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# LONG ISLAND SOLAR ROADMAP

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## Economic Analysis Work Plan – Updated 14 February 2019

### Goals

1. Characterize the direct and indirect economic costs and benefits of rooftop, parking lot, and ground-mounted solar installations and energy storage on both low-impact sites and a reference high-impact site type. Costs and benefits will be quantified when possible.
2. Describe how economic costs and benefits are allocated (i.e. to landowners, to developers, to municipalities, to the community members, to ratepayers, to the utility).
3. Identify the other economic considerations and barriers affecting the economic feasibility of developing each type of installation and setting.

The intended audience for these results is members of the consortium, policy-makers (local and state government, utility), local community and municipal leaders, and solar developers. We expect these results to be used to:

- Build knowledge/understanding of the comparative costs and benefits of each type of installation and site, including ground mounted systems on low-impact, previously disturbed land and in undisturbed natural areas.
- Improve understanding of whether sites identified through the spatial analysis are economically feasible.
- Identify the other economic considerations and barriers affecting the economic feasibility of developing each type of installation and setting.
- Inform the project's development of recommended economic policies, incentives, or disincentives to lower costs and drive solar to low-impact sites.
- Inform communication and outreach strategies to communities and policy makers.

### Deliverables

A written report that:

1. Characterizes and compares the direct economic costs of development for each type of solar installation (rooftop, parking lot, and ground-mounted) and energy storage, including how costs are allocated.
2. Identifies the additional economic considerations or barriers for solar development on commercial, non-profit, and municipal properties as well as for independent power producers purchasing or leasing space.

3. Describes the indirect economic benefits and costs of solar arrays, including to whom these impacts are allocated, during both development and operation.
4. Provides recommendations for addressing economic barriers, improving economic benefits, or reducing economic costs for solar development on low-impact sites.

## Research questions

1. What are the direct costs of developing each installation type on Long Island? See Economic Analysis Matrices, Q1. Direct development Costs per Type in the Appendix. Report as a range of dollars per watt (\$/W) of installed capacity, if possible. Costs will be categorized as low, medium, high if dollar values are not available.
  - a. Installation types include:
    1. Rooftop (including if possible differences in cost between flat vs pitched commercial roofs)
    2. Parking lot
    3. Ground mounted at undeveloped sites (assume they are wooded)
    4. Ground mounted at previously cleared, uncontaminated sites
    5. Ground mounted at Brownfield sites that have undergone remediation
    6. Ground mounted at closed and capped landfills
  - b. Proposed direct cost categories to be quantified and allocated to a recipient:
    1. Site acquisition or lease
    2. Site preparation before and after installation (such as land grading, roof replacement, structural upgrades, storm water management, parking lot resurfacing, revegetation, etc)
    3. Engineering & Design
    4. Materials (panels, mounting hardware, inverters)
    5. Labor
    6. Permitting
    7. Other 'soft costs'
    8. Interconnection study
    9. Interconnection work (cost per distance from substation?)
    10. Purchase of easements or rights of way
    11. Grid upgrades (can we divide these into categories?)
    12. Energy storage (consider several types?)
    13. Decommissioning
  - c. Summarize total cost and how it is allocated (illustrate with a pie chart showing total cost with wedges allocated to each category of cost)

2. What are the other economic considerations and barriers for developing each installation type in different settings? Identify solutions where they exist (see question 5). See Economic Analysis Matrices, Q2. Setting Considerations in the Appendix.
  - a. Proposed settings (where the equipment sits):
    1. Commercial
      - on-site energy use (behind the meter)
      - community / off-site energy use (site-lease, feed-in tariff)
    2. Non-profit
      - on-site energy use (behind the meter)
      - community / off-site energy use (lease, ppa, feed-in tariff)
    3. Municipal
      - on-site energy use (behind the meter)
      - community / off-site energy use (lease, ppa, feed-in tariff)
    4. Independent power producer
      - community / off-site energy use (lease, ppa, feed-in tariff)
  - b. Proposed economic considerations or barriers to be identified and, if possible, quantified for each setting:
    1. Availability and cost of financing
    2. Tax benefits/implications
    3. Availability of other incentives or funding--capture in which settings each is available
    4. Availability of owner/off-taker arrangements. Discuss which arrangements work best for different settings
    5. Power purchasing arrangements
    6. Electricity rate structure
    7. Other considerations unique to specific settings
3. What are the indirect economic benefits and costs of solar array development (benefits and costs that accrue only during the development phase of a project) and how are they allocated?
  - a. Proposed indirect benefits and costs to be identified, quantified, monetized (if possible) and allocated:
    1. Jobs created and related economic activity (multiplier effect from increased incomes) related to construction
    2. Economic benefits for property owners--those that own the system, those that lease the system, those that just lease the space
    3. Avoided cost of grid upgrades if generation or storage are located in areas of need
    4. Increased traffic and congestion
    5. Disruptions for neighbors
    6. Cost of mitigating construction impacts (dust, noise, erosion and runoff)

4. What are the indirect economic benefits and costs of solar array operation (benefits and costs that accrue only during the operation phase of a project) and how are they allocated?
  - a. Proposed indirect benefits and costs to be identified, quantified, monetized (if possible) and allocated:
    1. Economic benefits of kWh produced (different ways benefits can be allocated)
    2. Economic benefits of storage (including potential to reduce demand charges)
    3. Economic benefits for property owners other than kWh produced, such as lease payments
    4. Jobs created during operation
    5. Revenue for solar industry during operation
    6. Potential tax and other revenue impacts (loss or gain) for municipalities
    7. Other potential benefits to communities provided by solar companies
    8. Potential changes in retail electricity cost
    9. Monetized environmental benefits, including price of avoided CO<sub>2</sub> emissions and other air pollutants
    10. Other environmental impacts (such as soil erosion or compaction, avian impacts, water quality, etc)
    11. Monetized human health benefits of avoided air pollution
    12. Changes in aesthetics of adjacent properties
    13. Potential changes in property values for neighbors
    14. Resilience/grid reliability benefits
    15. Potential reduction of energy cost burden for LMI communities
5. What are potential economic and policy solutions to overcome identified barriers?
6. What are the potential economic and policy solutions to improve economic benefits or reduce costs identified?

## Methods

Literature review and analysis of existing data will be used to characterize and estimate the economic costs and benefits of solar development on Long Island based on the type of installation, setting, and financial/ownership arrangement using publicly-available, local and regional data and expert input from consortium members and advisors familiar with the Long Island and New York solar market. This economic analysis will look at future trends in drivers through 2020 when possible. The analysis will not generate new economic data.

This analysis will not attempt to value the energy generation by potential solar installations, nor report the economic costs and benefits provided by specific sites identified in the spatial analysis. Exploring the opportunity costs and benefits associated with a developing a solar project versus alternative development options may be pursued after completion of the research described above, if the Leadership team determines there is sufficient time, capacity, funding, and alignment with the project's overall goals.

Dr. Latika Gupta, an Energy Economist and Assistant Professor at Michigan Technological University, will lead a team of 10 graduate students to perform research and analysis to answer questions 1, 2, and 5. Questions 3 and 4 will be addressed by members of the Leadership Team and Economic Analysis Working Group. All research will be reviewed and revised for accuracy and completeness by the Leadership Team and Steering Committee. Production of the final written report is the responsibility of the Leadership Team.

## Key sources of information

1. Solar Electric Programs Reported by NYSERDA. Data points for solar projects completed and in the pipeline since 2000 separated by sector (residential vs commercial). Can help us show estimate project cost per installed capacity/expected annual production, changes in cost over time, etc. The website even provides a data visualization tool. <https://data.ny.gov/Energy-Environment/Solar-Electric-Programs-Reported-by-NYSERDA-Beginn/3x8r-34rs>
2. NYSolar Smart Survey Final Report. 2014. The NYSolar Smart Survey collected information on the policies and processes that affect balance of system (BOS) soft costs, particularly those under the purview of local governments across NYS. Long Island is well-represented in this survey. [https://nysolarmap.com/media/1289/nysolar-smart-survey-report\\_final.pdf](https://nysolarmap.com/media/1289/nysolar-smart-survey-report_final.pdf)
3. Solar and Storage Cost Survey. 2015. Solar and storage market participants were surveyed on solar+storage project information including: location, size, use, hardware and soft costs, financing, opportunities for cost reductions, and more. <https://nysolarmap.com/media/1449/dghubsolarandstoragecostsurveyresults.pdf>
4. Bureau of Labor Statistics info on Solar Voltaic Installers. Info on current and projected pay, current jobs, job growth, etc. <https://www.bls.gov/ooh/fastest-growing.htm> and <https://www.bls.gov/ooh/construction-and-extraction/solar-photovoltaic-installers.htm>
5. 2015 NY Solar Jobs Census. (In the Box Folder).
6. Energy Efficiency and Renewable Energy Annual Report. 2017 Annual Evaluation Reports (Volumes I & II). <https://www.lipower.org/about-us/contracts-reports/>
7. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. 2016. Provides results of analyses to estimate the social cost of CO<sub>2</sub> emissions, that is the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change. [https://www.epa.gov/sites/production/files/2016-12/documents/sc\\_co2\\_tsd\\_august\\_2016.pdf](https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf) Results were previously presented on the EPA's website: [https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon\\_.html](https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html)
8. Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide. Provides results of analyses to estimate the social cost of additional greenhouse gases, methane and nitrous oxide.

[https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/addendum\\_to\\_sc-ghg\\_tsd\\_august\\_2016.pdf](https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/addendum_to_sc-ghg_tsd_august_2016.pdf)

9. AVERT web tool by the EPA. 2019. The AVoided Emissions and geneRation Tool (AVERT) evaluates how energy efficiency (EE) and renewable energy (RE) policies and programs displace particulate matter (PM2.5), nitrogen oxides (NOX), sulfur dioxide (SO2), and carbon dioxide (CO2) emissions from electric power plants at a county, state, or regional level. Can be used to calculate the emissions avoided per MW of solar installed.  
<https://www.epa.gov/statelocalenergy/avert-web-edition>
10. COBRA web tool by the EPA. 2019. CO–Benefits Risk Assessment (COBRA) screening model is a free tool that helps estimate the economic value of the health benefits associated with clean energy policies and programs. It maps and visually represent the air quality, human health, and health-related economic benefits from reductions in emissions of particulate matter (PM2.5), sulfur dioxide (SO2), nitrogen oxides (NOX), ammonia (NH3), and volatile organic compounds (VOCs) that result from clean energy policies and programs.  
<https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool#1>

## Appendices of Additional Information

### Economic Analysis Matrices, Q1. Development Costs per Type

	<b>Rooftop</b>	<b>Parking Lot</b>	<b>GM - Undeveloped Wooded</b>	<b>GM - Previously Disturbed (Cleared)</b>	<b>GM - Brownfield</b>	<b>GM - Landfill</b>
Site Acquisition or Lease						
Site Preparation						
Engineering & Design						
Materials						
Labor						
Permitting						
Other 'Soft Cost'						
Interconnect Study						
Interconnect Work						
Purchase of easements or rights of way						
Grid upgrades						
Energy Storage						
Decommissioning						
*Hold system size, panel efficiency/type, and other environmental factors constant.						

**Economic Analysis Matrices, Q2. Setting Considerations**

<b>Setting</b>	<b>Energy use</b>	<b>Availability and cost of financing</b>	<b>Tax benefits/ implications</b>	<b>Availability of other incentives or funding</b>	<b>Availability owner/off-taker arrangements</b>	<b>Power purchasing arrangements</b>	<b>Electricity rate structure</b>	<b>Other</b>
Commercial Owner	Onsite							
	Offsite							
Non-profit Owner	Onsite							
	Offsite							
Municipal Owner	Onsite							
	Offsite							
Independent Power Producer	Offsite							