LONG ISLAND SOLAR ROADMAP

Advancing Low-Impact Solar in Nassau & Suffolk Counties

Acknowledgments

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Contents

Acknowledgments 2
Figures and Tables 4
Acronyms 5
Executive Summary 6
Introduction 12
Approach and Methodology 20
Key Findings 26
Opportunities for low-impact solar siting 26
Benefits of solar development for Long Island residents 33
Limitations for low-impact solar siting 38
Importance of battery storage 44
Opportunities and challenges for four major property types 45
Long Islanders' perspectives on solar development 55
Recommended Strategies and Actions 60
Strategy 1. Create frameworks for achieving CLCPA mandates 61
Strategy 2. Direct and incentivize low-impact solar siting 65
Strategy 3. Reduce development costs for low-impact sites 68
Strategy 4. Improve interconnection feasibility for low-impact solar 73
Strategy 5. Support low-impact, on-farm solar 77
Strategy 6. Encourage solar on commercial and industrial properties 82
Strategy 7. Improve access and equity through community solar 86
Strategy 8. Build and mobilize community support 90
Implementing the Roadmap in a Changing World 94
Online Resources 96
References 99
Appendices 106
Appendix A: Maps of low-impact sites in each city and town in Nassau and Suffolk Counties 106
City of Glen Cove 106
Town of Hempstead 107
City of Long Beach 108
Town of North Hempstead 109
Town of Oyster Bay 110
Town of Babylon 111
Town of Brookhaven 112
Town of East Hampton 113
Town of Huntington 114
Town of Islip 115
Town of Riverhead 116
Town of Shelter Island 117
Town of Smithtown 118
Town of Southampton 119
Town of Southold 120
Appendix B: Financial incentives and funding mechanisms for solar development 121
Appendix C: Solar business models 122
Appendix D: Recommended actions organized by sector 124

COVERS: Long Island Solar Farm at Brookhaven National Laboratory © Jessica Price/The Nature Conservancy

Figures

Figure 1. Total estimated low-impact solar siting potential in each Long Island city and town 8

Figure 2. Electric energy production in 2019 by fuel source 14

Figure 3. Average daily solar insolation in New York in 2017 16

Figure 4. Map of the properties where low-impact sites for mid- to large-scale solar installations are located 27

Figure 5. Number of low-impact sites by installation capacity (MW) 28

Figure 6. Map of low-impact sites for solar installations in Nassau County 29

Figure 7. Estimated potential solar installation capacity (MW) in Nassau County cities and towns 30

Figure 8. Map of low-impact sites for solar installations in Suffolk County 31

Figure 9. Estimated potential solar installation capacity (MW) in Suffolk County towns 32

Figure 10. Estimated available hosting capacity on Long Island distribution feeder circuits 41

Figure 11. Survey respondents' support for mid- to large-scale solar 56

Figure 12. Influence of siting, environmental, and economic factors on survey respondents' support 57

Figure 13. Survey respondents' support for solar project financing options 57

Tables

Table 1. New York State Goals and Target Dates 13

Table 2. Long Island Renewable Energy Goals and Progress Toward the 2030 CLCPA Mandates 15

Table 3. Factors Used to Determine Site Suitability Criteria for Solar Installations 22

Table 4. Estimated Potential Low-Impact Solar Installation Capacity (MW) on Long Island 27

Table 5. Estimated Area (mi^2) of Low-Impact Sites for Solar in Nassau County Cities and Towns 30

Table 6. Estimated Area (mi^2) of Low-Impact Sites for Solar in Suffolk County Towns 32

Table 7. Estimated Reductions in Fossil-Fueled Electricity Generation, Carbon Emissions, and Air Pollution from a 5-GW Increase in Installed Solar Capacity in the Northeast Region 34

Table 8. Estimated Avoided Human Health Impacts and Associated Monetary Savings Over a 20-Year Period from a 5-GW Increase in Installed Solar Capacity in the Northeast Region 35

Table 9. Number of Jobs in the Solar Industry Sector 2015–2019 37

Acronyms

AVERT	Avoided Emissions and Generation Tool
BTU	British Thermal Units
CCA	Community Choice Aggregation
CESIR	Coordinated Electric System Interconnection Review
CLCPA	Climate Leadership and Community Protection Act
CO_2	Carbon Dioxide
COBRA	CO-Benefits Risk Assessment model
C-PACE	Commercial Property Assessed Clean Energy Financing
DC	Direct Current
DER	Distributed Energy Resources
DOE	U.S. Department of Energy
EIA	U.S. Energy Information Administration
EIC	Energy Improvement Corporation
EPA	U.S. Environmental Protection Agency
FIT	Feed-In Tariff
GHG	Greenhouse gas
GW	Gigawatt
GWh	Gigawatt Hour
HVAC	Heating, Ventilation, and Air Conditioning
ICMA	International City/County Management Association
IDA	Industrial Development Agency
InSPIRE	Innovative Site Preparation and Impact Reductions on the Environment project
IOU	Investor-Owned Utility
IRP	Integrated Resource Plan
JEDI	Jobs and Economic Development Impact model
kW	Kilowatt
kWh	Kilowatt Hour
LIPA	Long Island Power Authority
LISSA	Long Island Solar and Storage Alliance
LMI	Low- and Moderate-Income
LSRV	Locational System Relief Value
MW	Megawatt
MWh	Megawatt Hour
NO_X	Nitrogen Oxides
NREL	National Renewable Energy Laboratory
NYISO	New York Independent System Operator
NYSDAM	New York State Department of Agriculture and Markets
NYSDEC	New York State Department of Environmental Conservation
NYSDPS	New York State Department of Public Service
NYSERDA	New York State Energy Research and Development Authority
NYSPSC	New York State Public Service Commission
PACE	Property Assessed Clean Energy financing
PM	Particulate Matter
PPA	Power Purchase Agreement
PSEG	Public Service Enterprise Group Long Island
PV	Photovoltaic
RGGI	Regional Greenhouse Gas Initiative
SEIA	Solar Energy Industries Association
SETO	Solar Energy Technologies Office
SMART	Solar Massachusetts Renewable Target
SO_X	Sulfur Oxides
T&D	Transmission and Distribution
USDA	U.S. Department of Agriculture
VDER	Value of Distributed Energy Resources

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Executive Summary

Solar power offers Long Islanders a host of benefits — reductions in greenhouse gases and air pollution, healthier communities, affordable access to renewable energy, and good paying jobs. Solar can also play a significant role in helping address the climate crisis and meeting the goals of New York's Climate Leadership and Community Protection Act (CLCPA). This nation-leading 2019 law requires 70% of the state's electricity to be generated from renewable resources by 2030 and 100% of electricity to be generated from carbon-free sources by 2040.

Many people are familiar with residential rooftop solar systems, which range in size from 3 to 10 kilowatts (kW). Larger commercial and utility-scale solar systems, which can generate hundreds to thousands of kilowatts each, offer the opportunity to realize the benefits of solar power more quickly and cost-effectively in the region. This report shows how solar power can be scaled up without impacting the natural areas that are critical for wildlife, water-quality protection, and quality of life on Long Island.

Low-impact sites like rooftops, parking lots, and other land already impacted by development, such as capped landfills and remediated brownfields, are excellent locations for the development of commercial- and utility-scale arrays. Building solar on low-impact sites minimizes impacts to natural ecosystems and habitat, reduces the potential for land-use conflicts and community opposition, decreases project cost and permitting times, and avoids the harmful release of carbon pollution that results from the conversion of natural areas for development.

The Nature Conservancy and Defenders of Wildlife created the Long Island Solar Roadmap (the Roadmap) with the aim of advancing deployment of mid- to-large-scale solar power on Long Island in a way that minimizes environmental impacts, maximizes benefits to the region, and expands access to solar energy, including access to benefits by underserved communities. The Roadmap's creation was supported by a diverse group of Long

Island stakeholders. Individuals from state, local, and county government; the solar industry; the farm community; environmental and community organizations; the electric utility; businesses; and academic institutions provided input and guidance on design, research, and strategies. The Roadmap identifies low-impact sites for solar arrays on Long Island and shows their energy generation potential. Key findings also highlight Long Islanders' opinions and preferences about solar development in their communities and provide information about the costs and benefits associated with bringing more solar online.

It is our hope that the cohesive set of strategies and actions provided in this report will help lower barriers to low-impact solar development that meets the needs of all Long Island communities and benefits the whole region.

Low-impact solar siting potential

Long Island has enough low-impact siting potential to host nearly 19,500 megawatts (19.5 gigawatts) of solar capacity in the form of mid- to large-scale installations (250 kilowatts and larger).[1] This much solar could produce enough renewable electricity to power 4.8 million New York homes each year, more electricity than the Long Island region uses annually. Approximately one-third of that total potential is on parking lots and rooftops; the other two-thirds comes from ground-mounted installations on land that has already been impacted by human activities. The report details low-impact siting potential for Long Island as a whole, for Nassau and Suffolk Counties individually, and for each of the 15 cities and towns in the region (Figure 1).

Visit the interactive web map of low-impact siting potential at solarroadmap.org/maps.

[1] We acknowledge that solar build-out will be gradual and that future changes in technology, as well as in the way the electrical grid is managed and regulated, will be needed to enable the integration of significant amounts of renewable energy generation. Technical, policy, economic, and social constraints may limit the feasibility of solar development on these sites.

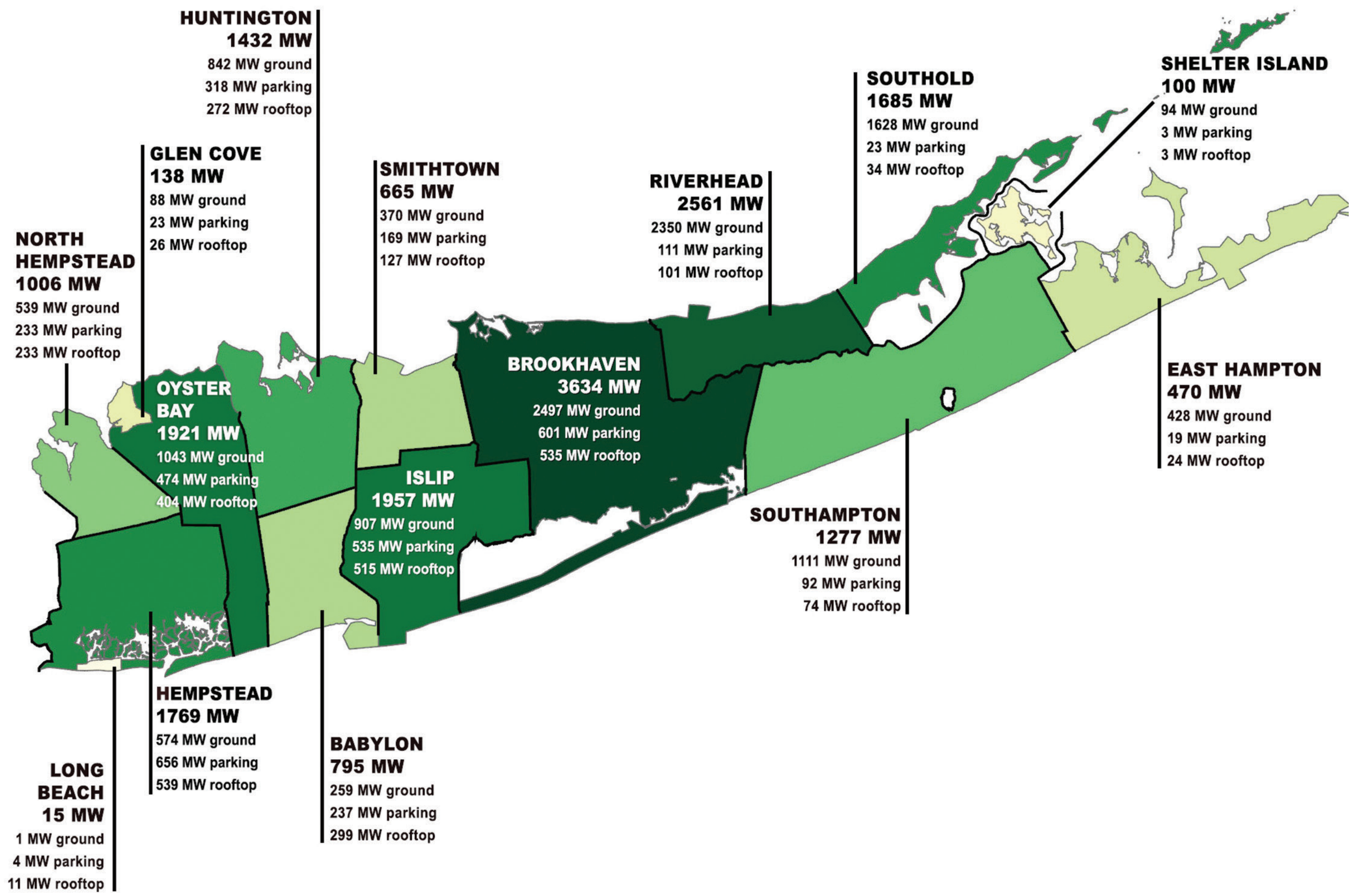

Figure 1. Total estimated low-impact solar siting potential in each Long Island city and town. This report focuses on mid- to large-scale solar arrays 250 kW and larger.[2]

Public opinion polling of Long Island residents shows that the overwhelming majority of respondents (92%) support mid- to large-scale solar energy development in their communities, with the greatest levels of support for solar arrays on rooftops, parking lots, and landfills and co-located with other land uses. This report explores the options for solar siting, business models, and financing that Long Island communities are most likely to support; communities' concerns; and how those concerns can be addressed.

Benefits of solar development

In addition to helping to fulfill the mandates of the CLCPA, adding more low-impact solar on Long Island will help provide a diverse array of benefits to Long Islanders. In this report, we model installation of 5,000 megawatts (5 gigawatts) of solar, about one quarter of the low-impact solar potential on Long Island, to illustrate the benefits of increasing solar energy generation on the environment and on human health. Adding this amount of solar by 2030 would:

[2] Due to rounding, numbers presented throughout this report and supporting documents may not add up to the totals listed.

- Reduce annual carbon dioxide (CO_2) emissions by 4.3 to 6.7 million tons. That's the equivalent of taking 718,140 to 835,253 cars off the road.
- Avoid the release of more than 8.2 tons of so-called criteria air pollutants each year, including particulate matter 2.5 ($PM_{2.5}$), nitrogen oxides (NO_X), and sulfur dioxides (SO_X), which cause cardiovascular and respiratory illnesses and death.
- Over the course of 20 years, reduce the impacts of air pollution on human health, resulting in 36 lives saved, 28 fewer hospitalizations, and $345 million in avoided health harms.

Adding solar power will also continue to build the growing solar industry and support both short- and long-term jobs. We estimate that meeting New York's goal of 6,000 MW of solar by 2025 could lead to a 30% increase in the number of solar jobs in New York, to as many as 13,600.

Strategies for advancing low-impact solar

Together, the key findings of the Roadmap point toward a promising future for Long Island as we transition to renewable energy. Taking full advantage of Long Island's solar potential will require the commitment and collective action of a diverse group of stakeholders, including local and state government, Long Island Power Authority (LIPA), PSEG Long Island, the solar industry, commercial and industrial property owners, farmers and farmland owners, nonprofits, and community organizations.

The Roadmap recommends eight strategies for supporting mid- to-large-scale solar power on Long Island. Each strategy is accompanied by a set of actions, including economic interventions, programs, policies, or practices, for achieving the strategy. Appendix D organizes the actions by sector so that all stakeholders know what they can do to help the transition to a clean energy economy and maximize the benefits of solar for Long Island. The Roadmap identifies strategies and actions that have potential for application across the region, recognizing that some solutions will need to be tailored to local circumstances.

Strategy 1 Create frameworks for achieving CLCPA mandates

To further the clean energy transition on Long Island, LIPA and PSEG Long Island should create a framework that sets and tracks renewable energy and community benefit targets for Long Island. A broad set of stakeholders should form a coalition to advocate for the funding, policy support, and other resources necessary to meet these goals.

Strategy 2 Direct and incentivize low-impact solar siting

To minimize environmental impacts, local governments, LIPA and PSEG Long Island should create and implement mechanisms to support low-impact siting. These should include updating local policies, creating structural incentives, and revising utility energy procurement practices to better incorporate and reward low-impact projects.

Strategy 3 Reduce development costs for low-impact sites

To improve the cost effectiveness of low-impact solar siting, state and local governments, LIPA, PSEG Long Island, and property owners should develop and implement policies and programs that reduce development costs. These should include financial incentives and programs, financing options, and streamlined permitting.

Strategy 4 Improve interconnection feasibility for low-impact solar

To realize the full potential of low-impact solar, LIPA and PSEG Long Island should improve the feasibility of interconnecting new projects to the electrical grid through investments that increase hosting capacity, mechanisms that reduce the cost of interconnection, and greater accessibility to information about hosting capacity and interconnection costs for solar developers and the public.

Strategy 5 Support low-impact, on-farm solar

To assist farmers and farmland owners in pursuing on-farm solar, state and local governments, individuals, and organizations focused on farming should collaborate to update state and local policy frameworks, improve financial programs, and provide technical assistance to enable low-impact, on-farm solar.

Strategy 6 Encourage solar on commercial and industrial properties

To increase solar adoption on commercial and industrial properties, LIPA, PSEG Long Island, local governments, and Long Island's eight Industrial Development Agencies (IDAs) should provide information and incentives that pave the way for solar on current and future commercial and industrial development.

Strategy 7 Improve access and equity through community solar

To improve all Long Islanders' access to solar energy and its many benefits, the solar industry, LIPA, PSEG Long Island, the business sector, and community organizations should coordinate to advance community solar, with a focus on working more closely with communities of color and low- and moderate-income (LMI) communities.

Strategy 8 Build and mobilize community support

To help build and mobilize community support for solar development on Long Island, state and local governments, LIPA, PSEG Long Island, solar developers, and nonprofit institutions should address the needs of Long Island communities for improved engagement and communication regarding solar siting and development, as well as the needs for greater local benefits and investments in the local workforce.

Implementing the Roadmap in a changing world

Since work on the Roadmap began in 2018, and particularly during 2020, we have seen disruptive changes in New York State, the United States, and around the world. The COVID-19 pandemic is having far-reaching health and economic impacts for households, government, the energy sector, and other businesses. There are renewed and increased demands to address the racial inequities of U.S. policies and institutions, including the lack of access to affordable clean energy and solar industry jobs by Black and other underserved communities. Addressing climate change is a priority for President Joe Biden; and his administration is expected to advance national policy that supports the renewable energy transition.


Uplands Farm Sanctuary © Dorothy Hong

Implementing the strategies and actions recommended in the Roadmap will require an awareness of the implications of recent and future social and economic developments. While COVID-19 will likely mean constraints in government budgets and a loss of jobs in some sectors, it might also lead to an opportunity to direct federal recovery funding to rehiring and new jobs in the clean energy sector and investments in energy infrastructure. As New York continues to assess the immediate and future economic impacts of the pandemic, it may require creative public–private partnerships and initiatives to address the issues highlighted within this report's recommendations. As we focus our attention on racial injustices in the United States, we can improve equity for all communities of color in access to solar energy and jobs in the clean energy economy.

We can also use New York State's leadership to model what that will take and call for greater support from the federal government and our national policymakers as we move through the energy transition that is critical for tackling climate change and securing a sustainable, healthy future for ourselves and future generations. We have an opportunity to "build back better," to chart a course through which New York's economy and communities become more resilient, equitable, and prepared for the challenges we face. Implementing the strategies and actions recommended in the Roadmap will put us on that path.

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Introduction

New York's urgent mandate

New York State's nation-leading Climate Leadership and Community Protection Act (CLCPA), adopted in July 2019, mandates that 70% of the state's electricity will be generated from renewable resources by 2030. By 2040, 100% of electricity must come from carbon-free sources.[3] And by 2050, the state's economy must be 100% carbon neutral[4] (State of New York, 2019). This ambitious legislation updates the Clean Energy Standard, established in 2016, which set a target of generating 50% of electricity from renewable sources by 2030. To achieve these mandates, the New York State Energy Research and Development Authority (NYSERDA) and the New York State Public Service Commission (NYSPSC) have set statewide goals for renewable energy and energy storage technologies, as well as goals for energy efficiency and reductions in greenhouse gas (GHG) emissions (Table 1).

In addition to the renewable energy mandates created by the CLCPA, New York has state-level policies and initiatives aimed at reducing GHG emissions and other forms of air pollution from electricity generation. The New York Independent System Operator (NYISO) has developed a proposal to incorporate the social cost of carbon into its energy market; it is now being considered by numerous stakeholders. If adopted, such a policy would incentivize the use of zero-emitting resources, like solar, and drive development of renewables, especially to locations where they would have the greatest reduction in emissions (NYISO, 2020). Further, the New York State Department of Environmental Conservation (NYSDEC) has proposed a requirement to reduce smog-forming air pollution

[3] Carbon-free energy sources include nuclear energy in addition to renewable sources like solar, wind, hydropower, and geothermal energy.
[4] Carbon neutral means that New York State will remove as much carbon dioxide from the atmosphere as is released from all sectors of the economy.

Table 1. New York State Goals and Target Dates

Goal	Target date
6,000 MW of distributed solar	2025
Energy efficiency 185 trillion BTU reduction vs. forecast	2025
1,500 MW of energy storage	2025
3,000 MW of energy storage	2030
70% of electricity from renewable sources	2030
40% reduction in GHG emissions from 1990 levels	2030
9,000 MW of offshore wind power	2035
100% of electricity from carbon-free sources	2040
Disadvantaged communities receive at least 35% of benefits from clean energy and energy efficiency investments, with a goal of 40%	

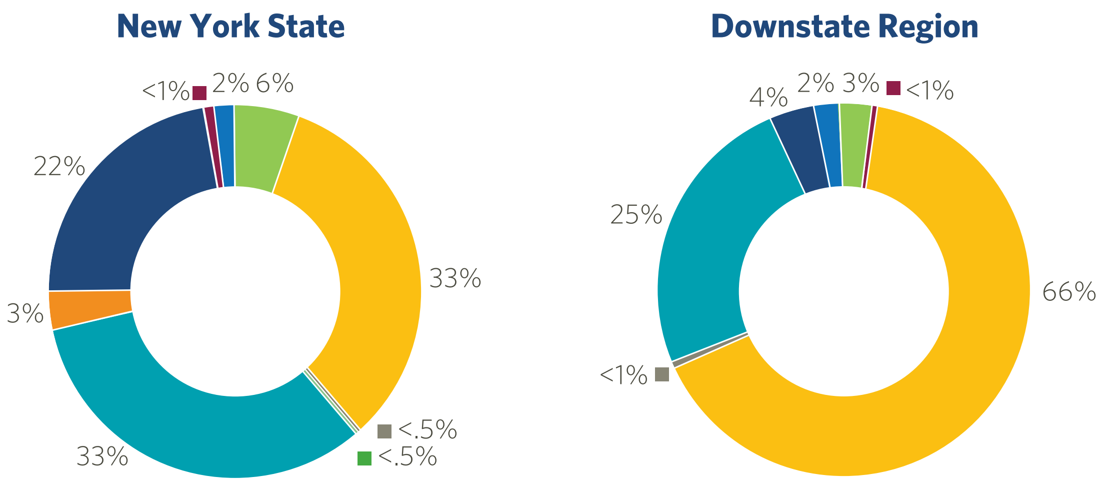
from fossil-fueled peaking plants, which come online when electricity demand is high. This could result in the deactivation of as much as 3,300 megawatts (MW) of simple-cycle turbine generation in New York City and Long Island (NYISO, 2019).

Long Island's critical role

Achieving these mandates and policy objectives requires a rapid transformation of the electric system, including extensive buildout of renewable energy generation, transmission, and energy storage across the state and the phasing out of fossil-fueled generation facilities. Long Island and other downstate regions, including the Hudson Valley and New York City, must be key contributors to increasing renewable energy generation and reducing GHG emissions. While nearly 28% of electricity statewide was produced from renewable energy resources in 2019, six percent of electricity produced downstate was renewable (NYISO, 2020). Figure 2 compares energy electricity production by fuel source at the state and regional levels.

As a major population center, Long Island has high electricity demand.[5] Its ability to import or export renewable electricity is limited due to statewide transmission constraints (NYISO, 2018).[6] To guarantee system reliability, NYISO established local capacity requirements for Long Island, mandating that a high proportion of electricity generation capacity be located within the region. This means that much of the electricity for Long Island, including new renewable electricity, must be generated locally.

[5] Annual energy demand on Long Island declined from 22,922 GWh in 2010 to 20,545 GWh in 2019 (NYISO, 2020a).
[6] Currently, transmission constraints would limit the ability to export renewable energy generated on Long Island that exceeds peak load.



2019 Production GWh (New York State)

Gas	7,273
Dual Fuel (Gas/Oil)	44,069
Oil	104
Coal	426
Nuclear	44,788
Wind	4,454
Hydro	30,141
Hydro Pumped Storage	583
Other Renewables	2,700
TOTAL	134,537

2019 Production GWh (Downstate Region)

Gas	1,781
Dual Fuel (Gas/Oil)	43,549
Oil	100
Nuclear	16,695
Hydro	2,616
Hydro Pumped Storage	234
Other Renewables	1,500
TOTAL	66,475

Figure 2. Electric energy production in 2019 by fuel source in New York State (left) and the downstate region (right), which includes the Hudson Valley, New York City, and Long Island (NYISO, 2020).

The opportunity

Fortunately, tremendous opportunity exists on Long Island for increasing renewable energy and energy storage while phasing out fossil-fueled electricity generation. Long Island has the state's highest solar (Figure 3) and offshore wind energy resources. Homes, businesses, and the electric utility have begun to take advantage of these sources of renewable energy. To meet New York State's clean energy goals, the Long Island Power Authority (LIPA) has committed to procuring 1,875 MW[7] of renewable energy generation capacity by 2035 (Table 2) and is making strides toward this goal (LIPA, 2020b). Between 2017 and 2019, LIPA signed power purchase agreements for 130 MW of offshore wind and 79 MW of utility-scale solar, in addition to the 527 MW of residential and commercial behind-the-meter solar[8] capacity installed in the region (NYISO, 2020). Moreover, 99% of LIPA's fossil-fueled generation contracts are up for renewal by 2030, which gives LIPA the flexibility to switch to clean energy sources in the near future (PSEG Long Island, 2017). In addition, LIPA's 2020 budget includes $291.2 million for clean energy investments.

[7] Throughout this report, renewable energy and solar installation capacity are reported in direct current (DC).

[8] "Behind-the-meter" solar systems (also called distributed energy generation, distributed energy resources, or DERs) are connected to the grid through a customer's utility meter, meaning that energy produced is used on-site and any excess energy generated by the system is delivered to the grid. "Front-of-the-meter" solar systems (also called utility-scale systems) deliver energy directly to the electrical grid, and none of the energy generated is used on-site.

In 2019, Long Island used 20,545 gigawatt hours (GWh) of electricity. The 2030 energy demand for the region is forecast to be lower, at 19,894 GWh (NYISO, 2020a).[9] Reaching the CLCPA goal of generating 70% of Long Island's electricity from renewable sources by 2030 will require generating 13,926 GWh of electricity from renewable sources. Battery storage, additional energy efficiency measures, or retirement of existing fossil-fueled generation could impact this estimate of future need. LIPA's current renewable commitments will produce an estimated 6,675 GWh of electricity annually, meeting 34% of Long Island's 2030 energy demand. Therefore, an additional 7,251 GWh of annual electricity generation will be needed from renewable sources to reach the 70% by 2030 mandate.

Because of the relatively high carbon intensity of Long Island's current energy mix for electricity generation (NYISO, 2020b), renewable energy generated in this region will have a greater benefit in terms of displacing carbon-emitting energy sources than in almost all other regions of the state (Figure 2). For these reasons, Long Island is the right place, and now is the right time, to accelerate development of solar, offshore wind, battery storage, and other renewable energy technologies.

Energy storage is also critical for creating a carbon-free electrical grid. Grid-scale energy storage resources, like batteries, pumped storage, and other technologies, enable better integration of intermittent renewable resources like wind and solar into the electrical grid by allowing energy generated at one time to be used at another. Pairing storage with solar enhances the energy system's ability to balance generation with load in both time and space, making the electricity grid more reliable and flexible. LIPA is committed to adding 375 MW of energy storage by 2030, and Governor Cuomo announced in 2019 that $55 million in Regional Greenhouse Gas Initiative (RGGI) funds would be available to support energy storage projects on Long Island (New York State Office of the Governor, 2019). In service of this commitment, LIPA has developed the Energy Storage Rewards Program to incentivize behind-the-meter battery storage (PSEG Long Island, 2020a), has installed two battery storage facilities, and plans to issue a request for proposals for additional utility-scale storage in the region in mid-2021 (PSEG Long Island, 2020b).

Table 2. Long Island Renewable Energy Goals and Progress Toward the 2030 CLCPA Mandates

Long Island goal[10]	Capacity installed (MW)	Estimated annual generation (GWh)[11]	Percent of 2030 demand
Distributed solar by 2025	750	1,353	7%
Offshore wind by 2035	1,125	5,322	27%
Planned renewables through 2024 (solar + offshore wind)	1,875	6,675	34%
Additional renewable needed to reach 70% by 2030		**7,251**	**36%**

9 Reflects impacts of energy efficiency programs and behind-the-meter generation.
10 LIPA, 2020b.
11 Annual electricity generation from each source is estimated using the following equation: Annual generation (GWh/yr) = Name plate capacity (MW) x capacity factor x (8760 hours/year) x (1GWh/1000MWh). Capacity factors for distributed solar and offshore wind are provided in the White Paper on Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act released by NYSERDA and the NYDPS (2020). The capacity factor for solar on Long Island was reported as 16.2% to 20.6%, and the capacity factor for offshore wind was reported as 41% to 54%; these estimates use the high end of each range.

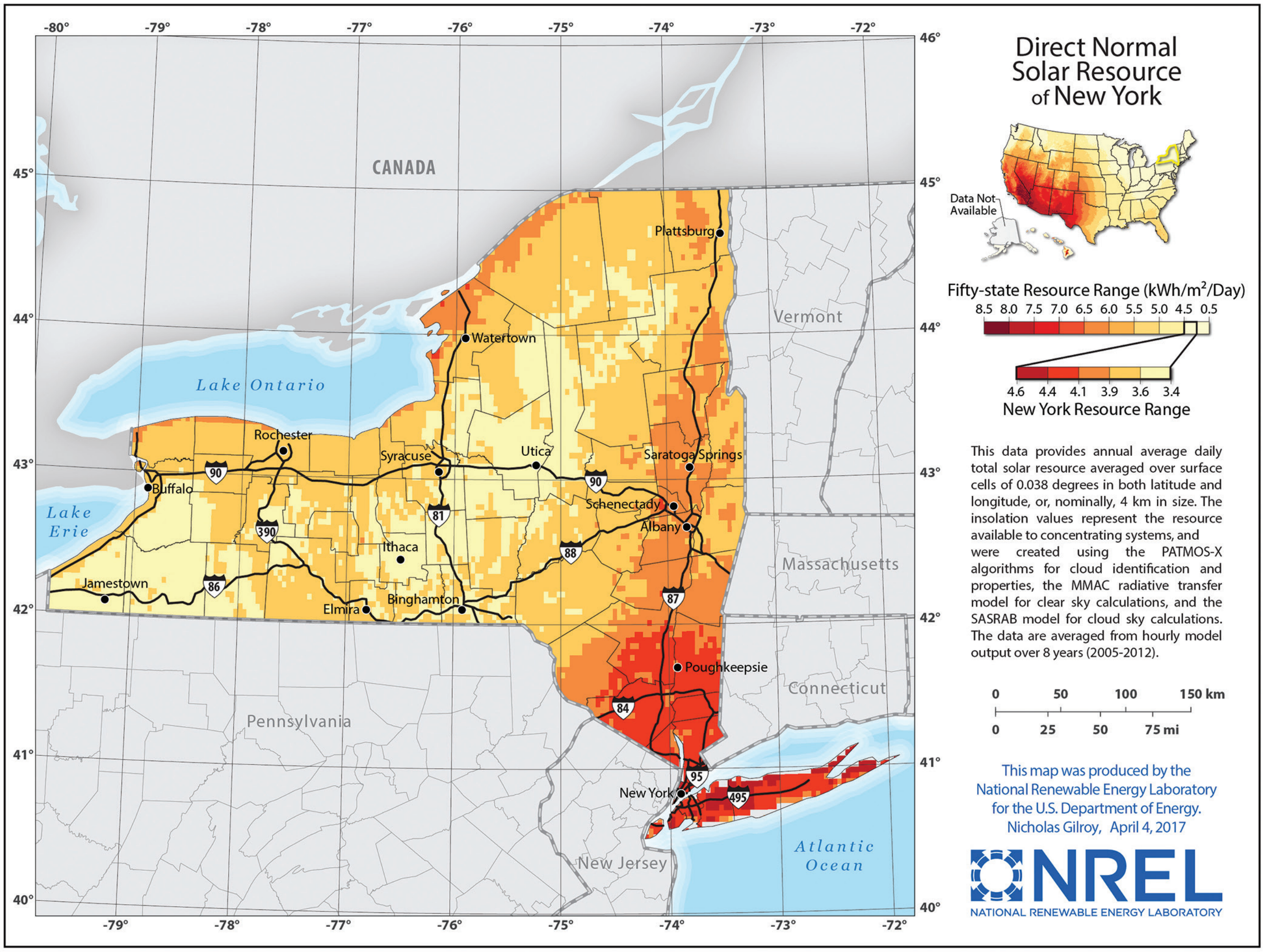


Figure 3. Average daily solar insolation in New York in 2017 (NREL, 2017).

Bringing this additional energy online is not without challenges. The Renewables on the Ground Roundtable, led by The Nature Conservancy and the Alliance for Clean Energy New York, identified key challenges to large-scale wind and solar development in New York and highlighted siting as a central issue (Renewables on the Ground Roundtable, 2017). Renewable energy generation facilities, specifically those that deliver energy directly to the electrical grid, typically have a larger footprint than fossil-fueled facilities (Kiesecker & Naugle, 2017), and siting these facilities has emerged as a central challenge facing the renewable energy transition.

Among renewable technologies, solar energy generation has the lowest land-use intensity (Denholm, Hand, Jackson, & Ong, 2000; Kiesecker & Naugle, 2017; Ong, Campbell, Denholm, Margolis, & Heath, 2013).[12] On Long Island, most of the terrestrial renewable energy production will come from solar photovoltaic (PV) installations,

[12] Land-use intensity considers the area directly and indirectly impacted by energy generation facilities and fuel acquisition per unit of energy output.

referred to simply as "solar" throughout this report. Concerns over solar installations' impacts on the local community and environment have led to growing conflicts over solar energy siting on Long Island, in other parts of New York, and nationwide (Poon, 2019).

Community support for non-residential solar development is critical, and local opposition can significantly slow or even halt solar energy projects and increase development costs. Research shows that low-impact siting helps limit project permitting time and development costs by reducing the potential for land-use conflicts and community opposition (Heard et al., 2019). Siting solar and other renewable energy projects on natural lands (areas that have not already been altered or impacted by human activities) degrades or destroys natural ecosystems and habitat and has the potential to reduce the GHG reduction benefits of renewable electricity generation by releasing carbon stored in vegetation and soils (McKenney & Wilkinson, 2020). Prioritizing areas for renewable energy development that minimize habitat and biodiversity loss can reduce costs and help achieve the speed and scale needed to meet New York's renewable energy mandates.

A crew carries out pollinator monitoring and vegetation maintenance at the 1 MW solar array installed by the Sisters of St. Joseph at their campus in Brentwood, NY. © Rusty Schmidt

Long Island's Electricity Sector

- The Long Island Power Authority (LIPA) is a not-for-profit public utility that owns the electric transmission and distribution system serving all of Long Island and the Rockaways. LIPA is governed by a nine-member Board of Trustees, which supervises and makes policy for the Authority.
- Since 2014, LIPA has contracted with Public Service Enterprise Group (PSEG) to serve as Long Island's electric service provider. PSEG Long Island, the retail brand name for PSEG's operations in New York, is responsible for operation and maintenance of the electric transmission and distribution system, customer service, billing, and meter reading.
- The Long Island branch of the New York State Department of Public Service (NYSDPS) provides regulatory oversight, electric service operation, and customer service practices on Long Island.

Advancing solar for Long Island

The Long Island Solar Roadmap (the Roadmap) aims to advance deployment of mid- to large-scale solar power on Long Island that minimizes environmental impacts, maximizes benefits to the region, and expands access to solar energy, including access by underserved communities. Meeting New York State's energy goals will require larger commercial and utility-scale installations in addition to residential solar arrays. The Roadmap focuses on mid- to large-scale solar installations with a capacity of 250 kilowatts (kW) DC or larger. Arrays with this capacity require as little as 0.7 acres of space—the size of half a football field.

The Nature Conservancy and Defenders of Wildlife, two organizations with an interest in advancing renewable energy deployment while minimizing biodiversity and habitat loss, convened a consortium of Long Island stakeholders to help further this goal. The consortium brought together a diverse set of Long Island stakeholders—state, local, and county governments; the solar industry; farmers and farm advocacy organizations; environmental and community organizations; the electric utility; businesses; and academic institutions—that participated in development of the Roadmap. The consortium worked together to advance three key research objectives:

- Identify and map low-impact areas of opportunity for siting mid- to large-scale solar installations (250 kW DC and larger) on rooftops, parking lots, and other areas previously impacted by human activities.
- Conduct public opinion research to better understand how solar energy projects can be sited, designed, and constructed in ways that meet the needs and preferences of Long Island communities.
- Characterize the barriers and opportunities for advancing solar installations on these low-impact sites.

Drawing from this information, the consortium developed a cohesive set of strategies and actions to accelerate environmentally sound mid- to-large-scale solar development on Long Island. Taking full advantage of Long Island's solar potential will require the commitment and collective action of diverse stakeholders. These strategies and actions are designed to empower all stakeholders and work in concert to leverage individual actions for greater cumulative success.

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Approach and Methodology

The Long Island Solar Roadmap Project is spearheaded by The Nature Conservancy and Defenders of Wildlife. The Consensus Building Institute provided process design and planning, facilitation, and other project support. Michigan Technological University provided public opinion research advising, design, and analysis and other project support. Representatives from these four organizations formed the leadership team.

The project began in 2018 as an effort to answer key questions and develop actionable strategies to support rapid development of mid- to large-scale solar power on Long Island. Three key elements of the project's approach were:

1) Engage stakeholders who have diverse interests, experience, knowledge, and roles on Long Island.
2) Employ an evidence-based and collaborative approach to develop a shared understanding of opportunities and challenges for low-impact, mid- to large-scale solar on Long Island.
3) Create feasible, proactive strategies that empower stakeholders to play a role in accelerating low-impact solar energy development.

This approach recognizes that multiple solutions or strategies are needed to accelerate solar development, and many individuals, organizations, and entities have crucial roles to play.

Engage diverse stakeholders

A vital component to the development of the Roadmap was the input and guidance from a consortium of diverse stakeholders. The 38 stakeholders represented state, local, and county government; the solar industry; farmers and farm advocacy organizations; environmental and community organizations; the electric utility; businesses; and academic institutions. Of these consortium members, eight served as the project's steering committee. The roles and responsibilities of both the consortium and steering committee are detailed in the project charter, available at solarroadmap.org.

Development of the Roadmap was the responsibility of the leadership team, with input from the consortium, including the steering committee. In addition to regular in-person and remote meetings, members of the leadership team, steering committee, consortium, and advisors formed working groups to contribute to and review the research. From September 2018 to August 2020, there were 11 steering committee meetings and six consortium meetings, as well as smaller meetings of the working groups. The on-the-ground knowledge and substantial input of the stakeholders ensured that the outcomes of this effort are realistic, practical, and ambitious.

Develop a shared understanding of opportunities and challenges

The Roadmap's three research components—spatial analysis, economic research, and public opinion research—were designed to reveal the opportunities and challenges for low-impact, mid- to large-scale solar development on Long Island. The goals and approach of each research element are described below.

Ground-mounted solar at the Estee Lauder Companies' campus in Melville, NY. © EmPower Solar

Spatial analysis

The goals of the spatial analysis were threefold: identify low-impact sites for potential solar energy development based on suitability criteria informed by the consortium; characterize the potential solar energy capacity that could be sited on low-impact sites; and provide information on where changes to land-use policies and grid modifications may be needed in order to utilize additional solar resources.

To achieve these goals, the consortium developed a set of suitability criteria to identify rooftops, parking lots, and land areas compatible with low-impact solar development. Criteria are based on ecological attributes, land use, and land-cover characteristics (Table 3).

Table 3. Factors Used to Determine Site Suitability Criteria for Solar Installations

Ecological attributes	Land use	Land cover
Wetlands and hydrological features. Areas within 300 feet of freshwater or tidal wetlands or waterbodies are suitable only for solar installations on existing parking lots and rooftops, not ground-mounted installations.	**Residential areas.** Areas that are classified as residential are not considered suitable for mid- to large-scale solar installations and are excluded from the analysis.	**Compatible land cover types.** Areas of unforested, sparsely vegetated, and grassy land cover, as well as areas of exposed soil, are considered suitable for ground-mounted solar. Areas with established vegetation, including grassland and forest cover, are not considered suitable.
Sensitive natural areas. Areas where sensitive natural communities or wildlife species are present are not considered suitable for any kind of solar installation.	**Protected open spaces.** Areas protected for ecological conservation, recreation, or open space are suitable only for solar installations on existing parking lots and rooftops, not ground-mounted installations.	
Flood zones. Areas within the 100-year floodplain are suitable only for solar installations on existing parking lots and rooftops, not ground-mounted installations.	**Agricultural land.** All agricultural areas are suitable for solar installations on existing parking lots and rooftops. Ground-mounted installations are considered suitable in areas with compatible land cover (see below) only on farms that are not enrolled in any farmland preservation program. Areas in various farmland preservation programs at the state, county, town, and nonprofit level are not suitable for ground-mounted solar installations.	
Contaminated areas. Active or not-yet-remediated brownfields and Superfund sites are not suitable for any kind of solar installation. Any contaminated areas that have been fully remediated are suitable for all types of solar installations.	**Areas of historic or cultural significance.** Areas officially designated for historic preservation are not suitable for any kind of solar installation.	

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Using these criteria, the spatial analysis identifies properties (delineated by county tax parcels) that could host a combined solar installation capacity of 250 kW or larger on rooftops, parking lots, and previously impacted lands in New York's Nassau and Suffolk Counties. The nature of tax parcel data excludes certain areas from the analysis, including some roads and highways, right-of-ways, buffer zones, and other areas. The parcel dataset, along with all other spatial datasets, represents conditions of the landscape as a snapshot in time (2010–2019) and may not reflect more recent changes. Due to the focus on mid- to large-scale solar installations, residential parcels were excluded from the analysis. A full methodology for the spatial analysis is available at solarroadmap.org/research.

We based estimates of installed capacity per unit area (panel density) on previous solar siting surveys (Clean Coalition, 2017a, 2017b, 2018) validated by consortium members. High, medium, and low panel density is defined as 8, 7, and 6 watts per square foot (W/ft^2), respectively. Clean Coalition asserts that these numbers are conservative to provide an additional downward margin and avoid overestimation. We use high (8 W/ft^2) and low densities (6 W/ft^2) to estimate a range of potential installation sizes for rooftop arrays to account for differences in rooftop configuration and the presence of equipment, such as heating, ventilation, and air conditioning (HVAC) units and ductwork, exhaust ventilation fans, service walkways, and other installations. We assume ground-mounted panels are installed at a high density of 8 W/ft^2, and panels in parking lot arrays are installed at a medium density of 7 W/ft^2.

To view the results of the spatial analysis as a web map with accompanying spatial overlays, visit solarroadmap.org/maps.

Accelerated Renewable Energy Growth and Community Benefit Act

- In 2020, New York State passed the Accelerated Renewable Energy Growth and Community Benefit Act, which aims to accelerate siting and construction of clean energy projects and provide benefits to communities. Major components of the Act include:
  - Creating the Office of Renewable Energy Siting, which will be responsible for review and permitting of all large-scale renewable energy projects.
  - Creating a Clean Energy Resources Development and Incentives Program, administered by NYSERDA. The program will work with state and local partners to create build-ready renewable energy projects on low-impact sites, such as underutilized commercial and industrial sites, brownfields, and landfills.
  - Establishing several programs aimed at providing benefits to host communities. These include the Host Community Benefit Program, through which NYSERDA will offer property owners and communities tangible benefits and incentives for hosting renewable energy facilities; a program created by the New York State Public Service Commission to provide utility bill discounts or other benefits for residents of host communities; and a local intervenor fund provided by NYSERDA to benefit local agencies and community intervenors.
  - Directing the state to develop a State Power Grid and Study Program to accelerate the planning and construction of electric transmission and distribution infrastructure to enable the clean energy transition.

Economic research

The goal of the economic research was to characterize the direct and indirect economic costs and benefits of solar development on Long Island in order to strengthen understanding of the factors affecting project feasibility and impacts to the region. A literature review, analysis of publicly available data, and expert input from consortium members and advisors were used to characterize several economic aspects of solar development on Long Island, including:

- The direct costs of developing rooftop, parking lot, and ground-mounted solar installations.
- Commonly used business and ownership models for mid- to large-scale solar development, including how costs and benefits are allocated in each model.
- Available financing and incentives for solar development on Long Island.

- Economic considerations and challenges for solar development on four types of property—commercial, industrial, and other private properties; properties owned by nonprofit organizations; government properties; and agricultural properties.
- The indirect costs and benefits of mid- to large-scale solar, including jobs and other economic development impacts, environmental and health benefits, and the potential reduction in energy costs for low- to moderate-income (LMI) communities.

This research was a collaborative effort of a working group composed of the leadership team and consortium members, with assistance from Dr. Latika Gupta, energy economist, and graduate student researchers at Michigan Technological University. View the full economic research report at solarroadmap.org/research.

Public opinion research

Public opinion research was used to better understand how solar energy generation can be sited, designed, and constructed in ways that meet the needs and preferences of Long Island communities and reduce siting conflicts. An online survey of residential utility customers on Long Island examined knowledge, preferences, and beliefs regarding mid- to large-scale solar energy development and the kinds of siting and financing choices involved in solar development planning. The online survey was developed by a working group led by Dr. Chelsea Schelly of Michigan Technological University and consisting of leadership team and consortium members, with input from PSEG Long Island staff. The online survey was administered by PSEG Long Island and sent to 50,000 randomly selected customer email addresses. The survey resulted in a total of 405 responses, including six responses to the Spanish language version of the survey. This sample size results in a 95% confidence level and a 5% margin of error. View the full public opinion research report at solarroadmap.org/research.

Create shared strategies

The Roadmap's strategies and actions were developed with input from the steering committee and consortium and informed by policy and practice research from the leadership team. Strategies are specific pathways for achieving the overall vision of the project, typically by addressing one or more of the key barriers or opportunities. Strategies are statements of *what* needs to be done. In contrast, actions are the economic interventions, programs, policies, or practices that advance each strategy. Actions are statements of *how* we will accomplish a strategy. In this project, we took particular care to identify actions that empower diverse stakeholders to play a role in accelerating low-impact solar energy development, including local and state agencies and authorities, the utility, solar developers, local government, business owners and landowners, farmers and farmland owners, and others.

Key Findings

Opportunities for low-impact solar siting

Long Island has the potential to host as much as 19,424 MW of solar in mid- to large-scale installations (250 kW and larger) on low-impact sites (Figure 4 and Table 4).[13] This much solar could generate as much as 35,052 GWh of renewable electricity annually,[14] an amount equivalent to the annual electricity usage of more than 4.8 million homes in New York,[15] and more than Long Island's current annual electricity usage. These results illustrate the role that low-impact solar energy can play in Long Island's transition away from fossil fuels. Visit the interactive web map of low-impact siting potential online at solarroadmap.org/maps.

These sites include large rooftops, parking lots, and land areas that are compatible with low-impact solar development, such as capped landfills, remediated brownfields, and parcels that have already been altered or impacted by human activities. Low-impact, ground-mounted installations offer the greatest potential (66% or 12,731 MW), and parking lots present the second-greatest opportunity (18% or 3,499 MW). As much as 16% of total potential capacity (3,195 MW) could be installed on rooftops across Long Island. The total area for each type of low-impact solar development was 57.1 mi^2 (36,532 ac) for ground-mounted installations, 17.9 mi^2 (11,474 ac) for installations on parking lots, and 14.3 mi^2 (9,168 ac) for installations on rooftops.

13 Throughout this report, capacity of solar installations is reported in MW of direct current (DC), and all reports of estimated capacity have been rounded to the nearest whole number, except when the estimate is less than one.
14 The capacity factor for solar on Long Island was reported as 16.2 to 20.6, and these estimates use the high end of the range (NYSERDA & NYSDPS, 2020).
15 According to the Energy Information Administration (2020), households in New York used an average of 604 kilowatt hours (kWh) of electricity each month in 2018, for an average annual consumption of 7.2 MWh.

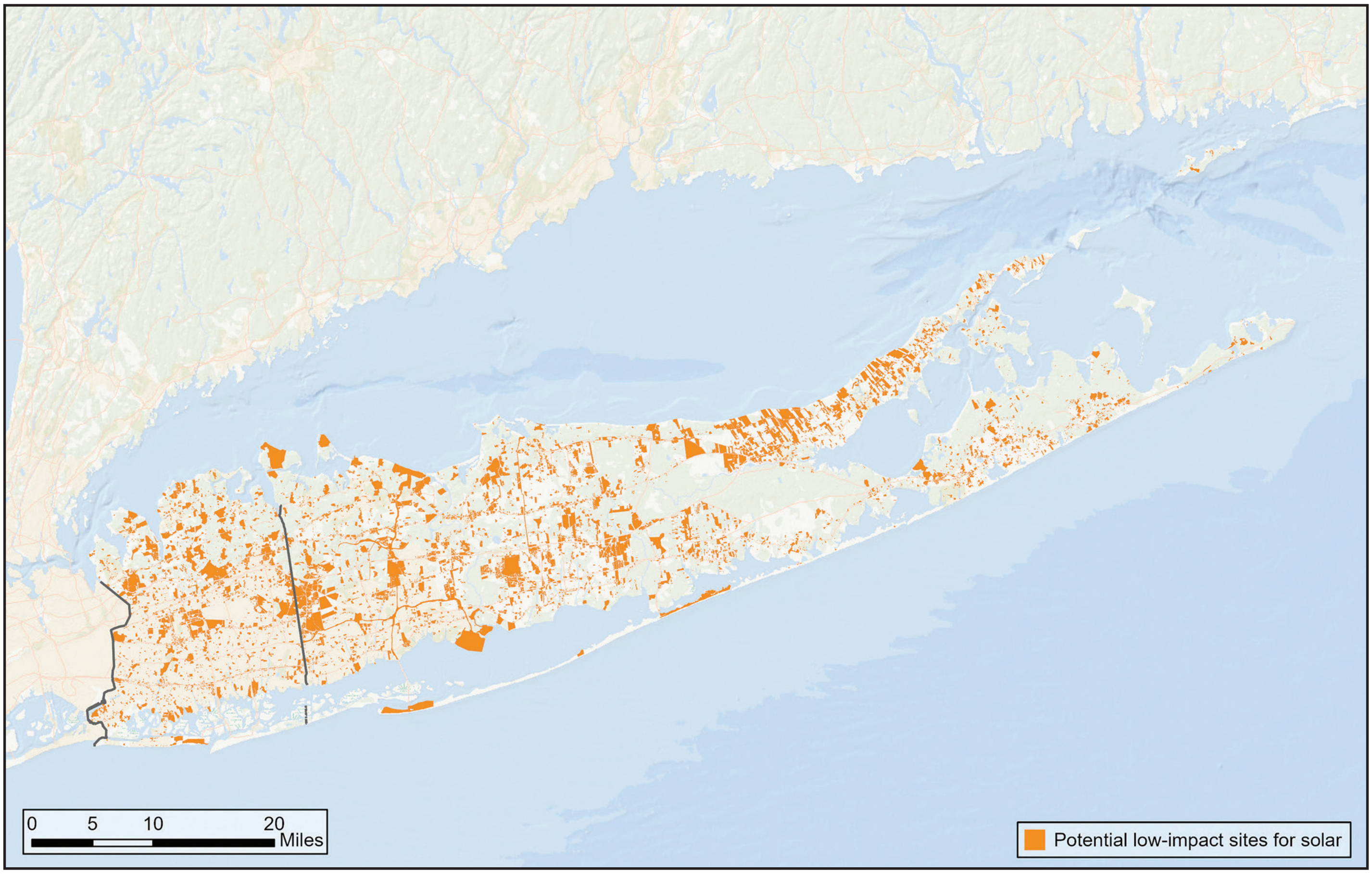

Figure 4. Map of the properties where low-impact sites for mid- to large-scale solar installations are located. Each parcel shown in orange has the potential to support a total solar installation capacity of at least 250 kW located on rooftops, parking lots, and previously impacted lands.

Results for both Nassau and Suffolk Counties are summarized in Table 4. Maps of low-impact sites for individual cities and towns in Nassau and Suffolk Counties are included in Appendix A. Summaries of the low-impact siting potential for each city and town are available online at solarroadmap.org/report.

Table 4. Estimated Potential Low-Impact Solar Installation Capacity (MW) on Long Island[16]

County	Rooftop (low density)	Rooftop (high density)	Parking lots	Ground-mounted	County total [17]
Nassau	909	1,213	1,391	2,246	4,851
Suffolk	1,487	1,982	2,108	10,485	14,575
Total	**2,396**	**3,195**	**3,499**	**12,731**	**19,424**

[16] Due to rounding, numbers presented throughout this report and supporting documents may not add up to the totals listed.

[17] Calculations assume 6 W/ft^2 for low-density rooftop, 8 W/ft^2 for high-density rooftop, 7 W/ft^2 for parking lot solar, and 8 W/ft^2 for ground-mounted solar. Two estimates are provided for rooftop arrays to account for differences in rooftop configuration and the presence of equipment. County totals are calculated using the rooftop high-density estimate.

Figure 5 shows the size distribution of potential low-impact solar installations across Long Island. Nearly three-quarters (72.5%) of the low-impact siting opportunity is for installations less than 1 MW in capacity, with the greatest number of potential sites (45%) for installations between 250 and 500 kW. This project did not map the potential for installations smaller than 250 kW. There are more than 3,600 low-impact sites that could support installations greater that 1 MW. Installing solar on fewer, larger sites might be a more expedient approach to increasing renewable energy generation than installing it on many smaller sites, as it could reduce both development time and costs.

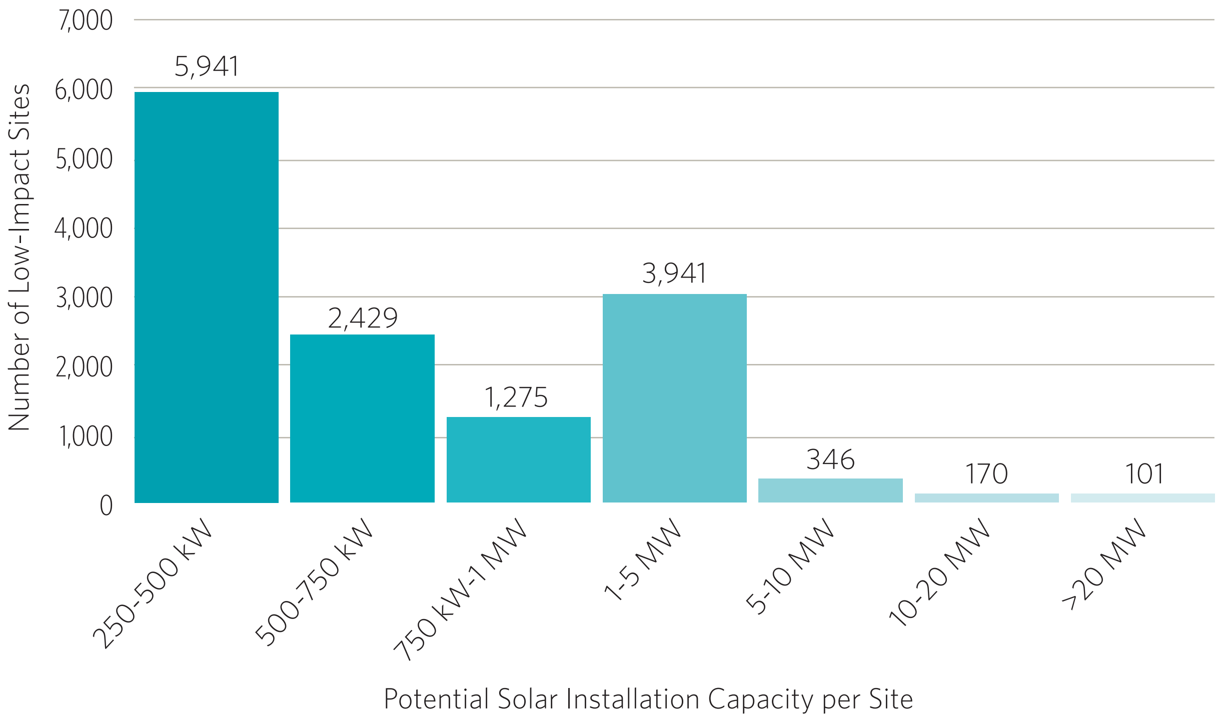

Figure 5. Number of low-impact sites by potential solar installation capacity (MW). The installation capacity for each site is the total amount of solar that could be installed on rooftops, parking lots, and previously impacted land.

These results illustrate low-impact siting potential. Technical, policy, economic, and social constraints may limit the feasibility of solar development on these sites. We acknowledge that solar build-out will be gradual and that future changes in technology, as well as in the way the electrical grid is managed and regulated, will be needed to enable the integration of significant amounts of renewable energy generation. This analysis relies on remotely sensed data acquired before March 2020, and more recent land-use changes and development events are not captured. These results are not intended to replace site-level evaluations and are not an endorsement for any current or future solar energy project.

Nassau County

A little more than 25% of the total potential capacity (4,849 MW) could be installed in Nassau County, which could host 909–1,214 MW of solar on rooftops,[18] 1,391 MW on parking lots, and 2,246 MW as ground-mounted solar on low-impact land (Figure 6 and Figure 7). Ground-mounted installations offer the greatest potential in Nassau

[18] Rooftop solar potential is reported as a range, because the density of panels can vary due to rooftop configuration and the presence of equipment.

County as a whole and in three of its five towns and cities: the City of Glen Cove, the Town of Oyster Bay, and the Town of North Hempstead. Parking lot installations offer the greatest opportunity in the Town of Hempstead, and rooftop installations offer the greatest opportunity in the City of Long Beach. The Town of Oyster Bay has the greatest potential for low-impact solar (1,921 MW), followed closely by the Town of Hempstead (1,769 MW), and the City of Long Beach has the least potential (15 MW) (Figure 7). The total estimated area of low-impact sites for solar installations in Nassau County is 22.6 mi^2 (14,486 ac) (Table 5).

Maps of low-impact sites for individual cities and towns in Nassau County are included in Appendix A. Detailed summaries of the low-impact siting potential for each city and town are available at solarroadmap.org/report.

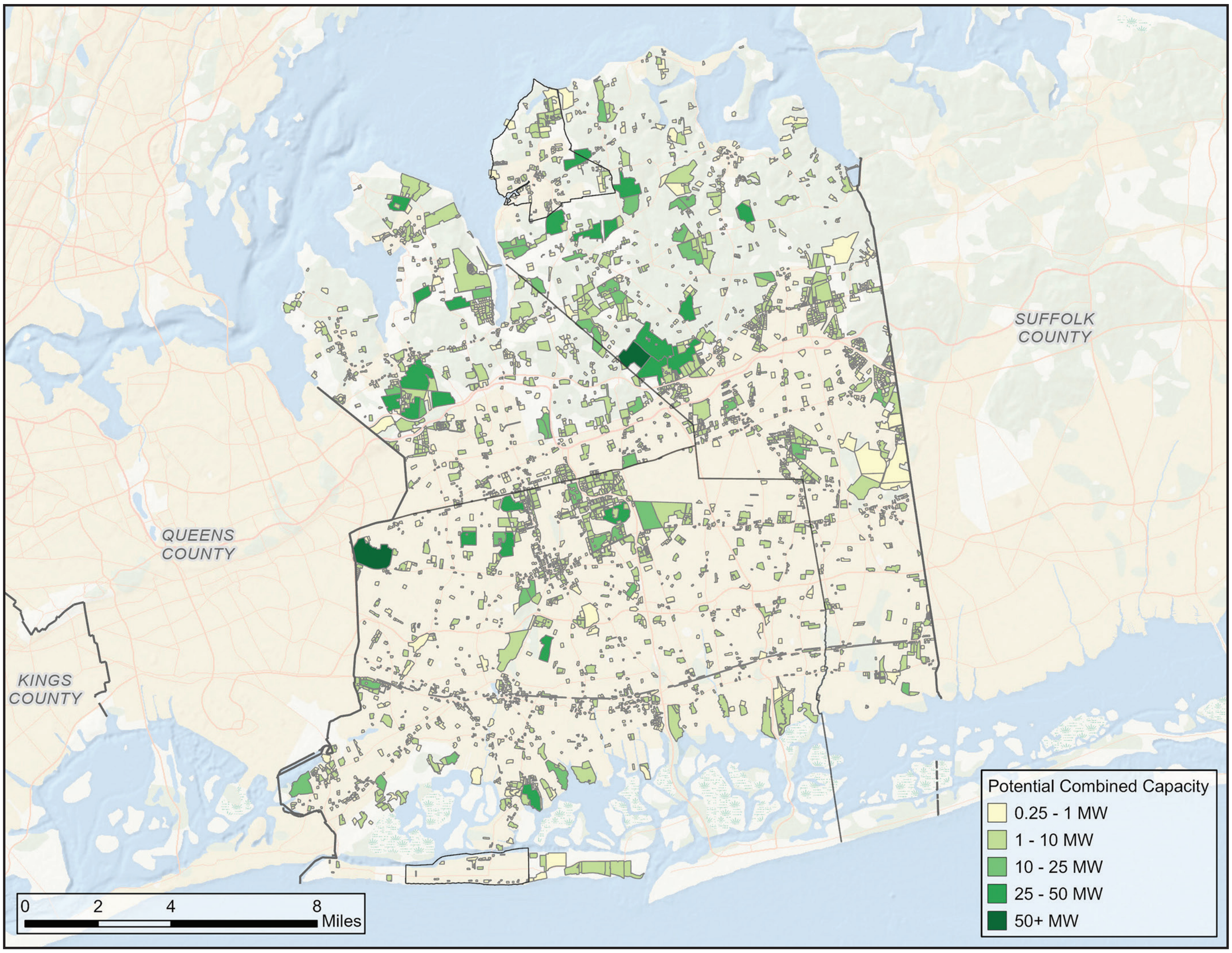

Figure 6. Map of low-impact sites for solar installations in Nassau County. Parcel colors indicate estimated combined generation capacity from rooftop, parking lot, and ground-mounted solar.

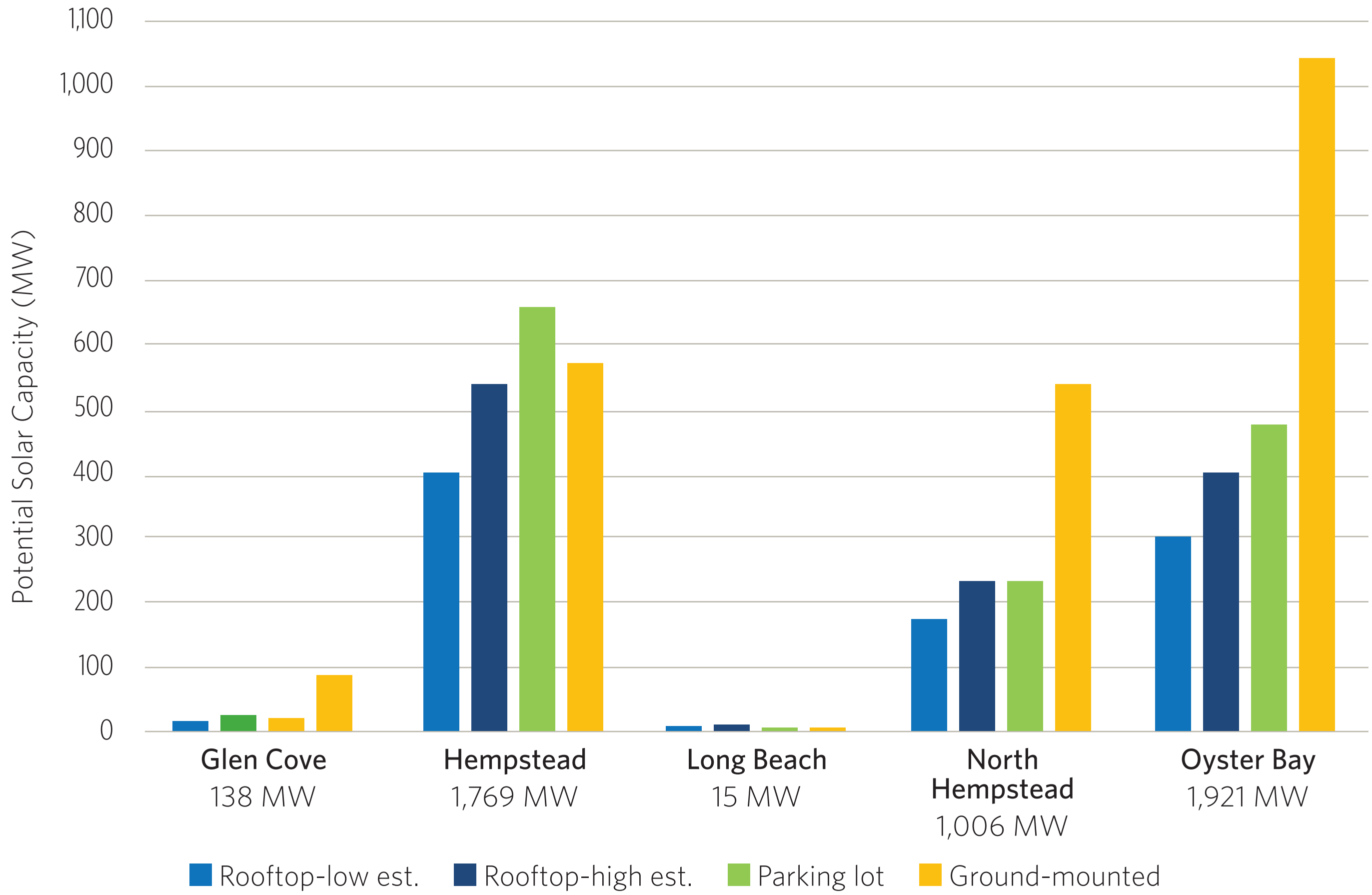

Figure 7. Estimated potential solar installation capacity (MW) in Nassau County cities and towns.[19]

Table 5. Estimated Area (mi^2) of Low-Impact Sites for Solar in Nassau County Cities and Towns

City or town	Rooftop area	Parking lot area	Ground-mounted area	City or town total
Glen Cove	0.1	0.1	0.4	0.6
Hempstead	2.4	3.4	2.6	8.4
Long Beach	0.05	0.02	0	0.07
North Hempstead	1.0	1.2	2.4	4.7
Oyster Bay	1.8	2.4	4.7	8.9
Total	**5.4**	**7.1**	**10.1**	**22.6**

[19] Calculations assume 6 W/ft² for low-density rooftop, 8 W/ft² for high-density rooftop, 7 W/ft² for parking lot solar, and 8 W/ft² for ground-mounted solar. Two estimates are provided for rooftop arrays to account for differences in rooftop configuration and the presence of equipment. City and town totals are calculated using the rooftop high-density estimate.

Suffolk County

About 75% of Long Island's low-impact siting potential (14,575 MW) is located in Suffolk County, partially due to the county's large size and relatively low density of development. The county could host 1,487 to 1,982 MW of solar on rooftops, 2,108 MW on parking lots, and 10,485 MW as ground-mounted solar on low-impact land (Figure 8 and Figure 9). As in Nassau County, low-impact, ground-mounted installations offer the greatest potential in Suffolk County as a whole and in each town individually, with the exception of the Town of Babylon, where rooftop installations may have greater potential capacity if they are installed at high density. In most towns, parking lot installations provide the second greatest opportunity. In the Town of Southold, rooftops offer the second greatest opportunity, while the potential for rooftop and parking lot installations is similar in the Towns of Babylon, East Hampton, and Huntington. The Town of Brookhaven has the greatest potential for low-impact solar (3,634 MW), followed by the Town of Riverhead (2,561 MW), while the Town of Shelter Island has the least potential (100 MW). The total estimated area of low-impact sites for solar installations in Suffolk County is 66.7 mi^2 (42,688 ac) (Table 6).

Maps of low-impact sites for individual towns in Suffolk County are included in Appendix A. Detailed summaries of the low-impact siting potential for each town are available at solarroadmap.org/report.

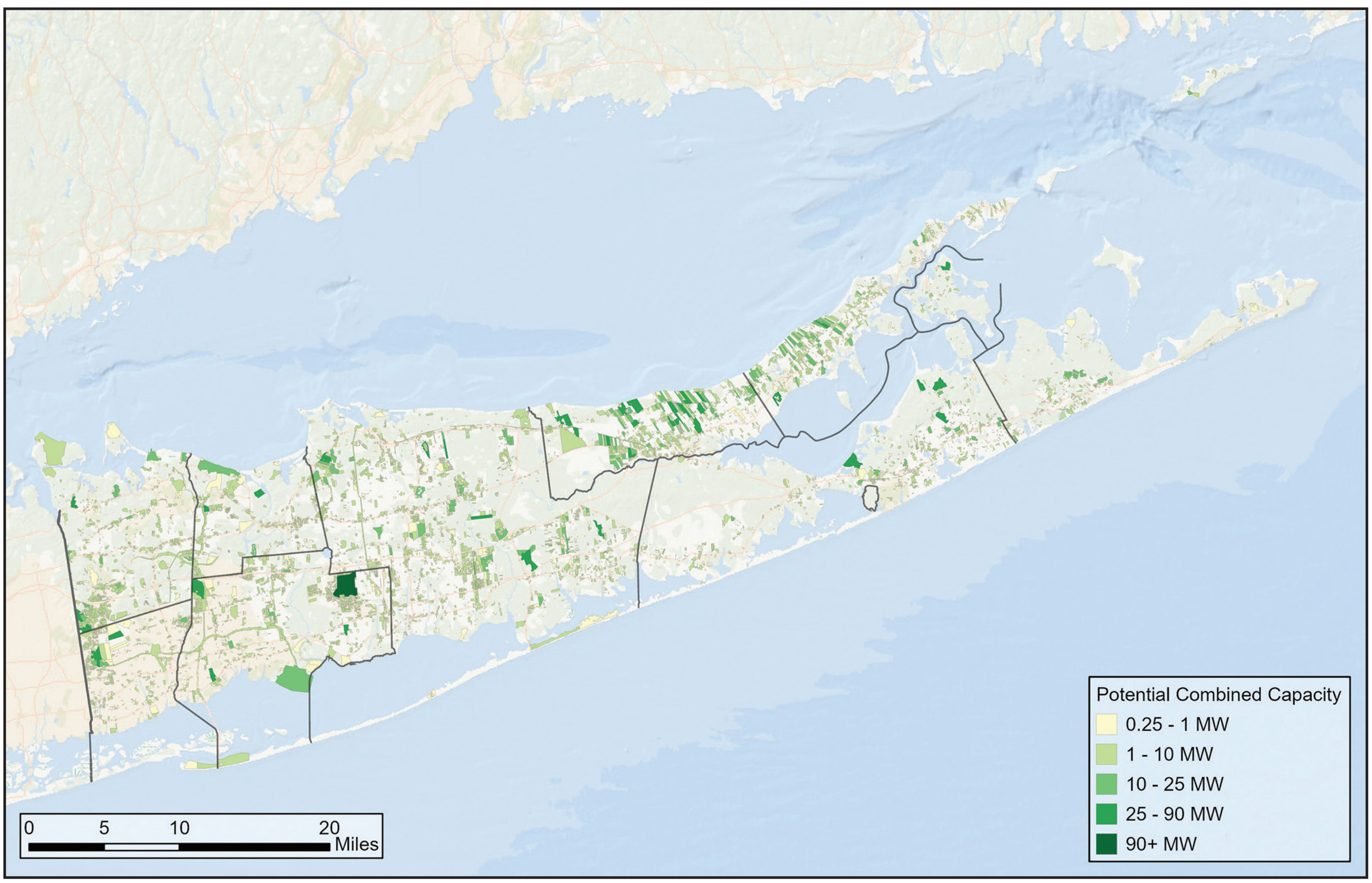

Figure 8. Map of low-impact sites for solar installations in Suffolk County. Parcel colors indicate estimated combined generation capacity from rooftop, parking lot, and ground-mounted solar.

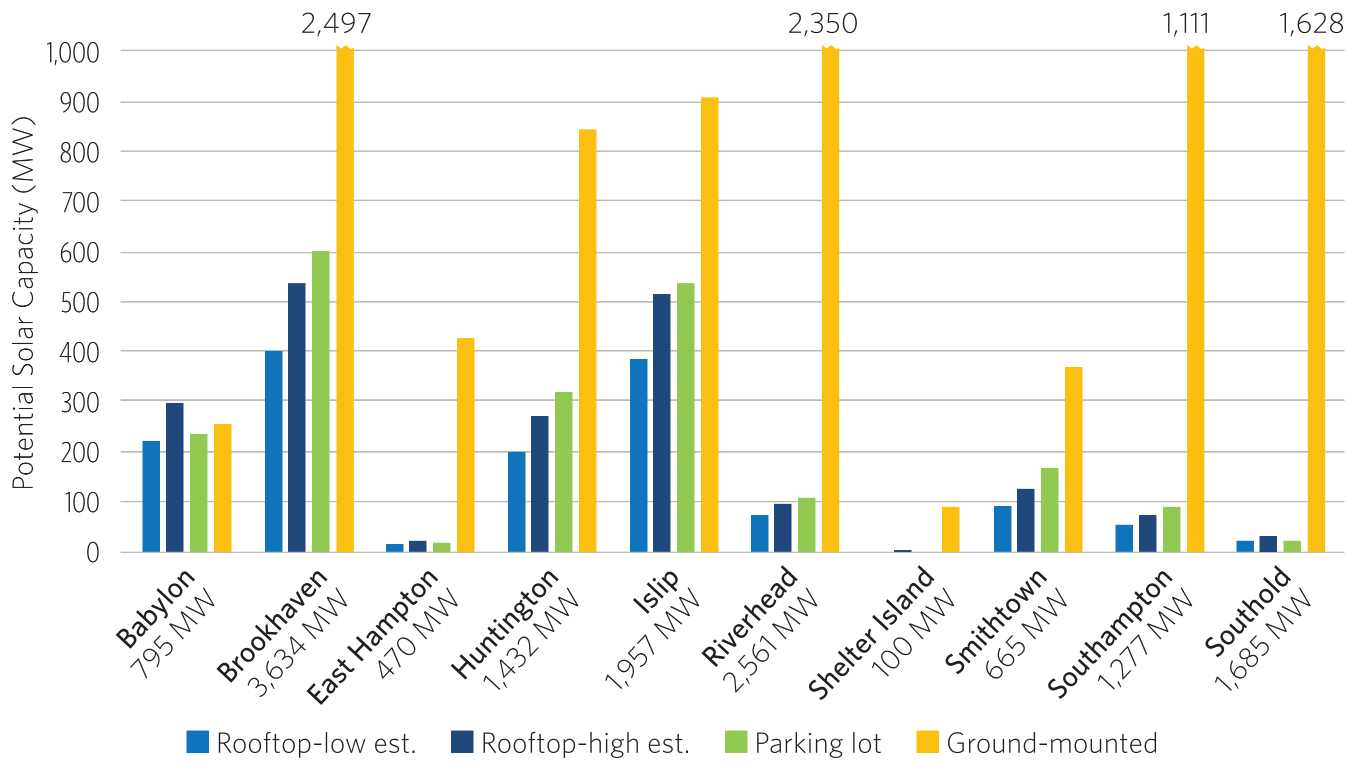

Figure 9. Estimated potential solar installation capacity (MW) in Suffolk County towns.[20]

Table 6. Estimated Area (mi²) of Low-Impact Sites for Solar in Suffolk County Towns

Town	Rooftop area	Parking lot area	Ground-mounted area	Town total
Babylon	1.3	1.2	1.2	3.7
Brookhaven	2.4	3.1	11.2	16.7
East Hampton	0.1	0.1	1.9	2.1
Huntington	1.2	1.6	3.8	6.6
Islip	2.3	2.7	4.1	9.1
Riverhead	0.5	0.6	10.5	11.6
Shelter Island	0.0	0.0	0.4	0.4
Smithtown	0.6	0.9	1.7	3.1
Southampton	0.3	0.5	5.0	5.8
Southold	0.2	0.1	7.3	7.6
Total	**8.9**	**10.8**	**47.0**	**66.7**

[20] Calculations assume 6 W/ft² for low-density rooftop, 8 W/ft² for high-density rooftop, 7 W/ft² for parking lot solar, and 8 W/ft² for ground-mounted solar. Two estimates are provided for rooftop arrays to account for differences in rooftop configuration and the presence of equipment. Town totals are calculated using the rooftop high-density estimate.


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Benefits of solar development for Long Island residents

Solar power offers Long Islanders a host of benefits, from cleaner air and healthier communities to clean energy jobs and a way to combat climate change. Public opinion polling of Long Island residents shows that a strong majority of Long Islanders (79%) feel that it is the responsibility of all Americans to take action to address climate change, and nearly as many (74%) think that solar energy is needed to address climate change. For additional polling results, see the Key Findings section on Long Islanders' perspectives on solar development, which begins on page 55. In the following section, we describe how solar energy development can benefit the health, well-being, and resilience of Long Island communities.

Improved environmental and human health

Generating electricity from renewable resources like wind and solar avoids creating GHG emissions that would otherwise be released by generating electricity from fossil fuels. In addition, solar energy does not generate other harmful pollutants such as particulate matter (PM), nitrogen oxides (NO_X), and sulfur dioxide (SO_X), thereby reducing the amount of these pollutants in the air and improving human health. The Roadmap identifies low-impact siting potential for nearly 19.5 GW of solar capacity, though technical, policy, economic, and social constraints may limit the feasibility of solar development on these sites. Here, we model installation of 5,000 MW (5 GW) of solar, about one-quarter of the low-impact solar potential on Long Island, to illustrate the potential environmental and human health benefits of increasing solar energy generation.

The U.S. Environmental Protection Agency's (EPA's) AVoided Emissions and geneRation Tool (AVERT) is often used to quantify the amount of emissions from fossil-fueled power plants that are avoided through renewable energy generation or energy efficiency improvements, according to region-specific electricity generation data, capacity factors, and emissions information (EPA, 2019a). We applied AVERT to 2018 emissions data to estimate the fossil-fueled generation and emissions avoided by building 5 GW of utility-scale (front-of-the-meter) and distributed (behind-the-meter) solar in the Northeast region, which includes New York.

AVERT modeling results showed that building 5 GW of mid- to large-scale solar in the Northeast region could reduce CO_2 emissions by 4.3 to 6.7 million tons annually, depending on the combination of behind-the-meter and utility-scale projects. This amount is the equivalent of taking 718,140 to 835,253 cars off the road (EPA, 2020). Table 7 shows the total annual emissions reductions in the Northeast region and in Nassau and Suffolk Counties on Long Island from behind-the-meter and utility-scale solar build-out.[21]

AVERT is often coupled with EPA's CO-Benefits Risk Assessment (COBRA) model to estimate and monetize air quality, human health, and related economic benefits that result from emissions reductions (EPA, 2019b). COBRA provides high and low estimates of avoided health impacts from exposure to air pollution over the course of 20 years, including deaths, illness and hospitalizations due to cardiovascular and respiratory conditions, and number of workdays lost due to illness. All impacts are monetized to show the associated cost savings of avoiding adverse health effects. We used the AVERT estimates of emissions reductions from adding 5 GW of utility-scale solar in the Northeast region, shown in Table 7, as inputs for the COBRA model.

COBRA modeling results showed that building 5 GW of mid- to large-scale solar in the Northeast region could result in up to 36 lives saved, 28 fewer hospitalizations, and $345 million in avoided health harms over the course of 20 years. Table 8 summarizes the total human health benefits and health-related economic benefits across the whole United States, the total benefits realized across all of New York, and the benefits that would occur in Nassau and Suffolk Counties. Because of air circulation patterns, air pollution can impact human health far from the source of emissions.

Table 7. Estimated Reductions in Fossil-Fueled Electricity Generation, Carbon Emissions, and Air Pollution from a 5-GW Increase in Installed Solar Capacity in the Northeast Region

	Annual displaced fossil-fueled generation (MWh)	CO_2 (tons)	SO_2 (lbs.)	NO_X (lbs.)	$PM_{2.5}$ (lbs.)
Utility-scale solar					
Northeast region	7,848,460	4,261,680	2,996,840	3,764,980	348,980
Nassau County	211,190	136,730	55,630	273,960	16,800
Suffolk County	589,110	378,920	423,790	500,710	70,660
Behind-the-meter solar					
Northeast region	6,740,110	3,664,140	2,584,010	3,227,140	299,880
Nassau County	181,470	117,520	49,320	235,650	14,420
Suffolk County	504,840	325,270	375,610	432,410	60,390

[21] Utility-scale solar delivers energy directly to the grid, and region-specific transmission and distribution losses are factored in by the AVERT model, while behind-the-meter solar delivers energy directly to end users and does not suffer from these losses. Therefore, avoided fossil-fueled generation and emissions will be higher for utility-scale solar than distributed solar PV. Both are reported here to illustrate the range of potential emissions reductions from installation of behind-the-meter and utility-scale solar generation. AVERT does not model transmission constraints and is not sensitive to the location of new renewable energy generation within the region.

Table 8. Estimated Avoided Human Health Impacts and Associated Monetary Savings Over a 20-Year Period from a 5-GW Increase in Installed Solar Capacity in the Northeast Region

	Estimates	U.S. Total	New York	Nassau County	Suffolk County
Total health savings[22]	Low	$152,617,442	$92,969,641	$12,042,293	$17,208,591
	High	$344,699,333	$209,851,012	$27,156,028	$38,902,056
Hospitalizations avoided[23]	Low	13	8	1	2
	High	28	16	2	3
Deaths avoided	Low	16	10	1	2
	High	36	22	3	4

Greater energy access, equity and affordability

Mid- to large-scale solar development can play an important role in enabling equitable access to renewable energy and improving energy affordability on Long Island. Currently, many Long Island residents cannot access clean, renewable energy because they lack suitable rooftop or other space, rent their homes or places of business, or cannot afford to own or lease a solar system. Nationally, almost half of U.S. households (more than 154 million people) fall into this category (Gallucci, 2019). Lower rates of home ownership by people of color also leads to racial disparities in access to renewable energy (Sunter, Castellanos, & Kammen, 2019).

When they are designed as community solar projects, mid- to large-scale solar installations can provide electricity to these households at a lower price per kWh than the standard electric utility rate. The cost savings provided by, and incentives for, community solar and other business models with no up-front costs can be especially significant for LMI households. An estimated 48.5% (or 3.5 million) of all households in New York are considered LMI (Carroll, 2017), with incomes that are below 80% of the area median income or state median income, whichever is greater. LMI households spend a disproportionate amount of their income on energy due to the legacies of structural discrimination in the housing market, which drives low-income households and people of color into older, less efficient buildings (Shahyd, 2016).

The proportion of household income spent on energy is referred to as the household's energy burden. Energy is considered affordable when the energy burden is 6% or less (New York State Office of the Governor, 2016). In New York, the average energy costs for low-income households are 12.6% of household income (Carroll, 2017). Results from the Energy Information Administration's (EIA's) 2015 Residential Energy Consumption Survey show that African American and Latinx households experience greater energy burdens and energy insecurity than their white counterparts (EIA, 2018).

[22] These results assume a 3% discount rate.
[23] This is the number of avoided hospitalizations related to respiratory and cardiovascular conditions, including nonfatal heart attacks, asthma, and chronic lung disease.

Long Island Cares installed solar on the roof of its headquarters—the Harry Chapin Food Bank located in the Long Island Innovation Park at Hauppauge. This community solar installation provides renewable energy to approximately 50 households experiencing hardship and food insecurity and is part of a larger strategy by the Hauppauge Industrial Association's Solar Task Force to transition the business park to renewable energy. © SUNation Solar Systems

Recent research also shows stark racial and ethnic disparities in installations of rooftop solar across the United States. In census tracts with the same median household income, those tracts that were majority Black, Hispanic, and Asian had an average of 69%, 30%, and 2% less rooftop solar, respectively, than racially and ethnically diverse census tracts that had no racial or ethnic majority across all income levels. Majority white tracts, by contrast, had 21% more rooftop solar than racially and ethnically diverse tracts with no racial or ethnic majority across all income levels (Sunter et al., 2019). Similar patterns exist on Long Island (Sunter 2020, personal communication).

Clearly, the benefits of solar energy, such as household energy savings and improved air quality, are not equitably distributed or accessible to all households and communities on Long Island and across New York State. The financial barriers for LMI households are particularly high. Community solar can play a vital role in providing equitable, affordable access to renewable electricity for all households, regardless of location or income, and can help reduce electric bills.

There are several business and ownership models available for community solar in New York. Solar developers, local governments, nonprofits, or community members can initiate and own community solar arrays. When solar arrays are cooperatively owned by local communities, community members have a say in the development and governance of the projects and have access to both the clean energy generated and a share of the profits. Community-owned shared solar is a way to strengthen equity and agency of local communities in energy resources.

In Strategies 1 and 7 (see pages 61 and 86), we recommend a set of actions that will advance community solar and enhance inclusion of currently underserved communities in the solar market and industry. These recommendations are consistent with the CLCPA's goals to address environmental injustice and create an equitable clean energy transition. The CLCPA mandates that at least 35% of clean energy program resources benefit disadvantaged communities and creates a just transition working group to ensure job training and opportunities for underserved communities (State of New York, 2019).

Supporting clean energy jobs

Creating good-paying jobs in the clean energy sector is an important economic benefit of renewable energy development. New York ranked fourth in the nation in solar job creation in 2019 (The Solar Foundation, 2020). From 2015 to 2019, the number of jobs in the solar sector on Long Island increased by 50% (Table 9), a pace similar to that of the statewide solar sector. Nearly one-quarter of New York's solar jobs are located on Long Island. Up to one-third of these jobs are temporary installation positions, while the rest include jobs related to operations and maintenance, manufacturing, wholesale trade and distribution, and other jobs (The Solar Foundation, 2019). In 2018, renewable electric power generation produced 14% (22,023 jobs) of all jobs in New York's clean energy sector (NYSERDA, 2019a).

Table 9. Number of Jobs in the Solar Industry Sector 2015–2019

Year	Number of jobs		
	Nassau County	Suffolk County	New York State
2015	812	913	8,250
2016	712	986	8,135
2017	818	1,221	9,012
2018	1,019	1,219	9,729
2019	1,180	1,400	10,740

Current and projected solar industry growth provides a tremendous opportunity for job creation and workforce development in New York, including on Long Island. The 2020 Draft Supplemental Generic Environmental Impact Statement for the CLCPA asserts that reaching the state's clean energy goals "will likely continue to drive additional job growth and economic growth," although a quantitative projection of that growth was not provided (NYSDPS & Ecology and Environment Inc., 2020).

In 2019, New York State installed 478 MW of solar statewide, and New York's solar sector employed 10,740 people in solar installation, maintenance, and operations jobs (NYSERDA, 2020c; The Solar Foundation, 2020). That number is about 22.5 jobs per MW, a figure in line with estimates by The Solar Foundation of 38.7 jobs per MW for residential solar and 21.9 jobs per MW for nonresidential solar projects (The Solar Foundation, 2019). As of 2019, solar projects generating 2,232 MW have been installed in New York. Reaching the CLCPA goal of 6,000 MW by 2025 will require the addition of approximately 628 MW of solar per year, roughly 30% more than the 2019 figure. Assuming the same number of jobs will be created per megawatt installed in the near future, we estimate that this industry growth could increase New York's solar workforce to 13,600 jobs.

In addition to these estimates, economic models such as IMPLAN (short for "impact analysis for planning") and the Jobs and Economic Development Impact (JEDI) model can be used to calculate the ripple effect of solar job creation through the economy (IMPLAN, 2019; NREL, 2019). These models estimate potential employment, earnings, and economic impacts from the construction and operation of solar facilities. Vote Solar used JEDI to estimate the workforce and economic benefits from adding 4,575 MW of solar to achieve New York's goal of 6,000 MW of solar by 2025. They found that meeting this goal would support 11,253 sustained full-time jobs during construction, create $5.7 billion in earnings for those employed during construction, create $10.9 billion in local economic benefits, and add $32 million in property tax revenues in just the first year of system operation (Garren & Tomic, 2019).

Limitations for low-impact solar siting

Development cost

The economic feasibility of solar development is largely determined by the up-front cost of installations and the potential revenue generated by or value of the energy produced. Federal, state, utility, and other programs help reduce the cost to develop solar and subsidize the energy produced. Overall, the cost of solar development is declining nationwide, mainly due to reductions in the cost of panels and other hardware. According to the U.S. Solar Photovoltaic System Cost Benchmark report for the last quarter of 2018 from the National Renewable Energy Laboratory (NREL), the average cost of commercial solar installations (200 kW size range) has dropped from $5.43 per watt in 2010 to $1.83 per watt in 2018, with most of that price drop attributable to reduced costs of equipment (Fu, Feldman, & Margolis, 2018). In comparison, the average cost of solar development (across all sectors) was $2.23 per watt for projects receiving NYSERDA funding in 2019 (NYSERDA, 2019d). Soft costs, which include permitting, taxes, overhead, land or lease acquisition, and labor, made up 35% to 56% of total development costs for solar installations 10 kW and larger and are not declining as quickly as hardware costs (Fu, Feldman, et al., 2018). Soft costs remain higher for mid-sized installations (<100 MW).

In addition, the cost of some interconnection and grid modifications or grid upgrades can significantly impact the economic feasibility of a project. The integration of front-of-the-meter solar systems[24] often requires upgrades to the distribution system to control and minimize adverse impacts, such as voltage fluctuations. When such upgrades are necessary for grid reliability, resilience, and safety, the costs of upgrades are usually borne by the developer and can impact the economic viability of a project. Data from Maryland show that upgrades typically cost ~$300,000 or less for a 2-MW solar project, while larger projects might require substation or distribution upgrades that typically add ~$1,000,000 or more to development costs. These interconnection costs, like other development costs, are passed on to the energy buyers, often the utility. The Maryland data show that interconnection costs

[24] Front-of-the-meter solar systems deliver energy directly to the electrical grid, and none of the energy generated is used on-site. Behind-the-meter solar systems are connected to the grid through a customer's utility meter; energy produced is used on-site and any excess energy generated by the system is delivered to the grid.

Rooftop and ground-mounted solar arrays at the Long Island National Golf Club in Riverhead © SUNation Solar Systems

can add $0.017 to $0.023 per kilowatt hour (kWh) to the price of the electricity (Daymark Energy Advisors, RLC Engineering, and ESS Group 2018). Utility-scale, front-of-the-meter projects can usually absorb the cost of such upgrades, while small- to mid-scale solar projects can become economically infeasible.

Development costs vary by installation type, with some low-impact sites being more economically feasible than others. According to estimates provided by EnterSolar, a solar development company with installations on Long Island, the cost of a 1-MW rooftop array and a 1-MW ground-mounted array were similar ($1,895,000 and $1,985,000, respectively), while a 1-MW system on a parking lot cost substantially more ($3,475,000). The higher cost of parking lot systems is the result of more expensive site preparation, involving racking and resurfacing. Solar development on closed, capped landfills is also more expensive, as such development requires additional permitting and legal approvals, engineering considerations, and ballasted racking,[25] increasing the cost of racking by as much as 50% over nonballasted racking. Additional factors that influence the cost of solar development include site preparation (clearing, grading), site remediation (planting, resurfacing), and site purchase or lease terms.

The market drives solar development to the least expensive sites that require little site preparation or remediation, which could include areas with other land-use values, such as undeveloped natural areas or unprotected farmland. To encourage solar development on low-impact sites on Long Island, we must use targeted strategies or mechanisms to make these sites more economically feasible (see Strategy 3). Current federal, state, and utility incentives and funding mechanisms for solar development are detailed in Appendix B.

While adding battery storage systems to any installation type increases the capital costs, such systems can help balance generation and load in time and space and reduce energy demand from the grid at peak times (peak-demand shaving). Therefore, energy storage may provide additional financial benefits to the owner. See the Key Findings section on the importance of battery storage, which begins on page 44, for a detailed discussion of the cost and role of battery storage.

[25] Ballasted racking is a solar array mounting system that uses a weight to hold down the racking and modules instead of attaching them directly to the site surface. This type of racking is often required for solar installations on landfills to avoid damaging the cap.

Grid interconnection

Since distributed energy resources (DERs), including solar and battery storage, change the electric load and flow of electricity on the electrical grid, all DER systems must be reviewed and approved by the grid operator to ensure system safety and reliability. On Long Island, LIPA oversees and PSEG Long Island implements the process for interconnecting DERs to the electrical grid. The Long Island branch of the New York State Department of Public Service (NYSDPS) also provides regulatory oversight of electric service on Long Island. The application process for interconnection varies according to the size of the solar installation (NYSERDA, 2019). As part of the application process, PSEG Long Island or the NYISO evaluates the ability of a proposed DER project to connect to the grid at the intended location. This determination is made based on technical factors, including system reliability, resiliency, safety, and the hosting capacity of the circuit. Hosting capacity is defined by PSEG Long Island as "the amount of additional DER capacity that can be accommodated on a certain location on the distribution grid without adversely impacting power quality or reliability" (PSEG Long Island, 2019a).

PSEG Long Island released a new hosting capacity map of the Long Island electrical grid in December 2020. This map provides detailed information for each distribution feeder circuit (often referred to as "feeders"), including the potential available hosting capacity for solar PV, the DER capacity currently connected, and the DER capacity in the interconnection queue (PSEG Long Island, 2021). This map is available at psegliny.com/aboutpseglongisland/ratesandtariffs/sgip/maps. Users wishing to access the map are required to submit the Hosting Capacity Map Access Request Form and pass a simplified background check.

According to the hosting capacity map, 43% of feeders have an estimated maximum hosting capacity[26] of 250 kW or more, the minimum size of low-impact solar installations considered in the Roadmap (Figure 10). Most feeders with available hosting capacity (84%) can host an estimated maximum of 1 MW of additional DER, and 16% can host more than 1 MW.[27] The high proportion of feeders (45%) estimated to have no available DER hosting capacity

Long Island Solar Farm at Brookhaven National Laboratory © Long Island Power Authority

[26] The maximum available hosting capacity is the approximate magnitude of additional DERs that can be accommodated at the most favorable location on the distribution feeder circuit without exceeding a 70% penetration ratio. It is possible that additional solar PV that exceeds the estimated hosting capacity can be interconnected provided detailed studies or supplemental screening are conducted. In areas with limited hosting capacity, PSEG Long Island requires a Coordinated Electric System Interconnection Review (CESIR), which varies in cost and takes up to 60 business days to determine necessary grid modifications and associated costs for interconnecting a project.

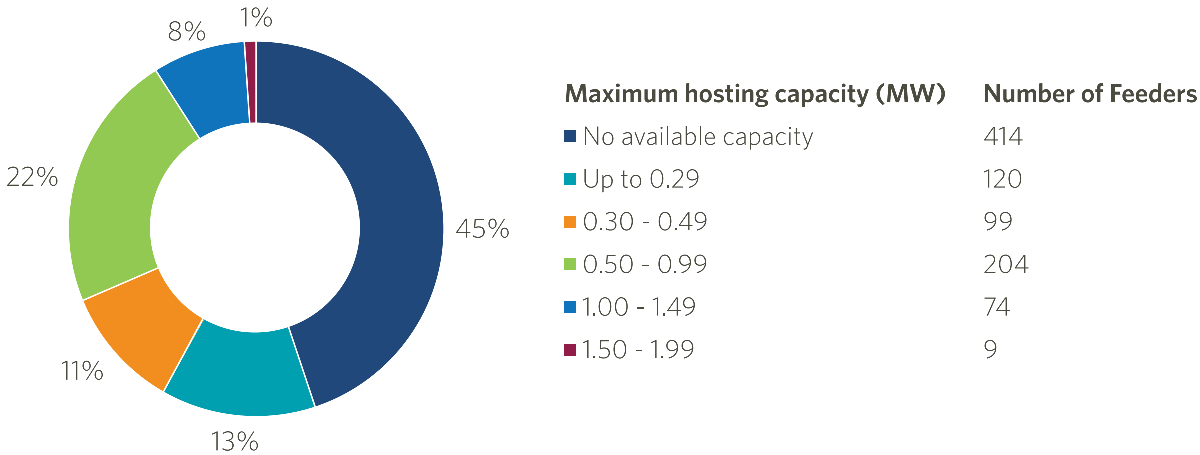


Figure 10. Estimated available hosting capacity on Long Island distribution feeder circuits for solar PV in January 2021 (PSEG Long Island, 2021).

and the inability of any feeder to connect more than 2 MW of DER indicate potential limitations to interconnecting mid- to large-scale solar installations across much of Long Island. Low hosting capacity can result in higher project costs, due to the need for more in-depth review by the utility, longer project timelines, and the cost of grid upgrades and equipment required to maintain a reliable, resilient, and safe electric grid. These data point to a continued need to invest in and upgrade grid infrastructure.

Funding and incentives

Programs to support the development of renewable energy often focus on improving the economic return on investment for energy installations by reducing the cost of development (incentives), increasing the value of the energy generated (compensation), or providing financial benefits after installation (tax credits). Another option is to encourage low-impact siting of energy projects by providing a greater return on investment for solar on low-impact sites than on higher-impact sites. While there are existing financial incentives for solar development (Appendix B), additional programs and creative public–private partnerships targeted at supporting low-impact siting should be established to accelerate mid- to large-scale solar development on Long Island.

Long Island currently leads the state in the total number of rooftop solar installations, due in part to successful deployment of utility incentive programs that began with the Solar Pioneer Program in 2010. Programs instituted by LIPA and administered by PSEG Long Island include solar rebate programs, remote net metering, five feed-in tariffs (FITs),[28] and the community solar program. Funding from the NY-Sun program and federal tax incentives have also played a role. These programs have succeeded in fostering an active, local solar market and laid the foundation for successfully accelerating mid- to large-scale solar development in similar ways. There are several options for using new and existing programs to spur development on the low-impact sites identified in the Roadmap.

[27] The interconnection data shown here is The Nature Conservancy's and Defenders of Wildlife's interpretation of the PSEG Long Island Hosting Capacity Map. This data may not reflect actual available capacity at any of the Long Island distribution feeders. The actual capacity and the cost to interconnect is determined by individual studies as per the LIPA Small Generator Interconnection Process. Additional information on the assumptions of the hosting capacity map can be obtained directly from the PSEG Long Island Hosting Capacity Website. PSEG Long Island and LIPA make no representation as to the accuracy of the data above and the interpretation of the hosting capacity map.

[28] FITs are a policy tool designed to encourage investment in renewable energy. FIT programs enable a utility to enter into a long-term contract to purchase the electricity delivered to the grid by a renewable energy system at a pre-determined price, usually above the retail cost of electricity and declining over time.

Suffolk County achieved the SolSmart Gold designation in recognition for its work to advance solar energy through policy and action, including developing solar arrays at many county facilities. © Suffolk County Economic Development and Planning Department

Among these options are mechanisms that increase the value of energy generated by projects on low-impact sites or that improve equitable access to energy. The value, or price per kWh, that solar project owners receive for the energy they deliver to the grid depends on the capacity of the system. Along with utilities across the state, LIPA transitioned to using the VDER (Value of Distributed Energy Resources) compensation mechanism for DERs greater than 750 kW in capacity for commercial accounts in April 2018 and for community solar in January 2020. Energy generated by solar installations smaller than 750 kW is compensated under remote net metering. Under VDER, also called the Value Stack Tariff, some components of the value per kWh are variable and depend on when the electricity is delivered and where it is going (Thoubboron, 2018). Community solar projects are incentivized by the VDER through an element known as the Community Credit. The Community Credit adds $0.12/kWh for projects in Con Edison territory, including New York City; $0.05/kWh on Long Island; and $0.0225/kWh in upstate New York (Merchant, 2020). Changes to the VDER value stack to reward projects developed on low-impact sites would need to be approved by LIPA, and Locational System Relief Value (LSRV) areas provide a precedent for higher compensation for projects through VDER based on location.

Similarly, "adder incentives" are designed to offer up-front rebates for energy generated by projects with specific characteristics, such as low-impact siting, community solar, or solar located in load pockets.[29] Adders are available in other regions of New York through the NY-Sun program and increase compensation for projects on low-impact sites or that expand access to solar for LMI households. For example, Con Edison provides a $0.40/W-DC adder for carport systems, and upstate projects can qualify for a landfill or brownfield adder of $0.10/W-DC (NYSERDA, 2020b). NYSERDA's recent petition to expand the NY-Sun program in line with the CLCPA goal of 6

[29] Load pockets are geographic areas where electricity must be supplied by local generation due to limitations in the ability to import energy over the transmission system during times of high electricity demand.

GW of distributed solar by 2025 proposes a community adder specific to community solar projects, although the proposal did not apply to Long Island (NYSERDA, 2019a). PSEG Long Island has developed a community adder of approximately $0.02/kWh to be offered to projects up to 750 kW AC, which was launched in June 2020.

In addition, LIPA has approved a new FIT, called Solar Communities Feed-in Tariff V (FIT V), that will incentivize up to 25 MW DC of solar installations by commercial customers, with the potential to award contracts for an additional 15 MW DC. Installations must be between 200 kW and 5 MW in capacity and will enter a 20-year term power purchase agreement (PPA) with LIPA. The price per kWh sloped bid price cap begins at $0.1649/kWh and will decline to $0.13/kWh as the total enrollment in the FIT increases. The initial enrollment period for FIT V was June 1 to September 30, 2020 (PSEG Long Island, 2020c).

Local governments can also incentivize low-impact solar development through financial or structural incentives that reward property owners and real estate developers for installing solar. Structural incentives are processes and policies that encourage green building practices through mechanisms like fast-tracked permitting or a bonus program, such as height or floor area ratio bonuses. These incentives provide a significant benefit to the property owner or real estate developer with little or no financial investment from local government. Additional mechanisms available to local governments are rebates or tax credits, exemptions, and waivers.

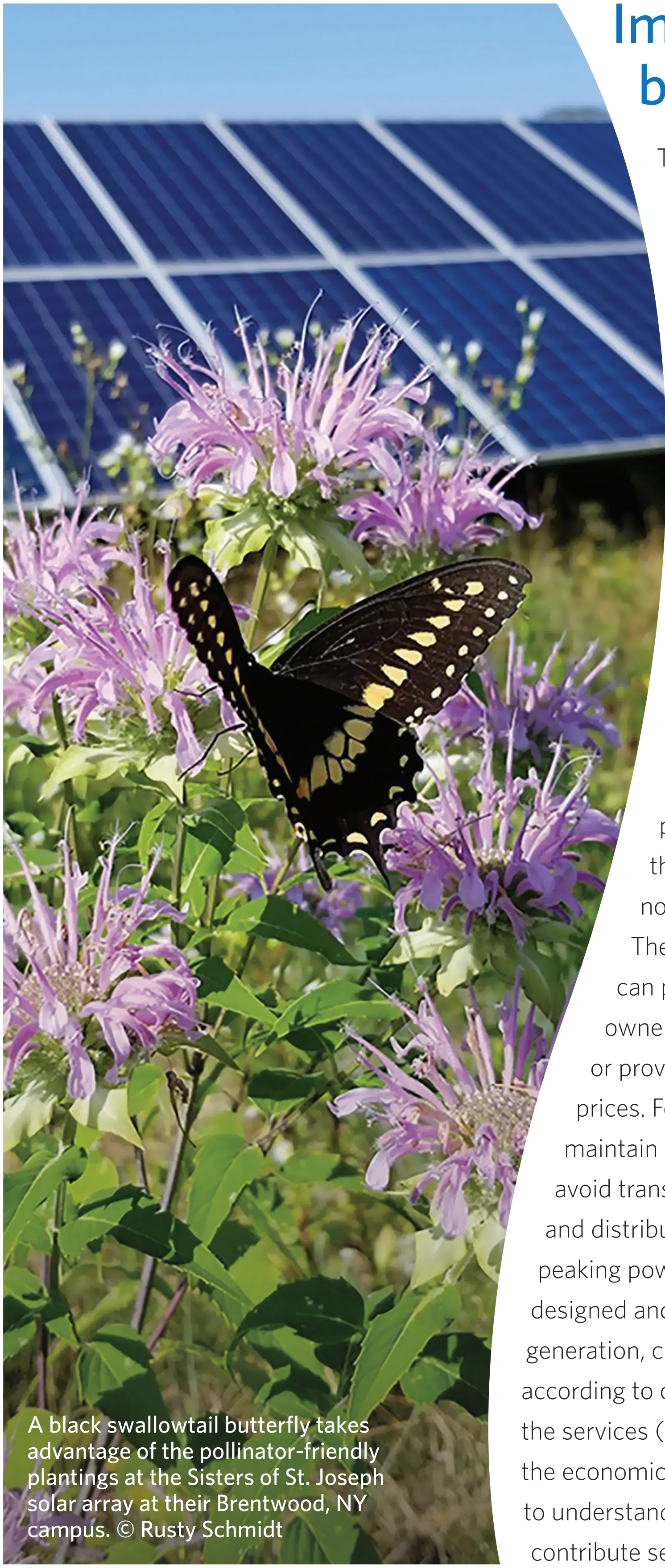
In Strategies 3 and 5 (see pages 68 and 77), we recommend a set of actions that will improve the economics of solar projects on low-impact sites, including projects on parking lots, rooftops, landfills or brownfields, and arrays co-located with agricultural production. Locating projects on these sites can minimize environmental impacts and maximize benefits to local communities, but it tends to have higher up-front costs. Funding for programs and incentives to support solar development can come from a variety of existing and potential sources, including local and state government budgets, a revised Clean Energy Standard budget, RGGI funds, new state funding that could be created through the state budget, CLCPA, a future New York State Bond Act, or federal stimulus funding.

Long Island's Clean Energy Accomplishments

Thanks to investments by LIPA, the clean energy industry, and Long Island communities, Long Island is home to:

- > 50,000 distributed solar installations
- Three of the largest utility-scale solar farms in New York
- Two of the largest battery storage facilities in the state
- The new Solar Communities program, aimed at providing community solar to low- and moderate-income customers

Source: Long Island Power Authority, 2019



A black swallowtail butterfly takes advantage of the pollinator-friendly plantings at the Sisters of St. Joseph solar array at their Brentwood, NY campus. © Rusty Schmidt

Importance of battery storage

The expansion of renewable energy brings with it two important practical concerns: 1) the ability of the electric grid to reliably and safely accommodate interconnection of these new resources; and 2) the inherent intermittency and unpredictability of renewable power generation. Compared with fossil-fueled power plants, solar energy generation facilities are more broadly distributed, and the timing and amount of power produced are less predictable and controllable. Fortunately, energy storage can help manage both concerns. Pairing solar with storage enhances the energy system's ability to balance generation with load in both time and space, making the electricity grid more stable and flexible.

The primary benefit of integrating storage with a solar system is to balance energy supply with demand by storing energy that may not be needed when the solar panels are generating electricity during the day and using the stored power to meet demand when the solar panels are not producing enough, such as on cloudy days or at night. There are many other benefits as well. For instance, storage can provide customers with emergency backup power, enable owners of solar power systems to use their own power at night, or provide power at peak load times to help avoid peak demand prices. For grid operators and utilities, storage can help the system maintain optimum voltage and quickly match power to demand, avoid transmission congestion, and forestall some transmission and distribution capital projects and the need for fossil-fueled peaking power plants that only operate during high demand. Properly designed and sited storage systems, particularly when paired with solar generation, can sometimes perform several of these different services according to changes in need, and thus "stack" their value by monetizing the services (Fitzgerald, Mandel, Morris, & Touati, 2015). To evaluate the economics of how solar might integrate with storage, it is important to understand the various ways that energy storage technologies can contribute services that may be of financial value.

Some energy storage technologies involve thermal means, such as melting salt and using it later to generate steam, or mechanical means, such as pumping water, compressing air, or spinning a flywheel to create potential energy that can be released later to generate electricity. New York has two pumped storage systems at existing hydroelectric plants, as well as a 20-MW flywheel (NYISO 2017), but space and siting considerations preclude mechanical storage in most sites. Most of the storage contemplated for Long Island will be in the form of batteries, most likely lithium-ion batteries.

According to the energy analysis firm Wood Mackenzie, per-energy-unit prices for lithium-ion batteries declined from $275/kWh in 2016 to $225/kWh in 2018. The firm forecasts that prices will continue to decline and will reach $150/kWh by 2023, while other firms predict even sharper declines (Henze, 2019). Further, Wood Mackenzie predicts that annual deployments will increase tenfold by 2024, reaching 4.4 GW per year with an annual market value of $4.7 billion (Wood Mackenzie, 2019). Total system costs (inverter, other hardware, labor, etc.) add substantially to both the overall and per-energy-unit prices and vary by duration of discharge capability. Modeling of cost benchmarks by NREL in 2018 found that the cost of a 60-MW system with a 4-hour duration was more than triple the cost of one with a 0.5-hour duration, but it had a lower cost per kWh due to its much larger output (Fu, Remo, & Margolis, 2018). Similarly, the New York Energy Storage Roadmap concludes that "many customer-sited and distribution system use cases and paired solar [plus] storage projects are, or will soon become, viable in downstate New York between now and 2025" (NYSDPS and NYSERDA 2018).

As storage costs continue to drop and efficiencies increase, the economics of adding storage improve, increasing the ability of the system to manage larger penetrations of renewables. NYISO is beginning to analyze and plan for these changes over the coming decades (NYISO, 2019). NYISO has proposed new policies and tariffs to facilitate integration of energy storage in its wholesale markets in preparation for meeting the CLCPA goal of 3,000 MW of energy storage by 2030. In April 2019, NYSERDA announced that $53 million will be available for retail and bulk storage projects on Long Island. To boost battery storage on Long Island, LIPA has developed the Dynamic Load Program to incentivize behind-the-meter battery storage, bought two 5-MW/40-MWh battery storage facilities, and plans to issue a request for proposals for additional utility-scale storage in the region in late 2020 (PSEG Long Island, 2020a, 2020b). In September 2020, the NYSPSC took further steps to implement the New York Energy Storage Roadmap by establishing two new programs that will incentivize deployment of energy storage technologies (NYSPSC, 2020).

Opportunities and challenges for four major property types

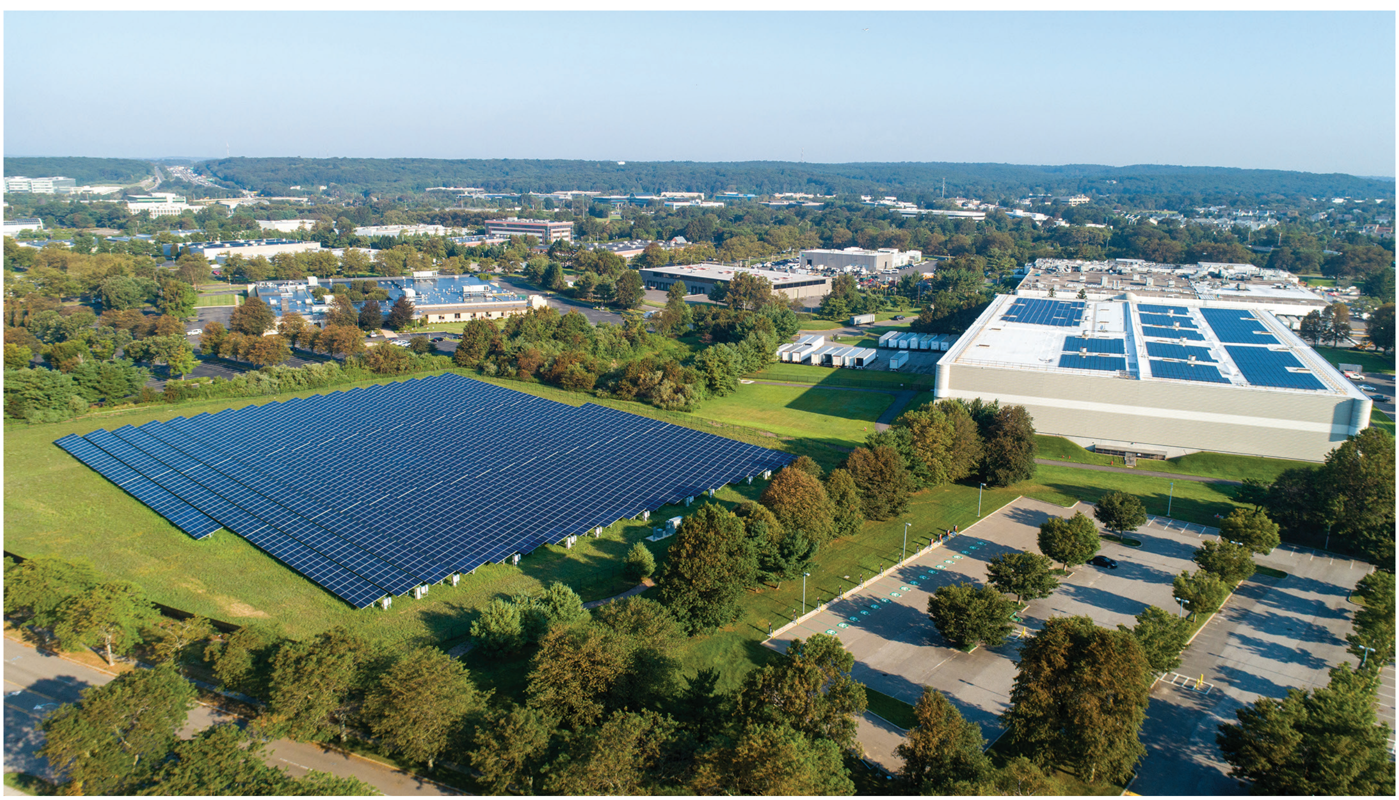
Opportunities and challenges for solar development vary according to the setting. Broadly speaking, mid- to large-scale solar systems can be installed on four types of property: commercial, industrial, and other private properties; properties owned by nonprofit organizations; government properties; and agricultural properties. These property types vary in their tax status and access to capital and financing options, and thus face differing challenges and opportunities for installing solar.

Commercial, industrial, and other private properties

Commercial properties refer to buildings and/or land used for business activities that generate a profit, either from capital gains or rental income. Examples of commercial properties include office buildings, distribution centers, private medical facilities, private schools, and retail spaces. Opportunities and barriers differ between owner-occupied commercial settings and tenant-occupied commercial settings. Farms are excluded from this category and addressed later in this section.

Generally, up-front installation costs present less of a barrier for commercial spaces, because for-profit businesses can usually take advantage of tax credits and other incentives, such as property assessed clean energy (PACE) financing (see Appendix B). It is important to note that federal tax credits are available to the solar system owner, who is not always the owner of the property where the solar system is located. In owner-occupied spaces, property owners can choose a business model that best suits their tax liability and energy use. A summary of solar business models is included in Appendix C. When solar energy generation potential and electricity use at a site are similar, the ownership or third-party ownership model may be most appropriate, because these models easily enable the system owner to use the energy generated by the system on-site and save on their energy costs. If commercial property owners are responsible for the electricity bill at more than one property, they may even choose to use LIPA's remote net metering program to credit electricity generated at one site to their other utility accounts.

In tenant-occupied commercial spaces, installation of solar is often hindered by the problem of split incentives. Split incentives arise when the entity responsible for using and paying for energy is different from the entity responsible for paying for measures to reduce energy consumption. The most commonly cited split incentive is when the



As part of their global citizenship and sustainability efforts, Estee Lauder Companies installed 2 MW of rooftop and ground mounted solar at their campus in Melville, NY. The array provides 100% of the electricity for their office. © EmPower Solar tenant pays the electricity bill. In the United States, roughly 83% of commercial building occupants pay their own utilities (Jessoe, Papineau, Rapson, & Davis, 2019). In this scenario, property owners may be reluctant to make energy-related capital investments such as installing rooftop solar, because energy cost savings accrue to the tenant and not the owner. However, the property owner could still accrue the tax benefits, energy subsidies, and other incentives associated with ownership of a solar system. Meanwhile, when the owner pays the energy bill, they may have a greater incentive to install solar or efficiency upgrades, but the tenant may be disincentivized to conserve energy.

The U.S. Department of Energy's (DOE's) Better Buildings Alliance offers several potential solutions to the split incentives problem (DOE, 2015). First, the property owner can invest in a behind-the-meter solar system and include electricity in the cost of the lease. Mechanisms such as a "green lease," a formal agreement between owner and tenant to partner on energy-saving mechanisms, can help formalize this arrangement (Institute for Market Transformation, 2019). For some customers, electricity-inclusive leases may reduce the motivation of tenants to reduce energy use by adopting energy-efficient behaviors. According to a study of the largest 10% of commercial electricity users in Connecticut, tenants who paid for their own electricity used up to 14% less energy in the summer than tenants who had electricity-inclusive leases (Jessoe et al., 2019). The property owner could also choose to provide energy from the solar system to tenants through a PPA or community-shared solar arrangement.

Alternatively, rather than investing in a solar system, the property owner could allow the tenant to install solar equipment as an improvement right. The property owner could also lease roof space to a third party that manages the financial arrangements of the system installation and sale of electricity to tenants, other off-takers, or the grid, like the host business model. One major barrier to this solution is that the terms and length of the tenant's lease may not align with the payback timeframe for the purchase of a solar system (under the ownership model) or a solar lease (under the third-party ownership model).

Nonprofit properties

Energy Improvement Corporation (EIC), formerly called Energize NY, has identified the nonprofit sector, including religious institutions, some hospitals and schools, charitable organizations, advocacy groups, and community-based institutions, as an area of major growth for renewable energy solutions (Hendricks & Thielking, 2016). Investing in renewable energy may align with the values or further the mission of the organization. However, the initial cost of development, combined with a lack of access to capital, financing, and tax incentives, is a major barrier to solar installations for nonprofits.

Nonprofits primarily invest financial resources in the programs and services that further the mission of their organization, and their budgets are often constrained. Further, nonprofits are underserved in debt markets, because they have unusual forms of credit or cash flows (Hendricks & Thielking, 2016). Some nonprofits also have restrictions on using endowments for capital improvements (Yazdi, Sherman, Baker, & Brennan, 2019). As a result, maintenance and other capital projects are often deferred and under-funded. Finally, because nonprofits have tax-exempt status, they are ineligible for all tax-based incentive programs. Group purchasing programs, PACE financing, serving as a host site for a solar system owned by a third party, or third-party financing tools tailored to nonprofits are options that can help nonprofits overcome these barriers (see Appendices B and C).

Group purchasing programs can help reduce initial costs. Such programs bundle multiple solar installations, develop them along the same timeline, and put them out to bid as a package. PowerUp Solar Long Island, a collaboration between the Long Island Progressive Coalition and Resonant Energy that is funded by DOE's SunShot Initiative, helps reduce the cost of solar installations for houses of worship and other nonprofits in the region. The cost for each project is reduced by 15–30% through group purchasing. So far they have helped four houses of worship on Long Island go solar (PowerUp Solar Long Island, 2019).

Solar business models that reduce or eliminate up-front costs are also suitable in nonprofit settings, such as the host model or the third-party ownership model (Appendix C). Under the host model, the revenue stream to the nonprofit is in the form of lease payments from the developer, and there is no change in their cost of energy. Under the third-party ownership model, the nonprofit could negotiate a PPA in which they purchase energy from the solar system at their site at a lower rate than the retail price of electricity from the utility, reducing their overall energy costs (EnergySage, 2019). PPAs are most suitable when the host's energy usage and available space for solar are compatible. When the solar energy generation potential of a setting is higher than on-site energy use, the host business model may provide income for the nonprofit host (Yazdi et al., 2019). Finally, PACE financing may be used to access low-cost capital for nonprofit energy efficiency and renewable energy projects through EIC's Open C-PACE program.

PowerUp Solar Long Island worked with Pastor Coverdale (left) and Pastor Liggon (right) at the First Baptist Church of Riverhead to provide a 15% cost savings on their 50-kW solar system through bulk purchasing and a third-party ownership model. © PowerUp Solar Long Island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Government properties

Government properties include those owned by federal government entities, New York State government entities, Nassau or Suffolk Counties, municipal governments, and public school districts. Solar systems and other renewable energy generation on government properties can reduce energy costs for the government facilities, or lease payments from solar developers can provide a predictable, sustainable source of revenue. These projects also help government entities achieve their renewable energy and GHG reduction goals. The International City/County Management Association's *Guide to Implementing Solar PV for Local Governments* provides detailed information and guidance for feasibility studies, financial options, and purchasing and contracting models, as well as solar system commissioning, operation, and maintenance (Dodson, Doyle, Lockhart, & Loomans, 2013). Public opinion research for the Roadmap shows strong support for municipal solar. See the Key Findings section (p. 55) on Long Islanders' perspectives on solar development for more details.

Just as with nonprofit organizations, the initial cost of development combined with financing obstacles and a lack of access to tax incentives are major barriers to solar installations on local government properties. According to research by Lawrence Berkeley National Laboratory, the cost of solar development was consistently ~5.5% to 15.7% higher for tax-exempt entities than for similar-sized projects in the residential and commercial sectors in 2012. This higher cost was attributed to a number of factors, including prevailing wage requirements, complex procurement processes, a higher instance of parking structure arrays, additional permitting requirements, and other issues (Barbose, Darghouth, Weaver, & Wiser, 2013). Permitting of municipal solar projects may be easier or faster in New York and other states with municipal home rule jurisdiction, where municipalities issue their own permits. In a 2016 survey conducted by the International City/County Management Association (ICMA) as part of the DOE's SunShot Initiative, high up-front cost was cited as the number one challenge for solar development by local governments (ICMA, 2017).

These barriers make the ownership model least accessible for local governments, as this model bears the highest up-front costs due to local governments' ineligibility for federal and state tax incentives (Appendix C). While financing renewable energy projects through tax-exempt bonds allows local governments to access low-interest rates for loans and ownership of a solar system, many municipalities are reluctant to increase their debt obligations. The presence of outstanding debt can lower a government's credit rating and increase its interest rates on loans for all other projects. Long Island elected officials may also want to keep debt low and stabilize the area's already-high taxes. Governments with lower credit ratings may be unable to issue bonds at an interest rate that makes a project feasible. Further, issuance of general obligation bonds for capital projects is limited by the availability of tax dollars to repay the principal and interest. New York's tax cap limits the increase in property taxes to 2% a year or the rate of inflation, whichever is higher. This cap limits the ability of local governments to use new tax revenue to fund renewable energy projects. Renewable energy projects may be eligible for revenue bonds, as the project can be structured to provide income to the municipality.

Third-party ownership models reduce the cost of development and are widely used to finance solar in government and nonprofit settings (Appendix C). While PPAs are the most common third-party finance structure, there are other options for municipalities, including operating leases, sale/leaseback structures, partnership/flip agreements, and hybrid financing structures. Third-party ownership models are most viable for larger-scale projects due to the higher cost of financing (Dodson et al., 2013).

Local governments may also choose to simply host a solar array by leasing land to a solar developer. In this case, the local government does not receive any of the power generated by the array and forgoes the associated energy cost savings, making this option less financially beneficial than some third-party ownership models. This option may

Aerial view of the 1,750 kW solar array in the parking lot of Suffolk County's H. Lee Dennison Building in Hauppauge. Suffolk County has installed solar arrays at six county parking lots and on buildings at seven county facilities. © Suffolk County Economic Development and Planning Department

The 32 MW Long Island Solar Farm at Brookhaven National Laboratory was built through a collaboration between BP Solar, the Long Island Power Authority, and the U.S. Department of Energy. © Flickr

be most appropriate for properties with no to low on-site energy use, such as closed landfills or other sites without major facilities. The simplicity of this financial arrangement relative to third-party ownership and the stable revenue from lease payments make this an attractive option in local government settings (Dodson et al., 2013).

Local governments also have unique opportunities to increase local renewable energy generation through community-shared solar and community choice aggregation. Community-shared solar is an arrangement in which a single solar system provides electricity to multiple off-site customers. A local government could create a community-shared solar system that provides renewable electricity to multiple municipal accounts (through remote net metering) and/or to residents. This may be a good option for properties with no to low on-site energy use and one that can reduce energy costs for LMI residents. Further, local governments interested in creating community solar could take advantage of LIPA's Community Solar FIT, which would help reduce system costs while providing clean energy to LMI households.

If a municipality wishes to supply renewable energy to residents but is unable to own or host a large solar system, community choice aggregation (CCA) is a good option that is now available on Long Island due to recent changes to LIPA policy. CCA allows local governments to source renewable electricity on behalf of their residents, businesses, and municipal accounts from an alternative provider, while the local utility still provides transmission and distribution services. According to the EPA, electricity prices under CCA may be as much as 15–20% lower than retail electricity prices due to the collective buying power of communities and other market trends (EPA, 2019c). NYSERDA has created detailed information and resources for municipalities that are considering CCA (NYSERDA 2019b). While CCAs are typically created to provide lower electric rates to participants, they can also drive local, low-impact solar development and provide local economic and environmental benefits when environmental impacts are considered in their energy procurement decisions.

Agricultural properties

Long Island has a rich agricultural history, and farming remains a vibrant and vital part of the region's character and economy. Most farmland is concentrated in Suffolk County, where approximately 35,000 acres, or 6.6% of the county's total land area, are in production (Suffolk County Department of Economic Development & Planning, 2015). According to the 2017 United States Department of Agriculture (USDA) Census of Agriculture, Suffolk County is the fourth largest agricultural county in New York State and has over $225 million in annual gross sales of agricultural crops, including fruits, vegetables, wine/grapes, nursery stock, greenhouse production, and horses, as well as an increasing number of other livestock farms with both large and small animals (National Agriculture Statistics Service, 2019).

Nationwide and locally, the agriculture sector is threatened by the effects of climate change. The Fourth National Climate Assessment projects that agricultural yields will decline as a result of high temperatures, intense storms, deepening drought, and expansions of agricultural pests (Gowda et al., 2018). Coastal flooding and saltwater intrusion due to sea-level rise are additional threats to some Long Island farms (Rosenzweig et al., 2011). By hastening the transition to a low-carbon future through solar adoption, farmers can help to preserve their agricultural legacy for future generations.

Almost 11,000 acres of farmland are protected under the Suffolk County Farmland Preservation Program, and an additional 10,000 acres are protected under various other municipal and land trust programs. These farmland preservation programs enable a farmer to voluntarily agree to a deed restriction on the land, which usually specifies that it can be used only for agricultural production in perpetuity. This limits the potential for mid- to large-scale renewable energy generation on agricultural properties on Long Island to the 14,000 acres of unprotected farmland in Suffolk County, plus any unprotected farmland in Nassau County. It is important to note, however,

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that some of this farmland may not be appropriate for ground-mounted solar even if it were not protected by farmland preservation programs, particularly if it contains prime soils—our nationally significant productive fertile land. Identifying these soils involves a sub-parcel level analysis that was beyond the scope of this project. Solar development on farmland should complement rather than replace existing farm operations, since maintaining agricultural lands in production is important to local economies and food systems.

Solar energy generation can provide both financial and ecological benefits to farms. On-farm solar can provide a stable source of year-round income to farmers, reduce energy costs, and improve farmers' access to financing. On Long Island and elsewhere around the state, farmers face a multitude of challenges that can increase their operating costs and reduce profits, threatening the ability of farms to persist into the future (Freedgood, Hunter, Dempsey, & Sorensen, 2020). The high land values on Long Island make it tempting to sell farmland for other uses, particularly when a farm transitions from one family generation to the next. In Suffolk County, for instance, 28% of farmers are over age 65, according to the 2017 Census of Agriculture (National Agriculture Statistics Service, 2019). Placing solar arrays on farmland could strengthen and expand the buy-local paradigm by bolstering the agricultural economy while also creating a more local, sustainable, and resilient energy-producing sector, so long as solar enhances farm viability and supports rather than displaces continued agricultural activities.

However, not all farmland is equally productive, and there are legitimate concerns, including on Long Island, that solar development could take highly productive farmland out of production, thereby reducing production of food and other crops and the availability of high-quality land for farming. Reduced agricultural output not only affects farmers' livelihoods but also affects the affordability and availability of farmland, particularly for farmer-renters, in communities and regions where agriculture is a major part of the economy. In addition, poor siting and operational practices can damage soil health, increase runoff, or require the use of herbicide for vegetation management.

Therefore, it is essential to take care during siting, construction, and operation to ensure that solar development contributes to farm viability, protects our best soils, and supports rather than displaces continued agricultural activities on the farmland. Avoiding siting solar on our most productive farmland soils and following best practices while innovating new solutions are critical to achieving low-impact siting on farmland.

We highlight two potential options for on-farm solar energy generation that minimize impacts to farmland while providing benefits to farms. First, solar arrays can be located on a portion of a farm with less productive, or marginal, land or on areas of the farm that can't be used for production, such as rooftops or parking areas, while the rest of the farm continues to operate as usual. This approach helps to maintain a steady income for farmers to support continued farm viability while helping to avoid GHG emissions. Solar development, especially the ownership, host, and third-party ownership models, can be a mechanism to preserve the soils and agricultural function of a farm if certain protections are put in place (Appendix C). For instance, developers would need to follow New York State Department of Agriculture and Markets (NYSDAM) guidelines for construction, operation and decommissioning, which are designed to protect the agricultural soils throughout the life of the project. Second, when a solar array on former farmland is decommissioned, mechanisms that encourage return of the land to agricultural use would guard against the unintended, permanent conversion of farmland. If these protections are put in place, solar on "full rights farmland" (farmland with no deed or other restrictions), represents lower-impact land use than more permanent types of development like housing or commercial projects.

Rooftop solar on the barns at Stratford Ecological Center, a nonprofit educational organic farm and nature preserve.
© Above the Light Photography

Second, there are also opportunities for co-location of ground-mounted solar panels and agricultural crops, grazing, and ranching, often called "agrivoltaics" or "co-utilization." Active research projects are being conducted around the United States and across the globe to further the co-location of agricultural activities with solar energy production. Research by NREL, as part of the Innovative Site Preparation and Impact Reductions on the Environment (InSPIRE) project, shows that agrivoltaic systems have potential benefits for farmers, the environment, and solar developers (Dreves, 2019). In addition to providing direct economic benefits to farmers, in some cases agrivoltaic systems can improve the yield of crops, reduce water use and nutrient loss, help control erosion, and provide habitat for pollinator species. Co-utilization has the potential to reduce the construction and operation costs for solar developers and to increase energy production, thereby lowering costs for energy off-takers (Mow, 2018), though these benefits vary by region and feasibility research is ongoing. It is also important to note that agrivoltaic systems may require additional project consideration and, in some cases, more costly design, so financial incentives to unlock this potential are likely necessary.

To realize the potential for on-farm solar, including co-utilization of solar and agricultural production, existing regulatory frameworks need to be considered. Supporting on-farm solar requires careful examination and likely modification of regulations governing how farms and agricultural production are defined for the purposes of local zoning, locally administered agricultural land tax assessment, and state-administered agricultural district protections. Strategy 5 suggests actions for updating local and state policies to enable well-sited on-farm solar, as well as mechanisms for providing financial and technical support for farmers who wish to integrate solar into their farm operations.

Long Islanders' perspectives on solar development

Community support for solar projects is essential. We used an online survey of residential PSEG Long Island customers to better understand their perspectives on the siting and development of mid- to large-scale (250 kW and greater) solar installations in their communities. The survey sheds light on what types of solar installations people are most likely to support in their community, what their concerns are, and how those concerns can be addressed.

The survey asked Long Islanders about their perceptions of various issues related to climate change, renewable energy, and solar electricity generation. Survey respondents agreed that it is every American's responsibility to act to address climate change (79% agreed or strongly agreed), that renewable energy can meaningfully help to address climate change (82% agreed or strongly agreed), and that solar energy specifically is needed to help address climate change (74% agreed or strongly agreed). Further, respondents largely agreed that solar energy is a good investment for local businesses (75% agreed or strongly agreed) and that solar electricity generation has the potential to meaningfully contribute to energy production for their communities (83% agree or strongly agreed).

The respondents overwhelmingly supported solar development in their communities, with 92% of respondents expressing support. Solar installations on rooftops, on parking lots, and on landfills received the highest levels of support (89–95%). Fewer respondents, though still a majority (64–65%), supported ground-mounted solar systems in other locations (Figure 11).

Respondents were asked about the impact of various siting, economic, environmental, and funding factors on their support for solar development in their community. Overall, a majority of respondents (53–79%) supported solar energy development regardless of the siting scenario (Figure 11). They were most supportive of solar projects co-located with other land uses (79% supported) and solar projects sited on farmland to provide additional income to farmers (72% supported). A majority of respondents reported that the potential for tree removal did not influence their support for solar development. Respondents were least opposed to tree removal for solar projects that were co-located with other land uses and most opposed when projects were for private use (Figure 12).

Economic and environmental factors are strong drivers of support for solar development. An overwhelming 93% of respondents believed solar development will provide economic benefits, and 73% supported solar projects that provide jobs to Long Islanders. Notably, 70% of respondents were more likely to support solar projects that lower their own electricity costs, and 69% supported projects that lower electricity costs for schools. The potential for solar development to provide financial benefits to other individuals, particularly LMI households, or to their

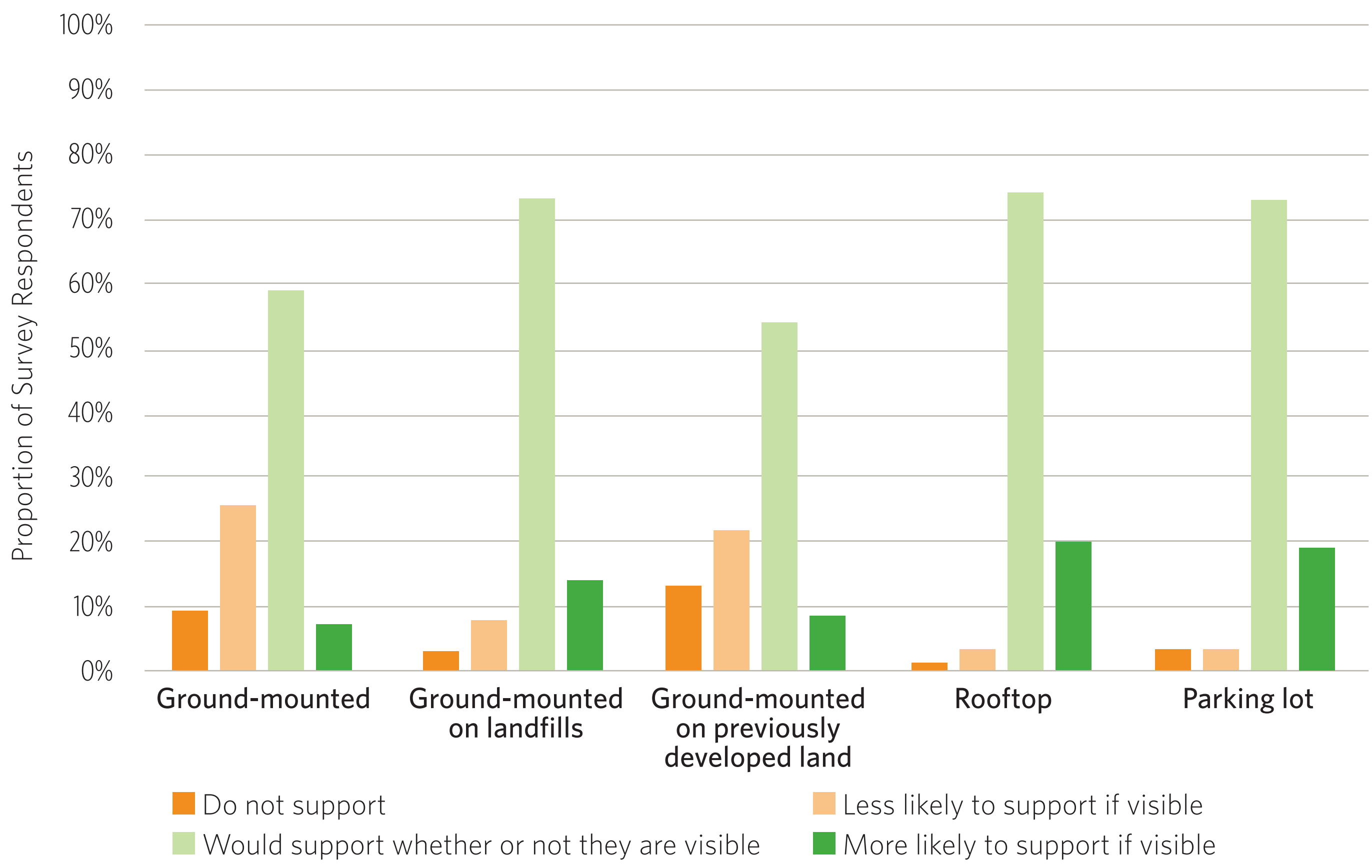

Figure 11. Survey respondents' support for mid- to large-scale solar. The total number of survey responses for each installation type option varied from 373 to 378.

community in the form of tax revenue, was less important to respondents (Figure 12). In addition, 70% and 69% of respondents were more likely to support solar development that reduces GHG emissions or as alternatives to new fossil-fueled electricity generation facilities, respectively (Figure 12).

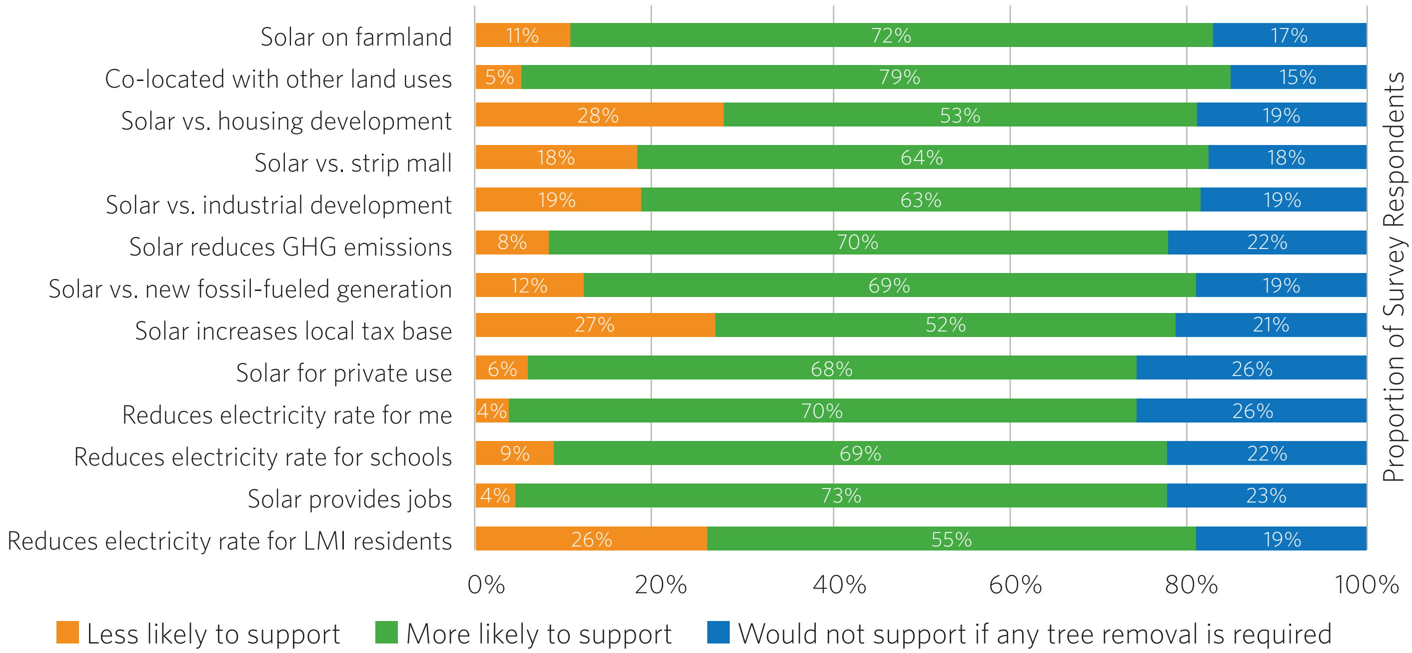

Figure 12. Influence of siting, environmental, and economic factors on survey respondents' support for mid- to large-scale solar installations in their community. The total number of survey responses for each solar siting option varied from 291 to 297.

With regard to funding and financing, respondents were most supportive of privately funded projects developed by local companies (82% supported), privately funded community solar, and municipally funded community solar. Overall, respondents were generally supportive of all funding models, with 69% being "more" or "most" likely to support even municipal financing. Municipal financing and municipally funded community solar received the highest levels of "do not support" responses, at 13% and 12%, respectively (Figure 13).

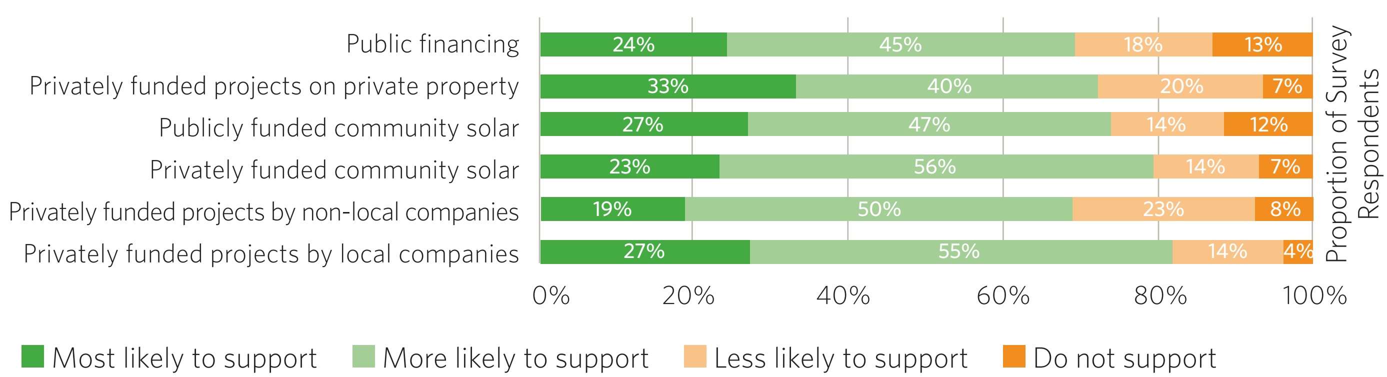

Figure 13. Survey respondents' support for solar project financing options. The total number of survey responses for each financing option varied from 292 to 298.

When asked about the perceived benefits or drivers of support for mid- to large-scale solar development on Long Island, respondents felt that environmental benefits were most important, with 17% identifying local environmental benefits and 18% identifying larger-scale environmental benefits. Economic benefits were next, with 16% of respondents identifying lower electricity rates and economic benefits as reasons to support. In addition, 13% of respondents identified health benefits, 12% identified the benefits of providing jobs, and 7% indicated that solar has appealing or neutral aesthetics. Only 1% of respondents identified no benefits.

When asked about potential concerns or drivers of opposition to mid- to large-scale solar development on Long Island, 23% of respondents had no concerns. The most common reason not to support solar development was that the economic benefits of solar development are unfairly distributed, with 22% of respondents reporting this concern, followed by 17% expressing concern that solar will increase their electricity costs. In addition, 12% of respondents were concerned that solar is not a good economic investment, 11% reported that they do not like the aesthetics, and 6% of respondents were concerned about negative environmental impacts and negative economic impacts.

The survey also asked respondents to rate their knowledge of solar energy generation. Just under half of respondents said they were knowledgeable or very knowledgeable (47%), and just over half reported little or very little knowledge (53%). These results suggest that Long Islanders across all levels of knowledge support solar development in their communities. These findings also highlight that education programs can provide opportunities to engage the public and motivate community members to actively support solar projects during project permitting.

Taken together, the survey results suggested strong support for mid- to large-scale solar development on Long Island. Long Islanders are most likely to support solar installations on low-impact sites, especially arrays located on rooftops, parking lots, and landfills, and when solar projects are co-located with other land uses (mixed-use) at a particular site, such as those on agricultural land that provide additional income to farmers. Respondents identified both economic and environmental benefits as the top reasons to support solar development, but expressed concern that the economic benefits are not fairly distributed. Survey results indicated that the potential for personal economic benefits, such as lower electricity cost for individuals and job creation, are stronger drivers of support than economic benefits that accrue to others, such as lower electricity costs for LMI residents or higher tax revenue for the community. Further, municipally funded projects developed by local companies and privately funded community solar received higher levels of support than projects receiving municipal financing or those developed by nationally or internationally owned companies. These results suggested that prioritizing the kinds of development that receive higher levels of support may help mitigate perceived conflict regarding development and that communicating about the nuances of development types may engage the public to support projects that align with identified project types.

These results should be interpreted with caution, as there may be a response bias in who was willing to participate in an online survey about solar energy development administered by the local utility. These respondents may be more supportive than the general public on Long Island, although people who were strongly opposed may have also been more likely to complete the survey in order to express those views.

The results suggest that siting conflicts are sometimes the result of a vocal minority expressing opposition and that this opposition stems from concerns about transparency and the distribution of economic benefits provided by solar energy development. In other words, public expression of concern about development may be perceived to relate to siting or aesthetics, but may actually be motivated by concerns about ownership, financing, and the distribution of access and economic benefits. Projects can be designed with these considerations in mind, and communication about development can highlight these key areas of concern through transparency and clarity to engage public support for projects.

Though it was not addressed explicitly in our survey, another concern often cited as a driver of opposition to solar is that a neighboring installation will negatively impact property values. While the literature is limited, studies have shown little to no effect on property values from solar or wind installations. A nationwide survey of public assessors in 2018 showed that proximity to a large (1 MW or larger) solar installation has either no impact or a positive impact on residential home values (Al-Hamoodah et al., 2018). A 2020 study of ground-mounted solar farms in New England found that the value of properties within one mile of a solar array reduced the selling price of homes by 1.7% when compared to similar homes one to three miles away (Gaur and Lang, 2020), and results suggest that impacts may be the result of reduced open space in suburban areas rather than the result of solar development in particular. However, this study did not consider the size of the solar array or whether measures to minimize visual impacts were in place. Examinations of the impacts of solar farms on home values in 84 matched pair studies from 17 states showed an average impact of just one percent (Prevost, 2020).

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Recommended Strategies and Actions

Together, the key findings of the Roadmap point toward a promising future for Long Island as we transition to renewable energy. With enough low-impact siting potential for nearly 19.5 GW of mid- to large-scale installations across the region, solar energy can play a big role in taking Long Island from 6% renewable electricity today to 70% by 2030 and 100% carbon-free energy by 2040. Long Islanders overwhelmingly support mid- to large-scale solar development, citing it as an important way to reduce greenhouse gas emissions, fight climate change, and benefit our economy. With more solar energy comes cleaner air, healthier communities, and more jobs.

The following eight strategies will help us achieve the overall vision of the Roadmap—rapid development of mid- to-large-scale solar power on Long Island that minimizes environmental impacts, maximizes benefits to the region, and expands access to solar energy, including access by underserved communities. Each strategy is accompanied by a set of actions, including economic interventions, programs, policies, or practices, that contribute to the overall strategy. We identify strategies and actions that have potential for application across the region, recognizing some solutions will need to be tailored to local contexts. Each action is identified with an icon indicating the appropriate lead sector or sectors, and Appendix D organizes the actions by sector so that all stakeholders know what they can do to help the transition to a clean energy economy and maximize the benefits of solar for Long Island. While these recommendations focus on facilitating low-impact solar development, we emphasize that energy efficiency, energy storage, offshore wind, and other renewable energy technologies identified under the CLCPA are also critical components of a successful clean energy transition. The benefits of pairing solar and battery storage are discussed in the Key Findings (see page 44), and we encourage solar projects on low-impact sites to include battery storage whenever it is technically and economically feasible.

Strategy 1
Create frameworks for achieving CLCPA mandates

To further the clean energy transition on Long Island, LIPA and PSEG Long Island should create a framework that sets and tracks renewable energy and community-benefit targets for Long Island. A broad set of stakeholders should form a coalition to advocate for the funding, policy support, and other resources necessary to meet these goals.

Achieving the long-term renewable energy mandates of the CLCPA will require a series of near-term plans and actions that necessitate cooperation, coordination, and implementation by all levels of government, LIPA and PSEG Long Island, and other stakeholders. New York State has begun work to enact the CLCPA on several fronts, including updating the State Energy Plan, enacting the Accelerated Renewable Energy Growth and Community Benefit Act, forming the Climate Action Council (of which LIPA's CEO is a statutory member), and promoting changes to the regulatory framework for consideration by the NYSPSC. LIPA and PSEG Long Island are also engaged in developing a new Integrated Resource Plan (IRP) that will evaluate measures to meet the CLCPA mandates and deliver safe, reliable, and environmentally responsible energy to LIPA customers at the lowest reasonable cost.

LIPA has committed to supporting the CLCPA by adopting renewable targets to achieve the new Clean Energy Standard (LIPA, 2020). Updating those targets and the system for monitoring progress will be critical. Success depends not only on proactive planning and sufficient resource allocation by LIPA, PSEG Long Island, and New York State, but also the active engagement of all stakeholders in advocating for policies and programs from the federal to the local level that support renewable energy and GHG reductions. Partnerships and coalitions among governments, the utility, solar developers, property owners, and nongovernmental organizations will create the collaborative framework needed to achieve this paradigm shift in electricity generation.

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Utility (LIPA and PSEG Long Island)

Action 1.1 Commit to ambitious local renewable energy targets and equal access to clean energy for all Long Islanders

We recommend that LIPA strives to ensure that 70% of Long Island's electricity is generated from renewable sources by 2030, to meet renewable energy targets by procuring energy from local renewable energy projects to the maximum extent practicable, and to provide LMI consumers with equal access to clean electricity.

In June 2020, NYSERDA and the NYSPSC released a white paper detailing recommendations for putting New York "on a rapid and irreversible path to achieve the 2040 Zero Emission Target," including updating the Clean Energy Standard by setting more aggressive renewable energy targets (NYSERDA & NYSDPS, 2020). The white paper emphasizes that renewable energy investments and procurement commitments are needed no later than 2026 to ensure that projects are operational by 2030.

According to the NYISO, electricity consumption is projected to be 19,894 GWh on Long Island in 2030 (NYISO, 2020a). If LIPA commits to procuring 70% of Long Island's electricity consumption from renewables, 13,926 GWh per year would be needed from renewables by 2030. Taking into account LIPA's current renewable energy commitments, including behind-the-meter solar and offshore wind goals, LIPA needs an additional 7,251 GWh to meet its target (Table 2). LIPA and PSEG Long Island are developing a new IRP that will evaluate measures to meet the CLCPA mandates.

LIPA can help ensure that the health, environmental, and economic benefits accrue to Long Island ratepayers through development of renewable energy projects on Long Island, supporting the solar industry and clean energy jobs, and making renewable energy accessible to LMI communities. Local projects are more likely to generate local jobs, reduce incidences of asthma and other negative health effects as fossil-fueled power plants are retired and replaced with clean energy, and improve access to renewable energy for underserved communities. Additional solar energy and battery storage on Long Island can also provide a diversity of renewable energy resources as offshore wind projects come online, contributing to grid stability and reliability.

Utility (LIPA and PSEG Long Island)

Action 1.2 Update and track progress toward renewable energy targets for Long Island

We recommend that LIPA and PSEG Long Island establish a clear, transparent process for setting, updating, and tracking CLCPA targets for Long Island, including renewable energy generation, emissions reductions, and equity.

Developing and tracking metrics will improve transparency and accountability, help track program success and enable adjustments, aid in securing and allocating resources, and ultimately contribute to success. Setting incremental targets needed to achieve the 2030 renewable energy goal for Long Island will be critical for planning programs and annual procurement that ensure long-term success. In their recent white paper, NYSERDA and the NYSDPS provide suggestions for how NYSERDA can set annual Tier 1 renewable energy procurements to ensure that investor-owned utilities (IOUs) stay on track for achieving CLCPA targets (NYSERDA & NYSDPS, 2020). The CLCPA also requires investor-owned utilities to "develop and report metrics for energy savings and clean energy market penetration in the low- and moderate-income market and in disadvantaged communities ... and post such information on the NYSERDA's website." As part of the annual reporting process, LIPA will provide information on its progress toward current goals and its plans to meet future goals. Additional guidance is suggested for how project viability and other factors should be handled in the annual review process.

NYSERDA is working with NYSDPS to create systems for tracking progress toward renewable energy and environmental justice targets, building on the information already collected and available on the Clean Energy Dashboard. LIPA and PSEG Long Island have committed to using the existing NYSERDA Dashboard or to create a similar platform for Long Island.

RESOURCES

- New York State Clean Energy Dashboard (nyserda.ny.gov/Researchers-and-Policymakers/Clean-Energy-Dashboard). The Dashboard provides information on programs by NYSERDA, electric utilities, and gas utilities that contribute to New York's clean energy and climate goals.

Action 1.3 Form a coalition to advance the clean energy transition on Long Island

Partnership

We recommend that local governments, LIPA, PSEG Long Island, nonprofit and community organizations, solar developers, the business community, agricultural producers, ratepayers, and other stakeholders come together to create a network focused on advancing clean energy, including low-impact solar, on Long Island.

Collaboration across sectors and organizations can leverage diverse resources, expertise, and capacity to create, advocate for, and implement the changes in policy and practices needed to direct and incentivize low-impact solar development on Long Island. Partnerships among local governments, LIPA and PSEG Long Island, and the nonprofit and private sectors can assist in energy planning, land-use planning and project siting, policy, research and development, and pilot projects and programs. A network can facilitate sharing of best practices and effective strategies to support low-impact siting. We highlight the opportunity to form a Long Island regional network as well as tapping into existing networks focused on local renewable energy development.

Another function of the network could be coalition-building around shared interests and issues. Coalitions can advocate for or provide input to many federal, state, local, and utility policies and processes that are key to advancing low-impact solar siting on Long Island: energy planning, creating funding for renewable energy and grid infrastructure, local land-use planning and policy, and more. A coalition of organizations and sectors can also be effective in advocating beyond Long Island to garner support for clean energy policies, programs, and funding at the state and federal levels. This Roadmap focuses on actions that can be taken at the state and local level since achieving the CLCPA goals is a state-driven mandate. Nonetheless, the organizations and governments of New York can present the implementation of the CLCPA as a model for national-scale action to further the deployment of renewable energy in general, and low-impact solar in particular.

In fact, there are signs that the opportunity to shape national policy is growing. In June 2020, the House Select Committee on the Climate Crisis released its 600-page climate action report, *Solving the Climate Crisis: The Congressional Action Plan for a Clean Energy Economy and a Healthy and Just America*. This report covers a wide array of possible actions to advance renewable energy, upgrade infrastructure, and build resilience. Furthermore, as the country recovers from the economic impacts of the COVID-19 pandemic, there may be opportunities to invest in a greener future. A coalition of Long Island stakeholders who support the Long Island Solar Roadmap can be a compelling set of voices for smart renewable energy policies.

RESOURCES

- The Community Tool Box (ctb.ku.edu/en). This is a free, online resource for those working to build healthier communities and bring about social change, provided by the Center for Community Health and Development at the University of Kansas. The Community Tool Box provides two modules on coalition building:
  - Coalition Building I: Starting a Coalition (ctb.ku.edu/en/table-of-contents/assessment/promotion-strategies/start-a-coaltion/main)
  - Coalition Building II: Maintaining a Coalition (ctb.ku.edu/en/table-of-contents/assessment/promotion-strategies/maintain-a-coalition/main)

Strategy 2
Direct and incentivize low-impact solar siting

To minimize environmental impacts, local governments, LIPA and PSEG Long Island should create and implement mechanisms to support low-impact siting. These should include updating local policies, creating structural incentives, and revising utility energy procurement practices to better incorporate and reward low-impact projects.

Low-impact siting reduces the potential for land-use conflicts and community opposition, minimizes impacts to natural ecosystems and habitats, and avoids the harmful release of CO_2 that results from conversion of natural areas for development. The recommended actions that follow aim to encourage solar developers to choose low-impact sites, reduce costs of development on these sites, and ultimately accelerate development of solar installations on low-impact sites relative to higher-impact sites.

Action 2.1 Create solar-friendly local planning and zoning policies

State or Local Government

We recommend that local governments review and update policies governing solar energy siting and development, including zoning and incentive policies (see Action 2.2), to identify low-impact sites where solar development is compatible with local priorities and needs and to designate solar-compatible zones.

Local governments can use the results of this project to identify sites with high potential for low-impact solar siting on rooftops, on parking lots, on previously disturbed land, on agricultural land that is not enrolled in farmland protection programs, and in business, commercial, and industrial areas. Refining local policies to clearly guide and create requirements for solar at those locations, including but not limited to siting and decommissioning criteria, system design, and size limits, can accelerate solar development and minimize impacts. Jurisdictions adopting solar ordinances can first adopt an amendment to their comprehensive plan with a statement about their intentions for solar development, the benefits of investments in solar, and the key considerations around regulation of solar siting.

RESOURCES

- National Renewable Energy Laboratory (NREL) Best Practices in Zoning for Solar (nrel.gov/state-local-tribal/blog/posts/best-practices-in-zoning-for-solar.html). NREL provides guidance and examples for creating solar-friendly zoning practices.
- The New York Solar Guidebook for Local Governments (nyserda.ny.gov/All-Programs/Programs/NY-Sun/Communities-and-Local-Governments/Solar-Guidebook-for-Local-Governments). The Guidebook provides a Model Solar Energy Local Law to inform and facilitate local efforts to expand solar energy generation in a sustainable way.
- SolSmart's Toolkit for Local Governments (solsmart.org/solar-energy-a-toolkit-for-local-governments). This resource is a roadmap to help local governments and community stakeholders encourage the use of solar energy and related technologies like battery storage, including a chapter on Planning, Zoning, and Development.

State or Local Government

Action 2.2 Encourage low-impact solar through structural incentives

We recommend that local governments utilize structural incentives to make low-impact solar development on rooftops and parking lots a more attractive option to real estate developers and property owners.

Structural incentives are processes and policies that encourage green building practices by rewarding real estate developers and property owners for environmentally friendly designs. We highlight two key types of structural incentives for encouraging low-impact solar development, which provide a significant benefit to the real estate developer with little or no financial investment from local government. First, expediting the review and permitting processes for development projects that include rooftop and parking lot solar systems can reduce project

Solar canopies cover parking at the Northport VA Medical Center. © Sunshine Plus Solar times and save money for the real estate developer. Streamlined local permitting, with an emphasis on fast-tracking projects on low-impact sites, is a key strategy for reducing development costs and is explained in more detail under Action 3.3. Second, offering height bonuses, floor area ratio (FAR) bonuses, reductions in landscaping requirements, or reductions in parking requirements, in return for including rooftop and parking lot solar installations, enhances profitability for developers and property owners and helps offset the cost of installing solar.

RESOURCES

- Local Leaders in Sustainability – Green Incentives (actrees.org/files/Research/aia_greenincentives.pdf). The American Institute of Architects provides an overview of the types of incentives that state and local governments can use to encourage green building practices in private development, including structural incentives.

Action 2.3 Integrate and incentivize low-impact siting in energy procurement

Utility (LIPA and PSEG Long Island)

We recommend that the LIPA and PSEG Long Island include low-impact siting criteria and incentives in their energy procurement mechanisms, including competitive solicitations and feed-in tariffs (FITs).

Competitive solicitations and FITs are major mechanisms through which the utility purchases energy and can direct solar energy development to low-impact sites. Bid evaluation criteria, which include siting as well as design, construction, and operation considerations, can be designed to reward proposals for projects on low-impact sites. FITs and competitive solicitations can also provide kW or kWh "adders" for energy generated by projects at certain types of sites, including parking lots, rooftops, landfills or remediated brownfields, and projects co-located with agricultural production. Adders can also be used to encourage solar projects with other positive characteristics, such as projects that provide equitable access to solar energy (see Action 7.1), those that are co-located with agriculture (see Action 5.4), or those that serve specific market segments (see Action 6.1).

Implementation of an adder program by LIPA and PSEG Long Island to encourage low-impact siting requires support from the NYSPSC and NYSERDA to incorporate Long Island into existing state-level programs, such as by providing additional funding for Long Island through the NY-Sun program or by funding Long Island–specific programs. These approaches direct or reward renewable energy developers to site and construct projects in ways that minimize impacts on the environment. We also encourage any entities procuring energy on Long Island, including CCAs and municipalities that self-supply, to incorporate low-impact siting criteria into their procurement processes as well.

Strategy 3
Reduce development costs for low-impact sites

To improve the cost effectiveness of low-impact solar siting, state and local governments, LIPA, PSEG Long Island, and property owners should develop and implement policies and programs that reduce development costs. These should include financial incentives and programs, financing options, and streamlined permitting.

While the overall development cost of commercial solar has declined nationwide, that decline has mostly been due to reductions in the price of hardware. Soft costs, including those related to permitting, taxes, land or lease acquisition, labor, interconnection, and grid upgrades, remain high. In addition, soft costs can be higher in some low-impact sites, such as parking lots and landfills, than in other places because additional work is required for site preparation, which makes such sites unattractive to development. Mid- to large-scale solar installations are especially impacted by high soft costs, because, unlike even larger projects, they may not be able to absorb these costs. Finally, interconnection costs related to project development can be significant enough to determine the overall economic feasibility of a project (see Strategy 2). Therefore, to realize the development potential of solar on Long Island, it is critical to reduce development costs generally and especially for low-impact sites. The actions under this strategy focus on providing financial incentives for developing on low-impact sites, standardizing local permitting processes, and facilitating development on brownfields through mechanisms such as land banks and bonds.

Action 3.1 Implement financial incentives for low-impact solar

State or Local Government

Utility (LIPA and PSEG Long Island)

We recommend that state and local governments, LIPA, and PSEG Long Island develop and implement new or expand existing financial incentives for low-impact solar development on Long Island.

Financial incentives are typically the most attractive mechanism to reduce the up-front development cost of renewable energy projects and can be leveraged to drive solar siting to low-impact locations. Past and current incentive programs have been successful at spurring solar development on Long Island and reducing its cost. New, state-funded incentive programs, or changes to existing programs like NY-Sun, could advance mid- to large-scale solar development on Long Island and could be designed to support low-impact sites such as parking lots and community solar. In the past, RGGI funding has also been used to support programs benefiting Long Island, and some of those funds have not been fully allocated in recent years (NYSERDA & NYSDPS, 2020).

Local governments could establish financial incentives for non-residential, low-impact solar. Such incentives could be in the form of transferable, corporate or personal tax credits, rebates, property tax exemptions, or waiver of sales taxes. Special incentive programs or grants to help facilitate the participation of underserved households in community solar programs could go a long way in ensuring equitable distribution of the benefits of solar (see Action 7.1). As New York's economy recovers from the pandemic and its impacts, both state and local governments can engage in creative public–private partnerships and initiatives to leverage private capital to spur renewable energy development, including low-impact solar.

Action 2.3 highlights mechanisms that could be used by LIPA and PSEG Long Island to incentivize low-impact siting, and Action 6.1 covers incentives for community solar.

Action 3.2 Utilize PACE financing

Business Community

Nonprofit organizations

We recommend that businesses, commercial space owners, and nonprofits all take advantage of PACE financing for solar installations.

New York State's PACE financing program offers financing for property owners to fund renewable energy projects on new and existing commercial structures through a special charge on their property tax bill. PACE financing is a great way to reduce up-front development costs for solar, because it provides financing over time without requiring the

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property owner to make a large initial investment. The Open C-PACE program, administered by the nonprofit EIC, provides financing for commercial properties for solar development in municipalities and counties across New York, including in Nassau and Suffolk Counties. More property owners, including nonprofits, can take advantage of this financing program.

To that end, local governments, the utility, and others can play an important role by educating property owners about the program and encouraging them to participate. Solar developers could also form partnerships with building owners and real estate developers to participate in this program.

RESOURCES

- Energy Improvement Corporation (EIC) (eicpace.org). This New York State nonprofit, local development corporation provides PACE financing to commercial and nonprofit property owners in member municipalities, which include counties and cities across New York State, through the Open C-PACE program.

State or Local Government

Action 3.3 Streamline and standardize local permitting for mid- to large-scale solar

We recommend that Long Island local governments collaborate to create a clear, standardized permitting application and review process for solar installations less than 20 MW, similar to the Unified Solar Permit established for residential solar installations.

Long Island has more than 100 municipalities, and each can have its own permitting process and requirements. This lack of standardization makes solar development more time-intensive and costly for solar developers and property owners. In 2011, the Long Island Unified Solar Permitting Initiative, a collaborative effort of local governments, LIPA, and others, completed the *Streamlined Application Process for Residential Rooftop Solar Energy System Installations* to address this issue for residential solar arrays. LIPA provided an incentive to municipalities to adopt the Unified Solar Permit. This pioneering work to accelerate solar development and reduce costs through standardized permitting served as the basis for the New York State Standardized Solar Permit. A recent report found that 12 of the 19 Long Island municipalities studied have adopted the permit (Citizens Campaign for the Environment, 2019).

We suggest expanding the existing permit or creating a similar standardized permit to include certain types of low-impact solar installations, such as commercial rooftop, parking lot arrays, and other low-impact sites identified by the Roadmap. Simplifying, standardizing, and expediting permitting for mid- to large-scale, low-impact solar development provides clarity to landowners and solar developers, reduces the administrative burden on local governments, and ultimately reduces the time and cost of development.

As noted in a recent report by Citizens Campaign for the Environment, soft costs can be reduced by speeding up permitting review and approval as well as by keeping application costs affordable. We suggest that application fees not exceed the cost of processing the application, including any required inspection. Furthermore, local governments could pass legislation based on the model law developed by NYSERDA to allow faster permitting of projects under their jurisdiction, typically projects under 25 MW. The model law provides definitions of systems, allows installations to require only building permits, establishes tiers of solar systems, and provides other regulatory relief to certain types of solar systems, thus providing uniformity across jurisdictions.

The new Office of Renewable Energy Siting (ORES), created by the Accelerated Renewable Energy Growth and Community Benefit Act, is responsible for reviewing and issuing permits for all large-scale, renewable energy projects, as well as streamlining the renewable energy siting and permitting process statewide. Local governments might also collaborate with ORES to identify best practices.


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RESOURCES

- NREL's technical assistance guide Permitting Best Practices Make Installing Solar Easier (nrel.gov/docs/fy13osti/57104.pdf). This resource provides solutions for addressing common permitting challenges.
- The New York Solar Guidebook for Local Governments (nyserda.ny.gov/All-Programs/Programs/NY-Sun/Communities-and-Local-Governments/Solar-Guidebook-for-Local-Governments). This guide contains a chapter on Solar PV Permitting and Inspecting.
- SolSmart's Toolkit for Local Governments (solsmart.org/solar-energy-a-toolkit-for-local-governments). The toolkit includes a section titled Solar PV Construction: Codes, Permitting, and Inspection, which covers the permitting and inspection process in the United States, followed by best practices for improving the process at the local level.

Solar Industry

State or Local Government

Action 3.4 Partner with land banks to facilitate solar on brownfields and underutilized sites

We recommend that solar developers work with the Suffolk and Nassau County land banks to facilitate solar development on brownfields and underutilized sites.

Under a land bank model facilitated by independent land banks, distressed and underutilized properties such as brownfields can be used to facilitate redevelopment of such sites for solar development. Under this model, tax-delinquent properties are sold at a significantly reduced market value, and the buyer performs site remediation to allow for redevelopment. This model reduces the overall cost of solar development through lower land-acquisition costs, and the requirements and cost of remediation for solar development may be lower than for other land uses. The Nassau and Suffolk County land banks both have several underutilized sites, including brownfields, which could be used for solar development. Solar developers can assist land banks with identification and acquisition of new and existing land bank properties that are compatible with solar development, as well as with prioritizing disposition and sale of such lands for solar development.

Brownfields and underutilized sites could also be nominated as "Build-Ready" sites under NYSERDA's new Clean Energy Resources Development and Incentives Build-Ready Program (NYSERDA, 2020a). This program is focused on identifying existing or abandoned commercial sites, brownfields, landfills, former industrial sites, and other abandoned or underutilized sites; carrying out pre-construction development activities; and competitively auctioning the developed sites, bundled with contracts for renewable energy payments, to provide a de-risked package for private developers to construct and operate projects at these sites. The program's first request for site nominations seeks sites 65 acres and larger (NYSERDA, 2020c).

RESOURCES

- Nassau County Land Bank (nassaucountyny.gov/4293/Land-Bank). This land bank directs funding and efforts to decrease the number of vacant, abandoned, and tax-distressed properties within the County and restore them to productive use.
- Suffolk County Landbank (suffolkcountylandbank.org). This land bank aims to facilitate the redevelopment of distressed and underutilized properties within Suffolk County.

Strategy 4
Improve interconnection feasibility for low-impact solar

To realize the full potential of low-impact solar, LIPA and PSEG Long Island should improve the feasibility of interconnecting new projects to the electrical grid through investments that increase hosting capacity, mechanisms that reduce the cost of interconnection, and greater accessibility to information about hosting capacity and interconnection costs for solar developers and the public.

The capacity of the Long Island transmission and distribution system to add new DERs is limited (Figure 10). As a result, upgrades to grid infrastructure are required on some circuits to add additional renewable energy generation while maintaining the reliability, resilience, and safety of the grid. Under current interconnection policy, these upgrade costs are often borne by the DER developer or project owner, whether that is a private-sector solar power company, a commercial building owner, local government, or the members of a community solar project. The cost of connecting mid- to large-scale solar projects to the electricity grid can be significant and can determine a project's overall cost-effectiveness and its potential to relieve or contribute to congestion on the grid. Very importantly, the cost to interconnect can be a determining factor in where a project can be sited. The cost, which is based on the utility's costs, is typically higher on Long Island than elsewhere in New York. Finally, developers do not currently have all the information they need to easily identify the best places to interconnect or know the cost of upgrading the system to make interconnection feasible. Instead, each site under consideration must be reviewed separately by PSEG Long Island, a process that can take days, weeks, or months depending on the size of the system and depth of analysis required. Moreover, these results are not publicly available.

The following actions are aimed at improving interconnection feasibility for low-impact, mid- to large-scale solar by providing information about interconnection capacity and cost, creating mechanisms to lower or share the cost of interconnection among solar projects, reducing the time required to evaluate interconnection options, and investing in grid modernization to enable greater deployment of solar to meet clean energy goals. LIPA, which owns the transmission and distribution system on Long Island, and PSEG Long Island, which manages and operates the system, both play key roles in addressing interconnection barriers.

Utility (LIPA and PSEG Long Island)

Action 4.1 Improve information available on interconnection capacity

We recommend that PSEG Long Island continue to improve detailed distributed generation hosting capacity maps and information, at the same standard as the investor-owned utilities (IOUs), available to developers and the public.

The new hosting capacity map released by PSEG Long Island in December 2020 provides significantly more detail about the ability of new solar installations to connect to the electric grid (PSEG Long Island, 2021). Detailed information is essential for helping project developers, property owners, and local government decision-makers make informed choices about the feasibility and the cost of interconnecting at low-impact sites. Having that information can reduce the amount of time that both project proponents and PSEG Long Island must spend reviewing project sites that are not feasible because of congestion on the system or the high cost of interconnection.

It is essential for PSEG Long Island to continue to work with the solar industry, to comply with best practices of the IOUs of New York, to add additional data and functionality to their hosting capacity map, and improve accessibly to the map. PSEG Long Island should continue to seek stakeholder input on the maps and underlying analyses as they provide periodic updates that are consistent with the reliability and safety of the grid, the needs of the solar industry, and state policy goals.

RESOURCES

- PSEG Long Island Interconnection Working Group (psegliny.com/aboutpseglongisland/ratesandtariffs/sgip/iwg). This group provides a forum for joint discussions and recommendations among the utility, the solar industry, and others on technical and procedural interconnection matters on Long Island.

Utility (LIPA and PSEG Long Island)

Action 4.2 Develop cost-sharing policies for interconnection

We recommend that LIPA and PSEG Long Island research and develop cost-sharing options to more equitably distribute the costs for grid upgrades, rather than assigning all costs of interconnection upgrades to the project that first triggers the need.

There are several different approaches to cost-sharing. New York State's Standard Interconnection Requirements were amended in 2017 to specify that subsequent projects (200 kW or greater) that benefit from an upgrade made by an earlier project developer must reimburse the developer who initially covered the cost of the upgrade, subject to a number of limitations (NYSPSC, 2017). The utility collects the prorated costs from subsequent developers and makes the reimbursement payments. While this approach is an improvement over no cost-sharing, it still results in considerable up-front costs for the initial developer and uncertainty about future reimbursement.

National Grid has tested a proactive approach in upstate New York that PSEG Long Island should consider. National Grid invested in upgrades at sites where a number of DERs were proposed, conducted an outreach campaign to let DER developers know about the upgrades, and recovered the costs by charging developers a prorated fee as they interconnected (National Grid, 2018). This approach reduces the burden on the first project interconnecting at the site, reduces project interconnection timelines, and decreases the cost uncertainty for all developers. If the interconnections do not cover the full costs, National Grid can submit the costs for recovery to be paid by utility customers as part of the utility's costs, paid through electricity bills.

California and Massachusetts have adopted another approach, called group study/group cost allocation (California Public Utilities Commission, 2020; Sena, Quiroz, & Broderick, 2014; Stanfield, 2014). At the distribution level, the utility can evaluate multiple projects interconnecting together to determine whether additional upgrades might be needed and can allocate the costs proportionally. The California Independent System Operator uses a similar approach for evaluating transmission-level interconnections. While the approach is not perfect (for example, changes might be needed when projects drop out of the queue), it warrants consideration on Long Island.

RESOURCES

- Two reports from NREL provide guidance for developing cost-sharing policies for interconnection:
  - An Overview of Distributed Energy Resource (DER) Interconnection: Current Practices and Emerging Solutions (nrel.gov/docs/fy19osti/72102.pdf)
  - Alternative Methods for Interconnection Cost Allocation (nrel.gov/dgic/interconnection-insights-2018-08-31.html)

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Utility (LIPA and PSEG Long Island)

Action 4.3 Increase investment in electric grid modernization

We recommend that as LIPA identifies investments in the transmission and distribution system, it continues to incorporate enhancements to the system to meet the CLCPA renewable energy goals and that it prioritizes upgrades in areas with low-impact solar siting potential.

The goals for carbon-neutral power by 2040 set by the CLCPA cannot be met with the current transmission and distribution infrastructure.[31] PSEG Long Island currently categorizes over half of the substations as having "not favorable" or "moderate" conditions for interconnection. As LIPA and PSEG Long Island are investing in upgrades to improve reliability, modernize the grid, and harden the system against storm damage, LIPA is evaluating investments in its transmission and distribution system to accommodate additional renewable energy. These investments will be based on proactive analysis and planning, or integrated distribution planning.

In addition, the information from the improved hosting capacity maps and analysis and the GIS information from the Long Island Solar Roadmap should be used to prioritize grid upgrades in areas with low-impact siting potential, especially in load pockets where there is congestion or lack of adequate transmission capacity to meet peak demand. The cost of these upgrades could be shared in the utility's rate base like other transmission and distribution upgrades, since all customers benefit from access to clean energy and the increased resilience that DERs bring to the system.

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[31] The recent FY2021 NYS Budget Bill included a commitment by the State to "make a comprehensive study of the state's power grid to identify distribution and transmission infrastructure needed to enable the state to meet the CLCPA targets..." and provide for timely development of these system upgrades by regulated utilities and LIPA.

Strategy 5
Support low-impact, on-farm solar

To assist farmers and farmland owners in pursuing on-farm solar, state and local governments, individuals, and organizations focused on farming should collaborate to update state and local policy frameworks, improve financial programs, and provide technical assistance necessary to enable low-impact, on-farm solar.

The Roadmap identifies opportunities for low-impact solar on farms that are not enrolled in farmland protection programs. These opportunities can provide renewable energy for Long Island and enhance farm operations. It is important to note that some of this farmland may not be appropriate for ground-mounted solar even if it is not protected by farmland preservation programs, particularly if it is comprised of prime soils—our nationally significant productive fertile land. Furthermore, maintaining agricultural lands in production is important to local economies and food systems; therefore, we do not advise wholesale conversion of farm operations to energy development. Policies and incentives to expand on-farm solar should focus on co-utilization with active agricultural production, siting on marginal land with less productive soils, and supporting installations on buildings and parking lots.

Increasing solar production on farms in ways that support continued production can provide a stable income source that enhances the financial viability of the farm operation. In turn, this can ease the pressure to convert agricultural lands to residential or other forms of development and can sustain the local farm economy. On-farm solar systems can also be co-located with certain types of production, like grazing and shade-tolerant crops (e.g., lettuce, spinach), while also potentially reducing energy bills by powering greenhouses or other on-farm operations. Co-locating solar and production is often referred to as agrivoltaics or co-utilization. Public opinion research for the Roadmap found that 72% of Long Island residents surveyed support solar on agricultural land that supplements farmer income.

Barriers to low-impact solar on farms remain, however. Landowners who are interested in developing solar on their land have faced local zoning and policy barriers, and have lacked technical, legal and financial assistance. The actions that follow are aimed at assisting farmers and farmland owners who are interested in pursuing solar installations to do so in a way that enhances the economic viability of the farm operation, rather than displacing agricultural activities from farmland.

Farm Community

Solar Industry

State or Local Government

Action 5.1 Identify appropriate locations for on-farm solar

We recommend that farmers and farmland owners, solar developers, land trusts, extension professionals, and local governments work together to identify low-impact areas of farm operations that are compatible with solar development, including marginal and less productive land, with the goal of allowing solar development on these locations via local policy.

Within any given agricultural operation, soil types may vary in their capability to support crop and forage production, based on their physical and chemical characteristics. Minimizing the loss of farmland with the highest soil quality, and in particular those lands designated as "prime farmland," is important for maintaining both ongoing food production and the economic viability of farm operations. American Farmland Trust has created maps and analyses that identify the most productive, versatile, and resilient land for sustainable food and crop production across the United States (Freedgood et al., 2020). In addition, farmers, farmland owners, and extension professionals can use local knowledge and experience to identify productive and less productive farmland. Solar developers can partner with farmers and extension agents to determine the appropriate size, configuration, and orientation of arrays, with sensitivity to soil conditions; help determine interconnection needs and financing options; and evaluate the potential and cost for solar on the rooftops or parking lots associated with the farm.

RESOURCES

- American Farmland Trust's Farms Under Threat: The State of the States (farmlandinfo.org/publications/farms-under-threat-the-state-of-the-states). This report identifies the most productive, versatile, and resilient land for sustainable food and crop production across the United States and serves as a resource for understanding where on-farm solar is compatible.

State or Local Government

Nonprofit organizations

Farm Community

Action 5.2 Provide technical and legal assistance to farmers and farmland owners

We recommend that academic, nonprofit, government institutions, and soil and water conservation districts work with farmers to provide technical and legal assistance for low-impact, on-farm solar development, including co-location (co-utilization) of solar and agricultural production.

The technical details of solar and agriculture co-utilization or agrivoltaics are one potential topic for research and outreach efforts. Solar panels create a shaded microclimate that is cooler during the day than the surrounding area, but also stays warmer at night. These conditions can be conducive to growing shade-tolerant crops like lettuce. In France, solar panels have been co-located with vineyards, a design that reduced water demand and prevented stunting during heat waves (Rollet, 2020). In some cases, a solar facility might be compatible with grazing operations, particularly for free-range poultry or smaller ruminants. Sheep, in particular, can provide on-site vegetation maintenance throughout the life of a project.

The panel type, height, configuration, angle, and ground preparation used for the solar installation will vary with the specific agrivoltaic use. Crop selection, water and soil management, monitoring, and harvest operations are all additional considerations. Co-utilization projects must also be designed to allow continued agricultural use through the life of the project, so that farmers have the flexibility to switch to different crops in response to market demand. Agrivoltaics are a relatively new endeavor, and much of the existing research has occurred in Europe, Massachusetts, Arizona, and California, so there is a considerable need for research to determine best practices in New York and transmit that information to agricultural producers.

In addition to technical assistance, farmers may also benefit from the development of resources and legal consultation to help them navigate the legal and technical issues of developing solar, including lease agreements.

Finally, agricultural producers may need further demonstration of the economic viability of agrivoltaic operations. Funding for research with an extension or university could help to convince producers of the benefits of adoption and allay their fears about risks. The Nassau and Suffolk County Soil and Water Conservation Districts, the New York State Soil and Water Committee, Cornell Cooperative Extension, the USDA Natural Resources Conservation Service, New York Farm Viability Institute, Northeast Sustainable Agriculture Research and Education Program, and NYSDAM are all potential sources of technical assistance or funding.

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RESOURCES

- The University of Massachusetts Amherst Clean Energy Extension provides resources for those considering solar PV on farms (ag.umass.edu/clean-energy/current-initiatives/solar-pv-agriculture) and a research initiative focused on agrivoltaics (ag.umass.edu/clean-energy/research-new-initiatives/dual-use-solar-agriculture).
- The Farmer's Guide to Going Solar (energy.gov/eere/solar/farmers-guide-going-solar). This resource was created by DOE to answer frequently asked questions about on-farm solar.
- American Solar Grazing Association (solargrazing.org). The association provides information and resources for farmers, solar developers, and landowners interested in grazing livestock below ground-mounted solar panels.

State or Local Government

Action 5.3 Enact policies to support on-farm solar

We recommend that local governments update local codes and land-use laws and that state agencies establish guidelines and supportive policies to enable low-impact solar on farms.

Several current policies limit farmers' abilities to add solar generation. Zoning is one barrier that can be resolved at the local level. Municipal governments should update zoning to encourage solar on marginal farmland, clarify criteria whereby solar might be permitted on prime farmland (for example, if paired with co-production of shade-tolerant crops), and allow solar on new and existing barns, greenhouses, accessory structures, and parking lot carports. At the state level, NYSDAM should establish guidelines and policies to support on-farm solar that enhances farm viability, such defining co-utilization and reducing or eliminating penalties for converting marginal farmland in agricultural districts.

For example, current law within agricultural districts limits energy production from solar to 110% of on-site use in order to retain agricultural tax assessment status. Increasing that cap for solar projects sited on marginal farmland could enable more low-impact solar siting on farms and improve financial viability for farmers. The farm community, solar developers, and nonprofit institutions could form a coalition to advocate for these and other policies that enable low-impact solar on farms and build local support for projects.

State or Local Government

Action 5.4 Provide financial programs to support on-farm solar

We recommend that state and local governments update their financial incentive programs to encourage co-location of solar and agriculture production. One possible state-level incentive is compensation rate adders, such as those found in the Solar Massachusetts Renewable Target (SMART) program, for solar projects that avoid prime and important farmlands, or that involve co-utilization. These adders would need to be carefully and clearly defined. The State of New York could also expand financing and loan programs to support agricultural operations

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as they navigate programs like NY-Sun and C-PACE. Municipalities could also consider expanding local tax benefits, particularly for those on-farm installations that expand solar access for underserved or LMI customers. Future agricultural preservation easement terms could be drafted so that new easements allow farmers the flexibility to develop solar on and around buildings and on marginal or less productive farmlands.

RESOURCES

- NYSDAM's Agricultural Environmental Management program (agriculture.ny.gov/soil-and-water/agricultural-environmental-management). This program provides assistance and funding to help farmers develop and apply solutions that meet farm goals while protecting the environment, such as on-farm solar.
- USDA's Rural Energy for America Program (REAP) (rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency). This program provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements.
- Solar Massachusetts Renewable Target Program (mass.gov/doc/agricultural-solar-tariff-generation-units-guideline-final/download). This state-sponsored program provides location-based compensation rate adders for solar on farms. The program's Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units specifies the criteria that a solar installation must meet to receive the adder.
- The Northeast Sustainable Agriculture Research and Education (SARE) program (northeastsare.org/Grants) and the New York Farm Viability Institute (nyfvi.org) are potential sources of funding for on-farm solar projects.

Strategy 6
Encourage solar on commercial and industrial properties

To increase solar adoption on commercial and industrial properties, LIPA, PSEG Long Island, local governments and Long Island's eight Industrial Development Agencies (IDAs) should provide information and incentives that pave the way for solar on current and future commercial and industrial development.

In Nassau County and the four westernmost, more densely developed towns within Suffolk County, over half of the potential for low-impact solar siting is on rooftops and parking lots. Much of this available space is on commercial and industrial properties. Rooftop and carport solar are also very strongly supported by respondents, and significantly, are the two types of installations that received the highest percentage of "more likely to support if they are visible" survey responses. Solar co-located with other types of land uses enjoys very high levels of support and the lowest levels of opposition, even when tree removal is required. This widespread acceptance may translate into a faster and less expensive permitting process and fewer soft costs compared with stand-alone ground-mounted systems that may trigger opposition. Commercial and industrial properties also generally have a ready off-taker for the electricity generated, either on-site or nearby, and may thus be able to avoid issues with limitations of grid capacity.

On the other hand, the systems that best lend themselves to integration with commercial and industrial zones—carports and rooftops—are more expensive than ground-mounted systems. Parking lot solar installations entail additional costs for site preparation (repaving) and racking, and rooftop systems may require expensive roof upgrades prior to installation.

Commercial and industrial property owners are able to access a wide array of financing options and tax incentives (see page 46), and one important incentive, the federal Investment Tax Credit, has been extended at 26% of the cost of the solar installation through 2022. Other commercial and industrial properties under public or nonprofit ownership may face a bigger barrier in financing. Furthermore, the issue of split incentives in tenant-occupied spaces may require creative solutions to ensure that the financial benefits of the solar system accrue fairly.

It is important for the business community to demonstrate leadership and support for low-impact solar siting, by hosting solar on their own property, advocating with local government, and engaging their peers in learning. Commercial and industrial property owners who install parking lot solar could also market it as an amenity—shaded, snow-free parking—and install EV charging stations, both of which could help to improve their profile and draw additional customers and tenants.

Action 6.1 Enhance information about utility programs for commercial users

Utility (LIPA and PSEG Long Island)

We recommend that LIPA and PSEG Long Island create an educational program to provide clear information about its solar, clean energy, and energy efficiency programs and incentives to commercial, nonprofit, government, and agricultural property owners.

The program should provide a greater understanding of the economic, environmental, and health benefits of these clean energy improvements and of accelerating solar on commercial spaces. It is essential to provide clearer information and understanding about benefits and costs to business owners, promote clarity and simplicity of billing, and enable small-scale FITs or other incentives. PSEG Long Island should also continue remote net metering to enable commercial entities that have multiple buildings or properties, such as hospitals or universities, to install a single large array to offset energy and demand costs at multiple sites. LIPA, PSEG Long Island, and the solar industry can also explore ways to reduce the cost of parking lot solar, since these systems provide the dual benefits of clean electricity and shading that reduces the urban heat island effect.

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State or Local Government

Action 6.2 Establish local incentives and mandates

We recommend that local governments take action to incentivize solar on current and future commercial and industrial developments.

One option could be to update zoning codes to allow solar as a by-right use in areas that are zoned for commercial and industrial use. Local governments could also provide tax incentives to business or commercial property owners for installing solar on-low impact sites. A transferrable incentive enables entities without tax liability (nonprofit and municipal entities) to "sell" the value of their incentive to a taxed entity. Local governments could also allow or incentivize commercial and industrial property owners to host community solar installations on their property; the resultant energy could be used locally by residents and businesses. Arrangements of this type can also help to overcome the "split incentives" problem by allowing the tenant or other members of the community to buy the electricity produced by the community solar system.

Another option is to phase-in mandates for solar installations or "solar-ready" preparation on low-impact sites in new development or re-development—for example, by adopting the NYStretch Energy Code 2020. Even modest solar requirements can be effective at connecting commercial property owners with solar industry professionals who can both provide information and assist with installations.

Another approach would be to offer incentives or financing that help defray the additional costs associated with carport or rooftop systems. Local tax incentives could also play a role: Suffolk County waives sales tax for both commercial and residential solar equipment. Nassau County, which currently only has a waiver in place for residential solar, should add a commercial waiver.

RESOURCES

- The NYStretch Energy Code (nyserda.ny.gov/All-Programs/Programs/Energy-Code-Training/NYStretch-Energy-Code-2020). This is a model code designed to help New York communities improve energy efficiency, reduce greenhouse gas emissions, and save money on energy costs through local building energy codes, including solar-ready building codes.
- The Sustainability Institute at Molloy College's policy analysis paper, Should Renewable Energy Systems Be Mandated in Local Building Codes for New Commercial Buildings? (molloy.edu/Documents/White_paper_Solar_Mandate_final_12_2018.pdf). This paper makes the case for solar mandates on new commercial buildings on Long Island.

- Sustainable Development Code's chapter on Solar Energy (sustainablecitycode.org/chapter/chapter-7/7-2). The chapter provides information, best practices, and resources for local ordinances that promote solar energy with incentives, property tax exemptions, density bonuses, solar-ready construction, and more.

Action 6.3 Create Industrial Development Agency incentives

Business Community

We recommend that Long Island's IDAs use their programs to incentivize solar adoption by existing or new businesses.

There are eight IDAs on Long Island. These economic development agencies provide various services to help businesses and local economies thrive. Generally, their goal is to attract businesses to or keep them from leaving the area. Direct financial assistance or a program to provide tax incentives for solar adoption could be part of the incentive package to accomplish this. Any incentives offered by IDAs could also be used in conjunction with C-PACE financing.

RESOURCES

- The Tompkins County IDA's off-site commercial solar photovoltaic policy (tompkinsida.org/wp-content/uploads/2018/10/TCIDA-commercial-solar-policy-FINAL-101217.pdf). This policy is an example of the types of incentive programs IDAs can create to support solar development.

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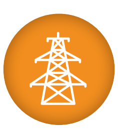
Strategy 7
Improve access and equity through community solar

To improve all Long Islanders' access to solar energy and its many benefits, the solar industry, LIPA, PSEG Long Island, the business sector, and community organizations should coordinate to advance community solar, with a focus on working more closely with communities of color and LMI communities.

Currently, many Long Island residents cannot access clean, renewable energy, because they lack suitable rooftop or other space, rent their homes or places of business, or cannot afford to own or lease a solar system. Communities of color and LMI communities have been underserved by current solar deployment. Further, LMI households in New York spend more than 12.6% of their household income on energy, more than twice the affordability threshold of 6% (Carroll, 2017). Racial and income inequities in solar deployment compound environmental injustice and point to the need for more inclusive and equitable policies and practices. The CLCPA's requirement that investments in the renewable energy transition benefit underserved communities and requirements for tracking these investments and benefits aim to address environmental injustice.

Mid- to large-scale solar development can play an important role in enabling equitable access to renewable energy and improving energy affordability on Long Island. We highlight community solar as a critical approach for providing equitable, affordable access to renewable electricity for all households, regardless of location or income, and helping reduce electric bills.



Utility (LIPA and PSEG Long Island)

Action 7.1 Prioritize community solar and expanded access for LMI households in utility programs

We recommend that LIPA and PSEG Long Island continue to support community solar and expanded access to solar energy for underserved communities through new and existing programs.

Two recent efforts demonstrate LIPA and PSEG Long Island's commitment to community solar. First, LIPA raised the Community Adder for projects on Long Island to $0.05/kWh to provide a compensation incentive for development of community solar projects. In addition, LIPA has approved a new FIT, called Solar Communities Feed-in Tariff V (FIT V), that will incentivize up to 25 MW DC of solar installations by commercial customers, with the potential to award contracts for an additional 15 MW DC. Installations must be 200 kW to 5 MW in capacity and will enter into a 20-year PPA with LIPA (PSEG Long Island, 2020c). The Solar Communities Program aims to provide discounted energy for more than 3,000 LMI customers.

We recommend provisions that ensure these and future programs benefit underserved communities, that there is no up-front cost for participation by LMI subscribers in any program, and that community solar projects benefit underserved communities through community and job development. Further, partnering with the private sector and community organizations can help ensure diverse participation of both hosts and subscribers.

RESOURCES

- NREL provides two key resources on community solar programs for LMI communities:
  - Low- and Moderate-Income Solar Policy Basics (nrel.gov/state-local-tribal/lmi-solar.html). This resource provides an overview of best practices, potential funding sources, and links to additional resources.
  - A report by NREL and Clean Energy States Alliance, Design and Implementation of Community Solar Programs for Low- and Moderate-Income Customers (nrel.gov/docs/fy19osti/71652.pdf). This report provides detailed guidance on program design and structure, incentives and financing, and marketing and customer outreach, drawing from existing LMI community solar programs.

Action 7.2 Initiate community solar projects

Business Community

State or Local Government

Nonprofit organizations

Farm Community

We recommend that businesses, local governments, nonprofit organizations, communities, and farmland owners initiate community solar projects on low-impact sites.

Community solar provides an opportunity for private and public property owners to play a pivotal role in advancing the transition to renewable energy on Long Island by hosting community solar projects. Solar adoption might not be attractive for property owners when the available space for solar development does not match up with the location of their energy use and therefore does not provide an energy cost savings. Community solar can overcome this challenge while expanding access to affordable clean energy. In the case of community solar, the size and location of available space for solar installations no longer needs to match on-site energy use, giving property owners and developers greater flexibility to utilize low-impact sites and deliver additional clean energy to Long Island communities.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Hosting a community solar installation can provide several benefits to property owners, including revenue from leasing the space for community solar, progress toward meeting corporate social and environmental goals, and reduced energy cost for the property owner if they become a subscriber.

In addition to developers, local governments, or nonprofits initiating projects, communities can come together to create cooperatively owned solar arrays. When solar arrays are cooperatively owned, community members have a say in the development and management of the project and have access to both the clean energy generated and profit-sharing. Community-owned shared solar is a way to strengthen local investment, control, and equity in energy resources.

RESOURCES

- NYSERDA's Affordable Solar Predevelopment and Technical Assistance program (nyserda.ny.gov/All-Programs/Programs/NY-Sun/Communities-and-Local-Governments/Predevelopment-and-Technical-Assistance). This program provides funding for predevelopment and technical assistance on proposed solar and/or energy storage projects that offer benefits to LMI households or residents of affordable housing.
- NREL's National Community Solar Partnership (energy.gov/eere/solar/national-community-solar-partnership). This partnership provides national and local stakeholders with tools, information, and technical assistance to support the design of and implement successful community solar projects.
- The Coalition for Community Solar Access's Community Solar Policy Decision Matrix (communitysolaraccess.org/wp-content/uploads/2019/04/2019CommunitySolarPolicyMatrix-2.pdf). This resource provides guidance for designing community solar programs.

Action 7.3 Elevate and build partnerships with community organizations

Partnership

We recommend that local government, solar developers, LIPA, and PSEG Long Island partner with and fund trusted community groups, faith-based organizations, existing LMI programs, and other nonprofit institutions to effectively engage LMI and underserved communities in community solar.

One of the most challenging aspects of community solar projects is connecting with and enrolling participants. Working with trusted community-based organizations and trusted ambassadors (see Action 8.3) can lead to greater success in engaging underserved communities. Community-based groups and organizations are already embedded in and serving a community and can leverage existing relationships and communication channels to reach community members. These organizations can advance community solar through outreach, facilitating customer acquisition and assisting in project implementation. Outreach and engagement are services that community organizations are uniquely well-suited to provide, and partners need to provide compensation and funding for their work on community solar. Community organizations are also essential members of a network to advance solar on Long Island (see Action 1.3).

RESOURCES

- A report by NREL and Clean Energy States Alliance, Design and Implementation of Community Solar Programs for Low- and Moderate-Income Customers (nrel.gov/docs/fy19osti/71652.pdf). This report includes guidance on outreach and collaboration with community organizations to improve the success of solar projects.

Action 7.4 Establish energy improvement districts

State or Local Government

We recommend that local governments establish Energy Improvement Districts to focus investment and resources to support low-impact solar development in the communities most impacted by energy and environmental injustice.

Special assessment districts are a development finance mechanism in which local governments collect a fee on properties within a defined area to fund specific improvements. In this novel approach, an Energy Improvement District could be established to fund investments in infrastructure and services that expand access to the benefits of solar development to residents in communities underserved by the solar market. These investments could include funding for community solar installations, implementing a Solarize campaign to help businesses in the district go solar, creating outreach and education programs through community organizations for residents on solar, and more.

Strategy 8
Build and mobilize community support

To help build and mobilize community support for solar development on Long Island, state and local governments, LIPA, PSEG Long Island, solar developers, and nonprofit institutions should address the needs of Long Island communities for improved engagement and communication regarding solar siting and development, for greater local benefits, and for investments in the local workforce.

Publicly expressed opposition to a solar development project can delay project implementation, increase costs, and ultimately hinder or even prevent development. Public opposition often receives significant media attention, without systematic evidence or consideration of whether the expressed opposition represents a majority or a vocal minority view. The ratepayer survey conducted as part of the Roadmap reveals high levels of support for mid- to large-scale solar development in communities across Long Island and highlights the need for increased public engagement in solar development.

Action 8.1 Improve information about solar costs and benefits

State or Local Government

Utility (LIPA and PSEG Long Island)

Solar Industry

We recommend that local governments, LIPA, PSEG Long Island, and solar developers provide information that clearly communicates low-impact solar development opportunities that can benefit communities, as well as explaining the costs and benefits of solar to utility customers and communities.

Public opinion research conducted as part of the Roadmap indicates that the distribution of economic benefits is a concern shared by those who support and those who do not support solar development, and it is often cited as a reason respondents oppose solar projects. Outreach, advocacy, and education to inform individuals and communities about the costs and benefits to ratepayers, the environment, and local health, is one way to address their concerns and build support. We also suggest that communities receive a clear articulation of funding and financial incentives and what they mean for Long Island.

Action 8.2 Implement robust public engagement

State or Local Government

Solar Industry

We recommend that local governments and solar developers implement early, robust, and frequent public engagement in planning, siting, and project design processes.

Improving transparency and public engagement require a sustained commitment from local governments, solar developers, and LIPA and PSEG Long Island to engage in two-way communication with communities about the nuances of solar development, including costs; ownership; economic, environmental, and health benefits; and the distribution of benefits. This engagement and communication must involve listening to the public and being willing to engage in project design processes shaped by public input. It can also involve providing information to the public. Public opinion research similar to the polling used to inform this Roadmap can be used to understand residents' perspectives on proposed solar installations or policies and gather information from a larger proportion of the community through community meetings.

RESOURCES

- SolSmart's Toolkit for Local Governments (solsmart.org/solar-energy-a-toolkit-for-local-governments). This resource includes guidance for municipal and county staff on how to develop and implement a public engagement strategy.
- The DOE's Solar Market Pathways project created the Expanding Engagement and Participation Toolkit (solarmarketpathways.org/innovation/engagement/#layoutsection_background-13). This toolkit can help government officials, the solar industry, and nonprofits engage a diverse set of champions and stakeholders in developing solar policies, programs, and strategies.

Action 8.3 Educate key audiences and elevate trusted ambassadors

Partnership

We recommend that local governments, LIPA, PSEG Long Island, nonprofit institutions, and solar developers collaborate on communication campaigns to inform key audiences about the economic, environmental, and health benefits of low-impact solar and elevate the voices of solar adopters and other solar ambassadors.

Research demonstrates that solar "champions" can influence public support, particularly when the champions are trusted local leaders with no clear financial incentive for promoting solar (Simpson, 2018). Solar champions can also be trusted faith, business, or advocacy leaders who provide accurate information about the benefits of solar energy. Successful outreach and advocacy rely on existing social networks of trust and elevating trusted social actors through education and communication efforts. Local governments, nonprofits, and solar developers can all work together to build trust and mobilize support by relying on local trusted leaders as solar ambassadors. Solar ambassadors can be particularly important for reaching underserved communities and growing community solar, as discussed in Action 7.3.

Solar Industry

Utility (LIPA and PSEG Long Island)

Action 8.4 Provide benefits to host communities

We recommend that solar developers, PSEG Long Island, and LIPA design projects to provide monetary benefits to system owners, hosts, neighboring property owners, and host communities.

The Accelerated Renewable Energy Growth and Community Benefit Act directs the Public Service Commission to consider host community benefits (NYSERDA, 2020). As part of the initiative to promote solar development on low-impact, build-ready sites, NYSERDA is developing a Host Community Benefits program, and NYSPSC is establishing a program to provide utility bill discounts and other potential forms of compensation to benefit communities hosting solar projects 25 MW and larger. Since LIPA is not regulated by the NYSDPS, this program will not be automatically available on Long Island. LIPA and PSEG Long Island, solar developers, and others should research and develop a similar program for low-impact sites on Long Island that are less than 20 MW.

Partnership

Action 8.5 Invest in the local workforce

We recommend that state government and the solar industry invest in workforce development for the solar industry through partnerships with Long Island colleges, universities, and Boards of Cooperative Educational Services.

The ratepayer survey clearly demonstrates that the public prefers solar projects developed by local companies that provide local jobs. Enhancing the solar energy workforce through investment in local workforce development, which state government and the solar industry can do through partnership and investment, can help build and mobilize support for low-impact solar siting and development on Long Island.

Workforce development can also play an important role in improving access and equity in the solar industry. Research shows that people of color are underrepresented in the solar industry (The Solar Foundation, 2019b), and LMI communities face high barriers to employment as well. Therefore, workforce training programs that empower underserved and underrepresented communities to become involved and employed by the solar sector can build the local economy, diversify the solar workforce, and drive support for solar generation within their own communities. Additional actions to improve access and equity to the benefits of solar are included under Strategy 7.

RESOURCES

- The Solar Energy Industry Association (SEIA) has created the Diversity Best Practices Guide for the Solar Industry (seia.org/research-resources/diversity-best-practices-guide-solar-industry).

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Implementing the Roadmap in a Changing World

Since the Roadmap project began in 2018, and particularly in 2020, we have seen disruptive changes to New York State, to the United States, and globally.

- COVID-19 is creating far-reaching health and economic impacts in the United States and abroad, including loss of jobs; loss of revenues for all levels of government, as well as for utilities and businesses; slowdown of the expected pace of renewable energy build-out; and long-lasting changes in the pattern and levels of energy use. These impacts will take years to be fully understood.
- The urgent need to address racial injustice and structural inequity throughout institutions in the United States and other countries has been brought into sharp focus by mass demonstrations and the racial disparities in the impacts of COVID-19. The energy sector is no exception. The previous siting of fossil-fueled power plants and other polluting activities within low-income communities and communities of color has led to a pattern of environmental injustices. Communities of color experience a greater energy burden, have less access to the benefits of solar energy, and are not well represented in the solar industry.
- The policy landscape in New York State has also been rapidly changing. Since the beginning of this project, New York State has passed the CLCPA and the Accelerated Renewable Energy Growth and Community Benefit Act and has begun to create the policy and regulatory framework for achieving CLCPA goals on several fronts.

President Joe Biden is expected to advance national policy that supports the clean energy transition. At this stage, we do not know what role the federal government will play in helping states, localities, utilities, and private sector actors move toward a low-carbon future.

We have an opportunity to "build back better" to chart a course in which New York's economy and communities are more resilient, equitable, and prepared for the challenges we face in the future, including the challenge of climate change. Implementing the strategies and actions recommended in the Roadmap will put us on this path. While COVID-19 is placing constraints on government budgets and causing a loss of jobs in some sectors, it might also mean an opportunity to direct federal recovery funding to rehiring and new jobs in the clean energy sector. As we focus our attention on racial injustices in the United States, we can improve access to solar energy and clean-energy jobs for communities of color and avoid further environmental injustice. We can also use New York State's leadership to model what it will take to add more solar installations nationwide and call for greater support from the federal government and our national policymakers as we move through the energy transition called for by the CLCPA.


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Online Resources

- **Clean Energy Communities Program** (nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Communities). This NYSERDA program helps local governments implement clean energy actions, save energy costs, create jobs, and improve the environment by providing tools, resources, technical assistance, and funding.
- **Energy Improvement Corporation (EIC)** (eicpace.org). EIC is a New York State nonprofit, local development corporation that provides PACE financing to commercial and nonprofit property owners in member municipalities, which include counties and cities across New York State, through the OPEN C-PACE program.
- **EnergySage** (energysage.com). EnergySage is an online solar marketplace backed by DOE that helps users understand solar energy and resources for comparing solar equipment, financing, and vetted installers.
- **Guide to Implementing Solar PV for Local Governments** (solsmart.org/resources/guide-to-implementing-solar-pv-for-local-governments). Funded by the DOE's SunShot Initiative, this guide by the International City/County Management Association provides local governments with detailed information and guidance for implementing solar projects on municipal buildings and land, including feasibility studies, financial options, and purchasing and contracting models, as well as solar system commissioning, operation, and maintenance.
- **Guidelines for Solar Energy Projects — Construction Mitigation for Agricultural Lands** (agriculture.ny.gov/system/files/documents/2019/10/solar_energy_guidelines.pdf). Provided by NYSDAM, these guidelines must be incorporated into development plans and applications for permitting and approval for solar projects that impact agricultural lands. They provide instruction for mitigating construction impacts on agricultural land during construction, post-construction restoration, monitoring and remediation, and decommissioning.
- **Just Energy Policies and Practices Action Toolkit** (naacp.org/climate-justice-resources/just-energy). The National Association for the Advancement of Colored People developed this toolkit with eight modules of practical, user-friendly guidance for individuals and communities to advocate for a just, clean energy transition.
- **Long Island Power Authority** (lipower.org). LIPA is the not-for-profit public utility that owns the electric transmission and distribution system on Long Island and contracts with PSEG Long Island for its operation and maintenance. LIPA resources referenced in the report include:
  - **Implementing New York's Climate Leadership and Community Protection Act** (lipower.org/mission/clean-energy/). LIPA's current goals and programs aimed at meeting the CLCPA targets are explained in this infographic.
  - **Contracts and Reports** (lipower.org/about-us/contracts-reports/). Information about LIPA's Integrated Resource Plan, Energy Efficiency and Renewable Plan, and other reports can be found here.
- **Long Island Solar and Storage Alliance (LISSA)** (nyseia.org/longisland). LISSA is a volunteer advocacy organization, made up of renewable energy companies and professionals, that aims to advance solar and energy storage on Long Island through education, advocacy, and collaboration.

- **National Renewable Energy Laboratory** (nrel.gov/index.html). Under DOE, NREL is the primary federal laboratory for renewable energy and energy efficiency research and development. NREL provides numerous helpful resources, including these:
  - **Best Practices in Zoning for Solar | State, Local, and Tribal Governments** (nrel.gov/state-local-tribal/blog/posts/best-practices-in-zoning-for-solar.html)
  - **Community Solar** (nrel.gov/state-local-tribal/community-solar.html)
  - **Low- and Moderate-Income Solar Policy Basics** (nrel.gov/state-local-tribal/lmi-solar.html)
  - **Solar Decision Support Resources for Local Governments** (nrel.gov/state-local-tribal/local-governments.html)

- **New York State Utility Corridor Pollinator Habitat Guidelines** (agriculture.ny.gov/system/files/documents/2020/06/pollinatorhabitatguidelines_0.pdf). The NYSDAM and NYSDEC provide guidelines that outline short- and long-term property management practices that provide and maintain native vegetation on properties to benefit pollinators, including bees, butterflies, and hummingbirds.

- **New York Solar Guidebook for Local Governments** (nyserda.ny.gov/All-Programs/Programs/NY-Sun/Communities-and-Local-Governments/Solar-Guidebook-for-Local-Governments). Provided by NYSERDA, this guide is a compilation of information, tools, and step-by-step instructions to support local governments with the development, installation, and maintenance of solar energy projects in their communities.

- **NYSERDA's Community Choice Aggregation (CCA) Toolkit** (nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Communities/Clean-Energy-Communities-Program-High-Impact-Action-Toolkits/Community-Choice-Aggregation). This toolkit provides resources to assist local governments and CCA administrators to develop CCA programs in New York State.

- **PowerUp Solar Long Island** (powerupsolarli.com/). The PowerUp Solar program helps nonprofits and religious institutions on Long Island go solar by combining several cost-saving strategies to reduce costs and improve accessibility. The program is organized by the Long Island Progressive Coalition and Resonant Energy and funded by DOE's SunShot Initiative.

- **PSEG Long Island** (psegliny.com/). PSEG Long Island is the electric service provider for Nassau and Suffolk Counties. Resources from PSEG Long Island referenced in this report include:
  - **DER Hosting Capacity Map** (psegliny.com/aboutpseglongisland/ratesandtariffs/sgip/maps). This map provides information about the ability for substations in the Long Island distribution system to accept capacity from DER.
  - **Rates and Tariffs** (psegliny.com/aboutpseglongisland/ratesandtariffs/tariffs). This page lists information about PSEG Long Island's electric tariffs and FITs for renewable energy.

- **Solar Energy Technologies Office** (SETO) (energy.gov/eere/solar/solar-energy-technologies-office). Housed within the U.S. Office of Energy Efficiency and Renewable Energy, SETO provides information on solar energy, including these materials:
  - **National Community Solar Partnership** (energy.gov/eere/solar/national-community-solar-partnership).
  - **Publication and Product Library** (eere.energy.gov/library/). Use this searchable database to find SETO funding program fact sheets, reports and technical papers about solar.

- Quarterly Solar Industry Update (energy.gov/eere/solar/quarterly-solar-industry-update).
- Solar Information Resources (energy.gov/eere/solar/solar-information-resources). This curated list of SETO funding programs provides resources for consumers, professionals, and state, local, and federal governments. It offers information ranging from solar energy basics to the latest in solar research and development.

- **Solar United Neighbors** (solarunitedneighbors.org/learn-the-issues/community-solar). This national organization of solar owners and supporters provides information and resources on key issues around solar. Their section on community solar provides educational materials and an extensive list of resources related to community solar.

- **SolSmart** (solsmart.org). Funded by the DOE, SolSmart is a national designation program recognizing cities, counties, and regional organizations that implement policies and programs to create thriving local solar markets. SolSmart provides no-cost technical assistance from a team of national experts to achieve designation. Resources include:
  - **SolSmart's Toolkit for Local Governments** (solsmart.org/solar-energy-a-toolkit-for-local-governments). This toolkit presents a roadmap to help local governments and community stakeholders encourage the use of solar energy and related technologies like battery storage. It includes chapters on stakeholder engagement; planning, zoning, and development; codes and permitting; community solar and more.
  - **SolSmart Issue Brief: Community Choice Aggregation** (solsmart.org/resources/solsmart-issue-brief-community-choice-aggregation). This resource provides an overview of how CCA is organized, the process local governments can use for establishing CCA, and how CCA can be used to increase solar deployment.

- **The Solar Foundation** (thesolarfoundation.org). This nonpartisan research organization provides impartial reports on solar sector economics and the solar sector workforce, capacity building, and no-cost technical assistance to cities and counties. It also conducts the annual Solar Jobs Census.

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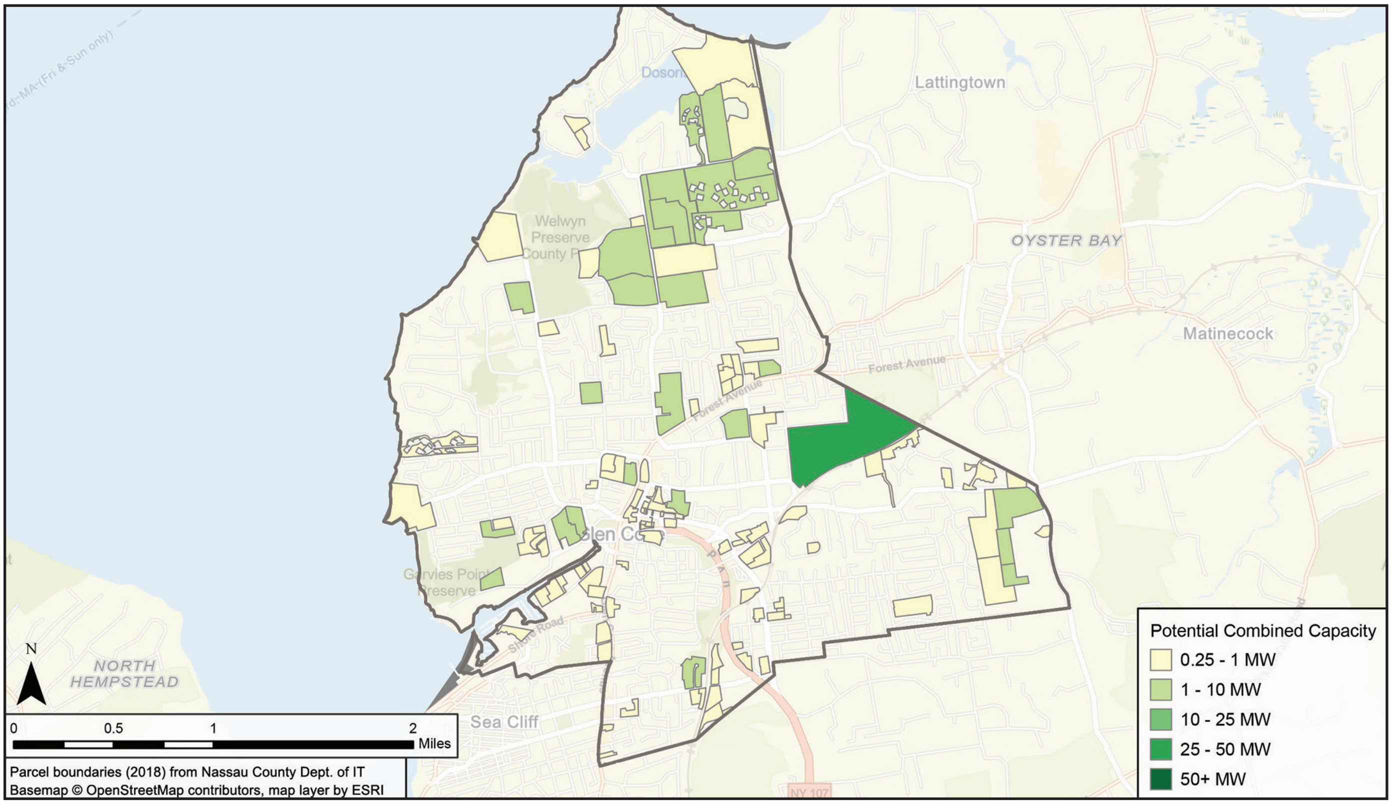
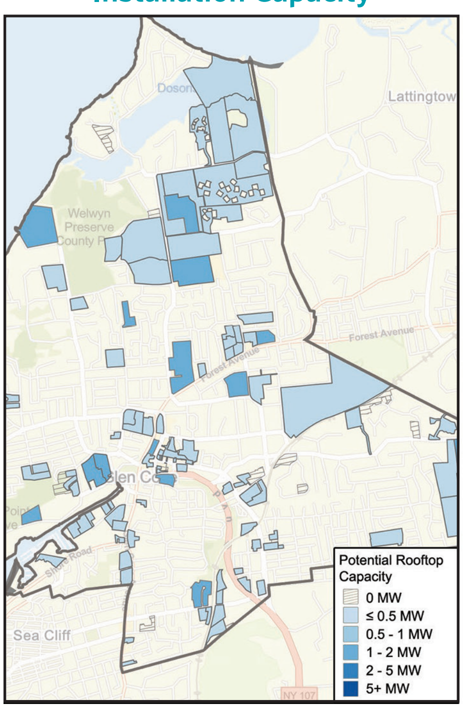
Appendices

Appendix A: Maps of low impact sites in each city and town in Nassau and Suffolk Counties

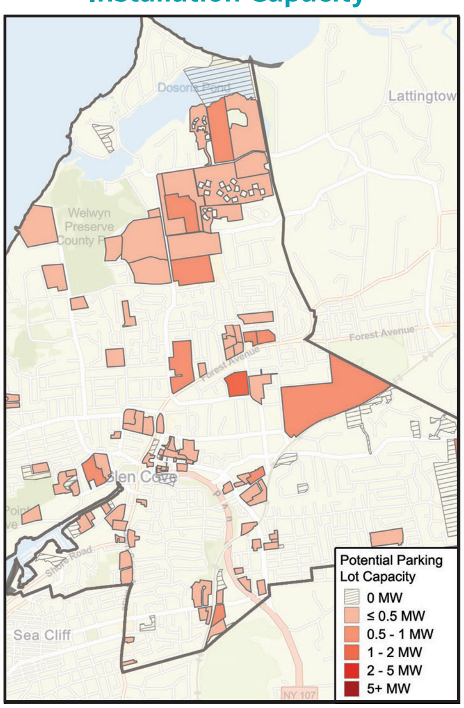
City of Glen Cove: Potential Combined Installation Capacity



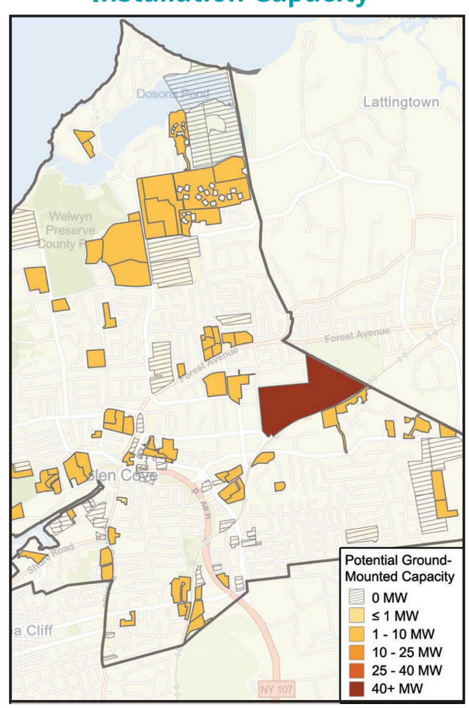
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity

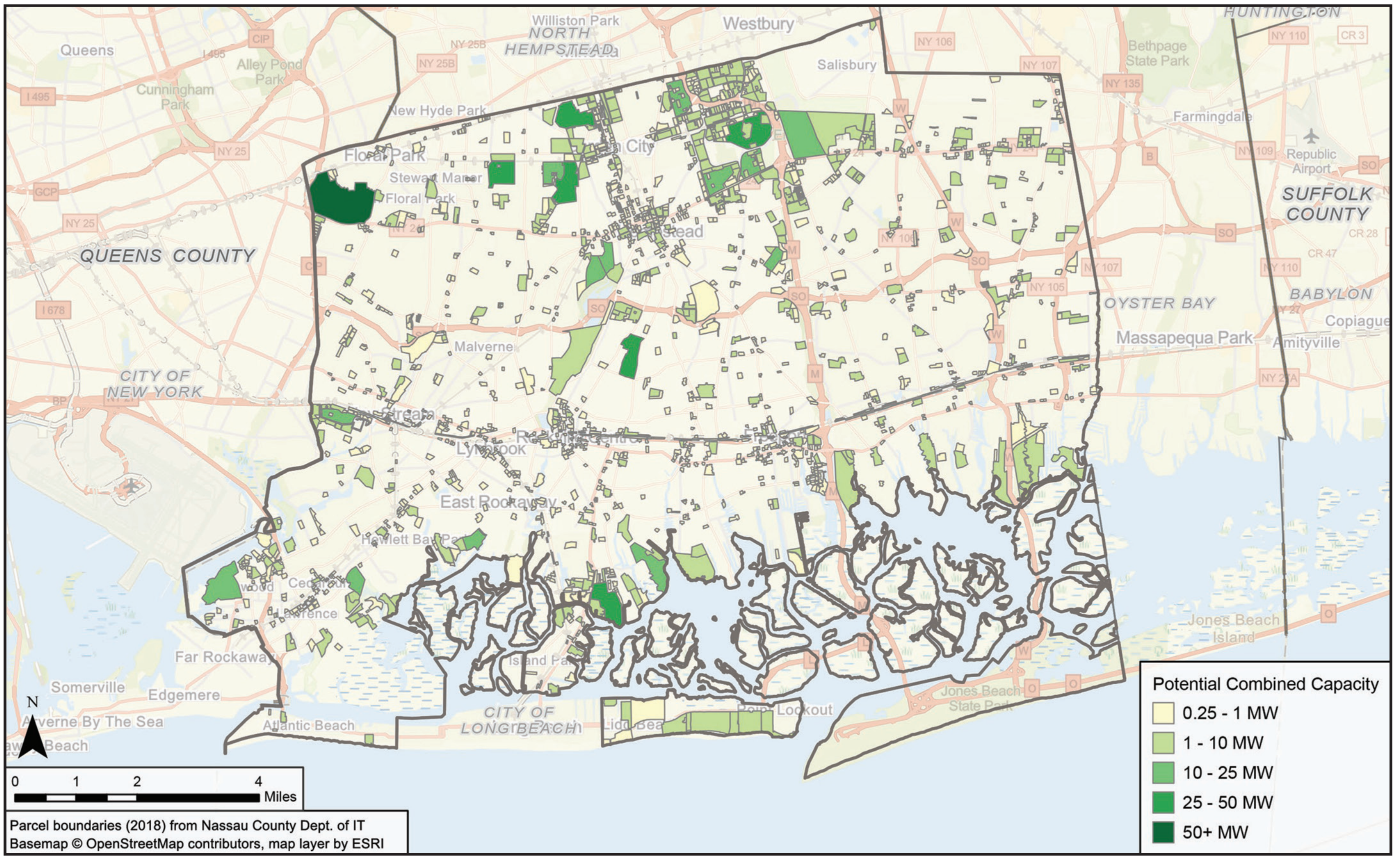


Potential Ground-Mounted Installation Capacity

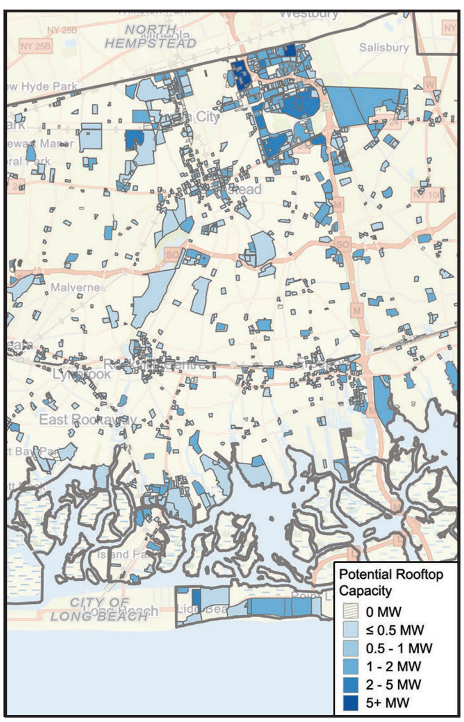


These illustrative results show low-impact siting potential only and do not take into account technical or policy constraints. These results are not intended to express where solar development should occur or to replace site-level evaluations. Installation capacity values are estimates. For more information about the Long Island Solar Roadmap and to access full maps, visit solarroadmap.org.

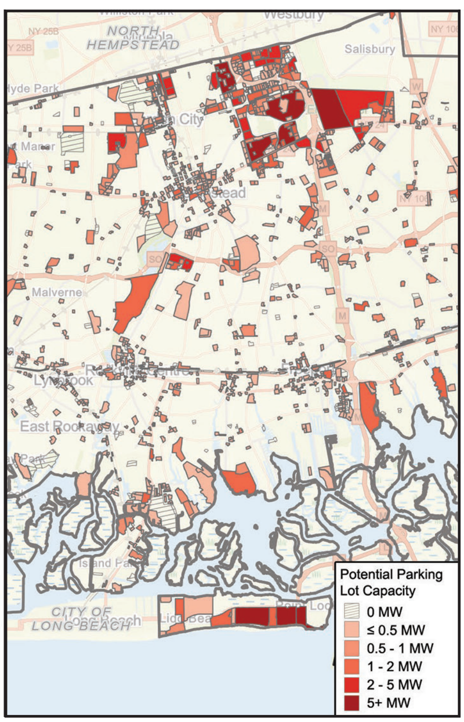
Town of Hempstead: Potential Combined Installation Capacity



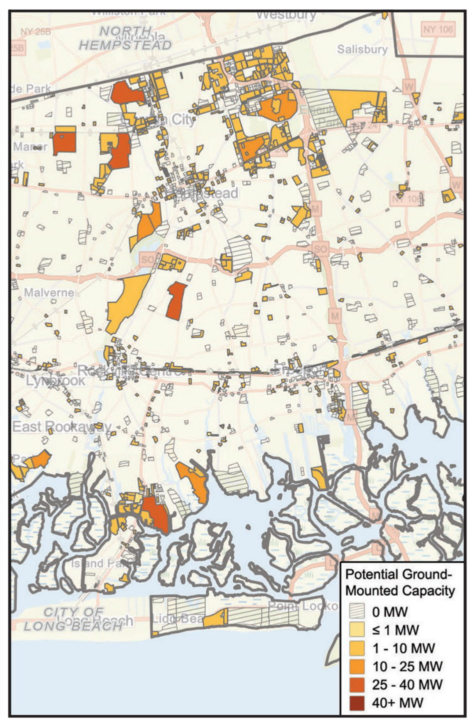
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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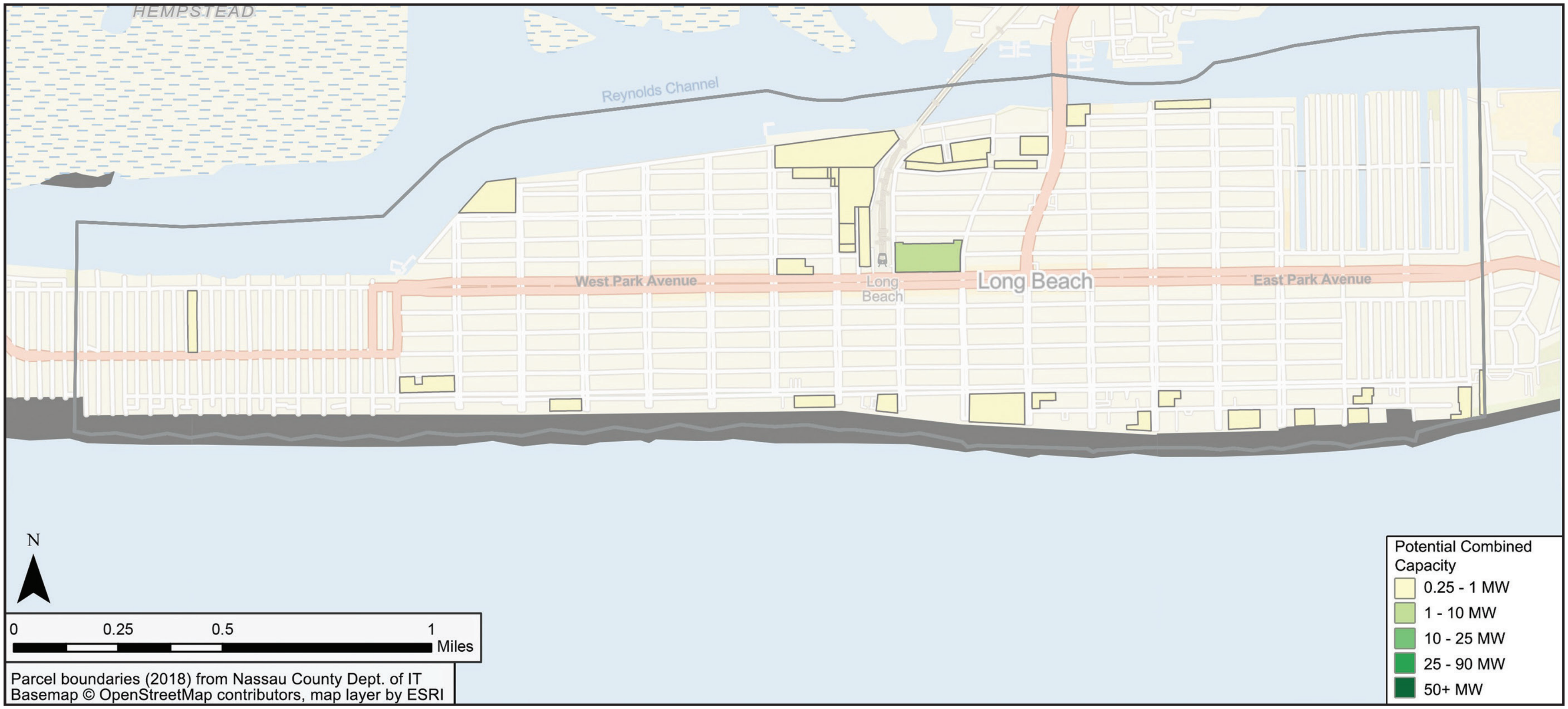
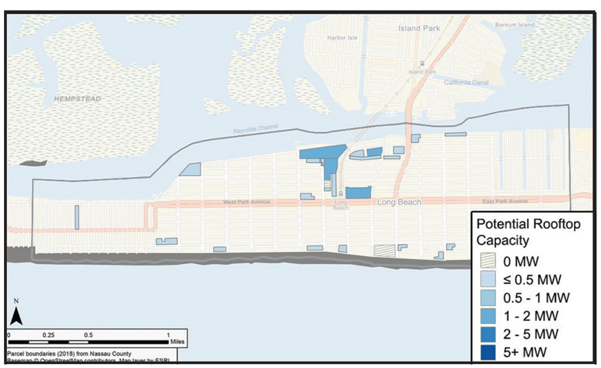
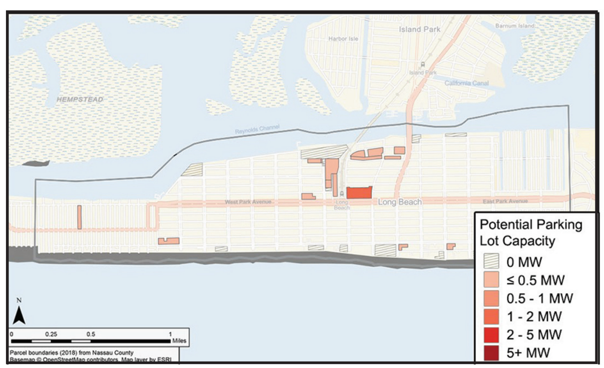
City of Long Beach: Potential Combined Installation Capacity



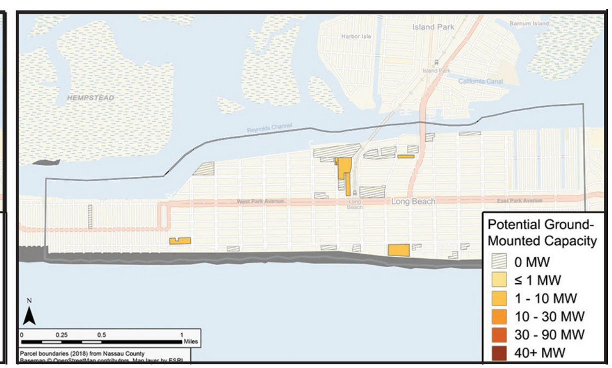
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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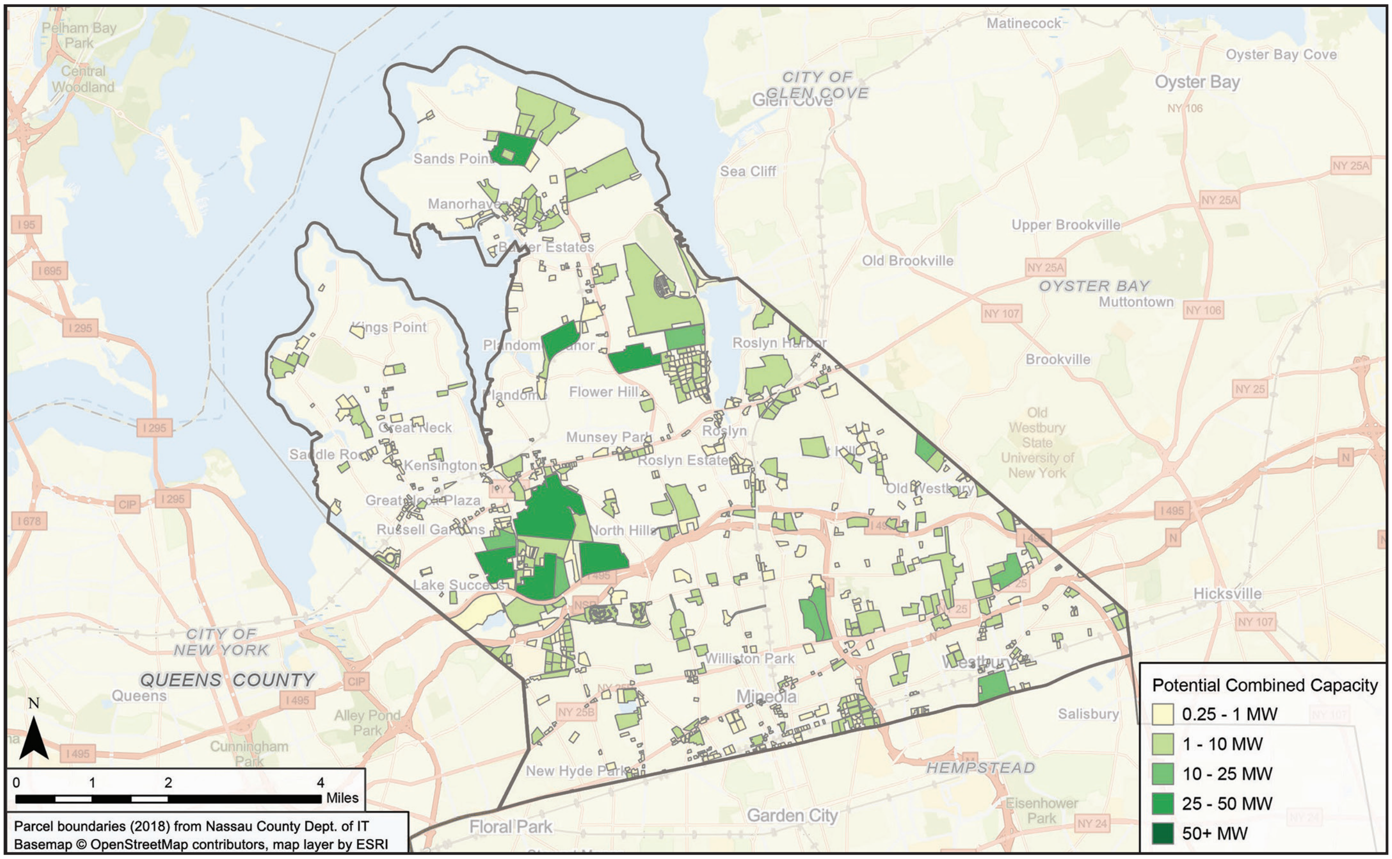
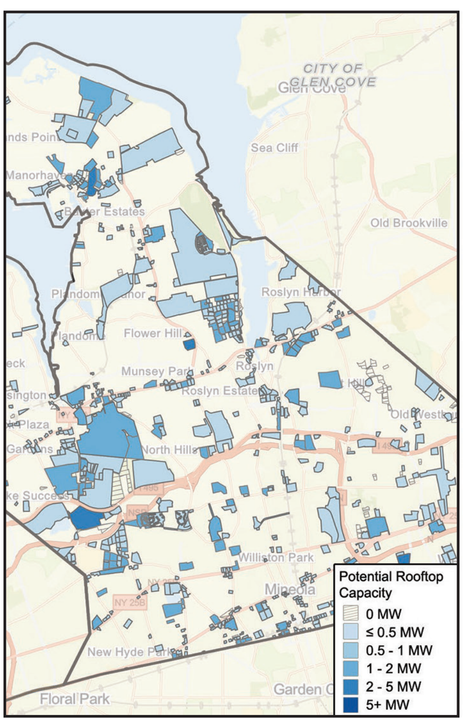
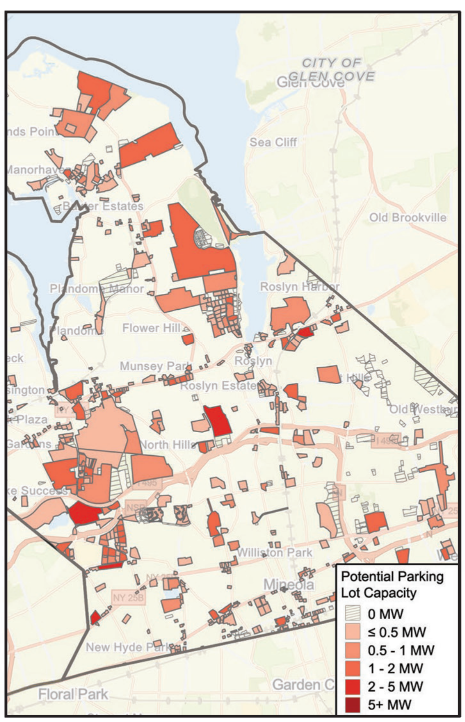
Town of North Hempstead: Potential Combined Installation Capacity



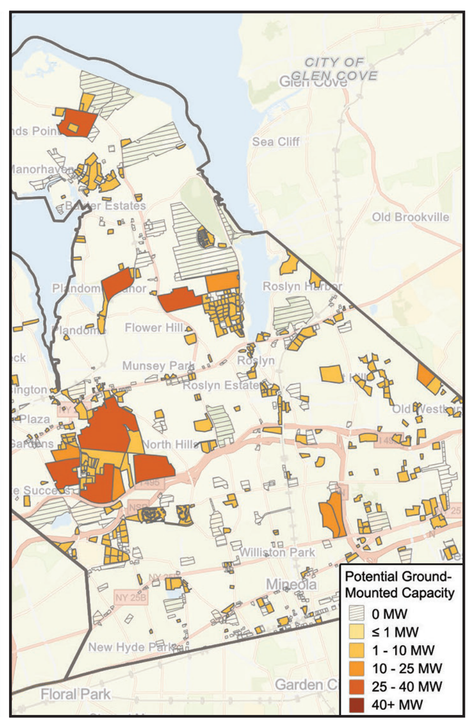
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity

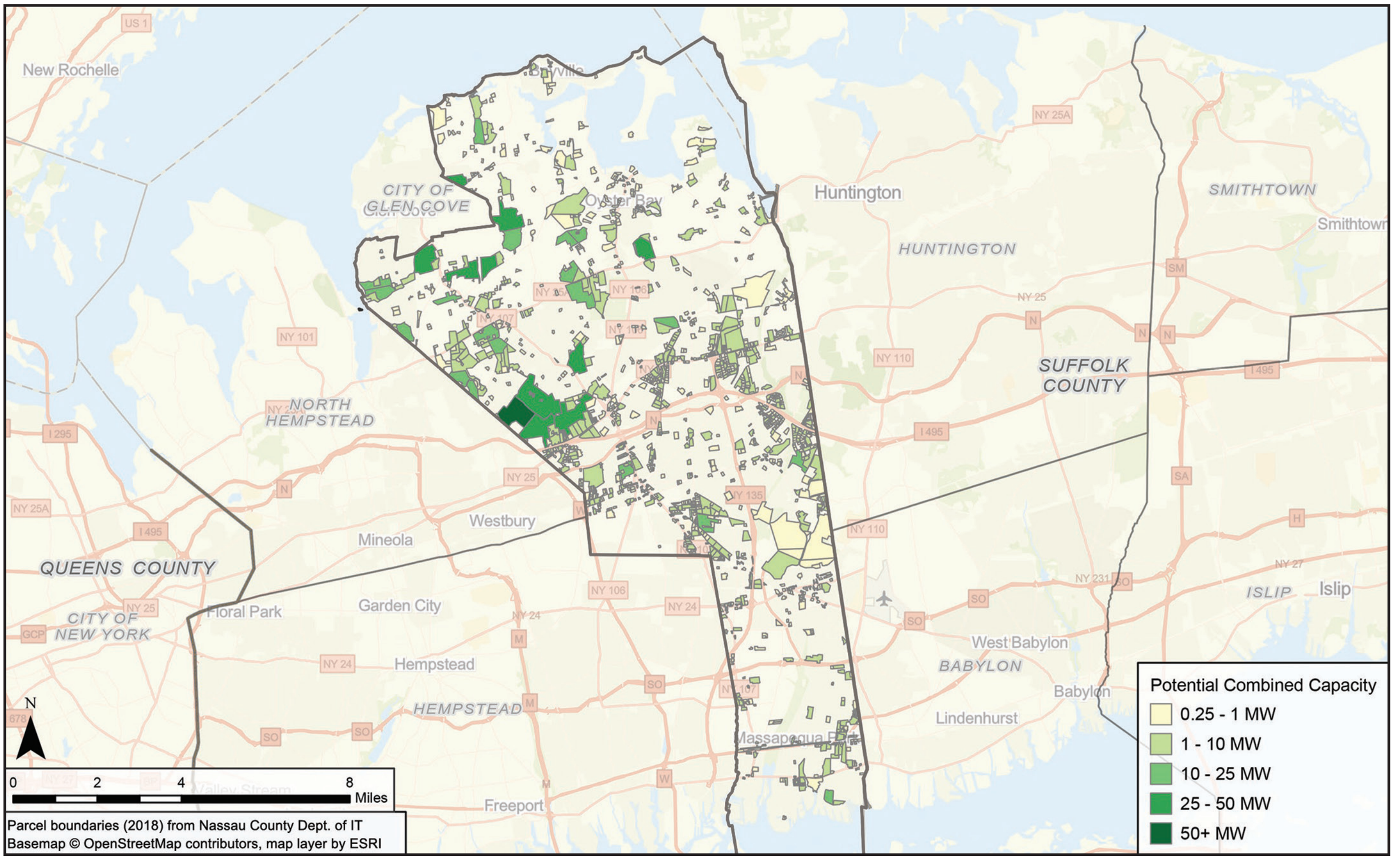


Potential Ground-Mounted Installation Capacity

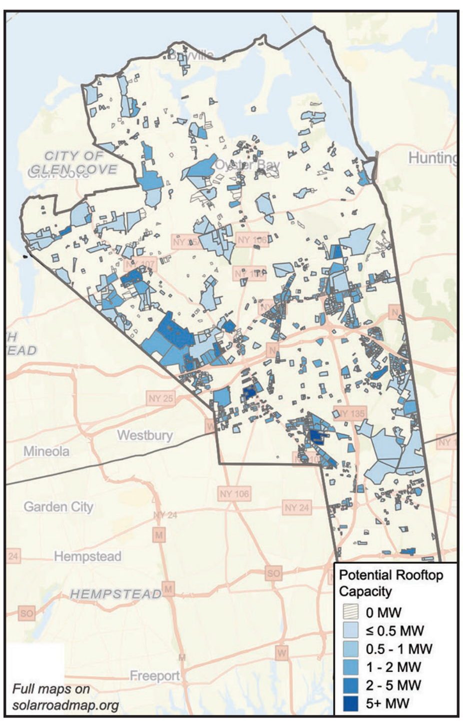


These illustrative results show low-impact siting potential only and do not take into account technical or policy constraints. These results are not intended to express where solar development should occur or to replace site-level evaluations. Installation capacity values are estimates. For more information about the Long Island Solar Roadmap and to access full maps, visit solarroadmap.org.

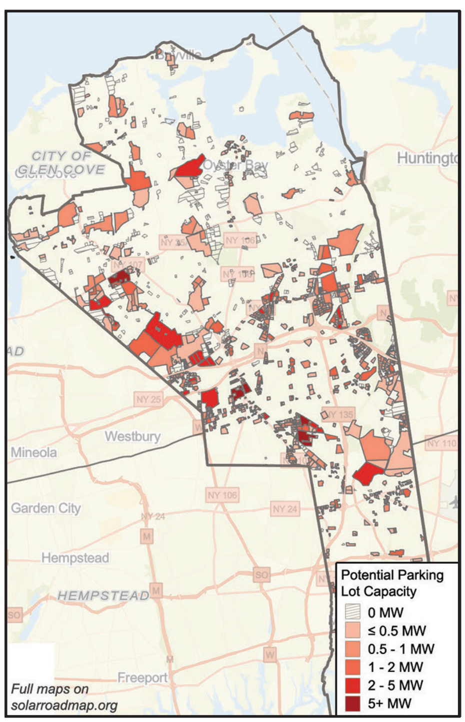
Town of Oyster Bay: Potential Combined Installation Capacity



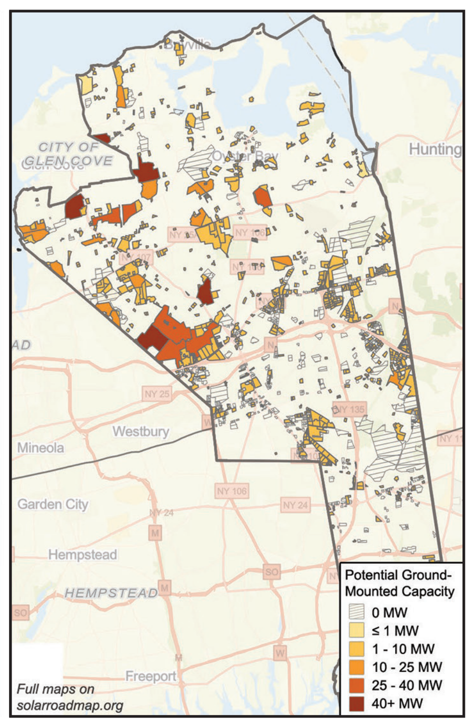
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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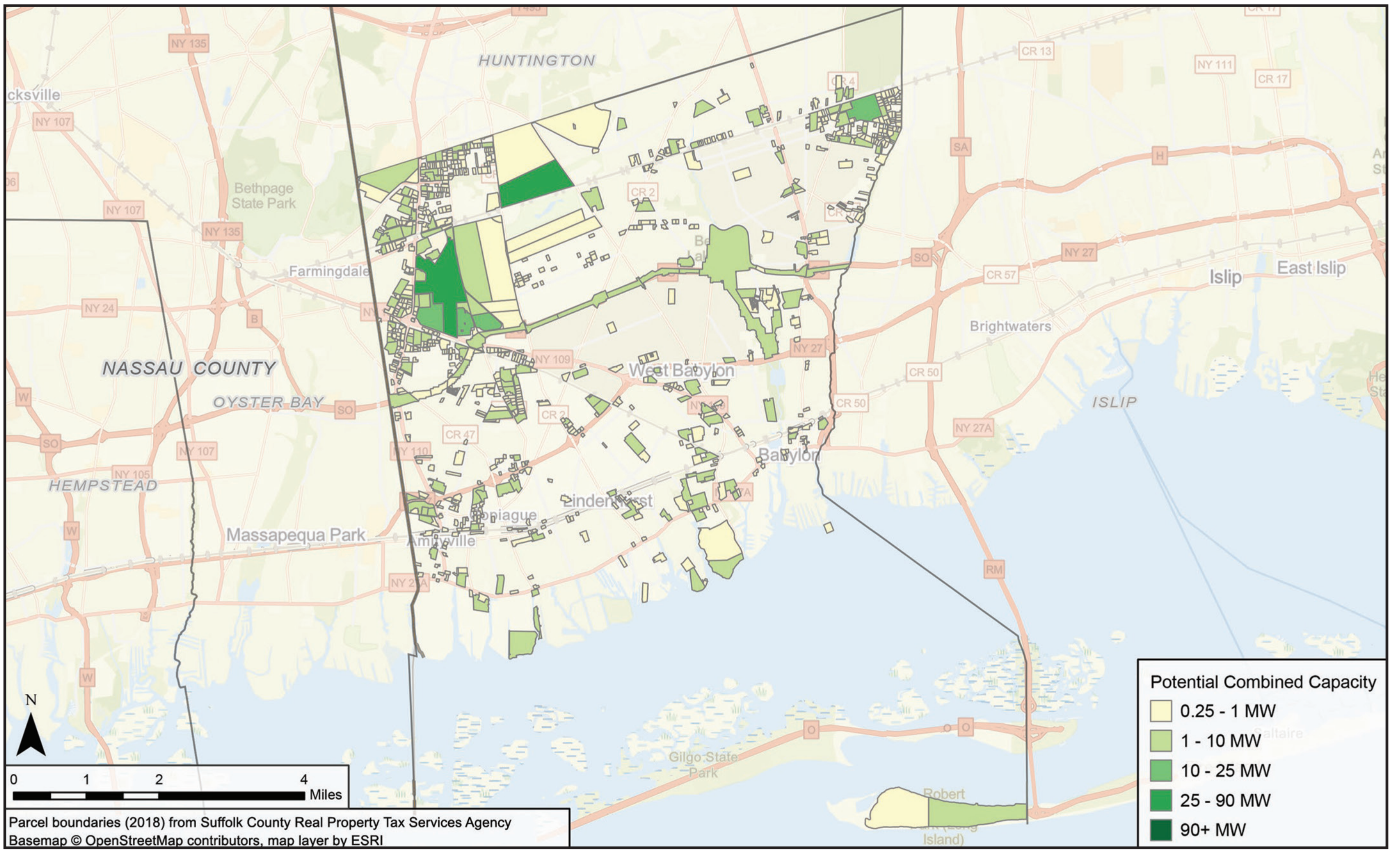
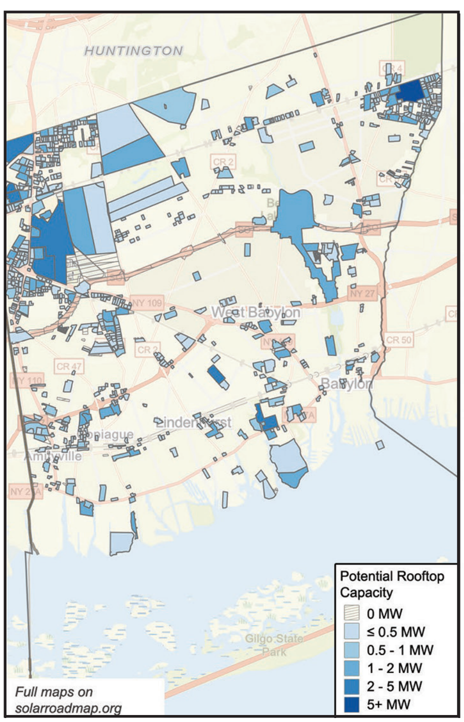
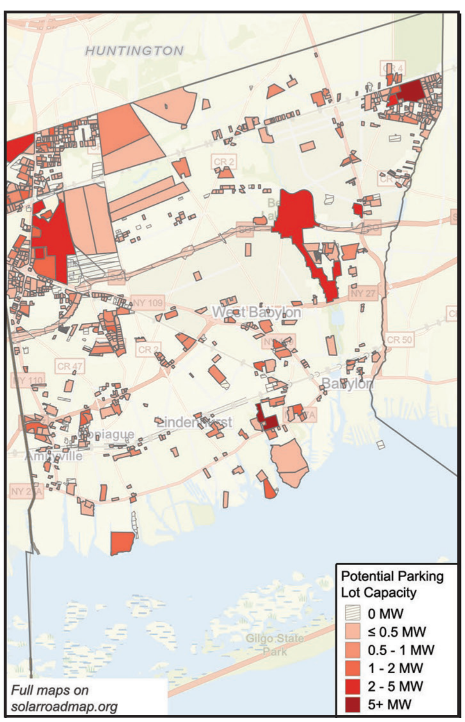
Town of Babylon: Potential Combined Installation Capacity



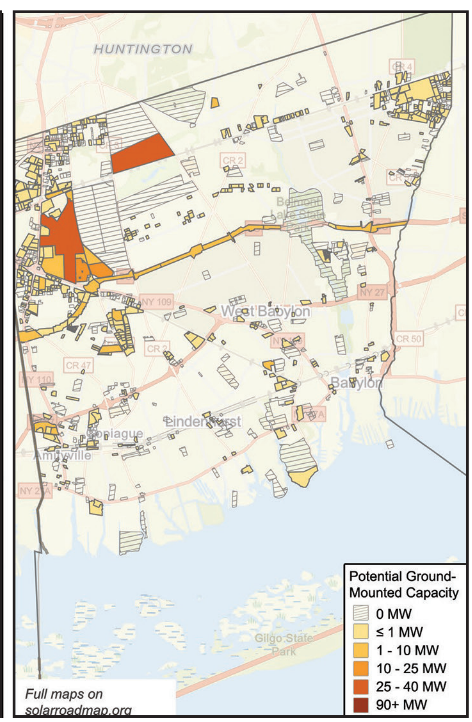
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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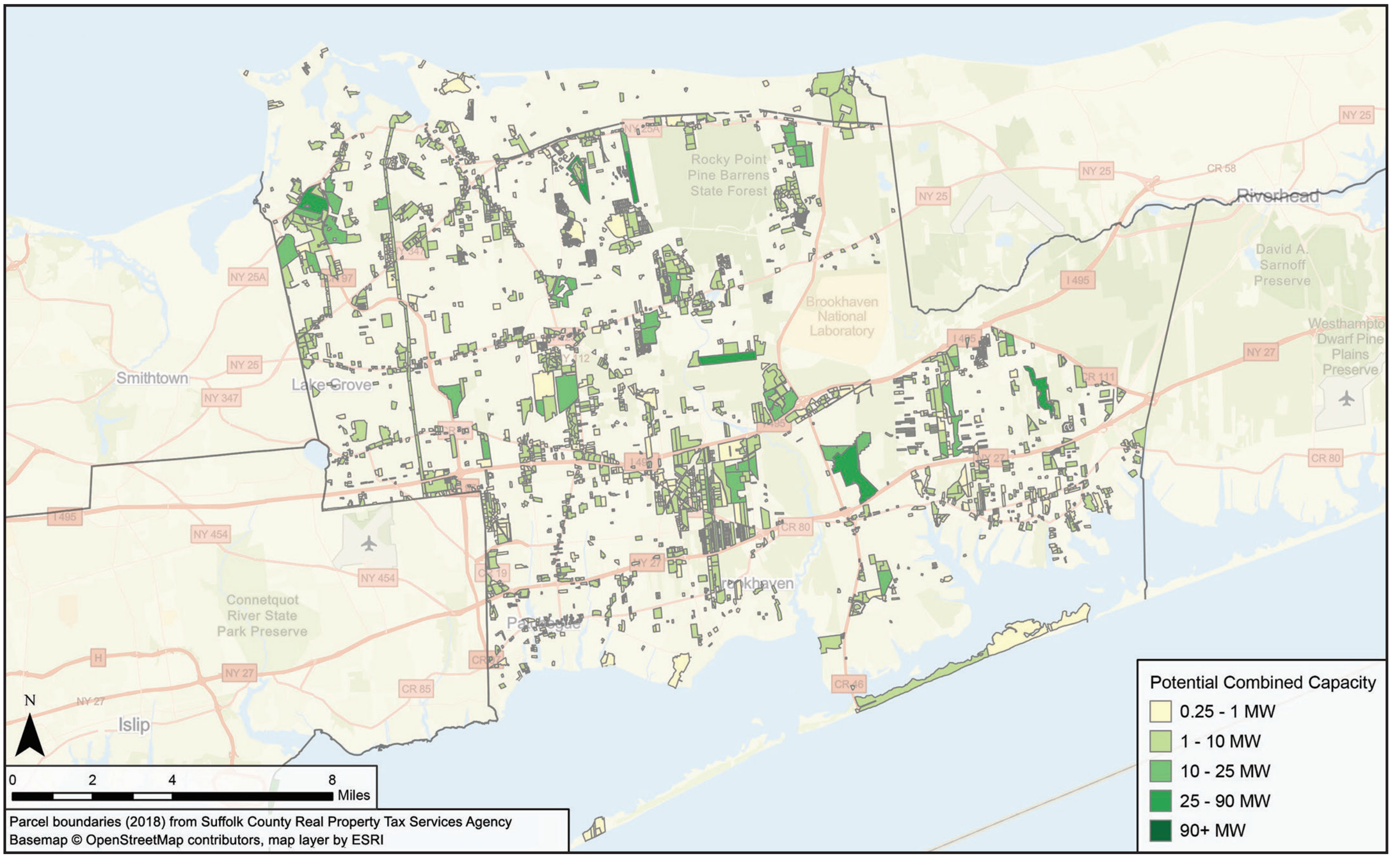
Town of Brookhaven: Potential Combined Installation Capacity



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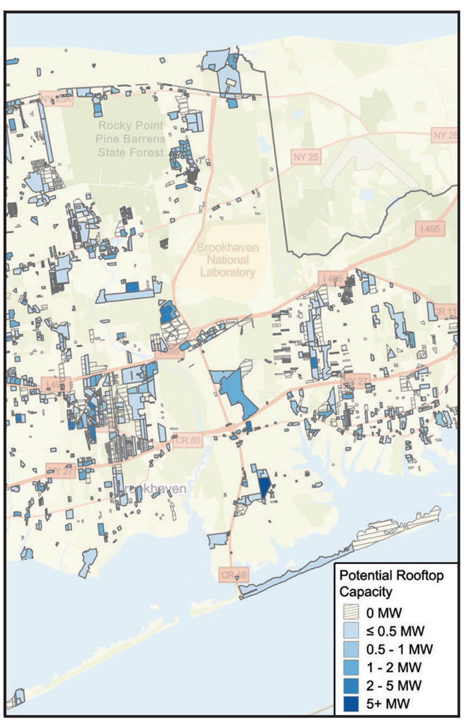
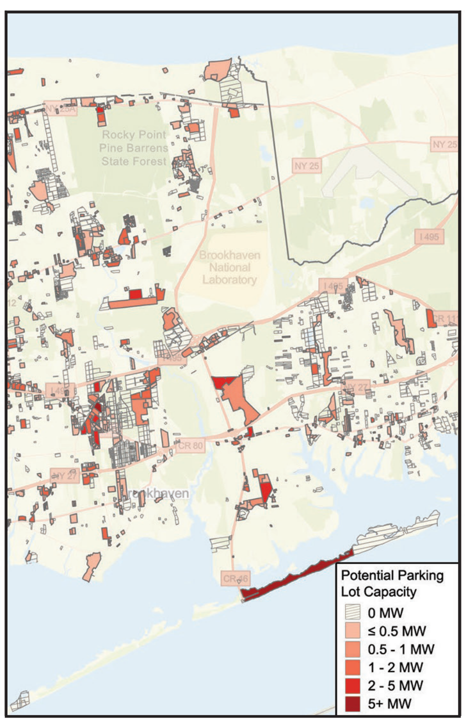
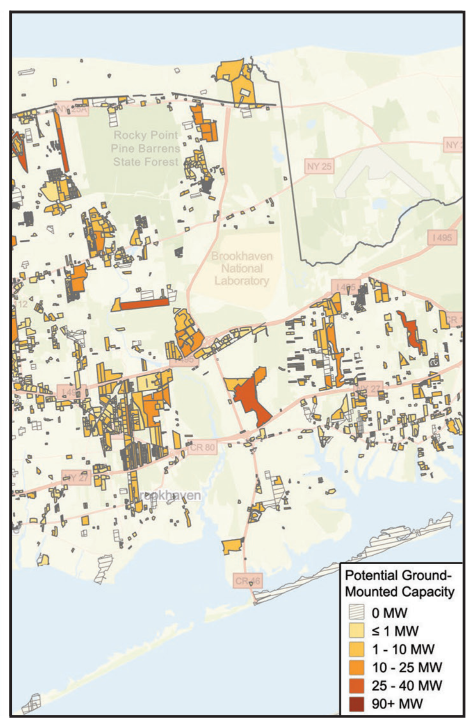


Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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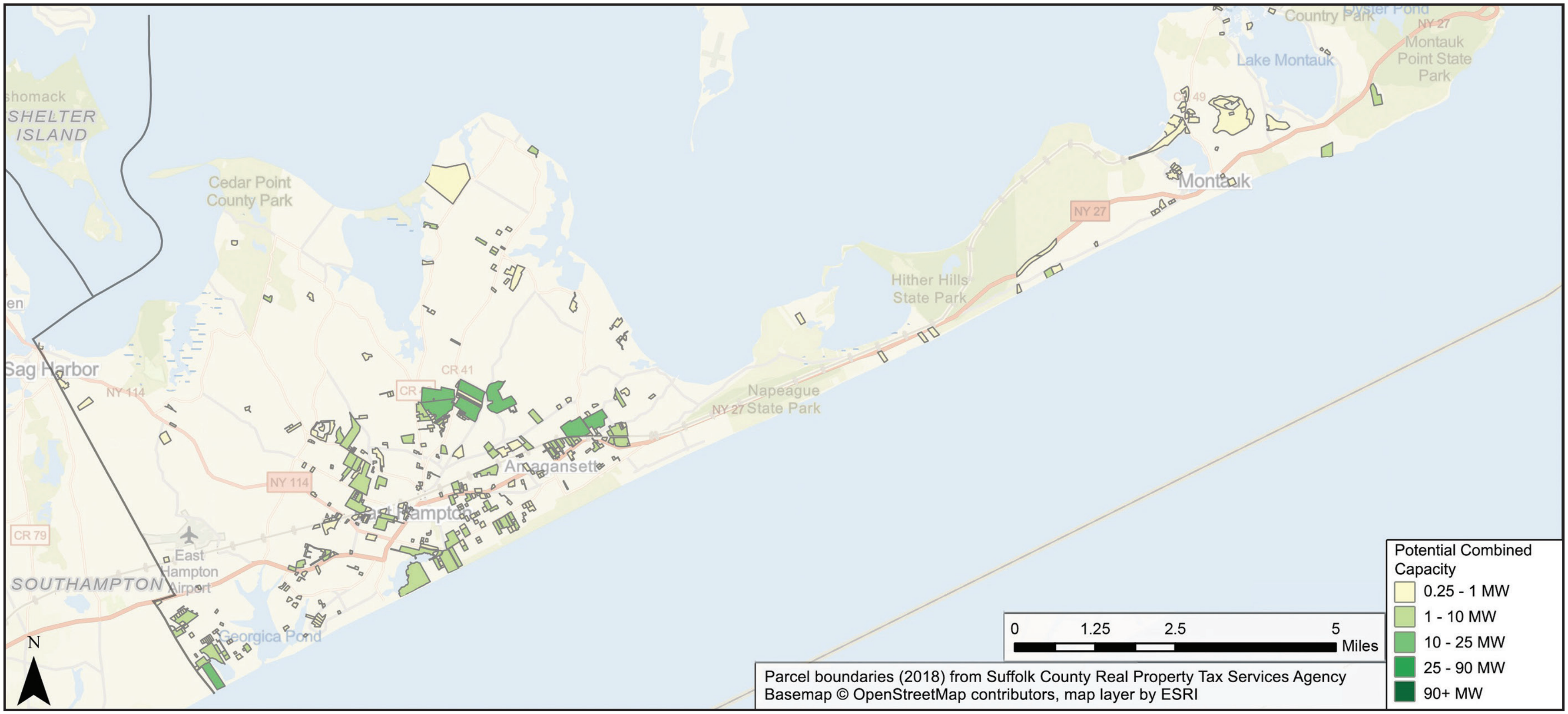
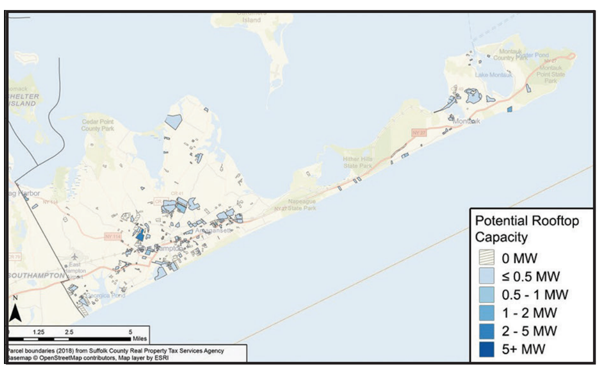
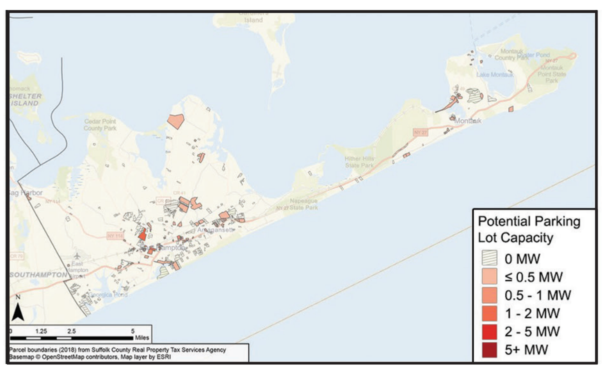
Town of East Hampton: Potential Combined Installation Capacity



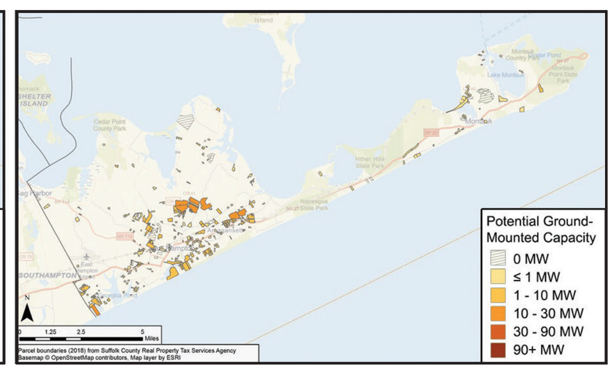
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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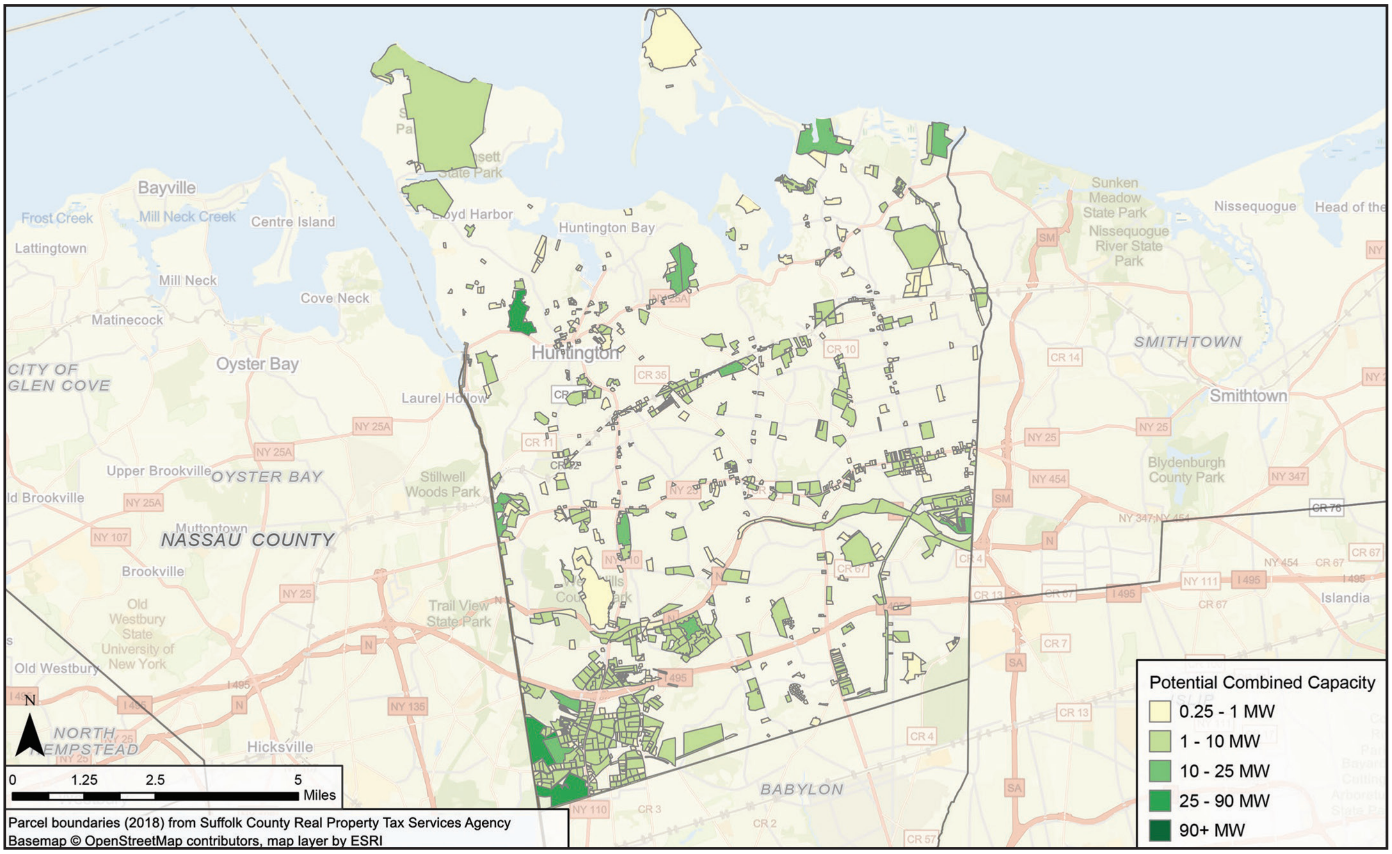
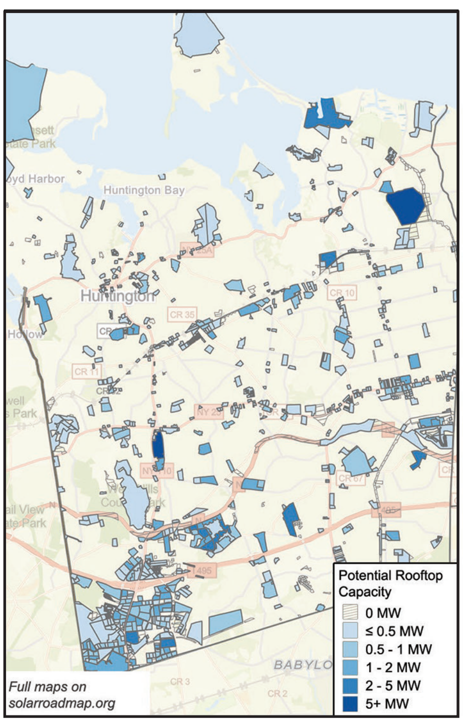
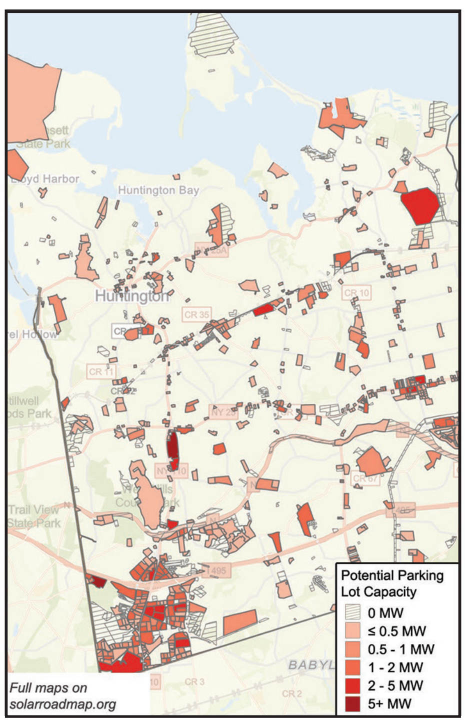
Town of Huntington: Potential Combined Installation Capacity



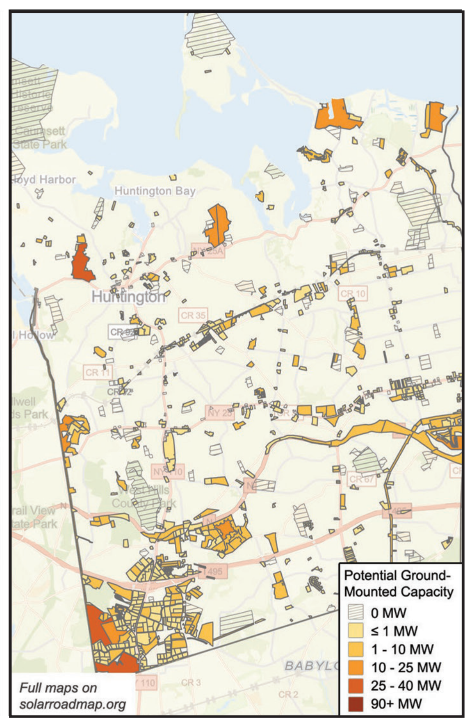
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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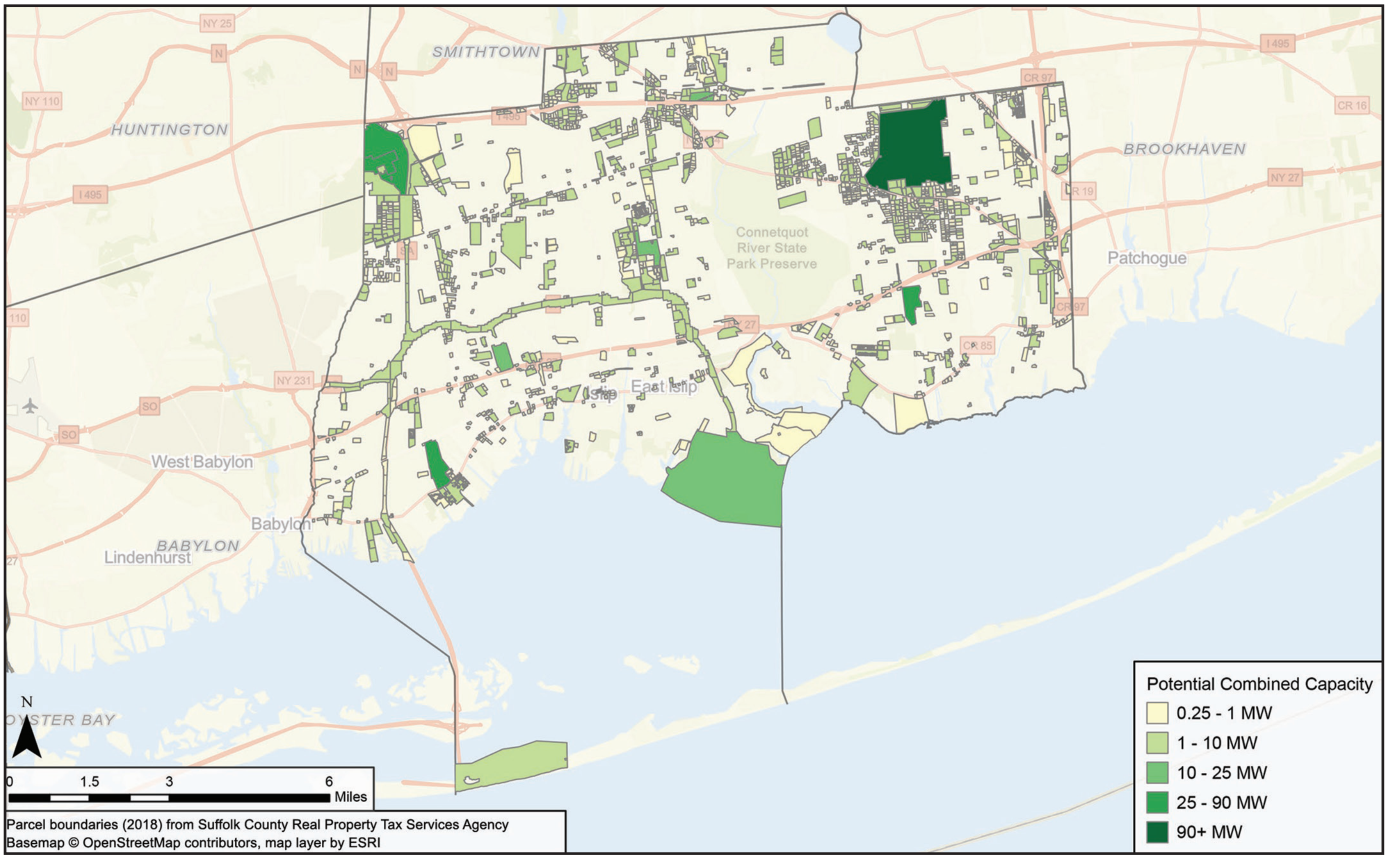
Town of Islip: Potential Combined Installation Capacity



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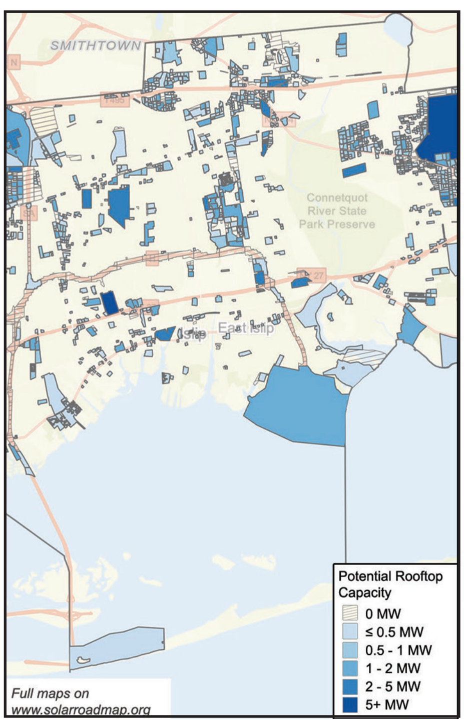
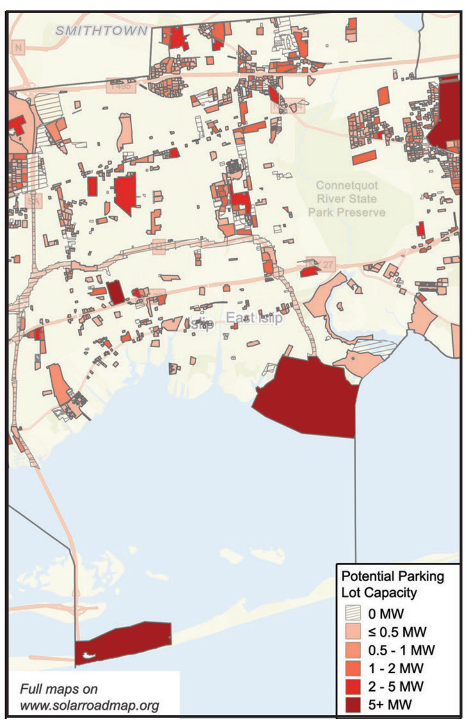
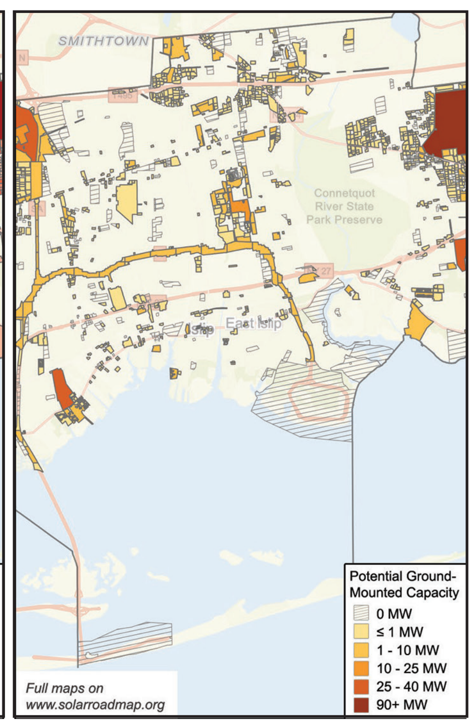


Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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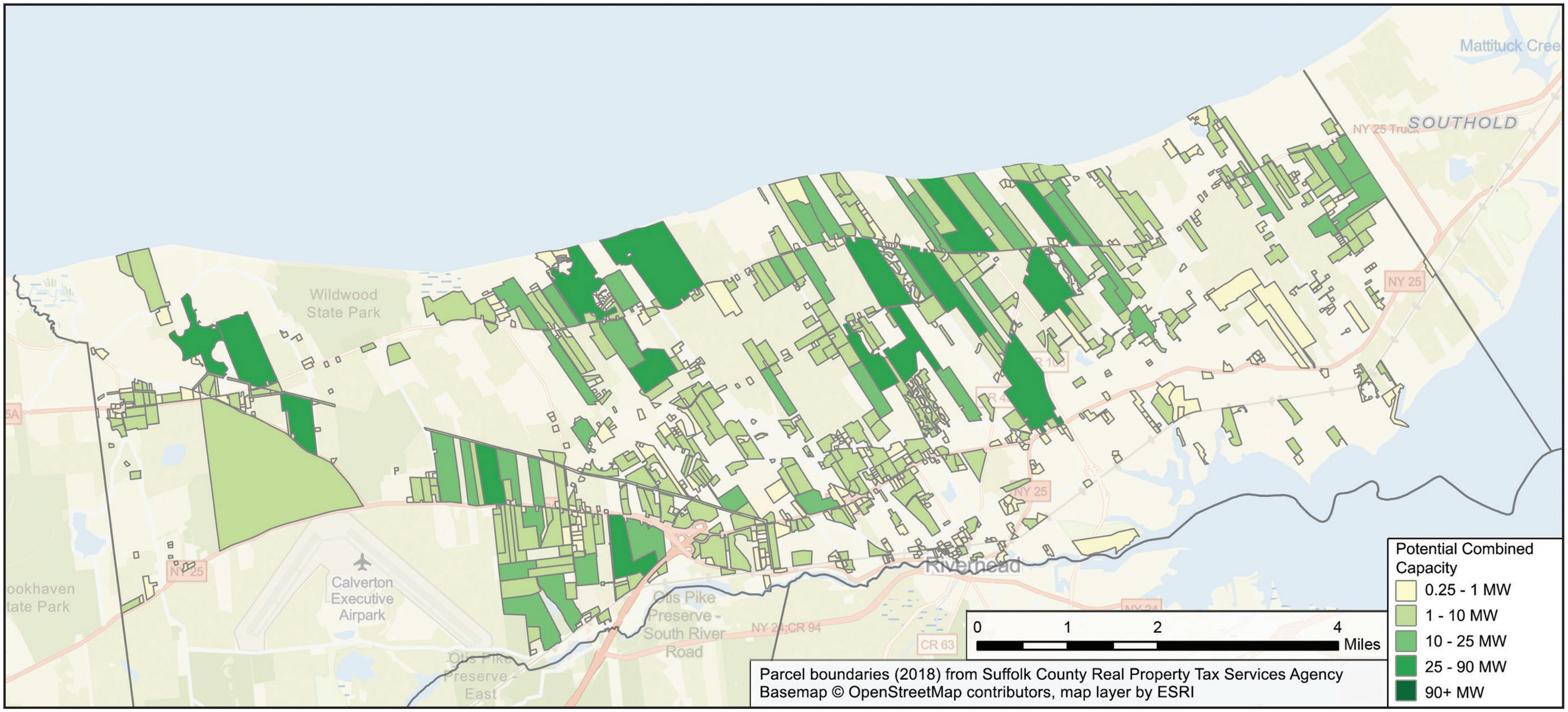
Town of Riverhead: Potential Combined Installation Capacity



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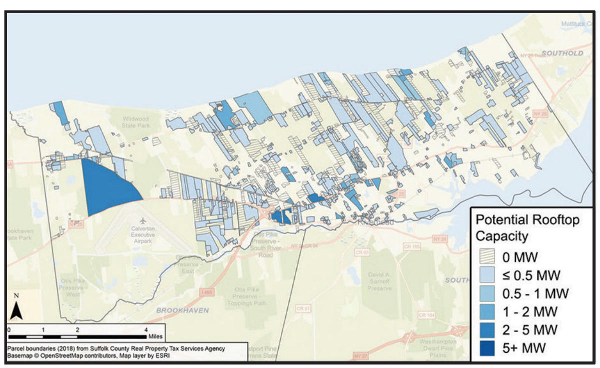
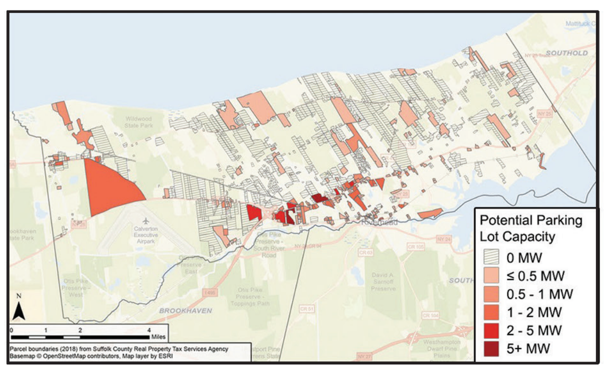
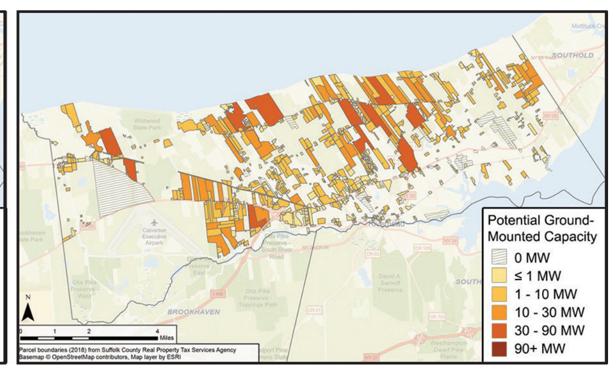


Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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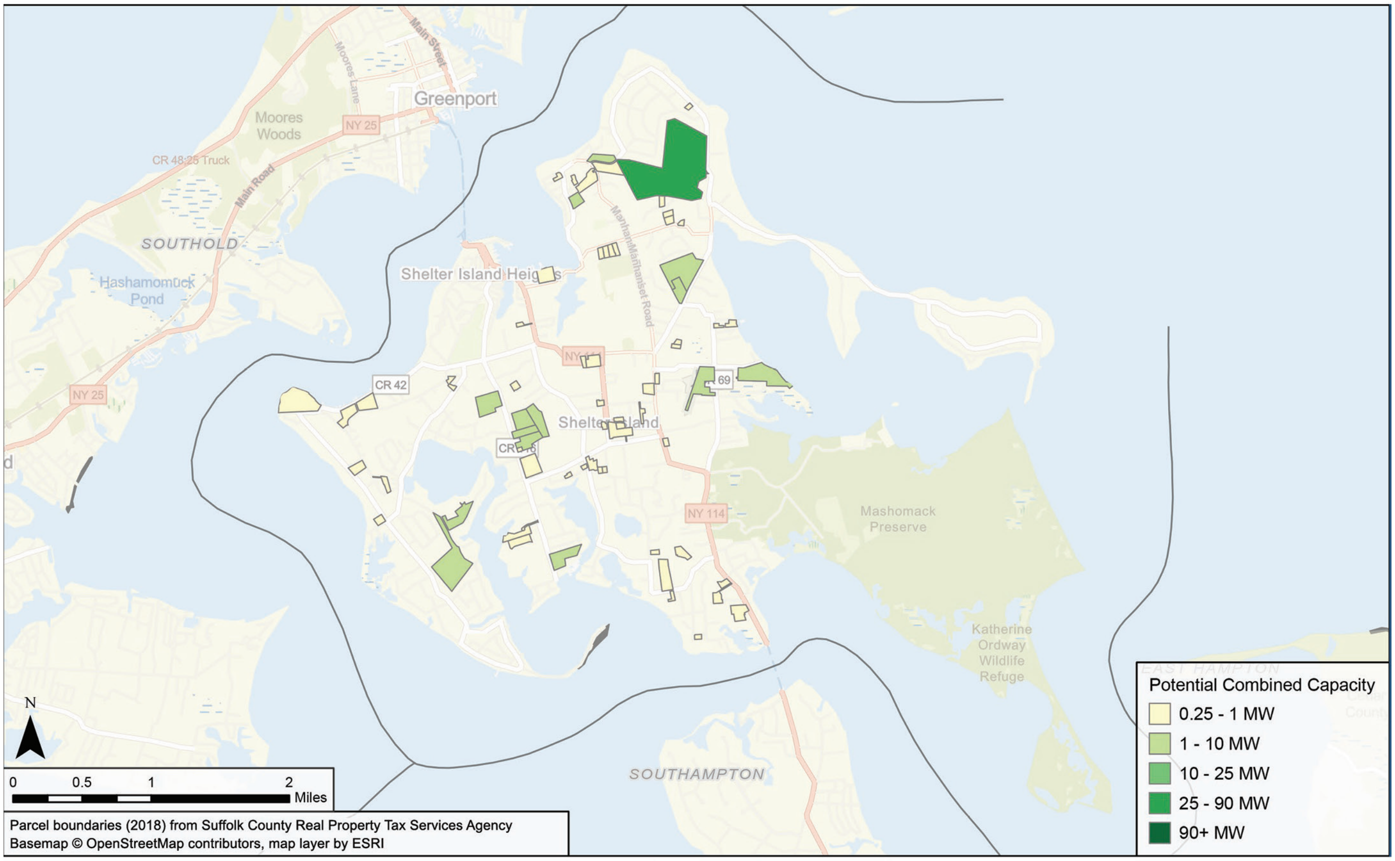
Town of Shelter Island: Potential Combined Installation Capacity



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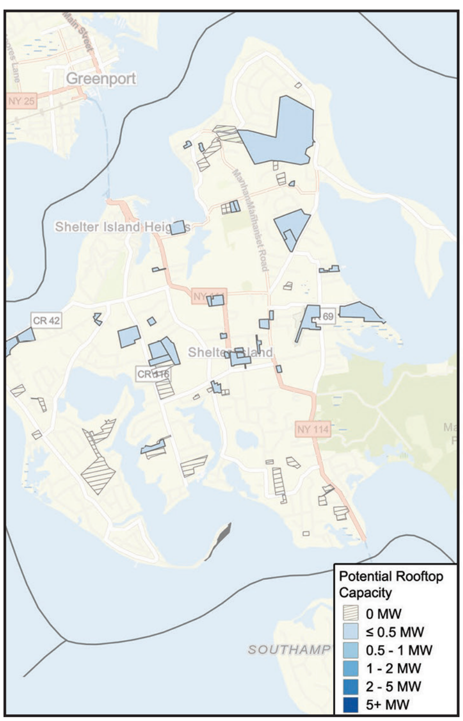
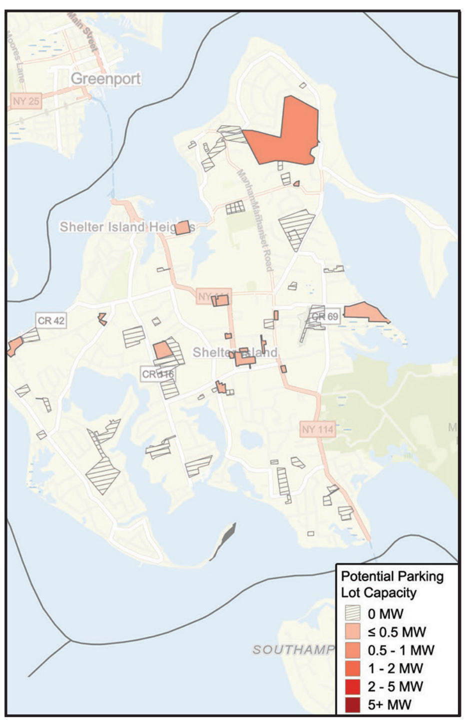
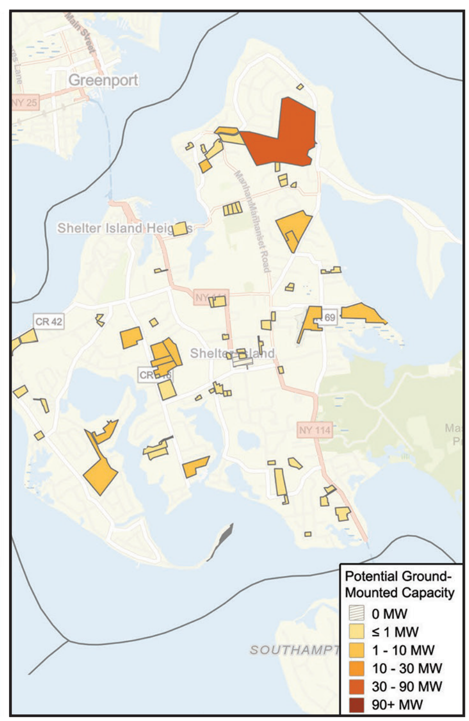


Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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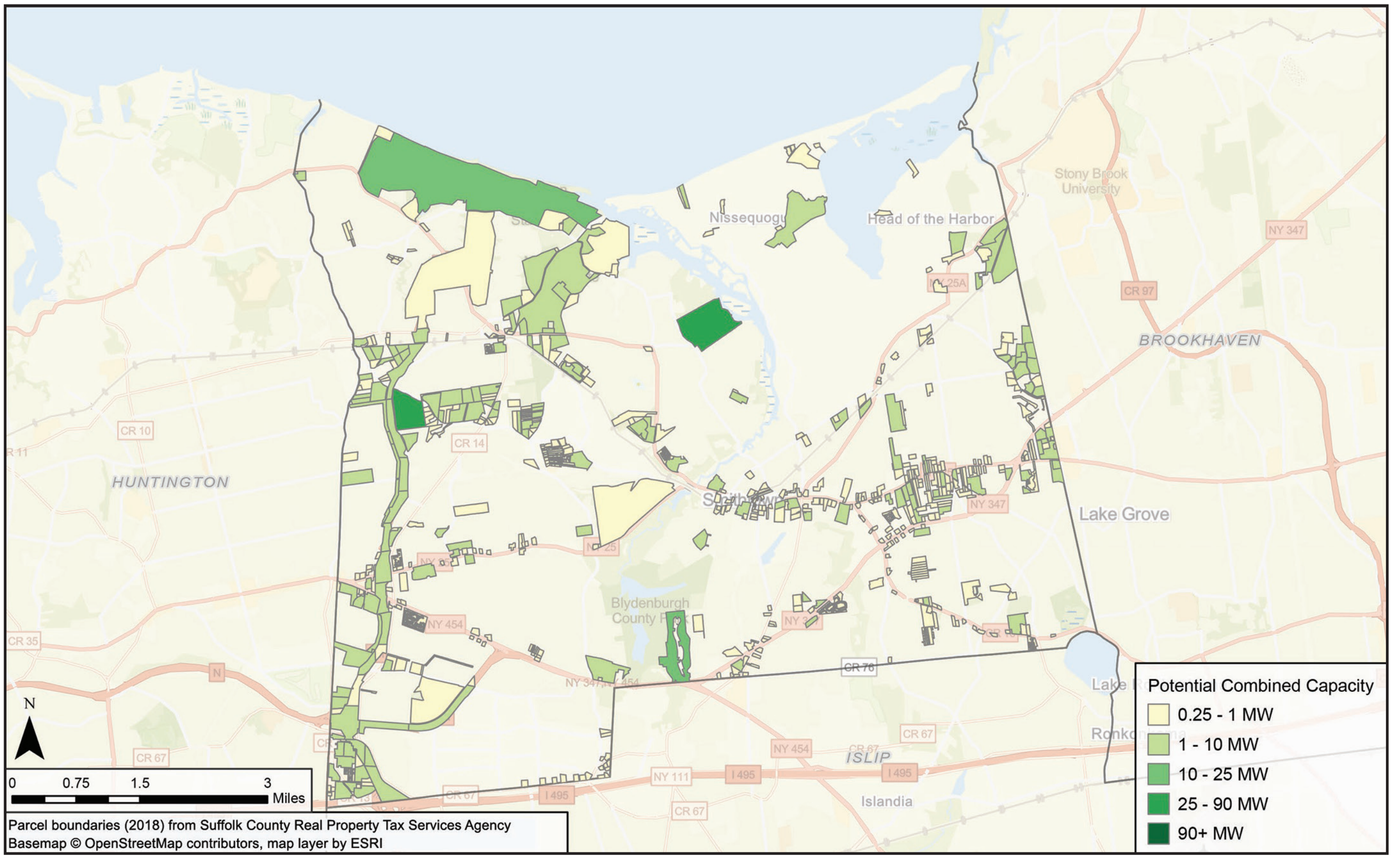
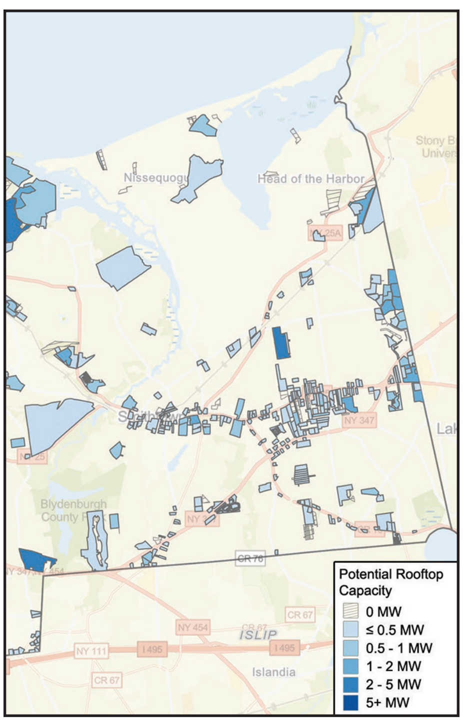
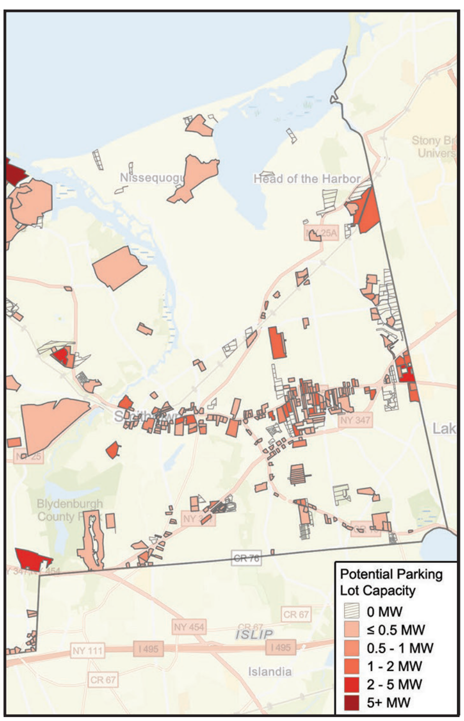
Town of Smithtown: Potential Combined Installation Capacity



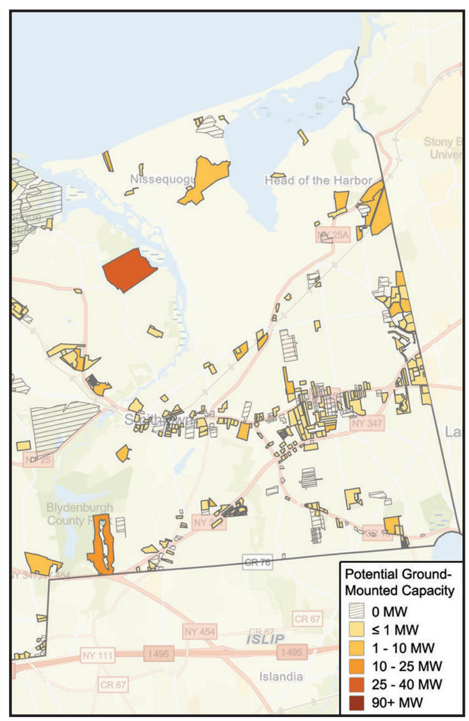
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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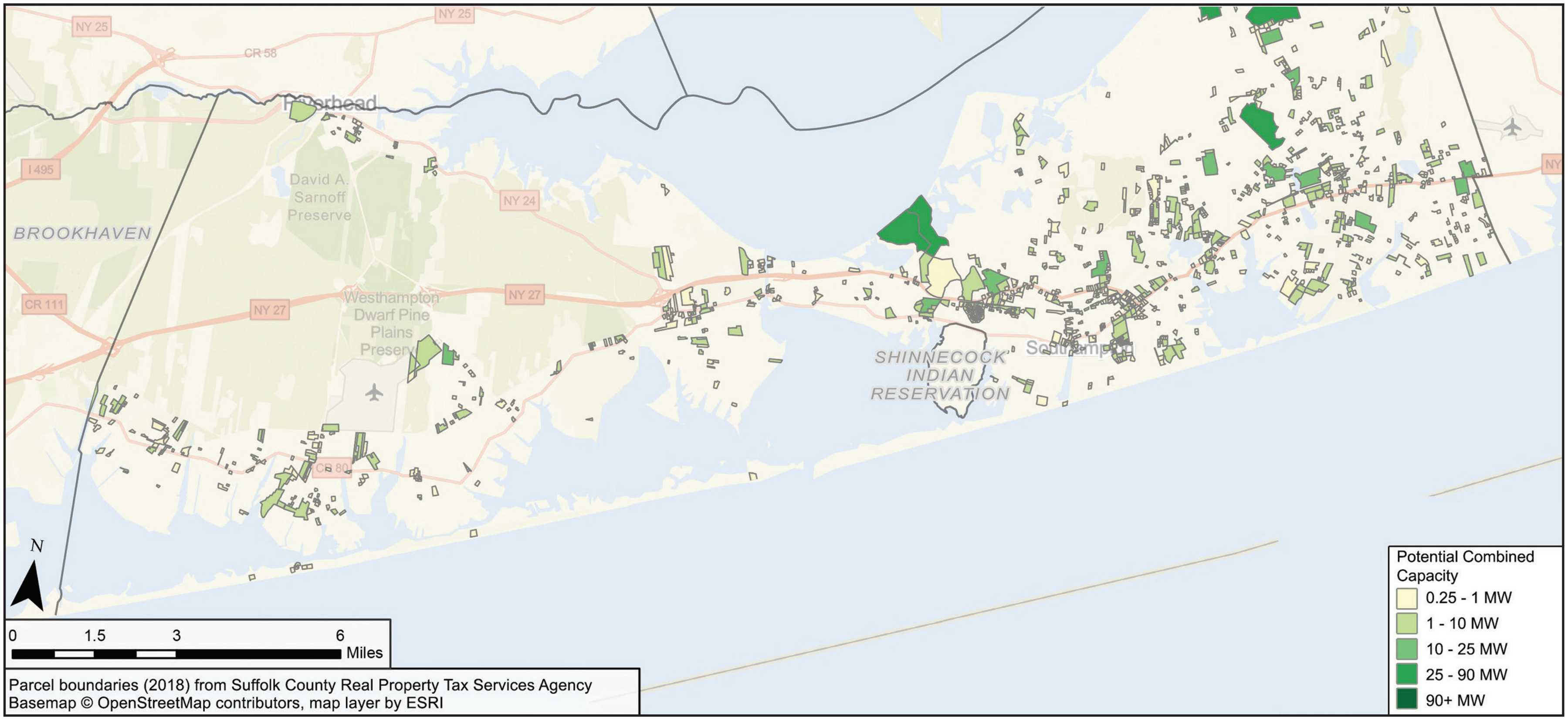
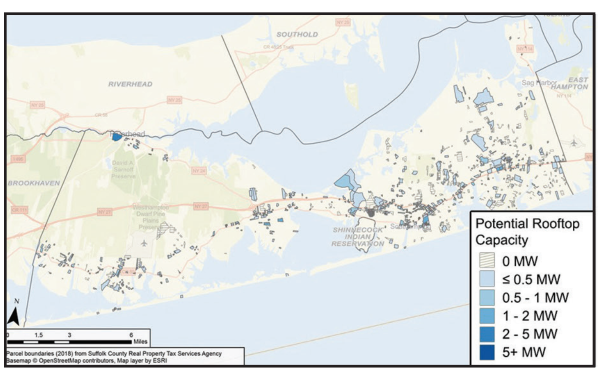
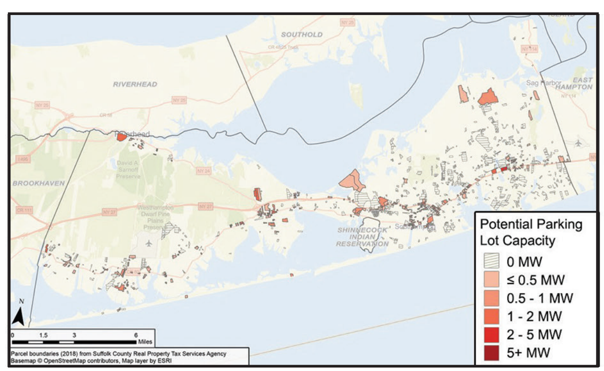
Town of Southampton: Potential Combined Installation Capacity



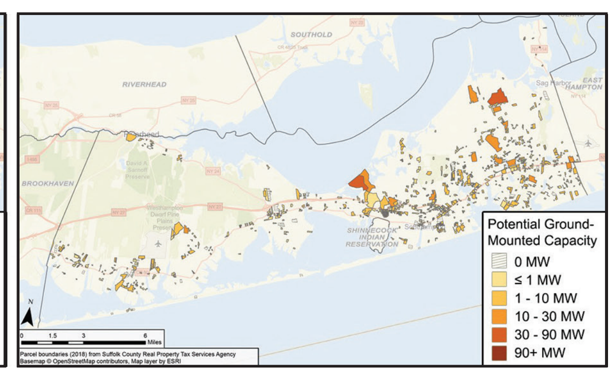
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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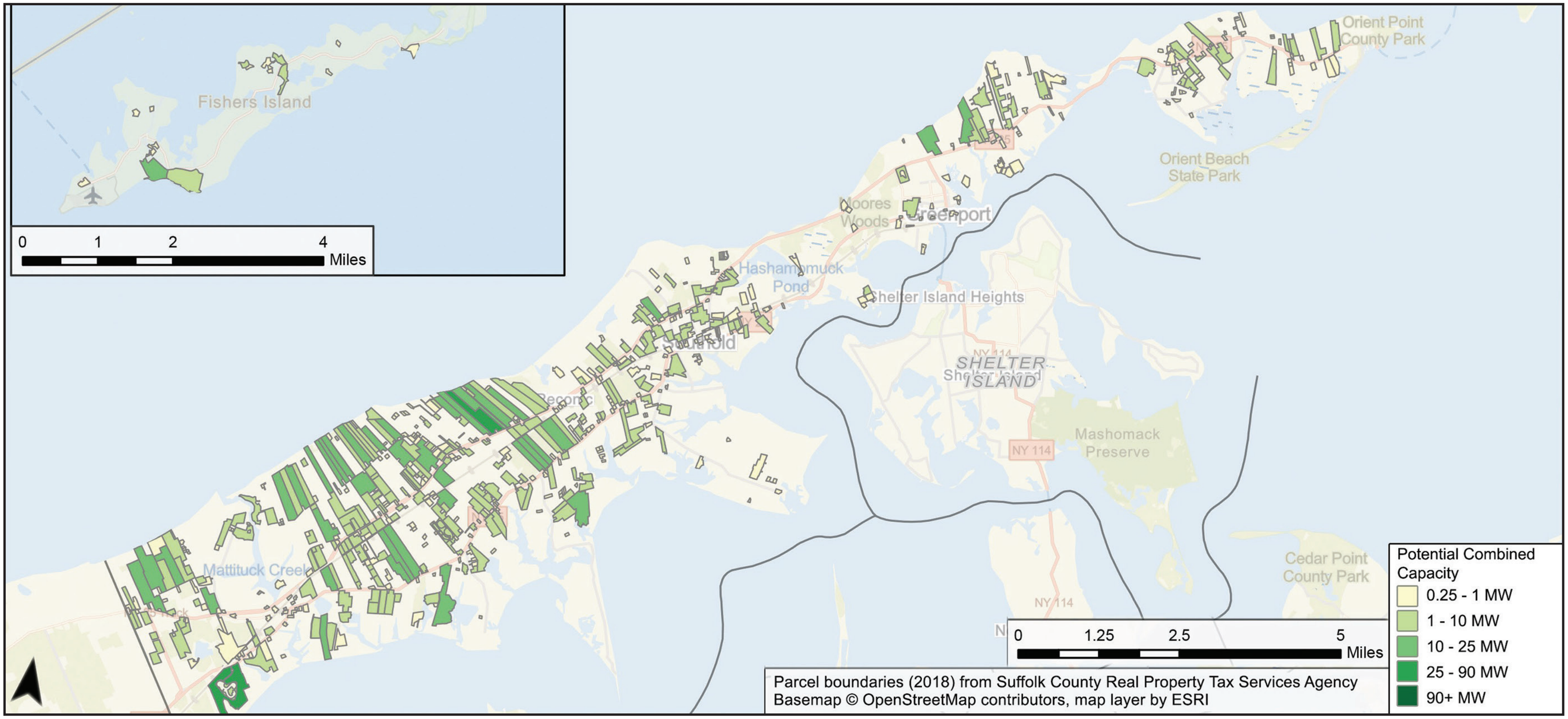
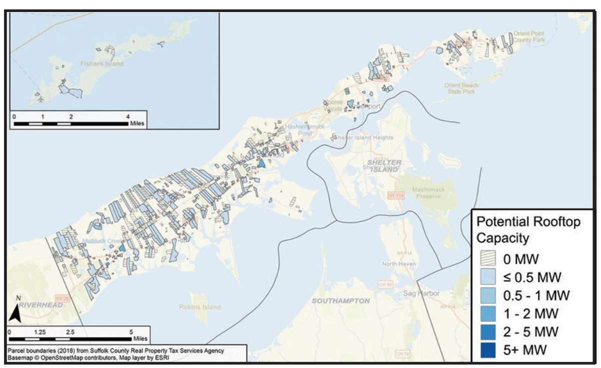
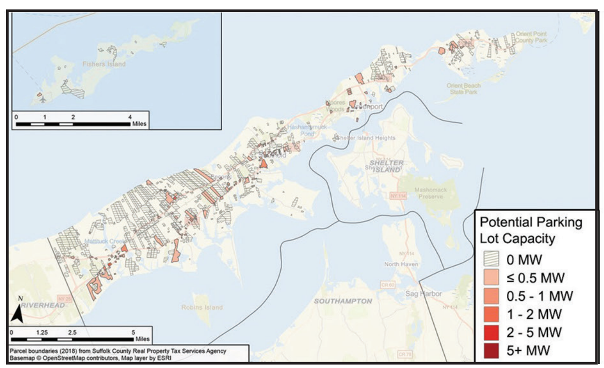
Town of Southold: Potential Combined Installation Capacity



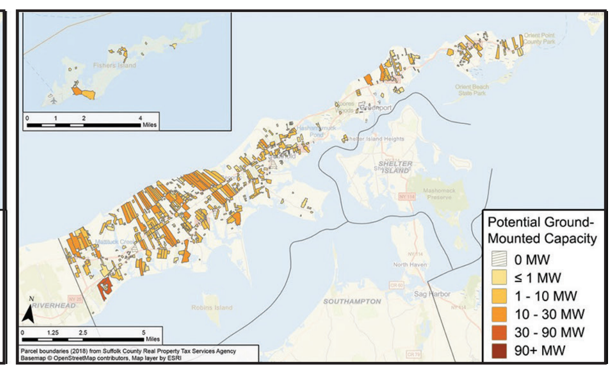
Potential Rooftop Installation Capacity



Potential Parking Lot Installation Capacity



Potential Ground-Mounted Installation Capacity



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Appendix B: Financial incentives and funding mechanisms for solar development

Summary of the types of financial incentives and funding mechanisms for mid- to large-scale solar development in New York and information about their availability on Long Island as of September 3, 2020.

Federal programs	Type	Available on Long Island	Description
Energy Investment Tax Credit (ITC)	Tax incentive	Yes	Allows the owner of solar energy projects that begin construction by the end of 2022 to deduct 26% of the installation cost from their federal taxes
Modified Accelerated Cost Recovery System (MACRS)	Tax incentive	Yes	Allows depreciation of the value of solar energy system equipment under the U.S. federal tax code
USDA's Rural Energy for America Program (REAP) Renewable Energy and Energy Efficiency Program	Financing and funding	Yes	Provides loan guarantees and grants to agricultural producers and rural small businesses to purchase or install renewable energy systems
New York State programs	**Type**	**Available on Long Island**	**Description**
New York Real Property Tax Law 487	Tax incentive	Yes	Provides a 15-year real property tax exemption for properties located in New York State with renewable energy systems
NYSERDA's Small Commercial Energy Efficiency Program	Financing	Yes	Provides two low-interest loan options to nonprofits and small businesses to finance the purchase and installation of solar systems
NY Green Bank	Financing	Yes	Provides loans for renewable energy development and other financial support, such as credit enhancement, project aggregation, and securitization
EIC's Open C-PACE Financing in New York	Financing	Yes	Provides PACE financing that allows commercial or nonprofit property owners to pay back the cost of clean energy upgrades, including solar installations, through a special charge on their property tax bill. Both Nassau and Suffolk County have authorized Open C-PACE financing.
NYS Clean Energy Communities	Assistance & funding	Yes	Provides local government with tools, resources, and technical assistance to improve sustainability through a variety of projects. Provides funding rewards for the completion of clean energy projects.
NYSERDA's Affordable Solar Predevelopment and Technical Assistance Program	Funding	Yes	Provides up to $200,000 in funding for predevelopment and technical assistance on proposed solar and/or energy storage projects that offer benefits to LMI households or residents of affordable housing.

Continued on page 122

Appendix B: Continued

Utility Programs	Type	Available on Long Island	Description
Feed-in tariffs (FITs)	Compensation on	Yes	Invites solar developers to bid on projects under an agreement to sell the energy to the utility at a pre-specified rate. A long-term energy generation agreement that feeds the grid.
Net metering	Compensation on	Yes, residential solar systems and commercial systems less than 750 kW in capacity	Solar energy producers receive volumetric credits from the utility for any energy exported. Each kWh sent to the grid is worth the same as the cost of a kWh received from the grid; both are valued at the retail cost of electricity.
Value of distributed energy resources (VDER)	Compensation on	Yes, all non-residential solar systems	Solar energy producers receive a monetary credit from the utility that can be applied to future billing cycles; the value per kWh is variable based on the Value Stack.

Appendix C: Solar business models

This table provides a summary of four solar business models available for mid- to large-scale solar installations.

Model name	Ownership model	Host model	Third-party ownership model	Community-shared solar
Description	Property owner owns site and owns their solar system. Energy produced goes directly to offset their own electric bill.	Property owner leases site to a solar installer. Energy produced goes directly to the grid.	Property owner owns site and leases their solar system. Energy produced goes directly to offset their own electric bill.	Community-shared solar from a solar system that sends energy directly and only to the grid, virtually crediting individual homes and businesses, typically at a discounted rate.
Behind-the-meter or front-of-the-meter	Behind	Front	Behind	Front
System owner and tax credit recipient	Property owner	Developer / financier / tax equity partner (can also be host)	Developer / financier / tax equity partner	Developer / financier / tax equity partner (can also be host)
Other beneficiaries				Homeowners and businesses can subscribe to receive discounted energy credits.
				The host of the physical site is typically paid by the system owner for providing site space for panels.

Continued on page 123

Appendix C: Continued

Model name	Ownership model	Host model	Third-party ownership model	Community-shared solar
Cash flows	Property owner hires a solar installation company to design and build the system.	System owner (financier/developer) funds the project.	Property owner hires a solar installation company to design and build the system.	System owner (financier/developer) funds the project.
	Installation company collects any eligible rebates and applies them to the system.	System owner pays a developer to install the project (or installs it themselves).	Installation company collects any eligible rebates and applies them to the system.	Owner pays a developer to install the project (or installs it themselves).
	Property owner purchases or finances the net system cost and claims tax credits for themselves.	System owner pays the host site an up-front and/or annual payment.	Solar company links the property owner to a solar lease provider who can own the system and take the tax credits.	Owner pays the host site an up-front and/or annual payment.
	Energy goes to offset the building's electricity bill.	System owner collects payments from the utility for energy delivered to the grid.	Solar lease company charges the property owner a monthly fee for the solar panels.	Owner collects payments from subscribers, typically in the form of a power purchase agreement.
			Energy goes to offset the property owner's electricity bill.	Owner collects tax incentives and rebates.
Typically good for	Property owner with good solar access and demand for energy at the same building.	Property owner with good solar access but no demand for energy.	Larger projects with higher up-front cost.	Property owners with a lot of roof space or large amount of property but no or little need for energy generation.
	Property owner with access to capital and financing.	Property owner with little to no tax liability.	Property owners who do not wish to be responsible for initial development and ongoing operation and maintenance.	

Appendix D: Recommended actions organized by sector

This table is organized by stakeholders so that individual sectors understand how they can be involved in and promote a clean energy economy and its benefits on Long Island. Actions that can be implemented by multiple sectors are repeated in each of the relevant sectors.

	Number	Action	Lead Implementers	Page #
Business Community	3.2	Utilize PACE financing	Business community and nonprofit organizations	69
	6.3	Create Industrial Development Agency incentives	Business community	85
	7.2	Initiate community solar projects	Businesses community, local governments, nonprofit organizations, and farm community	87
Farm Community	5.1	Identify appropriate locations for on-farm solar	Farm community, solar industry, and local governments	78
	5.2	Provide technical and legal assistance to farmers and farmland owners	State and local governments, nonprofit organizations, farm community	78
	7.2	Initiate community solar projects	Businesses community, local governments, nonprofit organizations, and farm community	87
Utility (LIPA and PSEG Long Island)	1.1	Commit to ambitious local renewable energy targets and equal access to clean energy for all Long Islanders	LIPA and PSEG Long Island	62
	1.2	Update and track progress toward renewable energy targets for Long Island	LIPA and PSEG Long Island	62
	2.3	Integrate and incentivize low-impact siting in energy procurement	LIPA and PSEG Long Island	67
	3.1	Implement financial incentives for low-impact solar	State and local governments, LIPA and PSEG Long Island	68
	4.1	Improve information available on interconnection capacity	PSEG Long Island	73
	4.2	Develop cost sharing policies for interconnection	LIPA and PSEG Long Island	73
	4.3	Increase investment in electric grid modernization	LIPA	76
	6.1	Enhance information about utility programs for commercial users	LIPA and PSEG Long Island	83

	Number	Action	Lead Implementers	Page #
Utility (LIPA and PSEG Long Island)	7.1	Prioritize community solar and expanded access for LMI households in utility programs	LIPA and PSEG Long Island	86
	8.1	Improve information about solar costs and benefits	Local governments, LIPA and PSEG Long Island, solar industry	90
	8.4	Provide benefits to host communities	Solar industry, LIPA and PSEG Long Island	92
Nonprofit Organizations	3.2	Utilize PACE financing	Business community and nonprofit organizations	69
	5.2	Provide technical and legal assistance to farmers and farmland owners	State and local governments, nonprofit organizations, farm community	78
	7.2	Initiate community solar projects	Businesses community, local governments, nonprofit organizations, and farm community	??
Partnership	1.3	Form a coalition to advance the clean energy transition on Long Island	Partnership	63
	7.3	Elevate and build partnerships with community organizations	Solar industry, LIPA and PSEG Long Island, community organizations	89
	8.3	Educate key audiences and elevate trusted ambassadors	Partnership	91
	8.5	Invest in the local workforce	Partnership	92
Solar Industry	3.4	Partner with landbanks to facilitate solar on brownfields and underutilized sites	Solar industry and local governments	72
	5.1	Identify appropriate locations for on-farm solar	Farm community, solar industry, and local governments	78
	8.1	Improve information about solar costs and benefits	Local governments, LIPA and PSEG Long Island, solar industry	90
	8.2	Implement robust public engagement	Local governments and solar industry	91
	8.4	Provide benefits to host communities	Solar industry, LIPA and PSEG Long Island	92

State and Local Governments

Number	Action	Lead Implementers	Page #
2.1	Create solar-friendly local planning and zoning policies	Local governments	65
2.2	Encourage low-impact solar through structural incentives	Local governments	66
3.1	Implement financial incentives for low-impact solar	State and local governments, LIPA and PSEG Long Island	68
3.3	Streamline and standardize local permitting for mid- to large-scale solar	Local governments	70
3.4	Partner with landbanks to facilitate solar on brownfields and underutilized sites	Solar industry and local governments	72
5.1	Identify appropriate locations for on-farm solar	Farm community, solar industry, and local governments	78
5.2	Provide technical and legal assistance to farmers and farmland owners	State and local governments, nonprofit organizations, farm community	78
5.3	Enact policies to support on-farm solar	State and local governments	80
5.4	Provide financial programs to support on-farm solar	State and local governments	80
6.2	Establish local incentives and mandates	Local governments	84
7.2	Initiate community solar projects	Businesses community, local governments, nonprofit organizations, and farm community	87
7.4	Establish Energy Improvement Districts	Local governments	89
8.1	Improve information about solar costs and benefits	Local governments, LIPA and PSEG Long Island, solar industry	90
8.2	Implement robust public engagement	Local governments and solar industry	91

Visit solarroadmap.org to access a digital version of this report and to view the interactive web map where you can explore low-impact sites for solar across Long Island.

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