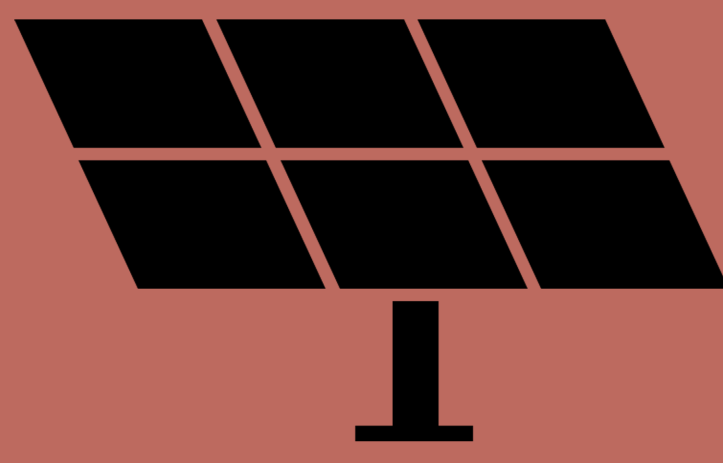


BUILDING A SOLAR STATE

ANALYZING TRENDS IN NEW YORK PHOTOVOLTAIC INSTALLATIONS



OVERVIEW

Solar photovoltaic (PV) technology constitutes a small, yet rapidly growing portion of the U.S. electric grid mix. New York State has become a leader in photovoltaic technology, ranking 10th in both installed megawatts of solar and future solar growth projections according to the Solar Energy Industries Association (SEIA). Although New York's solar landscape is growing, the details of that growth are complex and potentially dependent on a variety of factors including demographics and government policy. This project will look at the growth of solar PV since 2000, examine trends in said growth, and attempt to assign responsibility for this growth to a variety of factors.

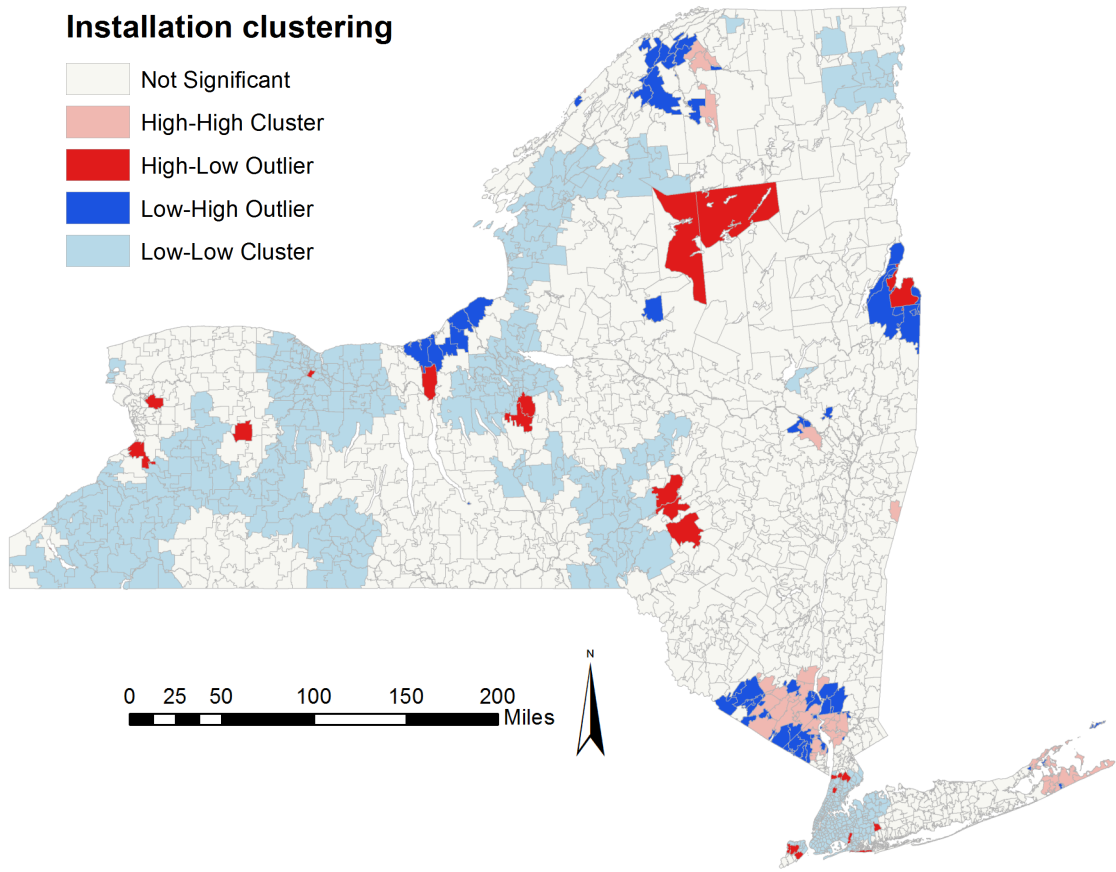
RESULTS

The NYSERDA installation data indicates that the Hudson Valley region of New York has some of the highest installations per capita in the state. Western New York. The maps produced as a result of time-space analysis indicate an increasing number of photovoltaic installations in every region of the state. There are a limited number of zip codes with zero installations, but most locations show increasing installations through time.

According to a Global Moran's I test, there is evidence of clustering with a significant z-score, indicating that PV installations in New York are not clustered by chance. A Local Moran's I analysis (included below) corroborates this finding, showing significant Low-Low clustering, as well as patches of High-High, High-Low, and Low-High clustering.

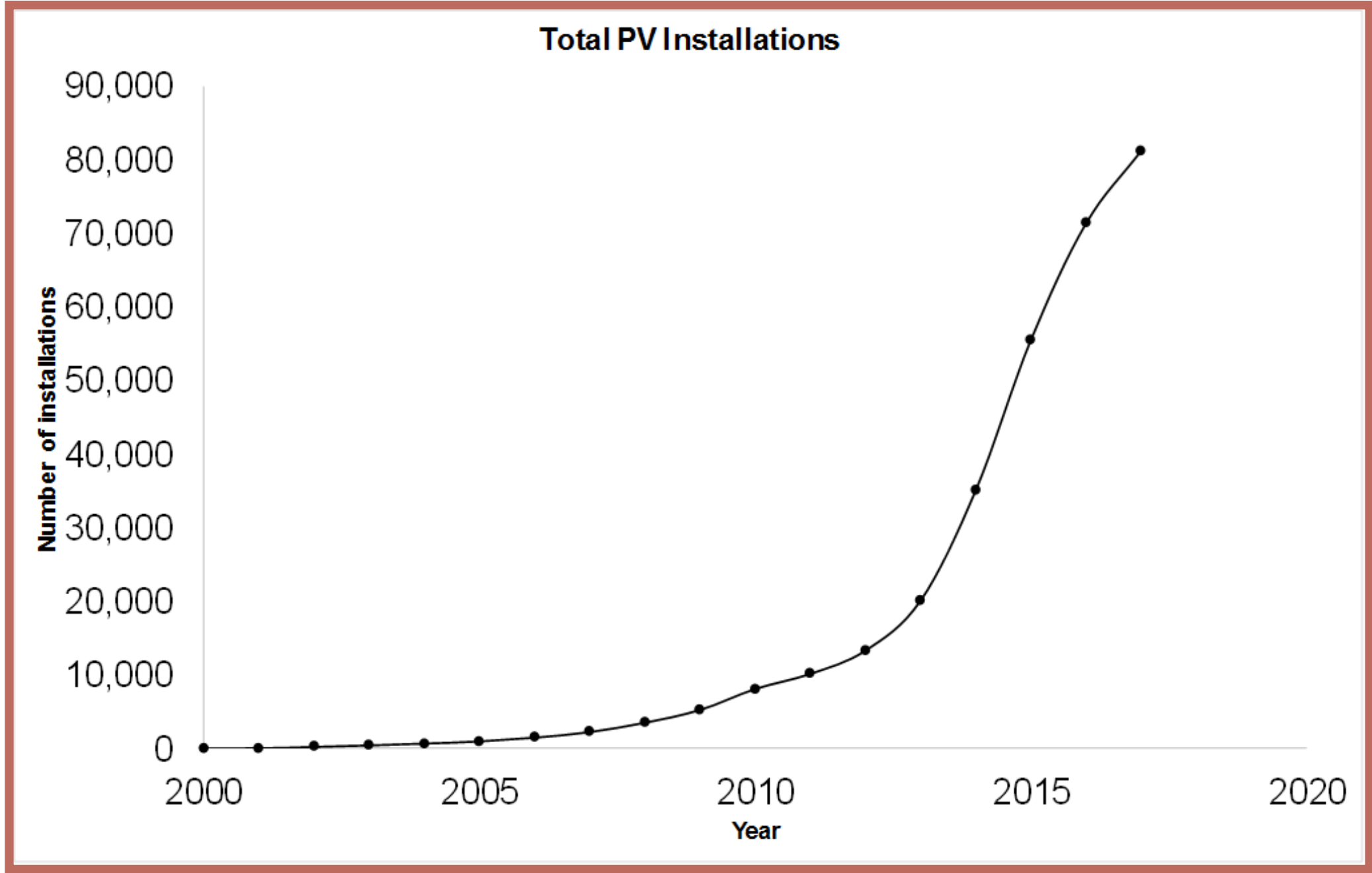
Bivariate regression analysis indicated installations per capita were positively correlated with white, male populations.. Median household income, a factor that might seem to be highly positively correlated with PV installations, was an insignificant factor in PV adoption. Below are the results of several bivariate regressions run in GeoDa.

Bivariate regression results		
Variable	T-statistic	Probability
Median household income	1.80492	0.07126
Per capita income	1.00449	0.3153
Male population	2.26673	0.02353
Female population	-2.27172	0.02323
White population	2.33151	0.01984
Black population	-1.66363	0.09637
Minority population	-2.11567	0.03452



METHODOLOGY

Data on solar installations in New York was obtained through the New York State Energy Research and Development Authority (NYSERDA), geocoded based on latitude/longitude measurements, and spatially joined to census and ACS data at the zip code level. Space-time analysis was used to visualize the changing PV installation landscape each year, resulting in maps displaying the progression of PV installations yearly. Bivariate spatial regressions were run in GeoDa to identify correlations between census and ACS information and total PV installations at the zip code level. Additionally, both local and global Moran's I tests were run to search for patterns of clustering for PV projects. In order to determine areas where PV adoption has been highest, installations per zip code were normalized by population. All calculations and maps were made on an installations per capita basis. In addition, ACS and census data was normalized by zip code population.



Total PV Installations in New York over the course of 18 years

ANALYSIS AND CONCLUSIONS

Time analysis: Looking more closely at the time analysis maps, an early enthusiasm for solar can be seen in zip codes on Long Island, where the first two installations in the NYSERDA database are located. By the end of 2017, although Long Island zip codes remained on the higher end of the installations per capita scale, several zip codes in the Hudson Valley region displayed higher total PV installations per capita. This could be a factor of population normalization, as Long Island zip codes have higher populations than those in the Hudson Valley on average. The time analysis also reveals an encouraging trend in solar adoption – as the solar market matures, installations are spreading to most zip codes in the state. There are pockets of high installations in every region of the state, indicating the value of solar PV to many types of residents. This has happened over the relatively short period of 18 years as well, pointing towards high future potential.

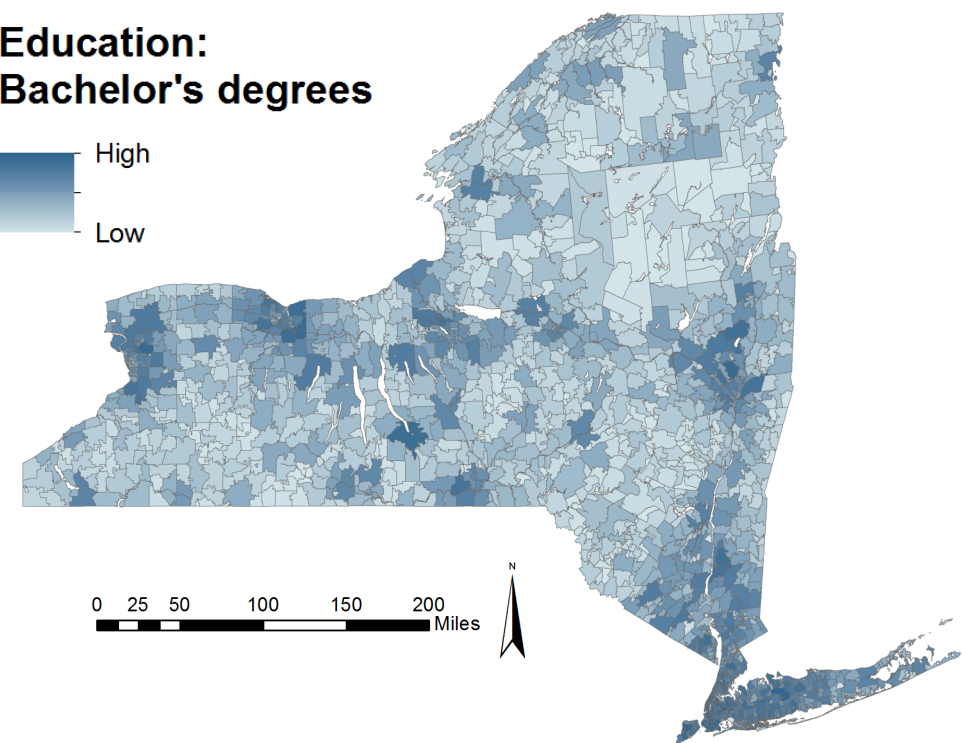
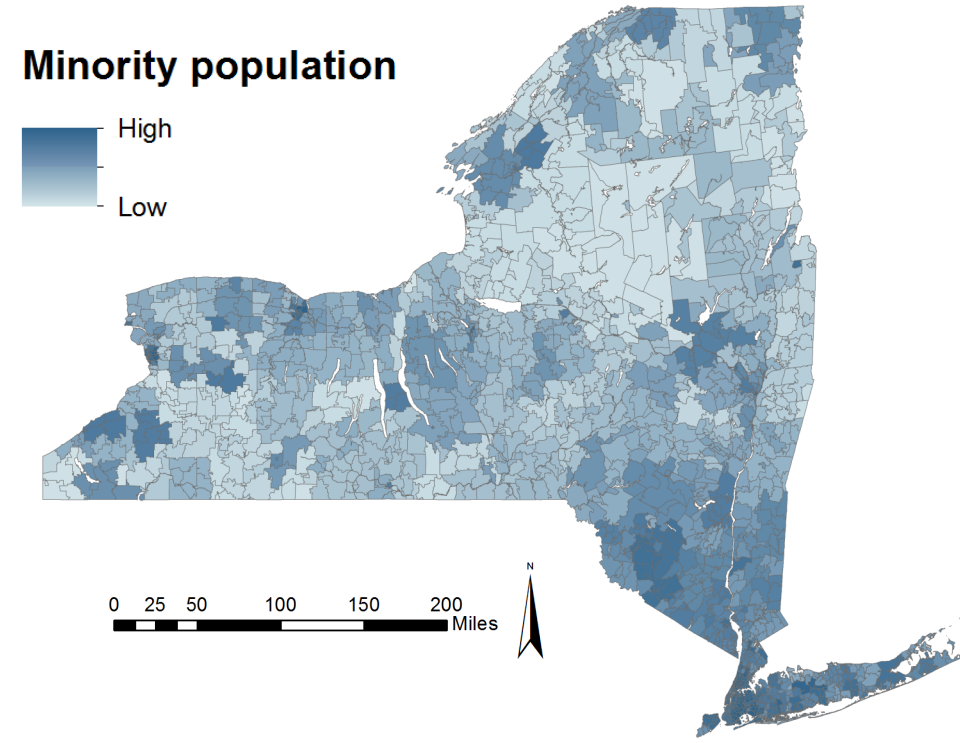
Clustering: Both Moran tests indicate that solar PV installations are prone to clustering distributions. There are widespread areas of Low-Low clustering throughout the state, indicating the need for an initial installation or group of installations to trigger PV growth in an area. The area of High-Low clustering in the northern part of the state is likely due to those zip codes being surrounded by designated wilderness areas with very low numbers of installations.

Policy decisions: A set of non-spatial factors in this analysis is the policy decisions and changes concerning solar, both at the state and national level. There have been several important policies implemented over the time that this project covers that are noted on the timeline below. The policies included are:

- Implementation of the 2002 New York State Energy Plan
- Reinstatement of the solar Investment Tax Credit (ITC) in 2005
- Launch of the U.S. Department of Energy SunShot Initiative in 2011
- Launch of the NY-Sun program in 2012
- Opening of the NY Green Bank in 2014
- Extension of the ITC in 2015

Although causation cannot be assumed, several of the major policy decisions by the federal and state governments came during times right before or during accelerated growth. One especially impactful policy decision seems to be the launch of the NY-Sun program in 2012. According to NYSERDA's website, NY-Sun has incentive programs covering a variety of solar customer types aiming to develop a sustainable, self-sufficient solar industry in New York.

Demographics: Solar installations were positively correlated with male population and white population based on bivariate regression analysis, and negatively correlated with minority population. This confirms commonly held beliefs about solar adoption. Below are two examples of maps showing minority population and bachelor's degrees. Bachelor's degrees are concentrated in Long Island and spots in the Hudson Valley, exhibiting a similar pattern to overall installations, while minority population is spread more evenly throughout the state.



SOURCES

Solar installations: data.ny.gov, compiled by the New York State Energy Research and Development Authority (NYSERDA)
Demographic and population data: 2010 U.S. census and 2010 American Community Survey (ACS), compiled by ESRI
Policy data: NYSERDA and the Institute for Energy Research, Solar Energy Industry Association (SEIA)

Projection: NAD 1983 StatePlane New York Central FIPS 3102 (Meters)

Cartography and research by Jacob Marsh



The 2002 New York State Energy Plan highlights recommendations for energy diversity and a healthy environment

The federal ITC is reinstated, giving solar shoppers a limited tax credit for investing in a solar energy system

NY-Sun is launched, a New York State program providing numerous incentive programs for going solar

The NY Green Bank opens, providing financing options for green projects

The U.S. Department of Energy launches the SunShot initiative to bring down the cost of solar

A new extension for the ITC is approved, keeping the credit around in some form indefinitely

