
LONG ISLAND SOLAR ROADMAP

Spatial Analysis Work Plan – Updated 11 February 2019

Goals

1. Identify low-impact, low-conflict sites for mid- to large-scale solar installations (250 kW DC and larger) on rooftops, parking lots, and previously-disturbed lands through a site suitability analysis.
2. Overlay site suitability analysis results with current land use regulations and grid interconnection information to determine where solar can be installed now and where permitting challenges and grid modifications may need to be addressed to utilize additional solar resources.
3. Generate map products and reports to summarize the maximum potential capacity of solar installations on Long Island.

We expect these results to be used to:

- Build knowledge/understanding of the potential for mid- to large-scale solar installations on Long Island
- Identify where opportunities exist to develop mid- to large-scale solar installations on low-impact sites
- Identify where potential opportunities are being restricted by current land use regulations and interconnection constraints
- Along with economic analysis and social science research, these data and maps will be used to inform recommendations to drive solar development to low-impact areas and reduce siting conflicts.

Deliverables

1. Online map displaying parcels in Nassau and Suffolk County that meet site selection criteria requirements for low-impact sites, containing spatial overlays for visualizing current land use regulations and grid interconnection feasibility. In addition to suitable parcels, polygons of the approximated available installation area for rooftop, parking lot, and ground-mounted solar will also be displayed.
2. Written report summarizing estimated maximum potential solar capacity on low-impact sites for each town and county, broken down by installation type (rooftops, parking lots, and previously-disturbed lands).

Research questions

1. What features make a site suitable for rooftop, parking lot, and ground-mounted solar installations?
 - a. What is the minimum parcel size to be included in the suitability analysis?
 - b. How do we define “previously-disturbed” sites for ground-mounted solar installations?
 - c. What ecological, land cover, land protection status, and other attributes make a site unsuitable and excluded from consideration?
2. Where are the suitable sites for mid- to large-scale (i.e. 250 kW and greater) solar development on Long Island?
 - a. How many suitable parcels on Long Island support the minimum target solar installation size?
 - b. What is the breakdown of available space for each type of solar installation within a suitable parcel?
3. What is the maximum solar energy capacity for each installation type that can be installed at suitable sites on Long Island?
4. Where do zoning and other municipal planning tools or programs restrict siting in low-impact, least-conflict areas?
 - a. What zoning and other municipal planning tools or programs restrict installation of each type of solar installation?
 - b. How many parcels and how much potential installed capacity are being restricted by current policies?
5. Where can solar on suitable sites be connected to the grid without additional investment in grid upgrades?
6. What overlays (e.g. environmental justice areas, Brownfields undergoing remediation) in addition to policy and interconnect capability should we consider for visualizing installation feasibility on suitable sites?

Approach

We have gathered input from members of the Leadership Team and Steering Committee, as well as our Advisors and Consortium members to develop a set of site selection criteria and overlays to answer research questions 1 and 6. The suitability analysis will be conducted by members of the Leadership Team and Spatial Analysis Working Group, using best available, publicly acquirable datasets. Members of the Leadership Team and Spatial Analysis Working Group will generate new data for the parking lot analysis using heads up digitizing based on high-resolution aerial imagery. We are also exploring the option of using automated image classification techniques, as well as crowdsourcing task platforms to address this data need. A graduate student intern from the Environmental Observation and Informatics

Program at University of Wisconsin-Madison will also support the spatial analysis work to address research questions 2 and 3. Details on data processing are outlined in the Methods section below.

We will collaborate with municipalities in Nassau and Suffolk Counties to provide zoning and land use regulation information to answer research question 4. Grid interconnection analysis will be conducted by Long Island Power Authority (LIPA) and PSEG-LI to answer research question 5. Creation of the final mapping product and accompanying reports is the responsibility of the Leadership Team.

Review of the suitability analysis results and of the final web map and reports will be completed by the full Consortium. Intermediary analysis results will be reviewed by the Steering Committee, and progress updates will be regularly shared with the Working Group.

Currently, we are setting aside farmlands from the spatial analysis as we continue to work with our partners in the farm community to strategize how best to incorporate farmlands in the project.

Opportunities to improve upon the spatial analysis work, such as incorporating additional overlays and estimating energy capacity for additional sites, may be pursued after completion of the research described in this work plan, if the Leadership Team determines there is sufficient time, capacity, funding, and alignment with the project's overall goals.

Methods

Suitability analysis

Suitability analysis for Nassau and Suffolk Counties will be undertaken using publicly-accessible data available at the countywide scale. Additional data that may provide more accurate results within specific towns or regions smaller than the county scale will be rolled in to the analysis at a later stage following county-wide data processing.

Parcel selection

1. Exclude parcels by New York State property type classification codes that are considered unsuitable for solar development (Appendix Table I).
2. Aggregate adjacent parcels by ownership type data found in New York State tax parcel records. Consolidated tracts of land may meet the minimum combined installation size threshold, where individual parcels may not. We are interested in identifying ownership type classes for private, public (municipal, county, and state), non-governmental, and public school entities.
3. Exclude parcels that do not meet the minimum parcel size, that is, parcels that are not large enough to host a minimum combined 250kW solar array on rooftops, parking lots, or previously-disturbed lands. We will use a minimum parcel size of **0.75 ac (32,670 sq. ft) in Nassau County and 1.25 ac (54,450 sq. ft) in Suffolk County**.

Setting a minimum parcel size threshold constrains the number of parcels we consider from the outset and is necessary to keep the project within the realm of our resource capacity and time frame. High-density rooftop systems require the least amount of space for solar energy

generation compared to parking lot and ground-mounted installations (Table 1), so using the rooftop requirement as a cutoff allows us to consider a larger initial pool of parcels than compared to parking lot or ground-mounted arrays. Basing this assumption on the highest efficiency arrangement ensures that we do not overlook sites that could support large-capacity solar.

To determine the minimum parcel size for each county, we analyzed the distribution of parcel size for parcels that contain rooftops large enough to host at least a 250kW solar array (Appendix Table II). The analysis indicated that 80% of all buildings in Nassau County that could support a 250 - 500 kW rooftop solar array occurred on parcels \geq **0.75 ac (32,670 sq. ft)**.

For Suffolk County, the parcel size distribution analysis (Appendix Table II) indicated that 80% of all buildings that could support a 250 - 500 kW rooftop solar array occurred on parcels \geq 2.25 ac (98,010 sq. ft). As this size would exclude parcels containing parking lots that could support the same size array (Table 1), we will use the minimum parking lot size of **1.25 ac (54,450 sq. ft)** as the parcel size threshold for Suffolk County.

Table 1. Minimum area needed for rooftop, ground-mounted, and parking lot solar installations. Due to the nature of how solar arrays must be installed on parking lots to allow for driving, the total lot size for parking lot installations is also reported. An expanded version of this table comparing additional system sizes is available in Appendix Table III.

System size	High-density rooftop array	Ground-mounted array	Parking lot array	Parking lot, total lot size
250kW	0.7 ac ¹ (30,492 sq. ft)	0.8 ac ² (34,848 sq. ft)	0.9 ac ¹ (39,204 sq. ft)	1.25 ac ³ (54,450 sq. ft)

4. Exclude areas incompatible with low-impact solar development. Full list of data sources to be used in the suitability analysis is available in Appendix Table IV.
 - a. Exclusions removing entire parcels from analysis:
 - Protected open space and other protected priorities, Suffolk County open space protection plan, PEP open space protection plan
 - Brownfields, Superfund sites, and other contaminated sites that have not completed remediation
 - Sites of historical and cultural significance
 - b. Exclusions removing unsuitable areas within parcels from analysis:
 - Areas within 300 feet of freshwater and tidal wetlands and hydrologic features
 - Ecologically-important areas

¹ Southern California Edison's Preferred Resources Pilot (PRP) Solar Siting Survey <http://www.clean-coalition.org/site/wp-content/uploads/2017/04/SCE-PRP-Solar-Siting-Survey-Summary-07_gt-08-Apr-2015.pdf>

² Estimates of ground-mounted arrays in Brookhaven, NY

³ Estimate of parking lot array in Athens, OH

5. Export results of parcel selection to conduct additional workflows for rooftop, ground-mounted, and parking lot suitability analyses described below.

Rooftop analysis

1. Overlay building footprints data on parcel selection results.
2. Calculate potential area for rooftop installations.

Ground-mount analysis

For this project, we will identify suitable sites for ground-mounted solar installations on previously-disturbed areas. We define “previously-disturbed” as developed areas undergoing un-development, areas that have been cleared and are not currently being used, and barren or vacated areas that remain unused.

1. Conduct land cover and urban imperviousness change analysis using existing data (2001 – 2011) to identify previously-disturbed areas where:
 - a. Areas were previously barren and remained barren
 - b. Areas were previously vegetated and became barren (cleared but not developed)
 - c. Areas were previously barren and becoming vegetated due to non-development (transitioning from developed/barren to shrubland/forest)
 - d. Areas were undeveloped (decreasing in % imperviousness, or transitioning from high-density developed to low-density developed or vegetated or barren)
2. Conduct land cover change analysis using image classification analysis on satellite imagery to identify areas that became previously-disturbed (following criteria above) between 2011 and the present.
3. Exclude areas incompatible with ground-mount solar installations, such as areas in flood zones, and areas vulnerable to sea-level rise. Full list in Appendix Table IV.
4. Overlay previously-disturbed areas on the suitable parcel selection results.
5. Calculate potential area for ground-mounted solar installation on previously-disturbed sites.

Parking lot analysis

1. Within suitable parcels, and where capacity to do so is available, digitize parking lots using current, high-resolution aerial imagery.
2. For all other suitable parcels where manual digitization is infeasible, overlay existing parking lots data (Open Street Maps).
3. Conduct image classification analysis to identify parking lots using current satellite imagery. Overlay results on suitable parcels.
4. Calculate potential area for parking lot installations.

Calculate solar potential

1. Estimate ranges of capacity (kW) for low to high efficiency solar arrays that could be installed on rooftops, parking lots, and low-impact areas. Summarize the total capacity that could potentially be installed on each parcel.
2. Exclude parcels that do not meet the combined minimum capacity of 250 kW.
3. For remaining suitable parcels, estimate the potential annual energy output (kWh) that can be generated from each type of installation using solar insolation data (Sustainable CUNY or similar). Summarize results by parcel.

Overlays

1. **Zoning feasibility.** Provide towns with the results of the suitability analysis and request feedback on the feasibility of solar installation on those sites based on current land use regulations and policies.
2. **Grid connection.** Provide LIPA with the results of the suitability analysis to conduct a grid interconnectivity analysis and identify where solar can be installed now and where grid modifications may be needed to utilize solar resources.
3. After receiving these analysis results from the towns and LIPA, estimate the solar potential and capacity that would be restricted due to policy or interconnection constraints.

Map product and final report development

1. Build web map using ArcGIS Online and host on TNC servers. Create layers for each of the solar installation types, as well as whole boundaries for suitable parcels. Layers can be toggled on and off to isolate individual datasets.
2. Produce a report summarizing data findings by county and by town, broken down by installation types.

Key sources of information

1. We will be using the best available, publicly acquirable datasets to define the suitability criteria. Please see Appendix Table IV for full list of data resources.
2. Parking lot digitization will be referenced from high-resolution aerial imagery from New York Statewide Digital Orthoimagery Program (NYSDOP 2016).
3. Solar insolation data from Sustainable CUNY or web tools such as Google Sunroof and PVwatts

Appendix

Table I. Parcels with the following land use codes are incompatible with solar energy development. Codes listed in *italics* pertain only to ground-mount solar, e.g. rooftops and parking lots within school parcels are eligible for solar. A full description of land use codes can be found here:

<https://www.tax.ny.gov/research/property/assess/manuals/prclas.htm>

Code	Description
183	Aquatic: Oysterlands, fish and aquatic plants
190	Fish, Game and Wildlife Preserves
200 – 283	Residential
315	Underwater vacant land
448	Piers, Wharves, Docks and Related Facilities
<i>612</i>	<i>Schools (primary, elementary, and secondary)</i>
<i>661</i>	<i>Army, Navy, Air Force, Marine and Coast Guard</i>
692	Roads, Streets, Highways and Parkways, Express or Otherwise (if listed) Including Adjoining Land
<i>695</i>	<i>Cemeteries</i>
820	Water
822	Water Supply
911	Forest Land Under Section 480 of the Real Property Tax Law (Forest Tax Law)
932	State Owned Land Other Than Forest Preserve Covered Under Section 532-b, c, d, e, f, or g of the Real Property Tax Law (State-owned forest land)
940	Reforested Land and Other Related Conservation Purposes (Tax exempt under the Forest Tax Law)
942	County Owned Reforested Land (Tax exempt under the Forest Tax Law)
970	Other Wild or Conserved Land
972	Land Under Water, Either Privately or Governmentally Owned
315	Underwater land (explicitly called out in Huntington’s database)

Table II: Number of buildings in Nassau and Suffolk County that can support solar system sizes, and the size distribution of the parcels they occur on.

System size	Minimum rooftop size required	# of buildings in Nassau	# of buildings in Suffolk	Distribution of parcel size in Nassau	Distribution of parcel size in Suffolk
250kW	0.7 ac (30,492 sq. ft)	1052 (0.7 to 1.39 ac)	1304 (0.7 to 1.39 ac)	70% of buildings are on >= 1.5 ac parcels, 77% are on >=1 ac, 80% are on >= 0.75 ac , 89% are on >= 0.25 ac	66% of buildings are on >= 3ac parcels, 75% are on >=2.5ac, 80% are on >= 2.25ac , 87% are on >=2ac
500kW	1.4 ac (60,984 sq. ft)	429 (1.43 to 2.87 ac)	681 (1.43 to 2.87 ac)	82% are on >=5ac parcels	80% are on >= 2 ac parcels
1000kW	2.9 ac (126,324 sq. ft)	176 (2.87 ac and up)	304 (2.87 ac and up)	81% are on >=10ac parcels	80% are on >= 5 ac parcels

Table III: Minimum area needed for rooftop, ground-mounted, and parking lot solar installations. Due to the nature of how arrays must be installed on parking lots to allow for driving, the total lot size for parking lot installations is also reported.

System size	High-density rooftop array	Ground-mounted array	Parking lot array	Parking lot, total lot size
250kW	0.7 ac ¹ (30,492 sq. ft)	0.8 ac ² (34,848 sq. ft)	0.9 ac ¹ (39,204 sq. ft)	1.25 ac ³ (54,450 sq. ft)
500kW	1.4 ac (60,984 sq. ft)	1.6 ac (69,696 sq. ft)	1.9 ac (82,764 sq. ft)	2.5 ac (108,900 sq. ft)
1000kW	2.9 ac (126,324 sq. ft)	3.2 ac (139,392 sq. ft)	3.8 ac (165,528 sq. ft)	5.0 ac (217,800 sq. ft)

1 Southern California Edison's Preferred Resources Pilot (PRP) Solar Siting Survey <http://www.clean-coalition.org/site/wp-content/uploads/2017/04/SCE-PRP-Solar-Siting-Survey-Summary-07_gt-08-Apr-2015.pdf>

2 Estimates of ground-mounted arrays in Brookhaven, NY

3 Estimate of parking lot array in Athens, OH

Table IV: List of county-wide data sources to be used in the spatial analysis.

Features that make a site unsuitable for solar:

Site feature	Data source(s)	Notes	Applies to:		
			Rooftops	Parking lots	Ground-mount
Protected open spaces	TNC; NYPAD; Suffolk County Open Space protection plan; PEP Open Space protection plan	Rooftops and parking lots in protected areas are eligible			x
Unremediated Brownfields & Superfund sites	EPA; NYS DEC Remediation Site Boundaries	Remediated sites are suitable	x	x	x
Areas of historic and cultural significance	NYS OPRHP Historic Sites and Park Boundaries; NYS Heritage Areas	Rooftops and parking lots in protected areas are eligible			x
Proximity to hydrologic features and wetlands	USGS National Hydrography Dataset National Wetlands Inventory	Features buffered 300 ft. Rooftops within buffer distance are eligible		x	x
Flood zones	FEMA	Rooftops and parking lots in 100-yr floodzones are eligible			x
Vulnerable to sea level rise	NOAA	Rooftops and parking lots in 3-ft SLR zone are eligible			x
Ecologically significant areas	Natural Heritage Community Occurrences		x	x	x

Additional data sources:

Tax parcel boundaries and tabular data	NYS parcel centroids 2016; Suffolk County 2018; Nassau County 2014
Building footprints	Suffolk County 2006; Microsoft US Building Footprints
Parking lots	OpenStreetMap; NYS property codes; image classification
National Land Cover Dataset	Multi-Resolution Land Characteristics Consortium 2001, 2006, 2011
Impervious surfaces	Multi-Resolution Land Characteristics Consortium 2001, 2006, 2011
High-resolution aerial imagery	NYSDOP 2016
Solar irradiation	CUNY; NREL 10-km avg total solar resource (1998-2009)

Environmental justice areas	DEC
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