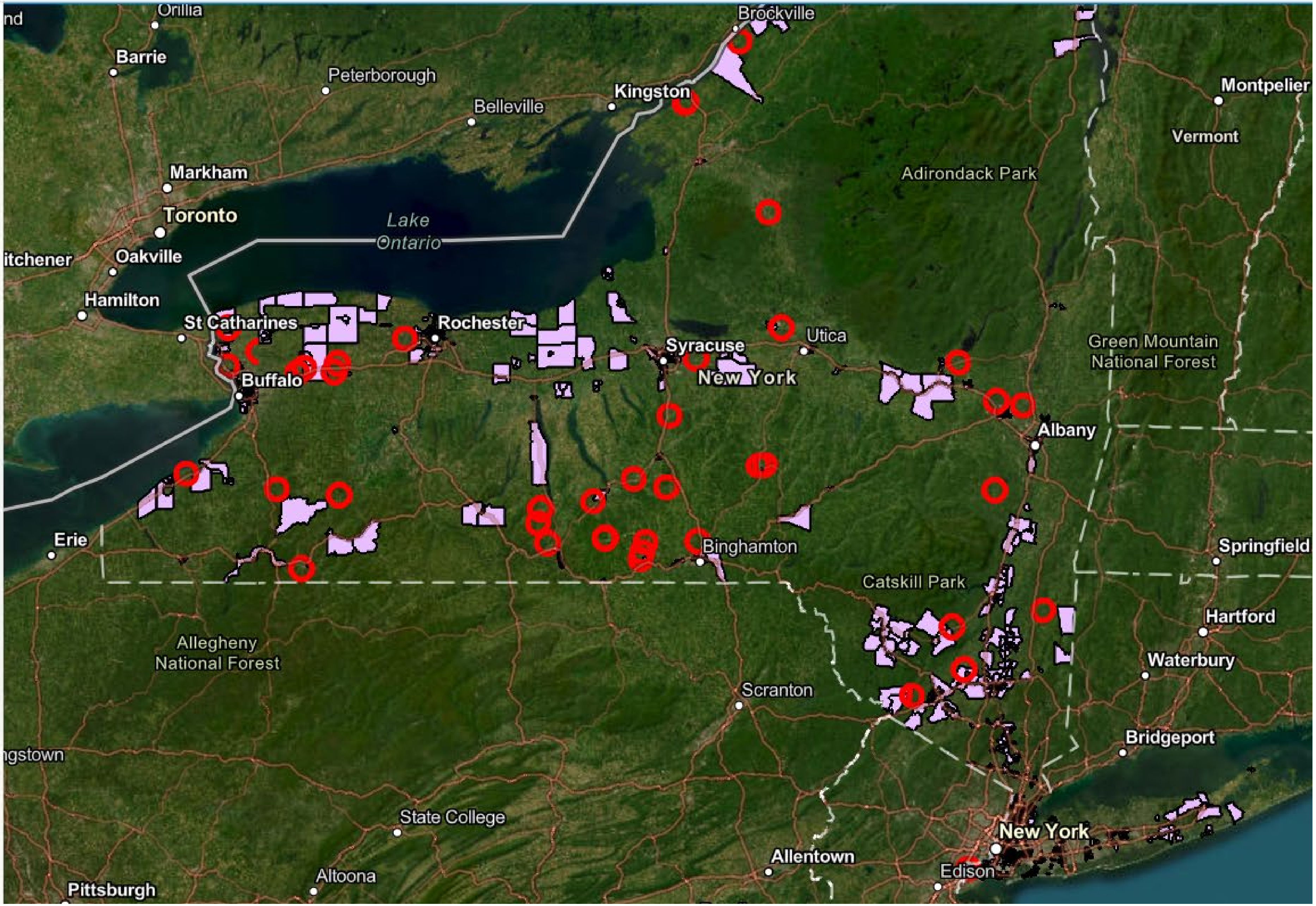
Learn more about Map Viewer

Solar_Panel_Outlines

Solar_Panel_Projects

Disadvantaged Communities

Add



# Summary Report

- 2 page report
- Includes before and after satellite image of land outlined from Google Earth
- Informational table concerning output, costs, subsidies, etc.
- Can be downloaded from interactive map

## Project Summary

| | |
|---|---|
| Project Number | 173742 |
| Street Address | 1414 Rowe Ave |
| City | Olean |
| County | Cattaraugus |
| ZIP Code | 14760 |
| Incorporated Municipality | Portville |
| Census Tract | 3.6E+10 |
| Program Type | Commercial/Industrial (MW Block) |
| Electric Utility | National Grid |
| Purchase Type | Power Purchase Agreement |
| Date Application Received | 43518 |
| Date Completed | 44649 |
| Project Status | Complete |
| Contractor | AES Distributed Energy, Inc. |
| Primary Inverter Manufacturer | SMA America |
| Primary Inverter Model Number | SC 2500-EV-US [550V] |
| Total Inverter Quantity | 2 |
| Primary PV Module Manufacturer | Shanghai Aerospace Automobile Electromechanical Co., Ltd. |
| PV Module Model Number | HT78-18X-585 |
| Total PV Module Quantity | 13776 |
| Project Cost | 8603218 |
| Total Nameplate kW DC | 7160.4 |
| Total Nameplate mW DC | 7.1604 |
| Expected KWh Annual Production | 8405164 |
| Expected MWh Annual Production | 8405.164 |
| Latitude | 42.06744 |
| Longitude | -78.3785 |
| Georeference | POINT (-78.37851209 42.06743749) |
| Total NYSERDA Incentive | 1611090 |
| Affordable Solar Residential Adder | 0 |
| Affordable Multifamily Housing Incentive | 0 |
| Community Adder | 0 |
| Inclusive Community Solar Adder | 0 |
| Expanded Solar For All Adder | 0 |
| Brownfield/Landfill Adder | 0 |
| Canopy Adder | 0 |

# Farmland
# Most common

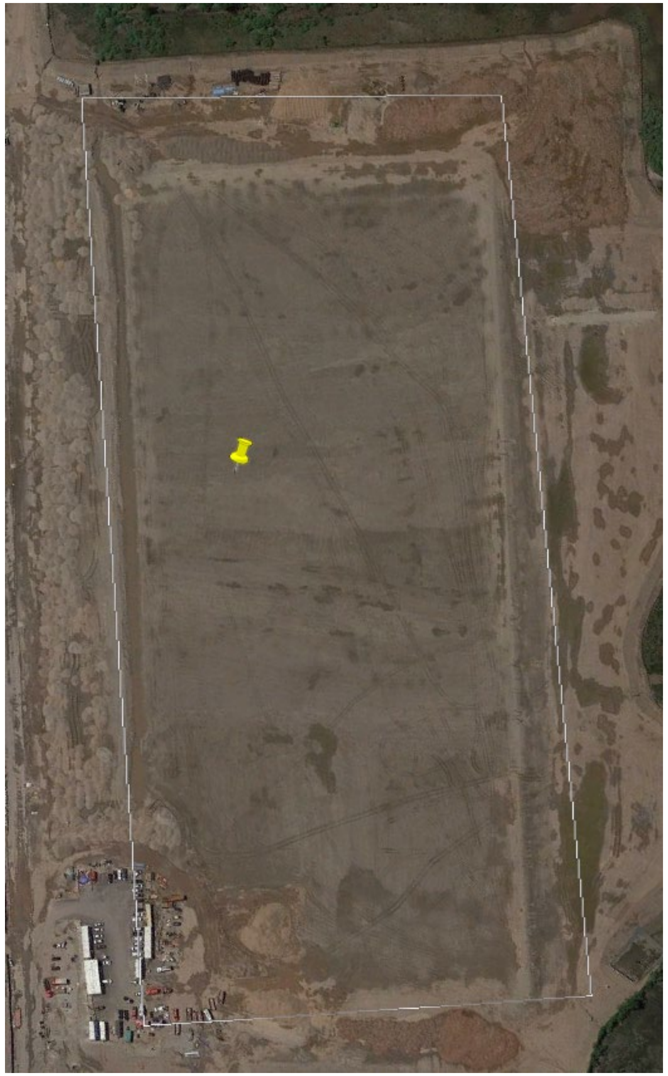
- Project ID: 156383_Ransomville
- Change from 2018 - 2022

# Forest & Farmland

- Project ID: 173742 (Olean)
- Change from 2016 - 2023

# Building

- Project ID: 243698 (Staten Island)
- Change from 2018 - 2022



# Practical Demonstration

- https://cugis.maps.arcgis.com/apps/mapviewer/index.html?webmap=c8fc3a3207544215b9fd5908c3743fbf

The Impact of Shared Renewable Policy on Farmland Values: Evidence from New York State

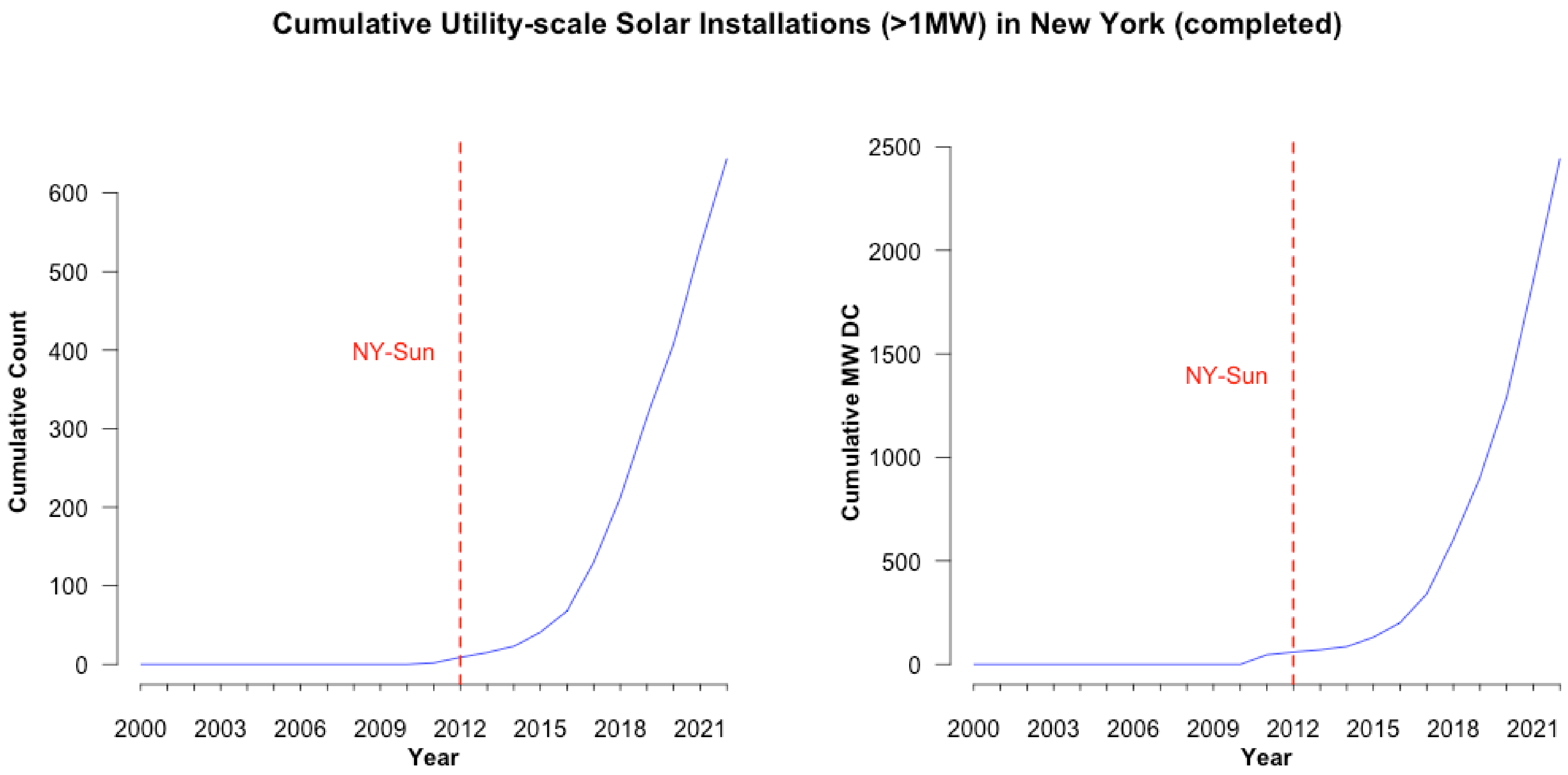
Zhiyun Li, Ariel Ortiz-Bobea, and Wendong Zhang *

This paper quantifies the impact of shared renewable policy on farmland values by using the parcel-level farmland transaction data from 2007 to 2022 and the uniform timing of the Shared Renewables Program (SRP) launched by New York state in 2015.

We examine how the SRP affects farmland prices across locations that are close or far away from transmission lines or substations. We observe a 15% higher price increase for farmlands within a 2-mile radius of electric grids compared to those situated farther away after 2019 when there was a substantial upsurge in community solar projects.

Moreover, we show that this effect is concentrated in regions with higher electric rates, making them more lucrative for solar development.

# NY-Sun and utility-scale solar installations in New York state



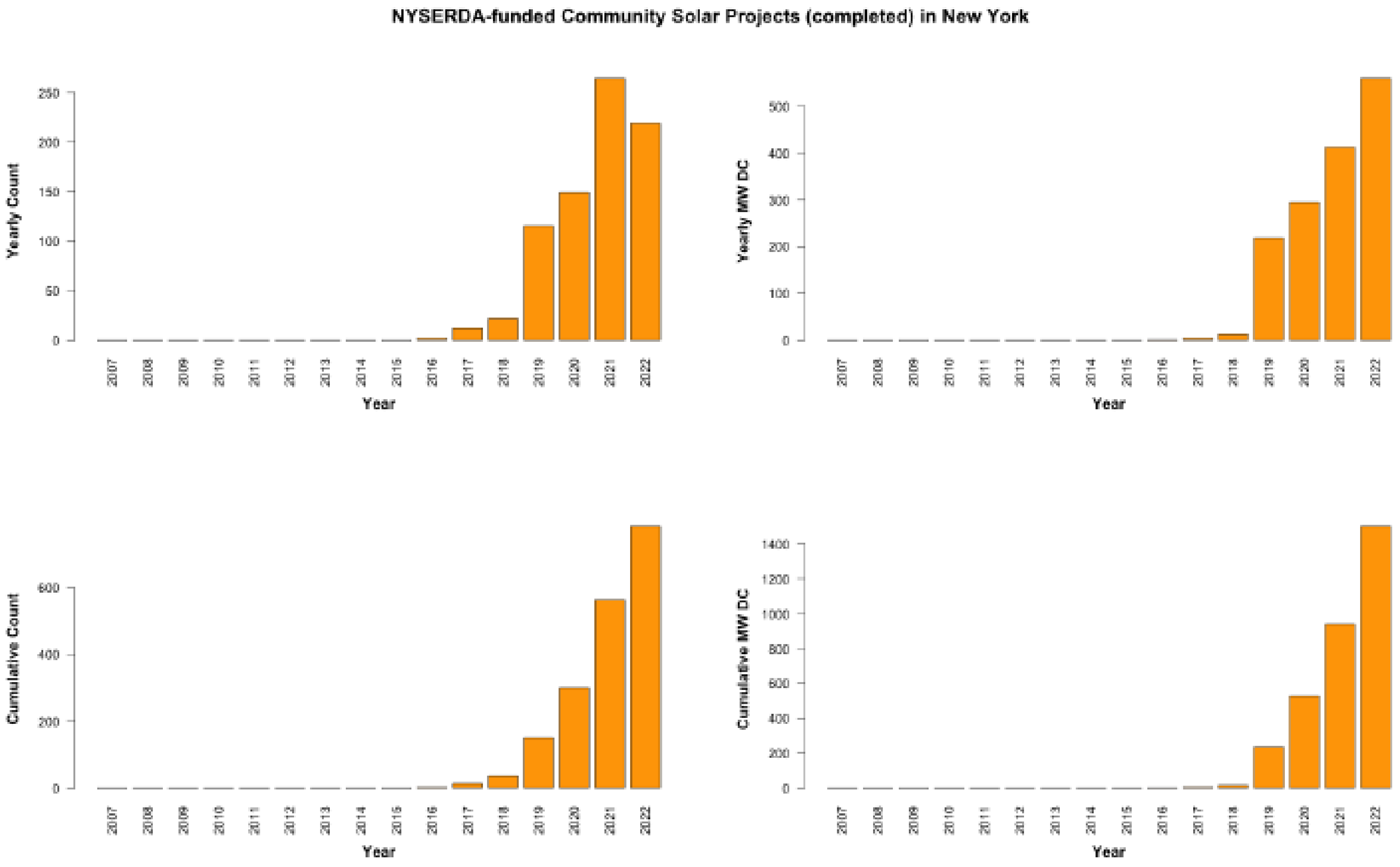

- The first utility-scale solar plant was completed in 2015.
- Although there was federal solar tax policy -Investment tax credit (ITC) prior to 2012, utility-scale solar installations were mainly driven by state energy policy - NY-Sun that was launched in 2012. In the first two years of NY-Sun, a total of 316 MW of solar electric was installed or under contract, more than was installed in the entire prior decade.
- NY-Sun Incentive Program (2014)

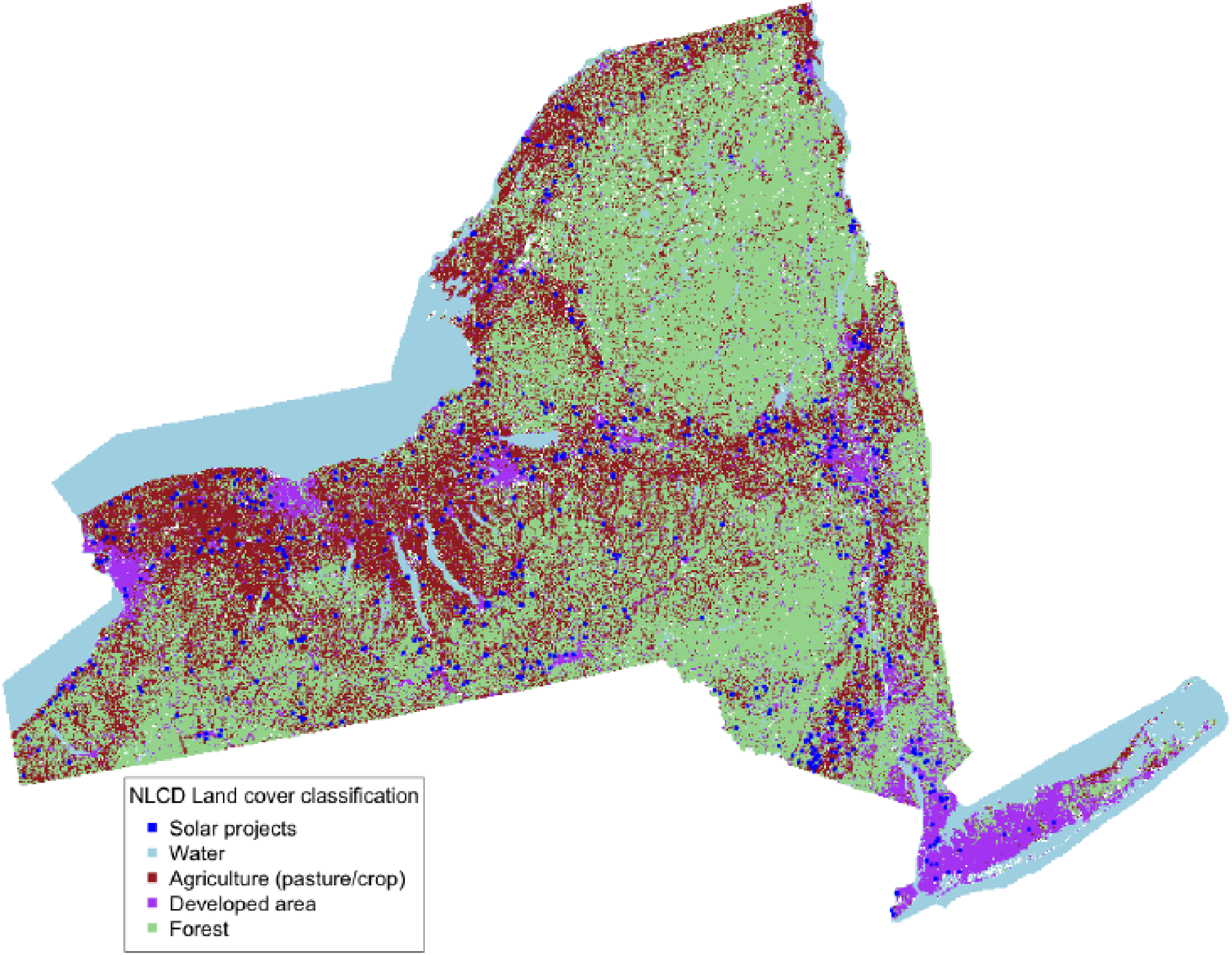
# Governor Cuomo Announces Expanded Access to Renewable Energy For Millions Of New Yorkers

Shared Renewables Program Provides New Opportunities for New York Residents and Businesses to Access Clean and Affordable Energy

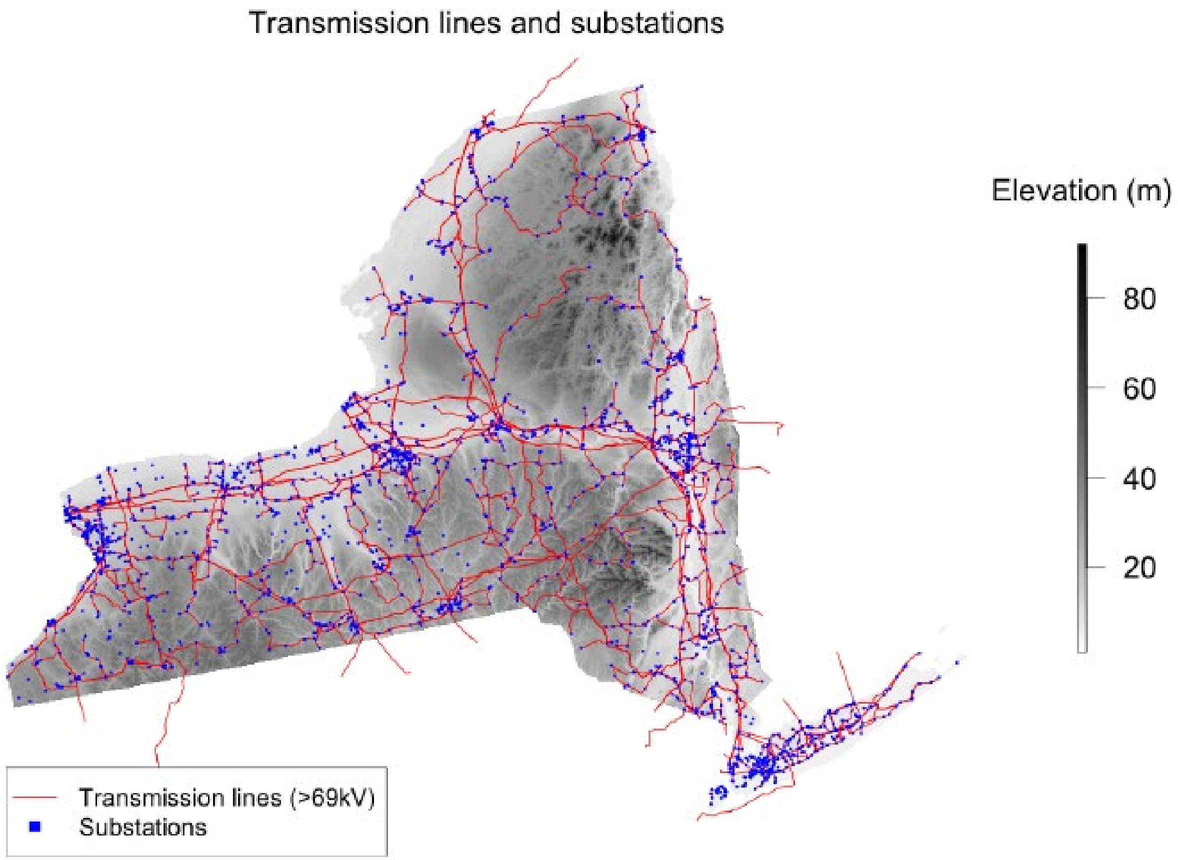
- July 2015; NEW YORK, N.Y.—Today Governor Cuomo announced the landmark Shared Renewables program, also known as community net metering. The program will expand community access to renewable energy in New York State by allowing energy customers to subscribe to a local renewable energy project and receive a utility bill credit for their portion of the energy produced.

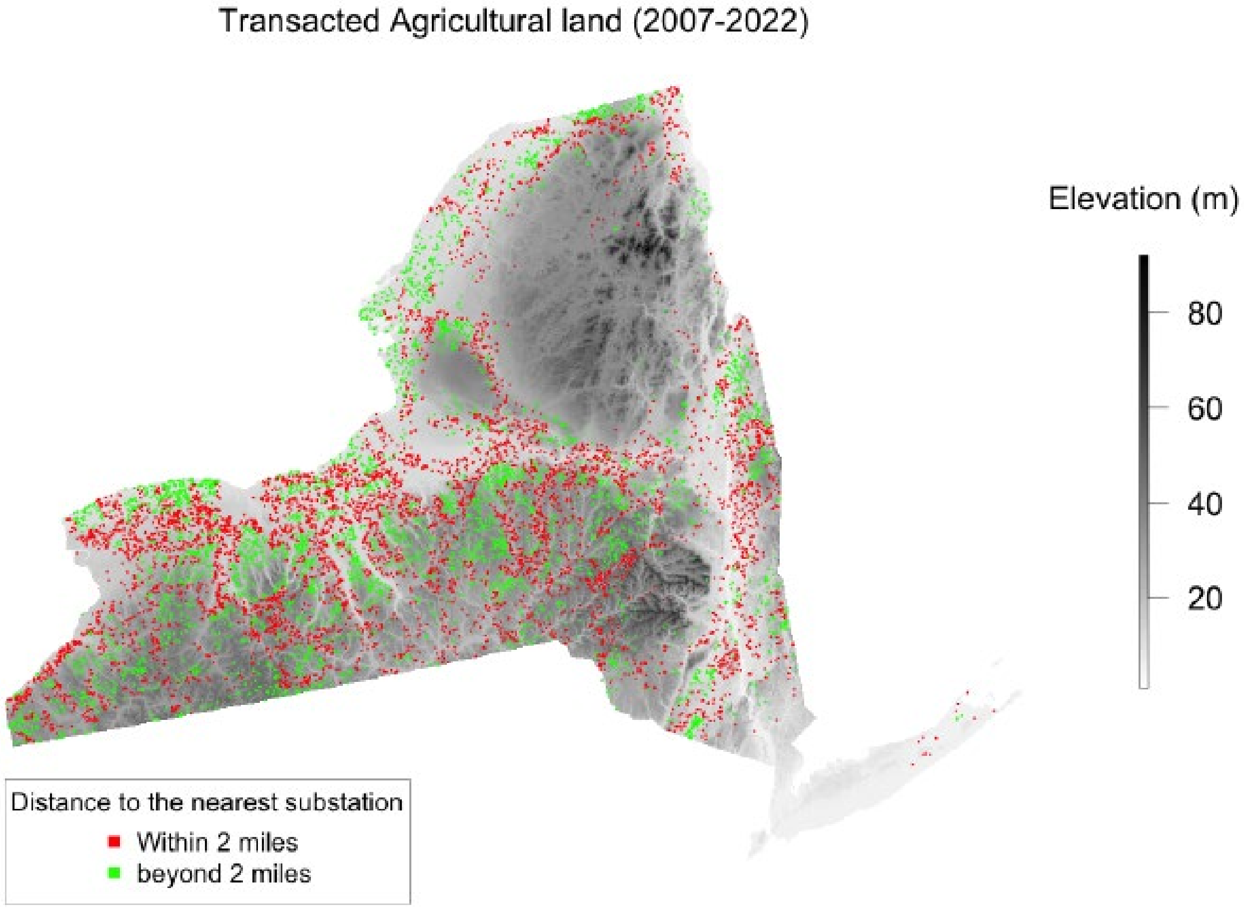
Figure 1: NYSERDA-funded Community Solar Projects (completed) in New York State



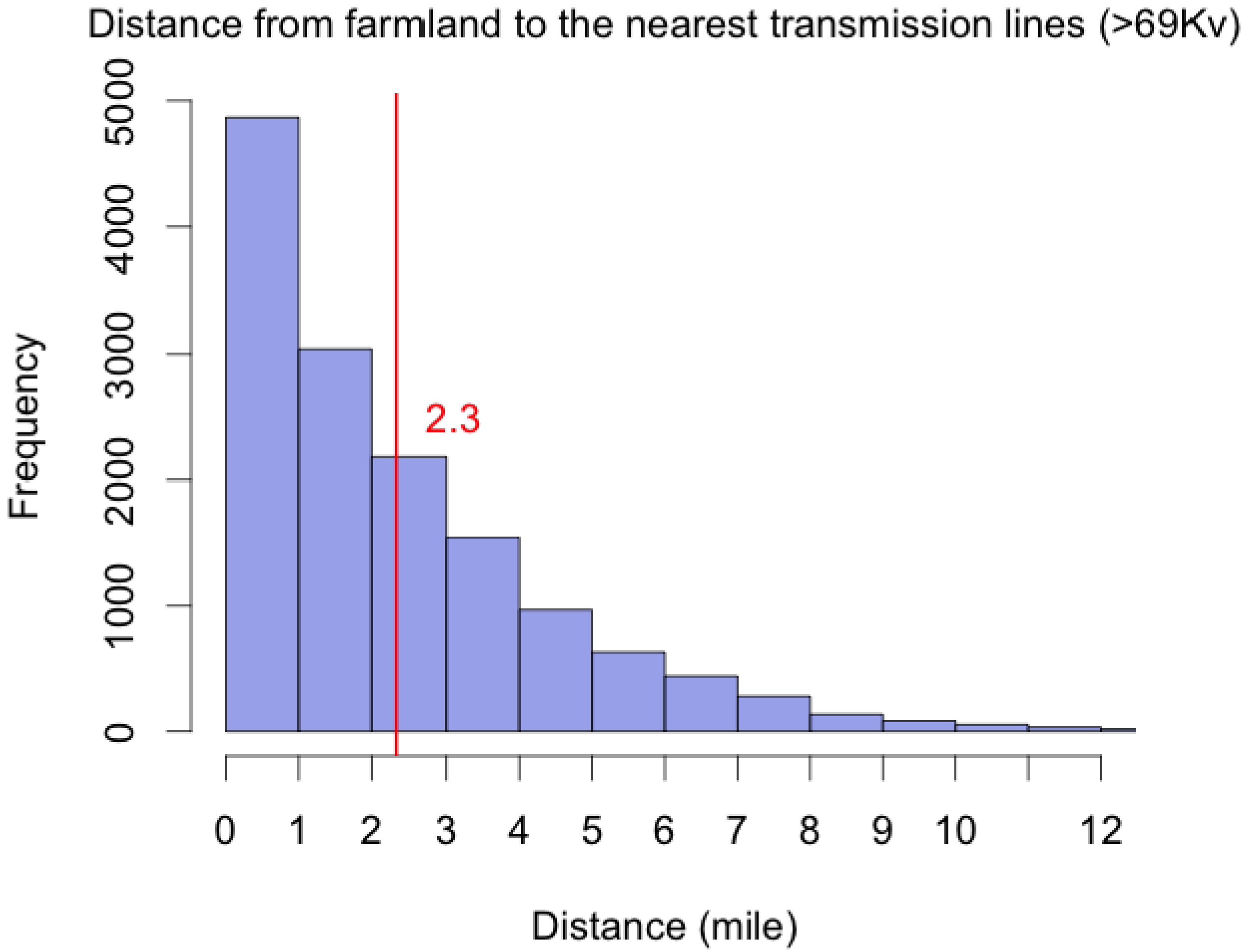


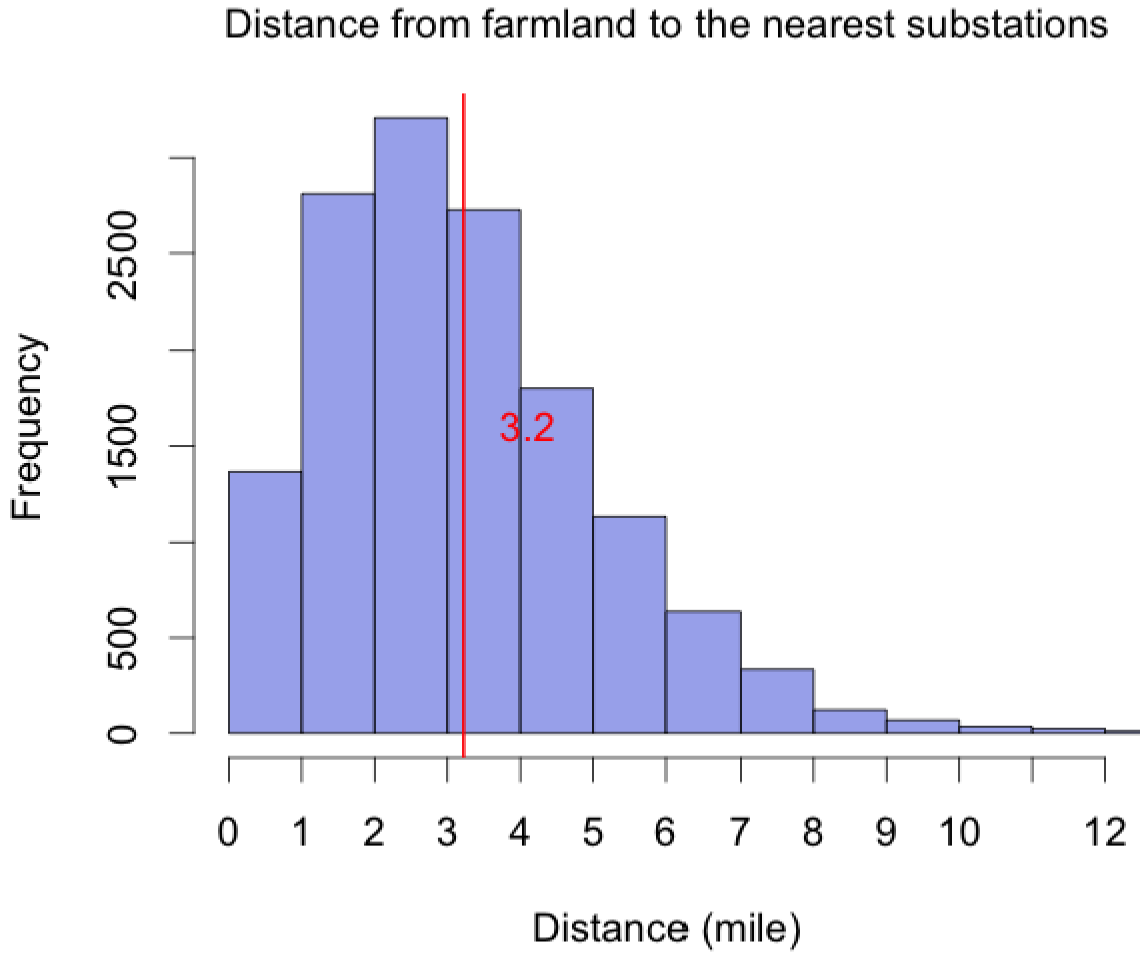

**NYSERDA-funded Community Solar projects (>1MW)**


Transmission lines and substations
Elevation (m)
80
60
40
20
Transmission lines (>69kV)
Substations

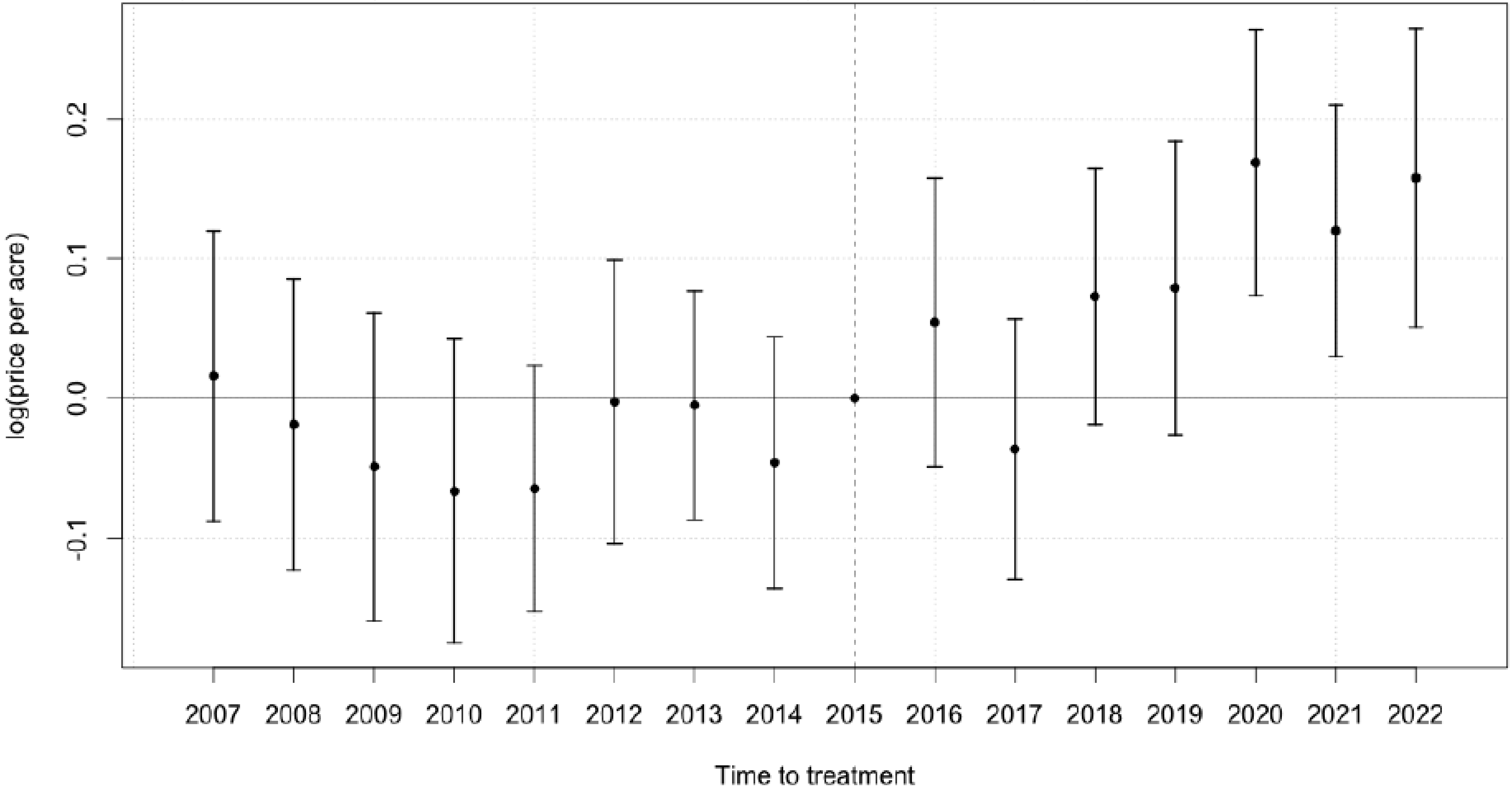

Transacted Agricultural land (2007-2022)
Elevation (m)
80
60
40
20
Distance to the nearest substation
Within 2 miles
beyond 2 miles

# Treated group: farmland parcels within 2 miles from TMLs (70kV+) or substations



# Parcels within 2 miles of TMLs or substations enjoyed 10-20% price premium, especially post 2020




t

Figure 6: Impact of SHP on farmland values

ELSEVIER

Journal of Housing Economics

Volume 62, December 2023, 101968


# Disamenity or premium: Do electricity transmission lines affect farmland values and housing prices differently? ☆

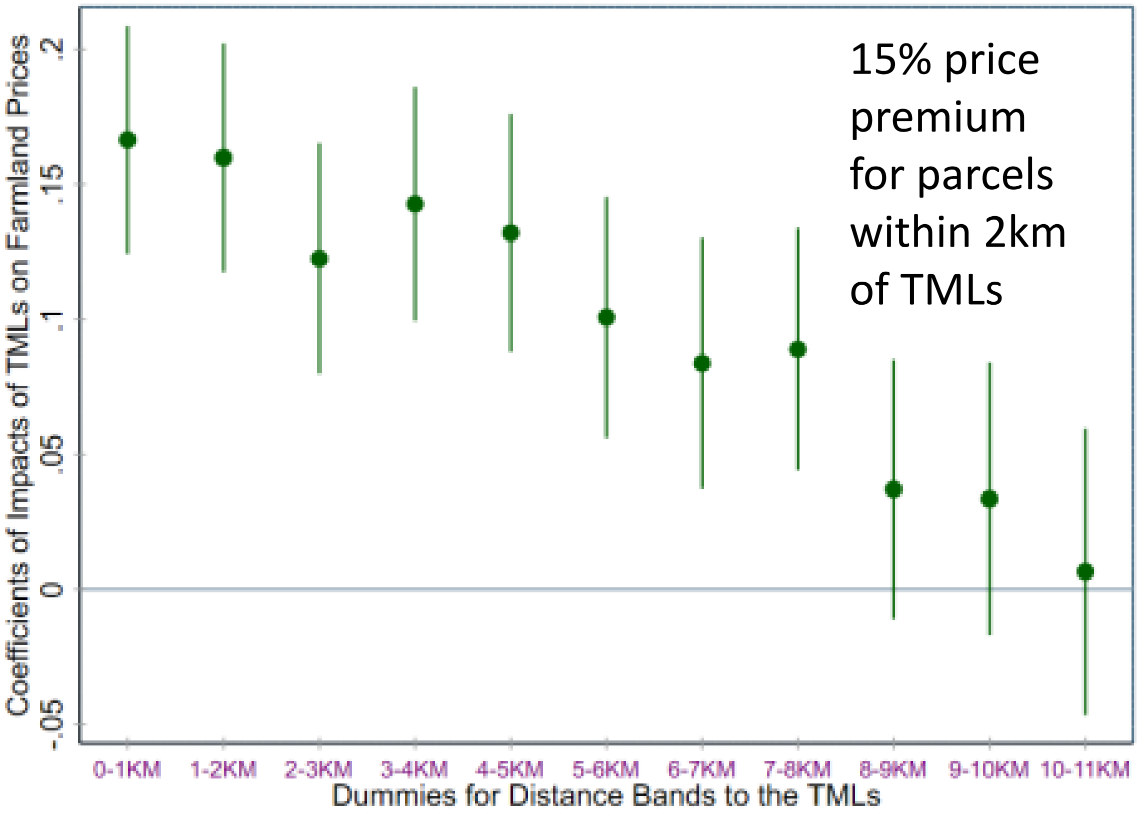
Qinan Lu [a], Nieyan Cheng [b], Wendong Zhang [c], Pengfei Liu [d]

Show more

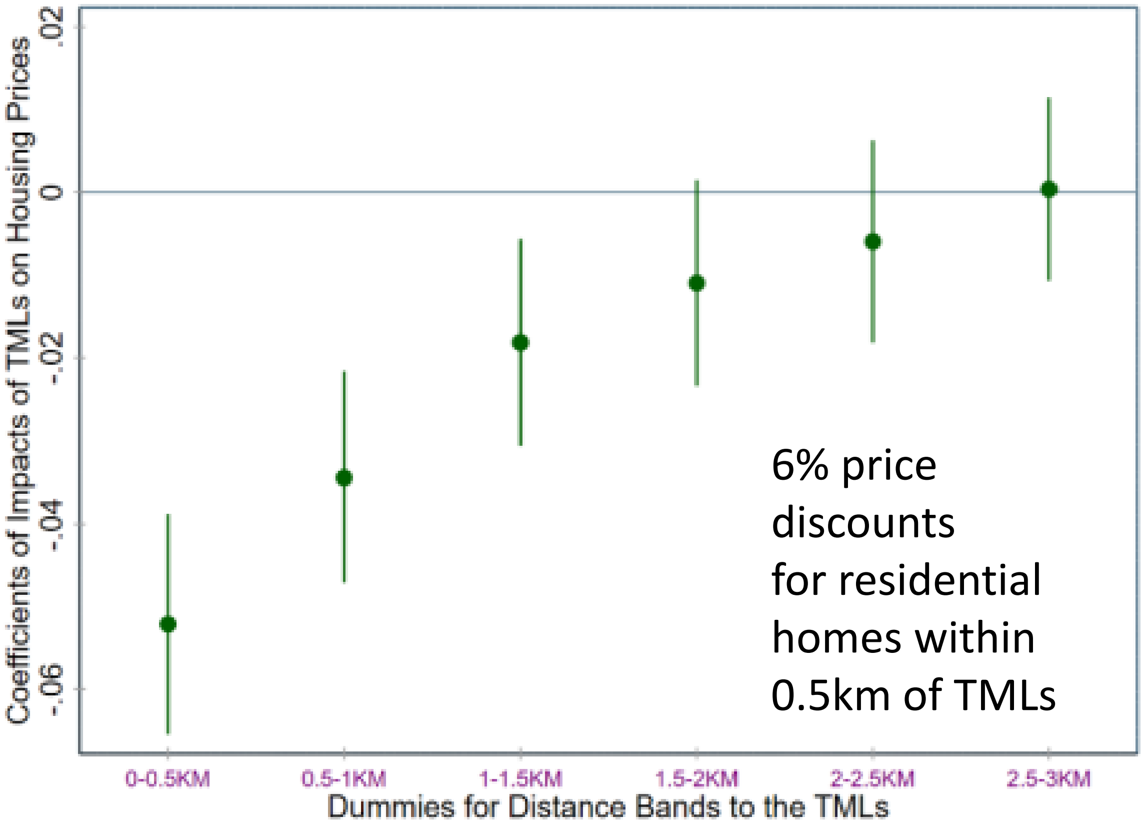
Add to Mendeley Share Cite

https://doi.org/10.1016/j.jhe.2023.101968

# TMLs: premium for farmland prices disamenity for residential housing prices




(a) Nonlinear Effects of Proximity to TMLs on Farmland Prices



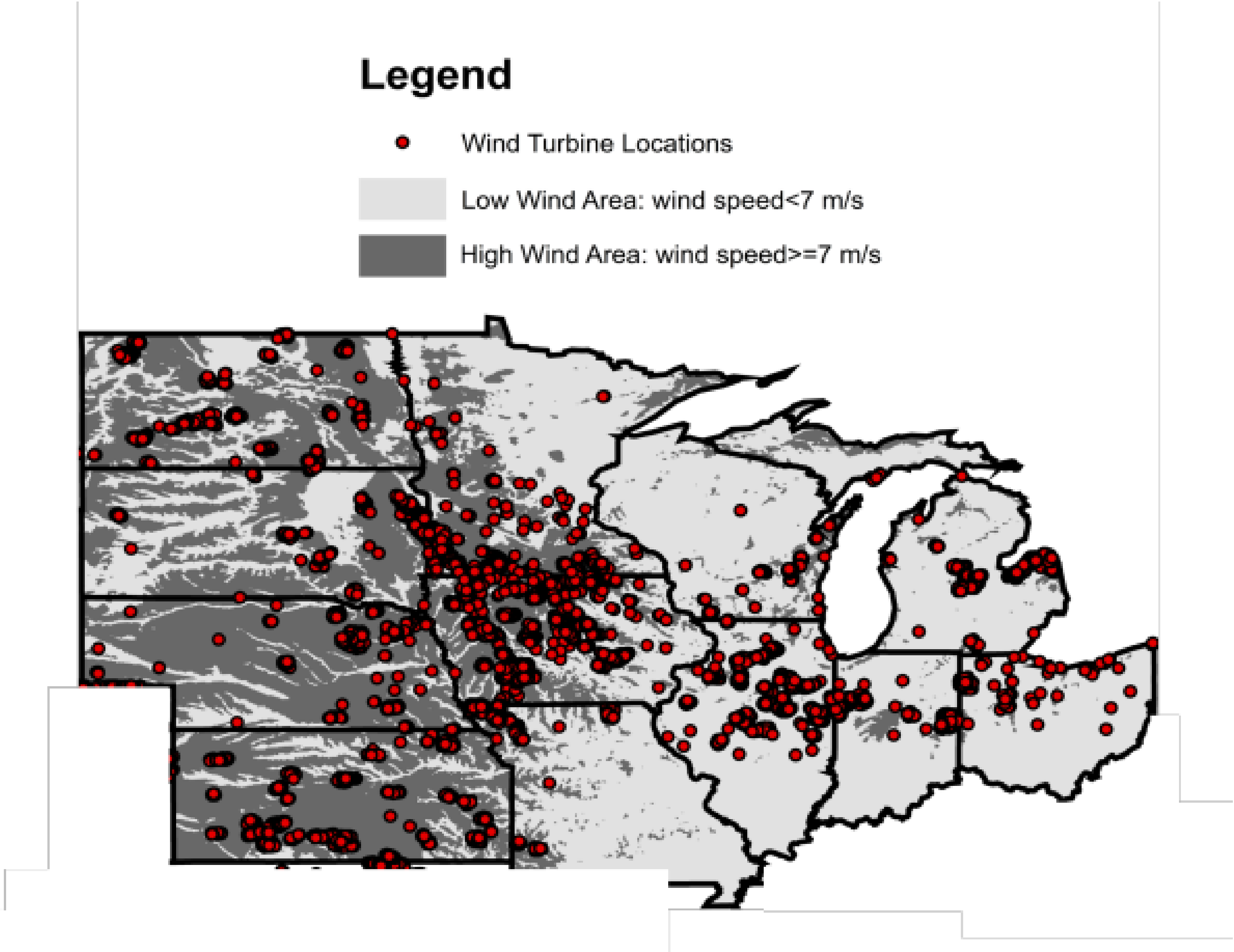

(b) Nonlinear Effects of Proximity to TMLs on Housing Prices

# TMLs bring more premium in high-wind-potential areas

**Table 2:** Effects of Proximity to TMLs on Farmland Values

| Dependent variable | Log of farmland prices | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance to the nearest TML | -0.0105*** | | | | | |
| | (0.0022) | | | | | |
| Distance band (0-2 km) | | 0.1042*** | 0.0794*** | 0.1085*** | 0.0681*** | |
| | | (0.0209) | (0.0237) | (0.0283) | (0.0224) | |
| Distance band (2-5 km) | | 0.0823*** | 0.0635*** | 0.0846*** | 0.0520** | |
| | | (0.0194) | (0.0218) | (0.0262) | (0.0209) | |
| Distance band (5-8 km) | | 0.0542*** | 0.0310 | 0.0715*** | 0.0267 | |
| | | (0.0193) | (0.0224) | (0.0245) | (0.0229) | |
| Distance band (0-2 km) × High wind | | | 0.0844* | | | |
| | | | (0.0464) | | | |
| Distance band (2-5 km) × High wind | | | 0.0612 | | | |
| | | | (0.0442) | | | |
| Distance band (5-8 km) × High wind | | | 0.0757* | | | |
| | | | (0.0440) | | | |
| Located at high wind areas | | | -0.0539 | | | |
| | | | (0.0409) | | | |

**Figure 2:** Spatial Distribution of Wind Speed at 100-meter Hub Height with Existing Wind Turbines



# The impact of large-scale solar facilities on nearby farmland values

Nico Ma (Dyson MS Student)
Wendong Zhang

# Proximity to solar farms, TMLs and substations bring premium for NYS farmland sales too

| | (1) | (2) | (3) |
|---|---|---|---|
| | Without Fixed Effect | County and Year FE | County and Year FE & Capacity>5MW |
| dist_solar | -.0034** | **-.0059*** ** | -.0067** |
| | (.0017) | (.002) | (.0029) |
| dist_tmls | -.0029 | -.0029 | -.006** |
| | (.002) | (.002) | (.0028) |
| dist_subst | -.0242*** | **-.0184*** ** | -.0133*** |
| | (.0032) | (.003) | (.0041) |
| urban_proximity | -.018*** | -.0071*** | -.0062*** |
| | (.0013) | (.0014) | (.002) |

Being 1km closer to solar facilities brings on average a 0.6% premium for farmland sales prices

- Substation: 1.84% premium

Transaction Data: NY SalesWeb

| Treated group | Close to solar+ close to substations | Close to solar | Close to substations |
|---|---|---|---|
| treat | .0079 | .0334 | .0098 |
| | (.0582) | (.0336) | (.0332) |
| post | .0815*** | .0847*** | .074*** |
| | (.0232) | (.0229) | (.0228) |
| treat_post | -.2039** | -.1307** | -.0645 |
| | (.0906) | (.0523) | (.0497) |

## PRELIMINARY:

We seem to find that while farmland parcels close to solar/substations enjoyed higher prices, this premium disappeared or even reversed to a price discount after the solar panels were installed.

ABASHIDZE, NINO. Essays on Economic and Health Effects of Land Use Externalities. (Under the direction of Dr. Harrison Fell).

frequently. Furthermore, there appears to be no empirical research that quantifies the effect of ground-level solar installations on local property values. In the first essay of my dissertation, I examine the effect of utility-scale, ground-level solar systems on agricultural land values. Agricultural transactions data are spatially linked to data on solar farm installations and are analyzed in a hedonic framework. The results provide no evidence that the construction of a solar farm creates any positive or negative spillover effects on nearby agricultural land values through either production process channels or changes in aesthetic views of the land. However, the estimates suggest that landowners value being in close proximity to transmission infrastructure after a solar farm is built in the area. This suggests that the solar farm construction in the area signals suitability of the land for solar development and thus increasing the option value of the land.


# NINO ABASHIDZE

**Postdoctoral Research Associate**

**Haub School of Environment and Natural Resources**

nabashid@uwyo.edu | Beta House, Rm 310


# Utility-Scale Solar Farms and Agricultural Land Values

Nino Abashidze and Laura O. Taylor

*Published online before print* December 29, 2022, 102920-0165R; DOI: https://doi.org/10.3368/le.99.3.102920-0165R

Article | Figures & Data | Supplemental | Info & Metrics | References

PDF

### Abstract

Property value models are used to examine how utility-scale, ground-mount solar farms impact nearby agricultural land values. Results indicate that solar farms do not have direct positive or negative spillover effects on nearby agricultural land values. However, results also suggest that solar farm construction may indirectly affect agricultural land values by signaling the land's suitability for future solar development. Specifically, results indicate that proximity of agricultural land to electric transmission lines may be positively valued after a solar farm is constructed nearby.

In this issue

Table 4. Select coefficient estimates for agricultural land sales over 30 acres.[a]

| | Sample Includes: | | | |
|---|---|---|---|---|
| | **Sale prices from $1,000 to $7,000 per acre** | **Sale prices from $1,000 to $10,000 per acre** | **Sale prices from $300 to $7,000 per acre** | **Sale prices from $300 to $10,000 per acre** |
| | **(1)** | **(2)** | **(3)** | **(4)** |
| ln *(dist_sf)* | -0.003 | 0.008 | -0.042 | -0.022 |
| | (0.047) | (0.051) | (0.055) | (0.058) |
| *After* | 0.158 | 0.164 | -0.050 | -0.065 |
| | (0.159) | (0.182) | (0.183) | (0.195) |
| ln *(dist_sf)* x *After* | -0.007 | -0.011 | 0.056 | 0.066 |
| | (0.069) | (0.071) | (0.088) | (0.089) |
| ln *(dist_tl)* | 0.043* | 0.044* | 0.024 | 0.037 |
| | (0.023) | (0.023) | (0.029) | (0.029) |
| ln *(dist_tl)* x *After* | -0.084** | -0.073** | -0.099* | -0.099** |
| | (0.036) | (0.036) | (0.050) | (0.048) |
| Adjusted R2 | 0.185 | 0.238 | 0.125 | 0.167 |
| Observations | 1,555 | 1,676 | 1,865 | 1,986 |
| Wald test[b] | 1.662 | 0.900 | 3.378 | 2.527 |
| P-value | (0.198) | (0.343) | (0.067) | (0.113) |

[a] The dependent variable is the natural log of sales price per acre. Agricultural land that sold between 2007 and 2019 and which are within 5 miles of the nearest solar farm are included in the sample. All models include all spatial and land characteristics as described in Table 3, as well as county-by-year fixed effects and solar farm fixed effects. Robust standard errors clustered at solar farm level are in parentheses, and *** p<0.01, ** p<0.05, and * p<0.1.

[b] Wald test is for ln *(dist_tl)* + ln *(dist_tl)* x *After* = 0, and the corresponding p-value is in the next row.

ABASHIDZE, NINO. Essays on Economic and Health Effects of Land Use Externalities. (Under the direction of Dr. Harrison Fell).

In the second essay of my dissertation, I link ground-level solar systems to housing prices in surrounding neighborhoods both in urban and rural areas. A novel, street network distance measure is utilized in the analysis to capture the visual externalities generated by solar farms. In a difference-in-differences-style framework, I explore the effect of the construction of a solar farm on houses in close proximity that are exposed to the externalities generated by a solar farm compared to houses located further away. The results provide evidence that the construction of a solar farm significantly decreases residential housing values for homes located less than one mile (measured via street network) from a farm and the effect is larger for houses located within a half-mile of a solar farm. The analysis also reveals that the construction of the solar farm reduces the number of house sales in close proximity. Interestingly, the results of stratified analysis indicate that the effect of solar farm construction is homogenous across communities.

# Property Value Impacts of Commercial-Scale Solar Energy in Massachusetts and Rhode Island

Vasundhara Gaur and Corey Lang
Department of Environmental and Natural Resource Economics
University of Rhode Island

September 29, 2020

While utility-scale solar energy is important for reducing dependence on fossil fuels, solar arrays use significant amounts of land (about 5 acres per MW of capacity), and may create local land use disamenities. This paper seeks to quantify the externalities from nearby solar arrays using the hedonic method. We study the states of Massachusetts and Rhode Island, which have high population densities and ambitious renewable energy goals. **We observe over 400,000 transactions within three miles of a solar site**. Using a difference-in-differences, repeat sales identification strategy, **results suggest that houses within one mile depreciate 1.7% following construction of a solar array, which translates into an annual willingness to pay of $279. Additional results indicate that the negative externalities are primarily driven by solar developments on farm and forest lands in non-rural areas.** For these states, our findings indicate that the global benefits of solar energy in terms of abated carbon emissions are outweighed by the local disamenities.

# When Energy Issues Are Land Use Issues: Estimating Preferences for Utility-Scale Solar Energy Siting

Vasundhara Gaur, Corey Lang, Gregory Howard and Ruth Quainoo

*Land Economics*, August 2023, 99 (3) 343-363; DOI: https://doi.org/10.3368/le.99.3.111221-0130R1



### Abstract

Although solar energy receives broad support in general, utility-scale solar arrays can be contentious because at the siting stage, it becomes a land use issue replete with potential disamenities and trade-offs. We conduct a choice experiment survey to estimate preferences for attributes of utility-scale solar arrays in Rhode Island, United States. Our results suggest that the largest indicator of solar development approval is prior land use, with residents willing to pay an additional $10–$21 in monthly utility bills for developments in commercial, industrial, brownfield, and covered landfill areas, and $13–$49 to avoid developments on farm and forest land.

# **New USDA Proposal**: Eliciting Landowner and Public Values and Preferences regarding Agrivoltaics: Inform Localities, Policymakers, and Solar Designers

PIs at Virginia Tech; co-PI: Dr. Rich Stedman

Figure 3. Example APV Systems

Note: Image sources are Fraunhofer ISE, University of Arizona, and NREL.

South Korean 20-Mile Solar Bike Highway Generates Electricity

Figure 2. A Graphical Illustration of Proposed Activities

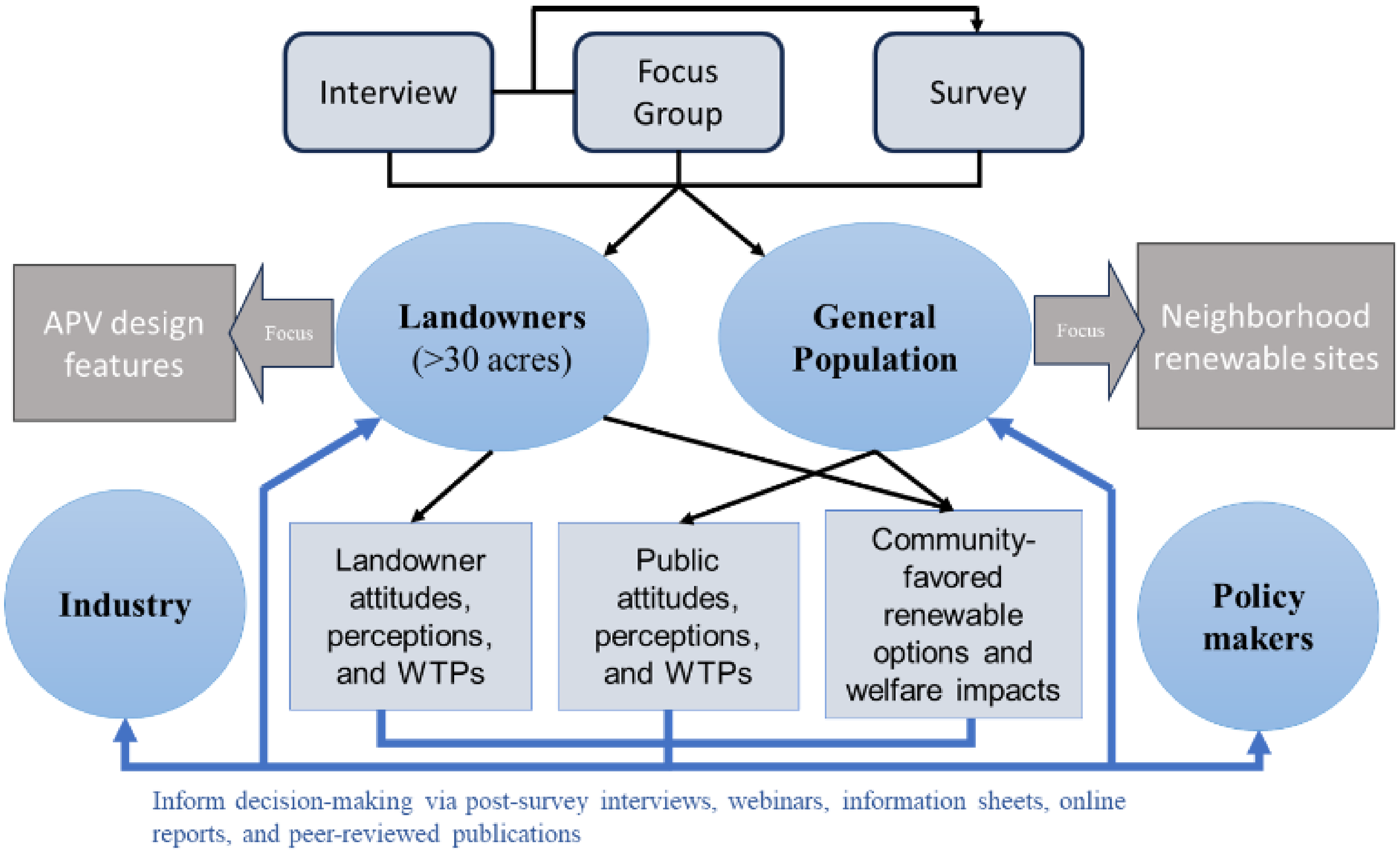


Figure 5. Example choice questions for landowners and general population

Example Choice Occasion for Landowners

| **I Choose →**<br>**Site Features ↓** | **Status Quo**<br>☐ | **Renewable Energy Option A**<br>☐ | **Renewable Energy Option B**<br>☐ |
|---|---|---|---|
| **Dual Use** | *N/A* | *Yes*<br>Agrivoltaics | *No*<br>Utility-scale solar site |
| **Generation Capacity**<br>(*MW-dc*) | *0* | *2 MW* | *5 MW* |
| **Site Acreage** | *N/A* | *23 Acres* | *25 Acres* |
| **Racking System** | *N/A* | *Overhead*<br>12 ft clearance height to allow normal ag. operation | *Ground-Mount*<br>Nature vegetation below solar panels |
| **Agricultural Operation** | *Row Crops* | *Row Crops* | *N/A* |
| **Agricultural Yield**<br>(*percentage relative to status quo yield*) | *100%* | *83%* | *0%* |
| **Future Cash Flow from Site for You**<br>(*$/yr., lease and dividends, not counting ag. revenue*) | *$ 0* | *$ 40,000 per year* | *$ 70,000 per year* |
| **Your Upfront Investment**<br>(*$, your upfront one-time cost to make it happen*) | *$ 0* | *$ 50,000* | *$ 30,000* |

Example Choice Occasion for Rural Residents

| **I Choose →**<br>**Neighborhood Site ↓** | **Status Quo**<br>☐ | **Renewable Energy Option A**<br>☐ | **Renewable Energy Option B**<br>☐ |
|---|---|---|---|
| **Site Type** | *N/A* | *APV*<br>Agrivoltaics | *PV*<br>Utility-scale solar site |
| **Installed Green Capacity**<br>(*MW-dc*) | *0* | *2 MW* | *5 MW* |
| **Installation Acreage** | *N/A* | *23 Acres* | *25 Acres* |
| **Visual Effect** | *N/A* | *Not visible* | *Visible from major road* |
| **Agricultural Yield**<br>(*percentage relative to status quo yield*) | *100%* | *83%* | *0%* |
| **Direct Benefits to you**<br>(*$/yr., your locality have negotiated these community benefits with the site owner, including dividends and lower energy bills for you*) | *$ 0* | *$ 400 per year* | *$ 700 per year* |
| **Your Upfront Investment**<br>(*$, your governments invest in the site with tax dollars from you*) | *$ 0* | *$ 300* | *$ 250* |

# Thank you!

Wendong Zhang
wendongz@cornell.edu

https://wendongzhang.weebly.com/

Cornell University Founded A.D. 1865

Dyson
Cornell
SC Johnson College of Business