New York City's Solar Energy Future

2011 Update

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Prepared By
Meister Consultants Group Inc.

for

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The City University of New York (CUNY)

As this nation's largest urban university, CUNY plays a transformational role in New York City's sustainable future with an educational footprint that spans 23 academic institutions and over half a million students, faculty and staff. CUNY is dedicated to integrating sustainability into the university and the surrounding metropolitan area through its curriculum, policy work, research, retrofitting, capital projects, workforce development and economic development activities. Sustainable CUNY is leading CUNY's efforts through three key pillars: the CUNY Sustainability Project, city-wide Sustainable Energy projects and SustainableWorks NYC.

The New York City Mayor's Office of Long-term Planning and Sustainability (OLTPS)

The Long Term Planning and Sustainability Office coordinates and oversees efforts to develop and implement a strategic vision for the City's future by working with City agencies and the Mayor's Advisory Board for Sustainability. On December 12, 2006, Mayor Bloomberg challenged all New Yorkers to take part in a conversation about how to transform New York City into a sustainable city by 2030 - an effort called PlaNYC. As part of this effort, the Mayor has outlined 10 goals to make New York City a healthier, more reliable and sustainable place -- not only for us, but for generations to come.

The New York City Economic Development Corporation (NYCEDC)

NYCEDC is the City's primary engine for economic development charged with leveraging the City's assets to drive growth, create jobs and improve quality of life. NYCEDC's mission is to encourage economic growth in each of the five boroughs of New York City by strengthening the City's competitive position and facilitating investments that build capacity, generate prosperity and catalyze the economic vibrancy of City life as a whole.

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Executive Summary

As one of the thirteen inaugural Solar Cities under the US Department of Energy's (DOE) Solar America Cities Initiative and in support of PlaNYC's long-term sustainability goals, the City of New York seeks to create and implement a strategy supporting large-scale solar energy market growth. This report represents the 2011 update to previous solar market assessments and strategies. In particular, it bridges past solar programs and policies with on-going solar initiatives, describing the current state of New York City's solar market, the future market outlook, and recommendations for accelerating solar market growth.

Over the past five years, solar PV capacity has more than tripled in the City, from 1.47 megawatts (MW) to 5.65 MW. While still relatively small, New York City's solar market has grown exponentially and is poised for continued growth. The success of New York City's solar market is due in large part to the work of NYC Solar America City Initiative (NYC SAC) partners in breaking down barriers, which are reviewed in detail in this report.

Of note is the collaboration between New York City leaders, Con Edison, and the National Renewable Energy Lab (NREL) in clarifying, simplifying, and (as a result) largely eliminating the technical uncertainty of solar PV's interaction with the network grid. Additionally, the City has worked with state leaders to develop new and lucrative incentives, like the property tax abatement and the Regional Program funding initiative. The former provides a tax abatement that offsets up to 20% of the installed cost of a solar system for property owners. The latter provides $25 million annually to New York City and Westchester County to support large-scale solar PV installations through 2015. Additionally, NYC SAC recently created Solar Empowerment Zones, which are geographic areas in New York City that have been prioritized for solar energy development because they maximize benefits for end-users, grid management, and the environment. By concentrating solar development efforts in such high-value areas, the City aims to better integrate solar PV into utility planning, deploy PV more strategically across the city and the grid, and focus PV outreach and funding efforts.

While New York City's past and ongoing solar achievements are significant, its solar future looks even brighter. This report examines past market growth patterns and estimates future market growth. Projections indicate that the New York City solar market could reach 45-70 MW of solar PV capacity by 2015. However, in order to do this, the City will have to compete with surrounding regions for state, federal, and private funds. To successfully compete, New York City must mitigate a number of persistent barriers to market growth, chief among these being a complicated and unwieldy solar permitting process. This report examines these issues in detail.

Finally, this report outlines intermediate and long-term recommendations that City leaders would need to implement in order to drive continued market growth. For example, the report recommends that the City focus on initiatives to support its emerging businesses entering the solar business cluster, develop a roadmap and incentive programs to support solar hot water installations, continue engaging the state in order to coordinate solar policy development, and streamline the solar permitting process, among other initiatives. In the final analysis, this report recognizes that in order for New York City to reach its potential for solar market growth, it must transition from planning to full-scale implementation of its solar strategy. As a result, the report focuses on actionable items, policies, and program development that will help drive New York City's solar market forward.

Introduction & Report Structure

Since New York City launched its first long-term solar strategy in 2005, the amount of solar photovoltaic (PV) capacity installed within city limits has more than tripled, from 1.47 megawatts (MW) to 5.65 MW. While this is a significant increase, New York City's solar future looks even brighter. Recent estimates suggest the City could reach 45-70 MW of solar PV capacity in the next five years.

New state and utility programs are directing significantly more financial resources for solar energy to the downstate region than they have in the past, but these resources are not guaranteed and New York City will have to compete for them. The City has done much to position itself to capture these resources and expand local solar power through its strategic planning efforts. As will be detailed in this report, New York City has successfully achieved almost all of the policy goals that it set in 2005, from establishing local incentives, to working with Con Edison to improve the electricity grid interconnection process. The central question for New York City's solar market is whether the City can now capture its "fair share" of solar funding and realize its full solar potential. This report reviews solar market development in New York City, and makes recommendations to transition New York City from planning to full-scale implementation of its solar strategy.

Report Structure

This report is broken into five sections.

Section I provides an overview of New York City's solar planning and policy development to date. It examines barriers that previously slowed the local solar market, and describes the solutions implemented by the City and its partners to resolve them.

Section II considers the growth of New York City's solar market to date, describes current market conditions, and projects the potential for growth over the next five years.

Section III describes persistent barriers to solar market growth that will need to be addressed as the City positions itself for continued expansion.

Section IV describes initiatives that are currently underway as part of the Solar America Cities Special Projects initiative with the intent of breaking down persistent barriers and accelerating solar market growth.

Section V makes recommendations intended to drive solar market growth into the future. The recommendations are drawn from an in-depth stakeholder consultation and survey process that was supported by research on international best practices.

New York City Solar Strategy History

Three key initiatives mark the growth and transformation of New York City's solar market to date. Each of these initiatives is briefly described below and will be referenced throughout this report.

Million Solar Roofs (2005 to 2007)

In 2005, the City University of New York (CUNY) launched the Million Solar Roofs Initiative (MSRI) in partnership with the US Department of Energy (DOE). Under MSRI, CUNY worked with City government, and partners from renewable energy, labor, environmental, and community organizations to analyze the solar market and identify the unique solar energy opportunities and barriers. This program was instrumental in establishing New York City's solar market and confirming the value of solar in reducing peak load, mitigating greenhouse gases and air pollution, and minimizing the City's exposure to the volatility of fossil fuel prices.

Solar America Cities (2007 to 2010)

In 2007, the New York City Solar America City partnership (NYC SAC), the Mayor's Office of Long-Term Planning and Sustainability (OLTPS), the New York City Economic Development Corporation (NYCEDC) and CUNY, secured a three-year Solar America Cities (SAC) grant for New York City from DOE. Under the Solar America Cities program, NYC SAC and its partners addressed barriers to solar development identified under the Million Solar Roofs Program. During this time, New York City's solar market more than doubled as key barriers to solar were removed. In 2007 Mayor Bloomberg's PlaNYC 2030 also set a goal of installing 800 MW of clean distributed generation (DG) by 2030 within New York City, acknowledging that renewable energy has the potential to supply a significant portion of New York City's energy supply (City of New York, 2007).

Solar America Cities Special Projects Initiative (2010 to 2011)

In 2009, New York City was awarded $1 million in additional funds from the US DOE and NYSERDA in order to implement several new initiatives during 2010-2011 as part of the Solar America Cities Special Projects program. In part, this initiative is focused not only on knocking down persistent barriers to New York City's solar market, but also on accelerating market growth. The goals of this initiative include streamlining solar permitting processes, promoting large-scale solar development, identifying and promoting solar empowerment zones, and building a solar thermal market in New York City.

1. Knocking Down Solar Barriers in New York City: Success Stories

Under the Million Solar Roofs Initiative (MSRI), CUNY conducted the first assessment of New York City's solar energy market (in 2006 and 2007). The results were published in a series of reports entitled *New York City's Solar Energy Future* (Rickerson, 2006; Rickerson et al., 2007a). The reports confirmed that solar energy is ideally suited to help New York City meet its in-City capacity requirements, reduce peak load, reduce greenhouse gas emissions and air pollution, and decrease the City's exposure to volatile fossil fuel prices. The reports also highlighted, however, that businesses operating in the New York City solar market must deal with complex barriers, including:

- Insufficient solar funding and investment: The amount of solar incentive funding from federal, state, and local sources was insufficient to support the continued expansion of New York City's solar market at its historical rates.
- High costs of installing PV in New York City: Solar installations were more expensive in New York City than in surrounding markets.
- Technical and administrative barriers: Barriers related to the City's electrical codes, Con Edison's interconnection process, and the electricity grid configuration within the five Boroughs impeded development of solar.
- Inadequate state policies for the NYC market: State solar policies and regulations were designed primarily to support small-scale and residential systems, and did not adequately address New York City's large-scale infrastructure.

These barriers were identified through a year-long stakeholder engagement process with the MSRI Steering Committee and national, regional, and local solar project developers. During the MSRI project, stakeholders made group recommendations intended to resolve barriers, which in turn formed the basis for New York City's Solar America Cities strategy. These barriers and recommendations were described in the *Solar Energy Future* reports.

The following section updates the *Solar Energy Future* reports by detailing how each of the barriers was actually addressed under the Solar America Cities program (2007-2010). A brief overview of each barrier is provided along with a description of the initial recommendation from MSRI and the actual actions taken to address the barrier.

1.1 Insufficient Solar Funding and Investment

1.1.1 Barrier: Lack of Public Sector Funds.

Prior to 2007, the majority of NYC solar capacity had been added through large public sector installations, such as the 332 kW Gun Hill Bus Depot installation; however, the New York Power Authority (NYPA), which provides electricity to public sector buildings and manages their solar installations, did not have a dedicated source of solar energy funds. As a result, public sector project development had been uneven, making it difficult to build a sustainable PV market in New York City.

Recommendation: The MSR Initiative recommended that NYPA dedicate substantially more funding to public sector projects and also explore alternative solar financing options – such as third party ownership models – for public facilities.

Solutions: Both the City and NYPA launched significant new efforts to support public sector PV. These included:

- Feasibility studies: In 2010, CUNY completed a survey of all major city agencies to determine the solar potential of municipal properties in NYC on behalf of NYPA. This study identified sites which could support approximately 60 MW of solar PV, and will be useful for targeting future public sector solar development. A recent study of Freshkills

Park by Columbia University, meanwhile, concluded that the landfill is also a potentially attractive site for large-scale solar development and could feasibly host over 24 MW of PV (Eason et al., 2010).

- Third-party ownership: In order to explore alternative financing mechanisms, the NYC Department of Citywide Administrative Services (DCAS) is planning to issue a request for proposals (RFP) to build 3.5 MW of PV on public buildings. The projects would be owned and operated by third parties.
- Demonstration projects: In parallel with DCAS's RFP, NYSERDA is funding nine PV demonstration projects totaling 340 kW on public buildings in New York City, which should be installed in 2011.
- NYPA RFP: Most significantly, NYPA (2010) issued an RFP for 100 MW of PV installed on public property around the state in January 2010. Of this 100 MW, NYPA has set a goal that 15 MW be installed within New York City. If NYPA reaches this goal, these projects alone would triple the City's installed PV capacity by 2015.

1.1.2 Barrier: Lack of Stable Funding for Private and Non-profit Sectors.

NYSERDA provides a major source of funding for New York City PV projects through the Renewable Portfolio Standard (RPS) Customer-Sited Tier (CST). The RPS funds, however, have been subject to repeated shortfalls. Moreover, NYC residents have not received their fair share of funding from the program, resulting in a persistent imbalance between the amount that NYC residents contribute to the RPS and the volume of PV incentives New Yorkers receive. It was clear from CUNY projections that the state RPS funds would be insufficient to sustain NYC's market growth at historical levels (Rickerson et al., 2007a).

Recommendation: The MSR Initiative recommended that the state identify new strategies to increase NYSERDA funds such as expanding the RPS rebate pool or approving state System Benefits Charge (SBC) funds to supplement PV rebates. MSRI also recommended that the City consider creating funding specifically for solar in order to supplement state funds and build market momentum in New York City.

Solutions: In response to these issues, a number of new policies have been implemented at the state and city level, including:

- Increased NYSERDA RPS funds: NYSERDA has repeatedly added more PV funds to the RPS CST by transferring monies from discretionary and/or other renewable technologies budgets or by seeking interim funding from the Public Service Commission (PSC) (2009a). In 2010, the PSC approved $2 million per month for PV through 2015 (PSC, 2010). Under the rules, PV system sizes are capped at 110% of total associated load, NYSERDA may adjust incentive levels every two months if the volume of applications exceeds available funds, and energy efficiency audits are required to receive funding. This steady schedule of PV funding should help alleviate some of the market uncertainty; however, these funds may primarily benefit upstate markets where PV installed costs are lower and installation timelines are shorter than in New York City.
- Customer-Sited Tier Regional Program (Regional Program): In response to comments from Con Edison, the City (2008), and other stakeholders, the PSC (2010) announced a Customer-Sited Tier Regional Program of $30 million per year in order to address the fact that the downstate region has not benefitted from RPS funds proportionate to the region's contributions. Whereas RPS rebates are available to projects statewide, the Regional Program funds are reserved for PV and renewable biogas installations located in New York City, Westchester County, and parts of the Hudson Valley. The implications of this program for the New York City market are discussed in Section 2.2.

- New York City incentives: The Mayor's Office of Long-Term Planning and Sustainability included a recommendation for a local property tax abatement for PV systems in the Mayor's first PlaNYC 2030 report (City of New York, 2007). The property tax abatement was submitted for consideration by the State Legislature and passed into law in August 2008. The NYC Solar Electric Generating System Property Tax Abatement Program – the first of its kind in the country – enables property owners to deduct up to 20% of the installed cost of a PV system from their property taxes over the course of four years, with an annual cap of $62,500. Although the abatement represents innovative leadership on the part of the City, its introduction has highlighted a number of administrative and permitting challenges, which are described in greater detail in Section 3.1.1.

Conclusion

During the past four years, the City, NYPA, and the State have each launched new funding programs for PV, with the result that there are now unprecedented opportunities for New York City solar to maintain or exceed its historic market growth rate (see Section 2.2).

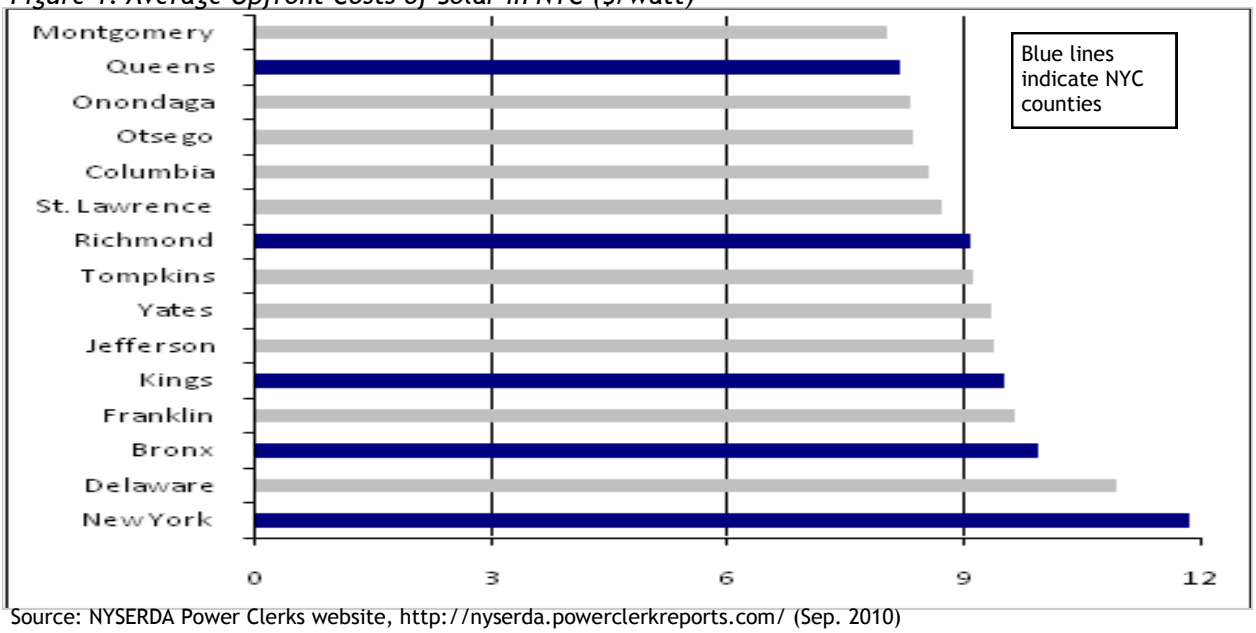
1.2 Cost of Installing PV in New York City

1.2.1 Barrier: High Costs of Installing PV in New York City.

New York City has the highest installed PV costs in the state, in part because labor, construction, and permitting costs are -- on average -- higher in New York City than in neighboring jurisdictions. According to September 2010 NYSERDA data, the five counties that make up New York City fall within the state's fifteen most expensive PV markets, with New York County (Manhattan) the most expensive (see Figure 1 below).

PV's high cost in New York City is closely related to the other three barriers described in this Section. Administrative and technical barriers (Section 1.3), for example, create transaction costs which raise the installed cost of PV in New York City relative to neighboring markets. The lack of reliable PV funds (Section 1.1) and lack of policies that appropriately target NYC's infrastructure (Section 1.4), meanwhile, prevent

Figure 1: Average Upfront Costs of Solar in NYC ($/watt)



Source: NYSERDA Power Clerks website, http://nyserda.powerclerkreports.com/ (Sep. 2010)

the scale of market growth that would lower installed costs through installer competition.

Recommendation: The MSR Initiative recommended bulk purchasing programs to drive scale, and declining incentives to put downward pressure on installed costs.

Solutions: Many of the programs that New York City and its partners have put into place during the past three years will contribute to lower installed costs in New York City and are discussed elsewhere in this report. The City and its partners are working to reduce transaction costs, for example, by developing a comprehensive online interconnection application tracking system (Section 1.3.1), by easing the external disconnect switch requirements (Section 1.3.3), and by removing the field test requirement from solar inspections (Section 1.3.4). As described in greater detail above, both NYPA and DCAS are pursuing bulk procurement initiatives. In combination with the new Regional Program, bulk procurement has the potential to significantly expand the local market and create opportunities for installed cost reductions through increased economies of scale and competition.

Conclusion

Although installed costs are still relatively high in New York City to date, recent and pending policy changes made in response to the recommendations laid out in the *Solar Energy Future* reports have the potential to drive cost reductions.

1.3 Technical and Administrative Barriers

1.3.1 Barrier: Interconnection Delays.

Although New York State has interconnection standards which specify the amount of time that application processing can take, installers reported that interconnection application approvals from Con Edison were frequently delayed.

Recommendation: The MSR initiative recommended that Con Edison and the PSC create a transparent online interconnection tracking system in order to provide installers and customers greater certainty with regard to project progress and timelines.

Solutions: The following solutions were implemented:

- Online tracking systems: Con Edison adopted the MSRI recommendation and worked with the PSC and CUNY to build an online interconnection tracking system, which allows installers to transparently track the progress of their projects through the interconnection process.
- Expedited interconnection process for small systems: In addition to developing an online interconnection tracking system, Con Edison expedited the interconnection process for PV systems under 25 kW in size in response to a PSC Order (PSC, 2009b). The new process reduces both administrative costs for the utility and transaction costs for developers and customers.

1.3.2 Barrier: Uncertainty Regarding the Technical Limits of Exporting Power to the Grid.

Interconnection of PV in New York City has been challenging due to the complexity of NYC's secondary network distribution systems (hereafter "network grid"). Most areas in the country rely on simpler radial systems to distribute electricity; however, New York and other large cities use network grids, which deliver power via numerous parallel circuits to improve reliability for large load centers. Network grids are typically designed for unidirectional power flow, and electricity which flows in the reverse direction – such as from distributed generators like PV – could require complicated coordination and protection schemes. Con Edison previously required all proposed commercial PV systems to undergo a study in order to evaluate their impact on the network grid, a time consuming and costly process for installers (Anderson et al., 2009).

Moreover, to protect the network from reverse power flows that could interrupt electric service, Con Edison required some distributed PV generators to install reverse power relays, which could add up to $40,000 to project costs (Rickerson et al., 2007a). Despite these regulations, uncertainty existed with regard to the amount of PV electricity the New York City grid could feasibly absorb.

Recommendation: The MSR Initiative recommended that Con Edison study, clarify and publicize the regulatory and technical parameters for interconnecting solar PV to New York City's network grid.

Solutions: In order to resolve these issues, NYC SAC worked with partners to implement the following:

- Grid analysis: The Solar America City initiative worked closely with Con Edison to investigate the technical feasibility of interconnecting PV to the area network. The City requested assistance from the National Renewable Energy Laboratory (NREL) to analyze the potential to integrate PV into New York City's grid. NREL published an initial survey of PV installed in network grids around the country in order to highlight success stories (Coddington et al., 2009). NREL then worked with NYC SAC and Con Edison to conduct a landmark analysis of the NYC grid to compare the load of specific networks with the maximum amount of PV electricity that could be generated if all feasible solar sites were developed (Anderson et al., 2009). The study assessed ten networks and found that six of them had network loads that were not exceeded at any time by proposed maximum PV generation. Additionally, the study found that if the other four networks incorporated a minimum of 100 MW, then PV generation could exceed network load. However, in the final analysis, the study found that PV integration would not be problematic until many years from now when PV reached much higher levels of installed capacity.
- Network grid policy clarification: Supported by the analysis above, Con Edison now generally allows solar systems less than 200 kW with UL-listed equipment to interconnect to the grid without requiring reverse power relays or engineering studies. NYC SAC's analytical partnership with Con Edison and NREL to address the network grid issue is one of the first such initiatives in the country and provides a model for other cities with network grids to consider.
- Net metering revisions: In tandem with Con Edison's work with NREL and NYC SAC, the New York State Legislature amended the net metering law in 2008, extending net metering eligibility to non-residential generators up to 2 MW in size. This change in law applied to all areas of the state and required Con Edison to develop strategies for interconnecting large commercial systems.

1.3.3 Barrier: Manual Disconnect Switch Requirements.

Con Edison required external disconnect switches to be installed in order to prevent power from flowing onto the grid during power outages and creating safety hazards for utility line workers. PV proponents argue that such requirements are redundant since modern PV inverters come equipped with an automatic disconnect feature (Coddington et al., 2008).

Recommendation: The MSR Initiative recommended that the external disconnect switch requirement be removed in order to reduce the cost (in both time and money) of PV installations.

Solutions: Per revisions to New York's Standardized Interconnection Requirements (PSC, 2009b), Con Edison changed its policies and allowed systems up to 25 kW in size to forgo the external disconnect switch.

1.3.4 Barrier: Electrical Code Requiring Field Testing by Nationally Recognized Testing Laboratories (NRTLS).

New York City PV systems must be field tested by a Nationally Recognized Testing Laboratory (NRTL) after installation. The requirement is unique to New York City and adds transaction costs of between $1,300 and $2,500 to PV installations.

Recommendation: The MSR Initiative recommended that the field testing requirement be removed from the New York City electrical code.

Solutions: The City's electrical code committees recommended that the field testing requirement be removed from the New York City electrical code. As of March 2011, however, the New York City Council has not yet formally adopted them.

Conclusion

By working proactively and collaboratively with its state, local, and utility partners, New York City has taken significant steps to resolve both administrative and technical barriers to PV development. The reduction of these barriers helped streamline system installation and lower installed costs within the five boroughs.

1.4 Inadequate State Policies for the NYC Market

The *Solar Energy Future* reports highlighted the fact that most New York State PV policies and regulations were designed to support small-scale or single-family residential systems, which are not typical of New York City's built environment. In other words, New York State's policy framework was not designed to support large PV, which would be most appropriate on the building types prevalent in New York City.

1.4.1 Barrier: Net Metering Only Allowed for Residential Systems, and Capped Total Amount of PV.

Net metering had been allowed only for residential systems that were 10 kW and below in size. Moreover, net metering policy capped total PV capacity within New York City at 8.1 MW.

Recommendation: The MSR Initiative recommended that New York State alter its net metering regulations in order to enable the development of larger solar systems in NYC's solar market.

Solutions: Two solutions were developed to resolve these issues:

- Net metering studies: NYCEDC commissioned a study to determine whether shifting net metering to take real-time pricing into account would benefit PV generators. The study concluded, however, that the benefit was ambiguous and would not be a significant driver for the solar market (McNamara et al., 2009).
- Net metering amendments: In 2008, net metering legislation was amended in three significant ways: first, the aggregate limit of net metered PV and biogas systems was raised to 1% of each utility's 2005 demand. For Con Edison, this equates to a cap of approximately 130 MW. Second, net metering eligibility was extended to non-residential systems (previously limited to only residential systems). Third, the eligible system size was increased to 25 kW for residential systems and 2 MW for non-residential systems. These amendments enabled development of commercial solar PV in NYC, which may be particularly appealing in combination with the Regional Program.

1.4.2 Barrier: Rebate and Tax Credits Only Target Smaller Systems.

Similar to the net metering regulations, state PV incentives tended to target small systems. The NYSERDA rebate, for example, only provided incentives to generators 50 kW and smaller. The state tax credit, meanwhile, targeted only small residential systems. Neither of these incentives was designed to support the scale of PV systems needed to serve New York City loads.

Recommendation: The MSR Initiative recommended introducing programs to support larger systems across a broader range of customer categories.

Solutions: The Regional Program will likely create opportunities to develop PV on New York City's larger properties (e.g. warehouse rooftops). The state tax credit was expanded to include PV systems on condominium and cooperative housing up to 50 kW (instead of just 10 kW residential) and the incentive cap was raised from $2,500 to $5,000. Although beneficial, the expanded tax credit is less significant than the Regional Program.

1.4.3 Barrier: Grid benefits of PV Are Not Fully Captured.

PV can create a number of ancillary benefits for the electricity grid (Contreras et al., 2008), such as peak demand reduction, transmission and distribution investment deferral, and emergency power, among others, which to date have not been fully valued or captured within New York City.

Recommendation: The MSR Initiative recommended that the utility benefits of PV be more fully analyzed and managed (e.g. evaluating PV eligibility for load reduction programs), and that the City explore the use of PV to provide emergency power service.

Solutions: Two initiatives were undertaken to address these issues:

- Emergency power: Under the Solar America Cities program, the City convened the various emergency management departments in NYC to review potential uses for solar energy in emergency situations. A report containing a menu of potential options for deploying PV for emergency power was recently published (CH2M HILL, 2009).
- Grid benefits: The grid benefits of solar energy have not yet been fully quantified or monetized in New York City. As described in Section 1.3.2, however, the detailed grid studies that Con Edison completed with NREL and NYC SAC have laid the foundation for better understanding and valuing of solar energy for the grid. In partnership with Con Edison, the next phase of the Solar America Cities program will focus on capturing the grid value of PV and integrating PV into utility planning.

Photo Source: EmPower Solar

2. The Outlook for Market Growth in New York City

The New York City solar market is poised to grow dramatically over the next several years as a result of new policies, programs, and incentives. This Section describes the growth of the New York City PV market to date and discusses potential for future market expansion.

2.1 Market Growth from 2005-2010

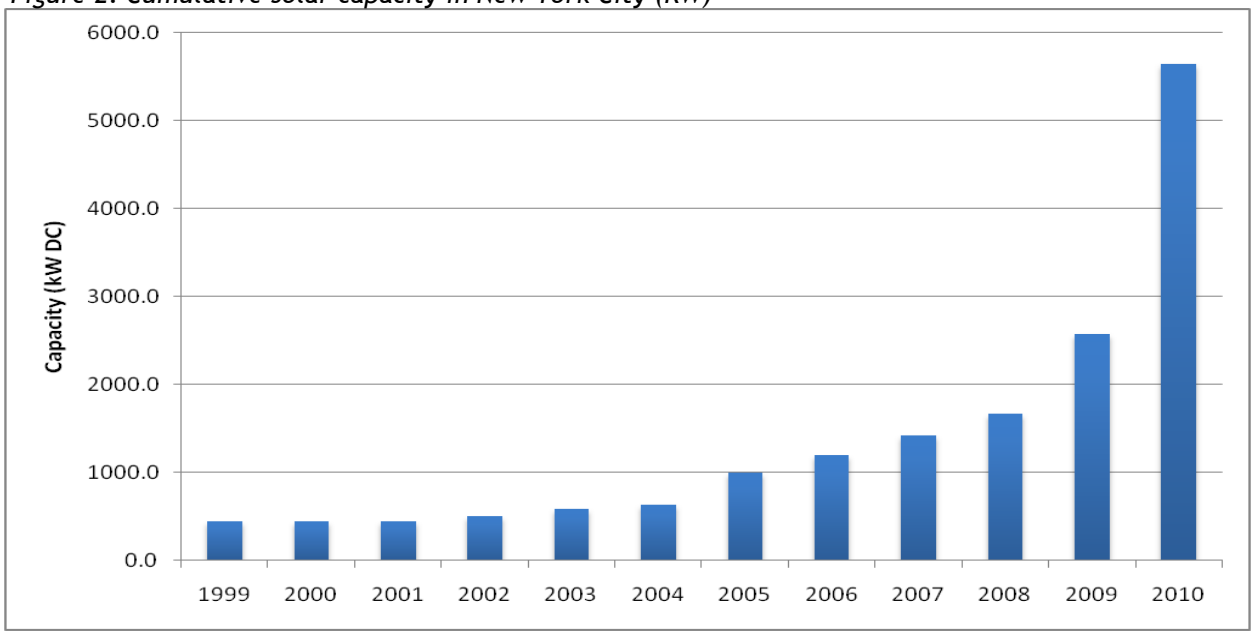
CUNY has tracked solar energy market development in New York City for the past five years, publishing a series of market growth projections. By cross-referencing state data with the results of local installer surveys, CUNY estimated that 1.1 MW of PV were installed in the five boroughs at the end of 2005. CUNY then conservatively projected that an additional half MW would be installed by the end of 2006 (Rickerson, 2006) and that between 3.5 MW and 6.5 MW of cumulative capacity would be installed by the end of 2009 (Rickerson et al., 2007b). Solar market growth in New York City has generally tracked to the lower end of CUNY's projections. By early 2010, as policies and incentives mentioned above were implemented, the market hit the low growth scenario projected in 2006, 3.5 MW. By the end of 2010, market growth had accelerated, with a total of 5.65 MW installed in New York City by the end of the year (see Figure 2). This doubling of installed capacity in New York City in 2010 (see Figure 2) could be considered just the beginning of a rapid expansion of this solar market, as described in the next section.

2.2 Projected Growth from 2011-2015

As noted above, market growth has tracked to the lower end of CUNY's projections because many of the policy initiatives formulated and launched during the 2006-2007 period are only now coming to fruition and impacting the market. New York City's strategic approach to solar policy and barriers has laid a strong foundation, however, which should allow the market to grow more rapidly in the near-term and will provide a framework for NYC SAC and its partners to continue to address persistent barriers (see Section 3 for discussion on current policies and barriers).

If current policies are enacted as anticipated, the solar market is projected to expand rapidly in the near-term. Projections for NYC's solar growth

Figure 2: Cumulative solar capacity in New York City (KW)



show that 45-70 MW of solar PV could be installed by 2015 (see Figure 3). The installed capacity projections are based primarily on the Public Service Commission's solar capacity projections under the Regional and RPS Programs. The projections also take into account pending RFPs for PV from DCAS and NYPA's RFP. Projections do not include anticipated solar thermal additions.

The new Regional Program provides $30 million annually to downstate regions, $25 million of which is reserved specifically for renewable biogas and large-scale PV in New York City and Westchester. It is also important to highlight extra 15% "sweetener" incentive that will be provided by NYSERDA for PV systems located in the New York City Solar Empowerment Zones, described in Section 4.2.1. The first solicitation for this program was released on March 14, 2011, and overall the Regional Program is expected to support approximately 15 MW of PV in total each year (across the region). Assuming New York City and Westchester share their allocation equally, this program will support the installation of about 6.4 MW of large-scale solar (>50 kW) in NYC annually.

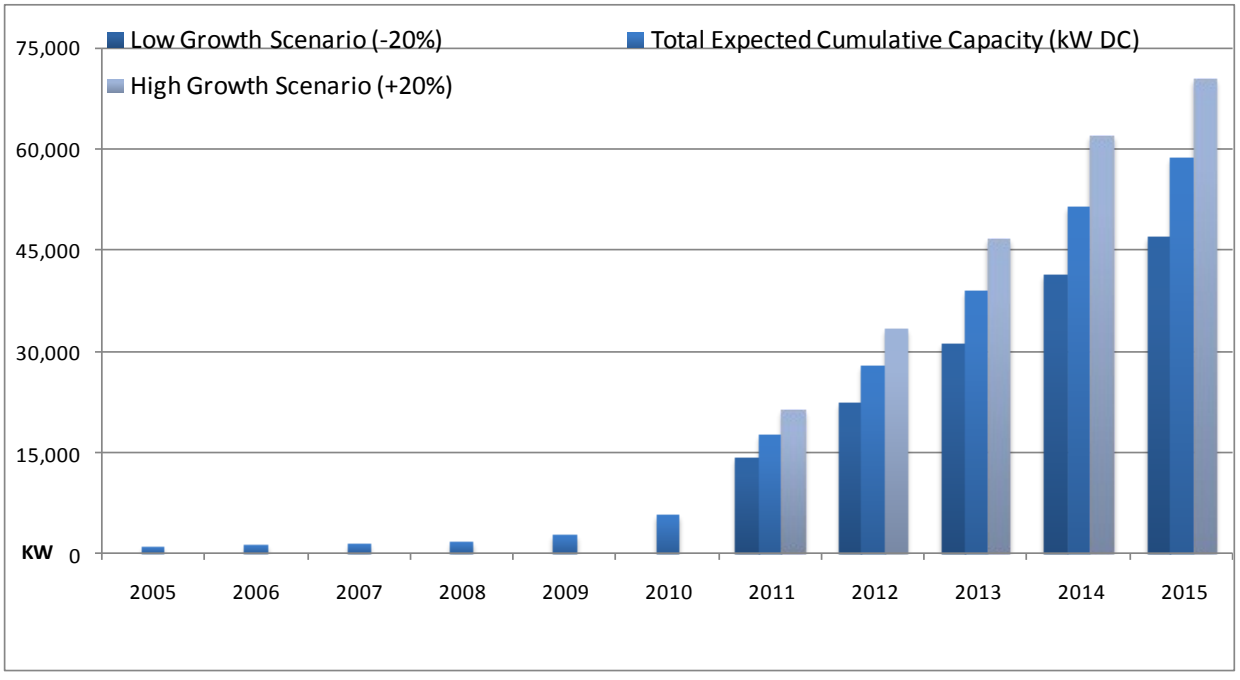
Additionally, DCAS expects that at least 340 kW of city-owned demonstration projects and 3.5 MW of capacity from the DCAS RFP will be installed on City buildings within the next twelve months. Finally, the New York Power Authority is underwriting a 100 MW RFP for PV, with a goal of installing 15 MW within New York City.

In order to estimate high and low-case scenarios, a 20% variation was modeled above and below the base case projection. Therefore, the range of expected funding could support between 45 MW and 70 MW of cumulative solar capacity by 2015.

Ultimately, these growth scenarios are dependent on the distribution of the Regional Program funding between New York City and the rest of the downstate area, as well as the outcome of the NYPA RFP. Therefore, NYC SAC's continued planning efforts are particularly important for New York City to secure its "fair share" of solar funding, and capture near-term market opportunities.

Recent bills in the state legislature could further accelerate the statewide solar market by several orders of magnitude during the next decade. For

Figure 3: Solar PV Growth Scenarios



example, New York City's solar market could substantially increase if the legislature passes the proposed state solar renewable energy credit (SREC) bill. Officially titled the *New York Solar Industry Development and Jobs Act of 2011* (Bill A5173), the bill would require investor owned utilities to procure SRECs, the environmental attributes generated by each MWh of solar energy. Under the proposal, New York State would develop approximately 5,000 MW of solar by 2025. Each utility would be responsible for obtaining 20% of their portion of this obligation from "small" retail distributed generation (DG) systems and another 30% from commercial retail DG. Compliance would be maintained through a PSC established alternative compliance payment (ACP), and the PSC would additionally develop terms and conditions for a "standard contract offer."

Regardless of whether the SREC bill is passed, NYC's solar market will certainly experience continued growth. To achieve its full potential, however, NYC will need to continue to engage in sound market planning, outreach, and development for its emerging solar market. Section 3 below describes persistent barriers to growth that could be addressed in the near term. Section 4 provides an overview of the activities already underway to address them, and Section 5 provides recommendations for developing the solar market over the mid- to long-term.

3. What's Next? Solar Market Barriers and Opportunities

As noted earlier, NYC SAC has collaborated with partners to identify and address barriers to the solar market. Under the Solar America Cities program, for example, New York City emerged as a leading innovator in solar policy by improving network grid interconnection and creating the local property tax abatement.

Nonetheless, persistent barriers to growth continue to hamper New York City's solar market and have prevented New York City from realizing its full solar potential. As a result, NYC SAC is currently pursuing several concurrent initiatives as part of its "next generation" policy and planning efforts.

In March 2010, CUNY, NYCEDC, and OLTPS convened New York City's Solar America Cities Advisory Board in a half-day workshop to review progress to date and identify barriers requiring continued attention in the near-term. The workshop was followed by one-on-one consultations with Advisory Board members. Additionally, in the spring of 2010, the Office of the New York City Solar Coordinator at CUNY conducted interviews with 36 installers active in, or considering entering into, the New York City solar market. The interviews sought to identify the most significant solar market barriers and recommendations for resolving them.

The results of these consultations revealed that although many barriers have been resolved, a number of barriers persist and several new barriers have been identified. The stakeholder consultations also highlighted that New York City is entering into a new phase of solar market development. The NYC solar community is focused on *accelerating* market momentum instead of just removing impediments to market creation. This is a subtle but important distinction. The following section examines the barriers and the strategic needs of the New York City solar market.

3.1 Technical and Administrative Barriers

With the resolution of the major grid concerns, numerous stakeholders indicated that the primary barrier to New York City solar is the lengthy and costly permitting process.

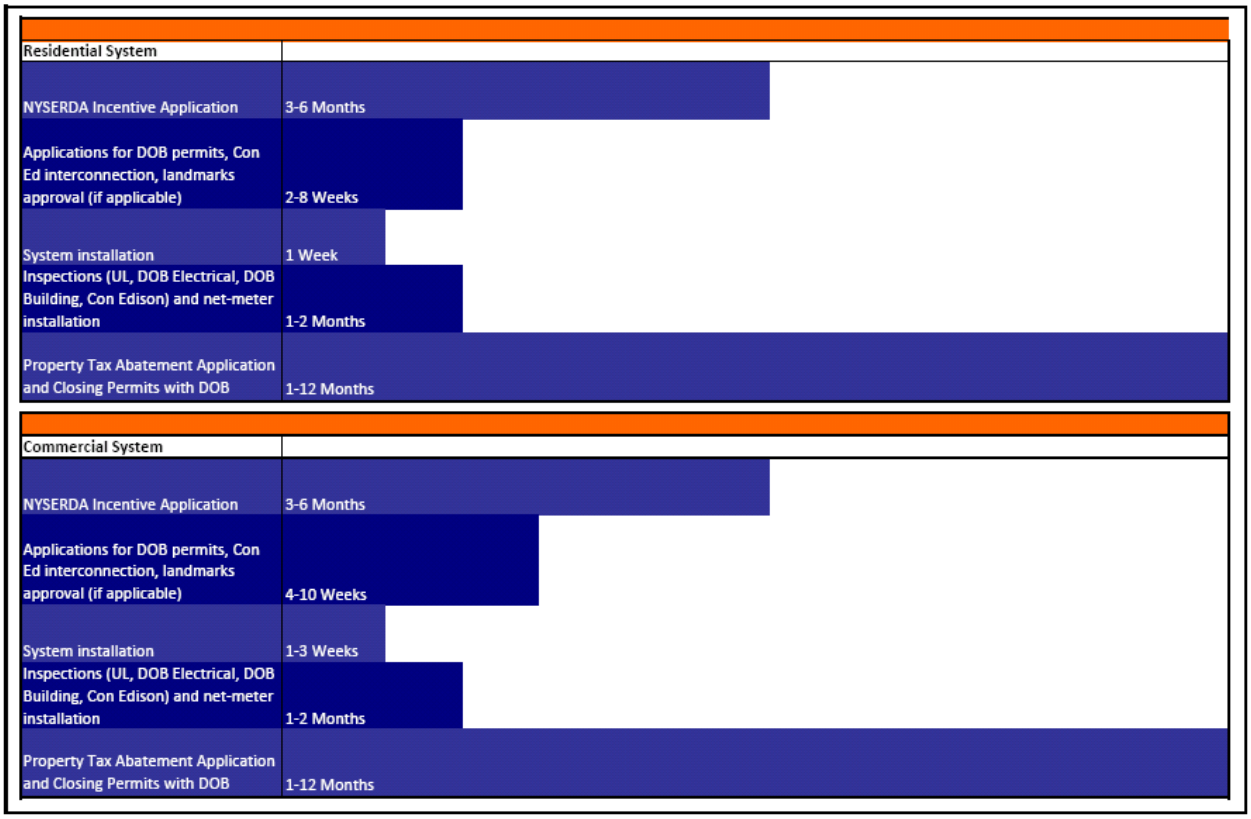
3.1.1 The NYC Solar Permitting Process.

Advisory board members and installers consistently highlighted the solar permitting process as one of the most onerous barriers to solar energy deployment in New York City. Installers note that the solar permitting process imposes unnecessary costs in time and money on solar installations. Altogether, installers estimate that commercial PV systems cost $0.50 to $2.00 more per watt in NYC than in surrounding areas. Residential systems cost $2.00 to $4.00 more per watt. As a result, many solar installers do not currently pursue projects – residential projects in particular – in New York City (Ginsburg, 2010).

The permitting process is enforced by the Department of Buildings (DOB) in New York City. Most installers use expeditors to complete permits at an average cost of $2,500 to $3,000 per job. In some cases, installers spent much more, up to $8,000 to complete the necessary paperwork (Ginsburg, 2010). Permitting has become more complex since 2009 with the

Photo Source: Mercury

Figure 4: Permitting and Incentive Timeline



introduction of the property tax abatement. Though the abatement is a potentially lucrative incentive, the application process is difficult and expensive to navigate. This has led some installers to the extreme position of encouraging solar owners to forgo the incentive altogether. Figure 4 above contains an overview of the solar permitting and inspection processes and timelines for residential and commercial systems in New York City.

3.1.2 NYSERDA Incentive Process.

Prior to April 2010, NYSERDA's incentive approval process, which took up to a year to complete, was the single longest delay in the administrative process for solar installers. This placed an unnecessary burden on solar installers, who struggled to keep projects on schedule and on budget as they contended with the long turn-around times for incentive approval. Since May 2010, NYSERDA has made programmatic and administrative improvements in their application process, which has significantly improved turnaround time (NYSEIA, 2010).

3.1.3 Fire Code Regulations.

PV systems can be problematic for firefighters, who must ventilate buildings via the roof or navigate across rooftops. As a result, the 2008 New York City Fire Code requires that a six foot wide clear path be established on rooftops of buildings 100 feet or less in height. PV installations can present impediments to rooftop access for firefighting operations, and these paths are intended to allow firefighters to access, traverse, and exit building rooftops safely, as well as cut through roofs for smoke ventilation (Bazel, 2010). This requirement, however, constrains installation of PV systems on rooftops of many residential buildings (e.g. brownstones and low-rise walk-ups). The New York City Fire Department will be undertaking a review of the Fire Code in 2011 and will be considering ways to accommodate solar installations and other green

roof initiatives consistent with the need for firefighter access.

3.2 Inadequate Policies for the New York City Market

Net metering amendments and the Regional Program will address the major challenges related to the mismatch between state policy and New York City infrastructure. However, stakeholders have additionally identified two other key policy-related barriers to solar in New York City.

3.2.1 Lack of Options for Long-term Financing.

Long-term financing for renewable energy has been persistently challenging for solar developers, a situation that has been exacerbated by the financial crisis. At present, there are only a few sources of financing available to cover the upfront cost of solar energy systems. Moreover, solar PV systems are no longer eligible for NYSERDA's Energy $mart Loan Program, which had previously provided low-interest loans for solar installations in New York. Similarly, Property-Assessed Clean Energy (PACE) bonds, a financing option under which local governments offer sustainable energy loans that are recouped through property tax payments, have been effectively blocked by the federal mortgage agencies. As a result, access to capital remains a challenge for solar developers.

3.2.2 Lack of Net Metering for NYPA Facilities.

Net metering has been identified by the Solar Energy Industries Association as one of the "Four Pillars" of policy required to "drive real, cost-effective solar markets." As discussed above, New York State has made significant progress in its net metering regulations and its amended rules were awarded a grade of a "B" in 2008 (up from a "D" in 2007) from the Network for New Energy Choices' *Freeing the Grid Report* (Rose et al., 2008). One of the report's primary recommendations for further improving the state's policy was to extend the net metering requirement to all utilities. In January 2009, the Long Island Power Authority issued its own net metering regulations, which closely mirror those required of the state's investor-owned utilities. To date, however, NYPA has not promulgated net metering rules. As a result, public sector projects are unable to reliably capture the full benefit that their PV systems produce.

3.3 Enabling Large-Scale Solar Development in New York City

In addition to the barriers identified above, solar stakeholders identified strategic issues that should be addressed in order to enable large-scale solar growth in New York City.

3.3.1 Resource Coordination.

As demonstrated in this and past market studies, the City's solar market has experienced slow but sustained growth that has tracked at the lower end of projections. Going forward, stakeholders identified a need for NYC SAC to continue to pursue a coordinated approach to resource deployment in support of PV. It is more likely that market growth goals developed in partnership with organizations such as government agencies, Con Edison, NYSERDA and NYPA will realize higher levels of growth.

3.3.2 Create and Aggregate Demand.

New York City has an opportunity to help businesses and residents take advantage of new funding opportunities and invest in solar power. Given the slate of new funding initiatives for the region, a number of stakeholders indicate that New York City should mobilize outreach and education initiatives in order to drive local demand. Moreover, the City could help aggregate private sector installations in order to drive installed costs down through bulk orders. Although bulk procurement for public sector agencies is underway, broad-based efforts to identify, educate, and aggregate purchases of solar from private sector hosts have not been pursued in a systematic way (see Section 4.2.1 on the "Solar Empowerment Zones" for a discussion of strategies underway to resolve these challenges).

3.3.3 Support Solar Energy in Under-served Markets.

The Regional Program aims to address inequalities between the amount of money that downstate residents and businesses pay into state renewable energy funds and the amount of rebates and benefits that they receive. In the process of regional balancing, however, it is important to develop strategies for constituencies that may not be well-positioned to access RPS funds. New York City, for example, has a high proportion of rental property. Under typical rental agreements, there is little incentive for either the landlord or the tenant to invest in solar power. As a result, these customers are denied access to many of the benefits of solar power. The same is true for the residents of buildings that have obstructed or shaded roofs (e.g. many buildings in Manhattan). Affordable housing residents also have difficulty getting their "fair share" of solar funds, because they often do not have access to the additional capital required to take advantage of PV rebates. To date, there has been little coordinated effort to create new solar opportunities for these and other under-served constituencies (see Section 4.2.4 on "Community Solar Pilots" for a discussion of strategies underway to resolve these challenges).

3.3.4 Identifying and Capturing the Value of PV to the Grid: Utility and Emergency planning.

By collaborating with Con Edison and NREL, the City has identified opportunities for PV on the City's network grid and created exciting new avenues to deploy PV strategically. As a result, solar energy has emerged as a potentially valuable peak shaving resource for New York City's grid. However, Con Edison's work on integrating PV into the network grid has no precedent in the US and additional work must be completed in order to identify, quantify, and capture the full value of PV. For example, most solar arrays lack real-time data loggers; thus, Con Edison cannot determine how much power PV systems are producing and is accordingly unable to determine the viability of interconnecting *large* volumes of intermittent generation to the grid. Moreover, without data collection systems, Con Edison cannot evaluate the reliability of PV systems to reduce peak demand or displace non-renewable generation sources (see Section 4.2.3 on "Data Acquisition Systems" for a discussion of strategies underway to resolve these challenges).

Photo Source: Solar Energy Systems

Similarly, New York City also needs to identify new strategies for storing and dispatching solar electricity as the amount of PV in New York City expands (Steingart, 2010). With support from NYSERDA and DOE, CUNY is installing a PV battery system at its LaGuardia Community College campus. This system will serve as a useful demonstration project, but there is a need to develop a longer-term plan for integrating PV, new storage technologies, and smart grid infrastructure in New York City.

Finally, PV can add additional value by serving an emergency back-up role for critical infrastructure. Although New York City has identified a menu of promising emergency power applications, it has not yet integrated PV into its emergency response infrastructure.

3.4 Support for Solar Thermal Energy in New York City

Solar thermal energy represents a significant untapped resource in New York City and it is estimated that up to 2,410 MW of solar thermal capacity could be installed on existing buildings

(Plunkett et al., 2003). Unfortunately, however, few incentives have supported solar thermal development to date in the City, though interest in the solar thermal appears to be building.

In 2010, the PSC (2010) approved RPS funds from the customer-sited tier to support solar thermal installations that displace electric water heating loads. Solar thermal incentives will equal approximately $3.2 million in 2010 and then $4.3 million annually through 2015. Overall, the PSC expects about 9 MW of new solar thermal capacity to be installed each year across the state. The number of electric water heaters in New York City is very small, however, and it is unlikely that this incentive will support significant in-City market growth.

New York City and CUNY staff recently participated in the development of a statewide solar thermal roadmap, which called for an increase in solar thermal power from 6 MW_{th} to 2,000 MW_{th} by 2020 (New York Solar Thermal Consortium, 2010). If this vision is realized, New York City could emerge as a leading solar thermal market. A recent NYSERDA report concluded, for example, that "New York City appears to be the most favorable market in New York State for solar domestic hot water, due to relatively high energy costs and levels of solar irradiation (Perlman and McNamara, 2008)."

Ultimately, solar thermal currently occupies a position similar to that of PV five years ago. New York City has enormous potential for market growth, but solar stakeholders and partners will need to collaborate closely to develop a solar thermal strategy specific to New York City (see Section 4.2.5 on "Solar Thermal Pilot Program" for a discussion on new City incentives).

NYC SAC and its partner organizations have recently begun to address many of the persistent barriers and strategic needs described earlier. In 2009, New York City was awarded $1 million in additional funding from the US DOE and NYSERDA in order to implement several new initiatives during 2010-2011 as part of the Solar America Cities Special Projects program. These initiatives were specifically designed to address key administrative barriers and promote large-scale solar development in New York City.

4.1 Technical and Administrative Barriers

As noted earlier, permitting represents the primary administrative barrier slowing development in New York City's solar market. As a result, NYC SAC is working with partners to mitigate the negative impact of permitting delays.

4.1.1 "100 Days of Solar."

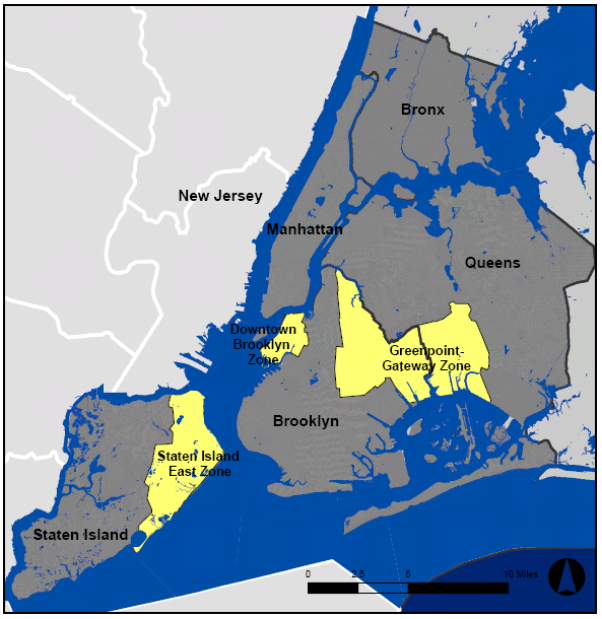
In an effort to support NYC SAC's goal to reduce solar transaction costs, Con Edison is leading an effort "to streamline the process for installing solar resources in New York City" by reducing the time from initial application for permits and incentives to physical installation and system operation. Currently, it takes up to one year for this process. Con Edison and partners seek to reduce this time to 100 days (Nelson, 2010). To this end, a task force was launched with representation from key City agencies, CUNY, Con Edison, NYSERDA, and other stakeholders in order to review the administrative processes related to solar installation, reduce the amount of duplicative information requested by different entities, and investigate the feasibility of one-stop applications.

4.2. Enabling Large-Scale Solar Development

In cooperation with partner organizations, NYC SAC has launched several ambitious and

positions which have been created at CUNY in the office of the New York City Solar Coordinator. The Solar Empowerment Zones will simultaneously lay the foundation for creating and aggregating demand (Section 3.3.2), supporting solar energy in under-served markets (Section 3.3.3), and identifying the grid value of PV for use in utility planning (Section 3.3.4).

Figure 5: Solar Empowerment Zones



4.2.2 New York City Solar Map.

In order to facilitate the screening and identification of promising solar energy sites, NYC SAC has engaged the Center for Advanced Research of Spatial Information (CARSI) at CUNY's Hunter College to develop a solar map for New York City. In addition to identifying the locations of existing PV installations, the solar map will incorporate a LIDAR layer (see Figure 6) of the City in order to calculate potential PV system output based on roof geometry and shading (Garcia, 2010). By the spring of 2011, CARSI plans to calculate the solar potential for every building in New York City, and calibrate the findings with actual output data from installed systems. In 2011, CUNY will publish a solar map with building-specific data online. The solar map will serve as a resource for building owners interested in installing solar, for installers to evaluate potential projects, for City solar staff to target outreach and provide technical assistance, and for Con Edison to identify additional strategic areas for PV development.

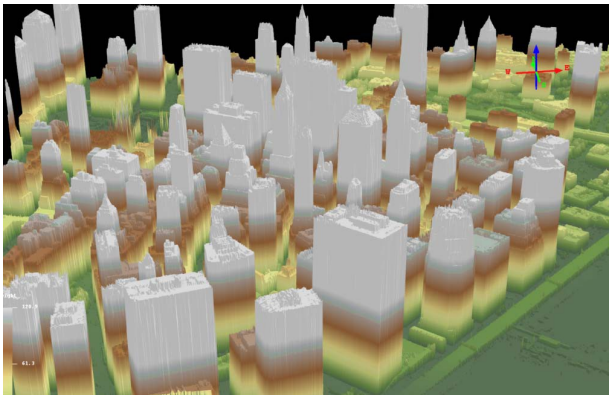
4.2.3 Data Acquisition Systems (DAS).

As part of the Solar America Special Project initiative, CUNY is purchasing Data Acquisitions Systems (DAS) for PV systems located within the Solar Empowerment Zones. The DAS for PV will benefit customers and developers by providing data on actual system performance, while providing critical real-time power production data to Con Edison. This data will enable Con Edison to integrate PV more effectively into its energy planning and decision-making, helping to overcome technical barriers to PV deployment on NYC's network grid. The DAS initiative will directly support the development of both the Solar Empowerment Zones and the Solar Map.

4.2.4 Community Solar Roadmap and Pilot.

Another primary focus of the Solar America Cities Special Project will be the development of a community solar roadmap and pilot program. As discussed earlier, many New Yorkers are unable to take advantage of solar power for their businesses and homes because of financial constraints, site constraints (e.g. shading, lack of space, or suboptimal orientation), or because of landlord/tenant issues. Community solar refers to efforts to create new models for solar investment that will allow a broader spectrum of New Yorkers to participate. This might include, for example, the installation of centrally-located

Figure 6: LIDAR Map Layer



solar farms owned by groups of investors. NYC SAC is researching existing community solar models and policies. It will make recommendations to help structure new programs, and then work to launch a pilot program within the Solar Empowerment Zones. This effort will support solar energy in under-served markets (Section 3.3.3).

4.2.5 Solar Thermal Pilot Program.

In 2009, the New York City Economic Development Corporation (EDC) launched a $1 million pilot program to provide incentives to commercial-scale solar thermal systems in New York City. EDC awards grants of up to 30% of total installed cost, with a cap of $50,000 per system (EDC, 2009). This grant program is the first in the state to provide incentives to customers no matter what type of heating fuel they use and will provide important data about the barriers and opportunities for solar thermal. This activity is a significant first step toward supporting solar thermal energy in New York City (Section 3.4).

5. Key Recommendations for New York City's Solar Market

New York City is poised to receive significant public funding from New York State's RPS through the standard Customer Sited Tier solar incentive program and the Regional Program as well as funding from private investors. In order to capture and leverage these resources, however, it is essential that New York City focus on developing near- and long-term opportunities to increase the size and efficiency of its solar market. The following section offers key recommendations drawn from New York City's stakeholders in order to assist the City in achieving these goals.

The recommendations below are broken into four main categories, which generally correspond to the barriers and strategic issues identified in Section 3: technical and administrative barriers, inadequate policies for the New York City market, enabling large-scale development, and support for solar thermal energy.

5.1. Technical and Administrative Barriers

5.1.1 Streamlining the Solar Permitting Process.

As noted earlier, installers identified the solar permitting process as one of the most time-consuming and costly barriers to solar development in New York City. The following proposals outline means to resolve the challenges associated with permitting.

One-stop application portal: NYC SAC has already taken the first step by engaging DOB, NYSERDA, and Con Edison on solar permitting requirements and working with Con Edison on its 100 Days of Solar program. In order to continue this progress and remove administrative barriers to solar in New York City, it is imperative that next steps should include efforts to simplify and eliminate redundancies in the application, inspection, and approval processes, and ultimately create a one-stop application portal for solar permitting. Currently, installers may complete utility interconnection, NYSERDA incentive, and electrical permit applications through the respective agency's website (or email); however, no comprehensive information center exists to guide applicants through the process and similar requirements are often repeated for different agencies. Moreover, construction and property tax abatement applications must be filled out in person at the New York City Department of Buildings. The "one-stop portal" would be a single, centralized website that explains the permitting process, and enables solar installers to access *all* permitting applications on-line. The one-stop portal could also develop a single application that could be submitted to each of the permitting and inspection entities simultaneously to cut down on duplicate requirements. In parallel with streamlining the paperwork involved, it would be necessary for the City and its partners to work together to eliminate the need for redundant physical inspections, and where possible, identify opportunities for cost reductions.

Streamline DOB Permitting and Property Tax Abatement Application (PTA) Process: NYC SAC has already taken action to help streamline the permitting process in reaction to suggestions made by Advisory Board members and other stakeholders during the May 2010 consultation process. Moreover, in order to assist the DOB with the increase in solar permitting and property tax abatement applications, CUNY has located a Solar Ombudsman part-time at the NYC Department of Buildings. The Ombudsman serves as a resource for both the DOB and for installers trying to navigate DOB's permitting and application processes. The Ombudsman is also working with DOB to evaluate and adopt streamlined permitting processes for solar installations. For example, the Solar America Board for Codes and Standards (Solar ABCS), a DOE funded collaborative of solar permitting experts, advocates a one-page streamlined solar permitting process for installations 15 kW or less

(Brooks, 2009). Solar ABCS additionally provides simple appendixes to guide authorities in permitting larger commercial installations. The Ombudsman will work with DOB to evaluate whether such national models, or other innovative ideas such as an online permitting platform, could be adapted to New York City's process.

Expedite incentive applications and certify installation companies: A continued partner effort between NYC SAC and NYSERDA will increase the efficiency with which solar incentive applications are processed within the context of the 100 Days of Solar Initiative and similar efforts. The NYSERDA rebate submission timelines and deadlines, for example, could be tracked online in a similar fashion to Con Edison's interconnection applications, or the two processes could be tracked in combination online. Changes in the certification process of solar installers could also help to lower barriers to entry in New York City, and NYC SAC and partners could also to work with NYSERDA to find other potential solutions. Furthermore, solar installers must be certified by NYSERDA in order to access state rebates. NYSERDA installer certification requires proof of having led three PV installations, a burdensome requirement because it is attached to the individual installer, not the solar installation company (Ginsburg, 2010). This in turn discourages entry into the solar market, especially from established local electrical contracting firms that could help drive prices down in New York City's already expensive solar market (Personal Communication, Lee Smith). Some NYSERDA officials indicate that they would be interested in changing the rules to certify companies (Warren, 2010).

5.1.2 Investigate Fire Code Best Practices.
As discussed earlier, the New York City Fire Department will review the Fire Code in 2011. By working closely with the Fire Department to examine best practices from around the country, NYC SAC can provide valuable input in order to determine how best to ensure safety while also encouraging rooftop solar installations.

5.1.3 Adopt the Recommendations of the New York City Green Codes Task Force.
In July 2008, Mayor Bloomberg and Council Speaker Christine Quinn convened the New York City Green Codes Task Force in order to analyze the laws and regulations affecting buildings in New York and determine ways that they could be amended to better support green infrastructure. The Task Force's final recommendations were published in February 2010, but have not yet been formally adopted. In particular, the Task Force report contains recommendations for solar power that would clarify standards for attaching rooftop solar panels, enable large solar rooftop installations, remove zoning impediments to alternative energy, and remove landmarks impediments to alternative energy (Urban Green Council, 2010). Of these proposed revisions, the solar industry has indicated that the most significant would be the zoning impediments, which currently pose a significant barrier to solar development. The ongoing work of NYC SAC and its partners could create opportunities for innovative approaches to this issue both within the Solar Empowerment Zones and beyond. The recommendations of the Green Codes Task Force should be adopted in order to further streamline and support solar energy in New York City.

5.1.4. Pass the Proposed Electrical Code Revisions.
As noted in Section 1.3.4, new solar-friendly revisions to New York City's electrical codes have been formally proposed to the City Council. These revisions would undo the unique requirement that all completed PV systems be tested by professional laboratories. The City Council has not yet passed these revisions.

5.2. Inadequate Policies for the New York City Market

5.2.1 Explore New Financing Mechanisms for Solar Energy in New York City.
In order to fill the financing gap for solar installers in New York City, NYC SAC and its

partners could take several different approaches. First, NYC SAC could work with NYSERDA to explore the development of a new statewide clean energy loan program, interest rate buy down, or a loan loss reserve fund in order to support PV and solar thermal installations. Second, NYC SAC could work with Con Edison, NYPA and the Department of Environmental Protection (DEP) to explore the possibility of using electricity or water bills to support on-bill financing. Third, NYC SAC could survey and map current PV financing practices within the City in order to identify active or potential lenders. Finally, NYC SAC could continue to explore third-party financing and ownership, such as

Photo Source: Aeon Solar

supporting the entry of residential third-party owners into the market or working with water agencies, such as DEP, to become owners and operators of solar water heating systems on private property.

5.2.2 Create a NYPA Net Metering Tariff for City Buildings.

Net metering has been identified by the Solar Energy Industries Association as one of the "Four Pillars" of policy required to "drive real, cost-effective solar markets." To date, however, NYPA has not followed LIPA's lead and promulgated net metering rules. As a result, public sector projects are unable to reliably capture the full benefit that their PV systems produce. In order to help unlock the potential capacity identified in recent feasibility studies (Section 1.1.1), NYPA could work with the City and its partners to develop a net metering tariff that reflects national best practices and is at least at parity with the policies in place for the investor-owned utilities and for LIPA.

5.3. Enabling Large-Scale Solar Development in New York City

5.3.1 Articulate Solar Targets and Milestones for New York City.

New York City is on track to meet and exceed its goal of 8.1 MW installed within the City by 2015. Given recent policy changes, the City should consider setting new targets for its solar market growth. Rather than set these targets in isolation, however, NYC SAC could work closely with its key partners, such as NYSERDA, NYPA, and Con Edison, to jointly develop and set these new targets and then commit to helping to meet them. Progress towards these targets could then be periodically reviewed and could form the basis of an iterative and collaborative management and review strategy.

Once these targets have been developed, the City could consider integrating them into the next update of its PlaNYC 2030. The original PlaNYC 2030 established a goal of 800 MW for clean distributed generation and recognized the significant potential contribution of PV. PlaNYC 2030, however, did not set a specific long-term PV target to complement the near-term goal of 8.1 MW. In consultation with its state and utility partners, the City could revise both its near term goals and establish a realistic and specific long-term solar target within the context of PlaNYC 2030.

5.3.2. Actively Coordinate City, State, and Utility Funds.

In order to meet targets set in collaboration with state and utility partners, New York City must engage NYSERDA, NYPA and Con Edison to ensure coordinated resources. Historically, renewable energy funds from New York City have been diverted elsewhere: from 2006-2009,

New York City ratepayers contributed approximately $293 million of the total $762 million collected by NYSERDA in RPS funds, but only received an estimated $4 million back in projects during this same period. In other words, 98% of RPS funds collected from New York City ratepayers were used to develop upstate and out-of-state renewable energy projects. City and state partners can build off current efforts, such as the support NYC SAC has given NYPA on its 100 MW RFP, or the current Regional Program efforts, in order to strategically identify programs and policies to even out the distribution of statewide funding opportunities.

5.3.3 Extend the New York City Property Tax Abatement.

The New York City property tax abatement, which was intended to address the issue that state incentives were not well suited or targeted to New York City's infrastructure, is set to expire at the end of 2012. The City has an opportunity to revisit the policy and propose amendments based on new market realities. Specifically, stakeholders recommended that the property tax abatement levels be revised and extended for two more years and that it include a built-in review process to determine the need for future renewal, rather than a fixed expiration date. Stakeholders also recommended that the property tax abatement application and approval process incorporate lessons learned from the first several years of the program.

5.3.4 Promoting Large-scale Solar Projects in NYC.

Due in part to a lack of incentives (NYSERDA caps rebates at 50 kW), few large scale projects in NYC have been developed. In order to take advantage of forthcoming Regional Program funding (which specifically targets large-scale solar greater than 50 kW), the NYC SAC team should identify and pre-qualify sites that could host large solar projects.

Identify and aggregate demand: In order to support the goals of the Solar Empowerment Zone program, NYC SAC should perform pre-feasibility and feasibility assessments of eligible rooftops within the Solar Empowerment Zones and aggregate sites to promote large solar development. The staff of the New York City Solar Coordinator is well-positioned to facilitate aggregation of solar projects to mobilize new demand. For example, the Solar Coordinator and/or Ombudsmen could utilize the City's emerging solar mapping capabilities to screen rooftops within the Solar Empowerment Zones and identify strong candidates for solar projects. This screening process could be combined with outreach efforts to generate and aggregate interest in solar energy investment. The aggregation of willing solar host sites will likely reduce the transaction costs associated with generating new business in New York City and potentially provide economies of scale (through bulk purchasing), thus enabling installers to develop projects more cost-effectively. Ultimately, aggregation and screening of large solar projects will enable New York City to compete more effectively for Regional Program funding and/or could attract interest from installers offering power purchase agreement or leasing options.

Leverage the marketing efforts of NYC SAC partners: In addition to utilizing its own marketing resources, NYC SAC could work with its project partners to leverage related marketing channels. Some state and utility energy efficiency programs, for example, have integrated audits for solar thermal or photovoltaic feasibility into their standard efficiency audits. Some cities, meanwhile, are exploring options for pairing clean energy audits with traditional city services, such as health and safety inspections for rental units or site visits conducted through home repair and upgrade programs. NYC SAC could identify similarly promising new avenues for "mainstreaming" solar site assessments.

5.3.5 Developing Innovative Policies and Outreach Strategies in NYC's Solar Empowerment Zones.

As noted earlier, NYC SAC and Con Edison have identified Solar Empowerment Zones in Staten Island East, Greenpoint Gateway, and Downtown Brooklyn that have desirable load profiles, adequate roof space, and other characteristics that make them ideal areas for solar PV installations (See Section 4.2.1 Solar Empowerment Zones). However, to fully take advantage of the Solar Empowerment Zones, NYC SAC and its partners must develop a comprehensive strategy that engages residents, businesses, installers, and developers. The following recommendations describe options for developing an effective outreach and solar development strategy for the Solar Empowerment Zones.

Pilot Innovative Solar Policies and Programs within the Solar Empowerment Zones: By employing aggregation and outreach techniques described above, NYC SAC can drive demand for solar across commercial and residential sectors. Moreover, as part of its outreach strategy, NYC SAC should pilot innovative solar policies and programs within the zones to further encourage solar development. For example, NYC SAC and Con Edison could pilot innovative incentive structures in the Zones that appropriately reward solar project owners for interconnecting as the full benefits of solar are better quantified. This could take the form of an incentive program that compensates solar systems with storage for the grid congestion benefits or policies that decouple incentive payments from building loads and enable landlords to invest in solar (e.g. the feed-in tariff currently being considered in Los Angeles) (Matz, 2010).

Launch a Brownfields to Brightfields Initiative: As part of PlaNYC 2030, New York City established the Mayor's Office of Environmental Remediation (OER) as the lead agency for brownfields planning, testing, and cleanups. There are opportunities for the City and its partners to work with OER to develop joint strategies for converting brownfields into "brightfields" and for exploring solar power on vacant properties. OER estimates that approximately 7,600 acres of brownfield sites currently exist in New York City. NYC SAC is in a position to work with OER to identify promising candidates for ground-mounted solar installations. Such sites could potentially leverage both solar funding and sources of brownfields funding to support brownfields redevelopment and the utilization of vacant properties. The state, for example, currently offers a Brownfields Redevelopment Tax Credit, which a recent NYSERDA report identified as being potentially useful to fund alternative energy sources such as PV (Bourgeois et al., 2009).

5.3.6 Support Solar in Under-served Markets

Launching community solar pilots: Several different types of community solar models have been attempted around the country (Coughlin and Cory, 2009). Two prominent models include the upfront ownership model and the subscription model. Under the first scenario, a central organization or private developer initially finances and operates solar projects on behalf of customers. Costs are then recovered from customers through sales. Customers acquire an ownership share in the project and receive payment for the corresponding value of the energy over the life of the project. Ashland Oregon's Solar Pioneers II project operates under this model. Under the second scenario, a central organization (which could be the utility) owns solar generation and sells annual subscriptions to customers to offset a portion of their energy consumption. The Sacramento Municipal Utility District (SMUD) operates its Solar Shares program under this model. Ideally, after evaluating these and other models, NYC SAC could work with Con Edison, with NYSERDA, and with its other partners to launch its own community solar pilot with the goal of dramatically expanding the pilot if it is successful.

Pursuing Solar for Affordable Housing: Affordable housing represents an under-explored opportunity for solar energy development in New York City. Affordable housing residents typically pay into ratepayer-funded renewable energy programs, but are frequently unable to take advantage of rebates or other incentives that those programs offer. Moreover, energy costs represent a significant proportion of annual expenses for affordable housing owners and tenants. Solar power can significantly reduce the annual energy cost burden while also helping to insulate operating budgets from volatile energy prices. Numerous models for supporting solar energy in affordable housing have been recently pioneered across the country. Several promising models that NYC SAC could explore include:

- Leveraging Federal Low-Income Housing Tax Credits (LIHTCs) for solar projects: New affordable housing developments with rental units are eligible to compete to claim a 9% LIHTC on their eligible investments each year for 10 years. This tax credit can also be claimed on PV investments. When combined with other state and federal incentives, the 9% LIHTC can make PV on affordable housing a low cost proposition. Developers can also pursue a 4% LIHTC if they are unable to secure the 9% credit, which also creates significant economic incentive for PV (Peregrine Energy Group and Clean Energy Group, 2006). The City could play "matchmaker" between affordable housing developers and solar developers and help ensure that projects qualifying for LIHTCs are also screened for potential PV investments and receive assistance to navigate the PV development process. The New Jersey Housing and Mortgage Finance Agency pursued such a strategy under its Solar Underwriting with Low Income Tax Credits, or SUNLIT program. SUNLIT successfully facilitated the installation of over 1 MW of PV on affordable housing between 2005 and 2008.
- Performance Contracting for Public Housing: Under performance contracts, energy service companies (ESCOs) complete energy efficiency upgrades at no upfront cost to building owners, finance the projects based on the savings that the upgrades are projected to generate, and then typically guarantee that a certain level of savings will be achieved each year. Although performance contracts have been used primarily for energy efficiency, it is possible to combine solar energy and energy efficiency in performance contracts such that the savings from quick payback efficiency measures accelerate the paybacks of the solar systems. The Boston Housing Authority recently launched a $63 million performance contract covering 4,300 apartment units across 13 buildings. In addition to incorporating standard energy efficiency measures, the project will also incorporate solar energy systems. The New York City Housing Authority could explore the integration of PV and/or solar thermal into performance contracts or similar financing mechanisms.
- Solar ready requirements. The City could also require that all affordable housing developments that receive City funding (e.g. CDBG, HOME, etc.) be built "solar ready." Building solar ready includes a series of low-cost measures that will enable easy solar installations in the future. The Enterprise Green Communities Criteria for affordable housing include a PV readiness requirement (Enterprise Community Partners, n.d.), and NREL recently published guidelines for solar ready construction (both PV and solar thermal) (Lisell et al., 2009). As part of PlaNYC 2030, the NYC Department of Housing Preservation and Development (HPD) will require all buildings that it funds to meet the Green Communities Criteria starting in 2011. HPD could require that the solar readiness requirement be mandatory, rather than optional, and could also extend the criteria to also apply to solar thermal in lieu of PV.

Photo Source: Solar Energy Systems

5.3.7 Identifying and Capturing the Value of PV to the Grid: Utility and Emergency planning

Quantify Benefits of PV: Although Con Edison has begun to identify high-value locations for PV installation, the full benefit of solar PV has not yet been quantified in New York City. As a result, it is unclear whether PV installations receive full compensation for services they provide, such as peak shaving, demand response, environmental benefits, and so forth. NYC SAC has embraced a number of initiatives already that focus on quantifying the impact on solar on the grid (e.g. data loggers in the solar empowerment zones); however, expanded efforts could grow from this groundwork in order to provide evidence for PV's specific value to New York City (grid benefit or otherwise). A study that quantifies the full value of solar PV in New York City and positions PV to participate in existing or emerging markets for energy services and environmental attributes, including peak load management, forward capacity, and demand response programs, would provide strong support for the New York City solar market.

Planning for Emergencies with Solar Power: In the event of a disaster, traditional central grid resources may be incapable of delivering power to New York City residents. As a distributed resource that uses sunshine for fuel, solar power provides obvious benefits to residents and first responders in the event that a disaster knocks out the grid. Building on the menu of emergency planning options developed under the Solar America Cities program, it is recommended that the City build off of this initial work to prioritize and implement several solar emergency planning strategies. The following describes emergency planning programs the City could employ.

- Increase Interagency Coordination to Site Solar at Critical Facilities: Critical facilities serve or house displaced persons in the event of a natural disaster and typically include buildings such as hospitals, fire stations, police stations or other emergency service facilities. They may also include utility lifeline facilities, such as water, electricity, and gas supply buildings. Because solar is a quiet, clean, and sustainable form of power generation, it carries significant fuel benefits for critical infrastructure in the event of a disaster. Additionally, the Office of Emergency Management opens designated "cooling stations" at critical facilities around New York City during heat waves to assist those experiencing physical discomfort. Most of these facilities use back-up diesel generators that require expensive fuel inputs to operate during heat waves. In such cases, solar power represents an ideal solution, minimizing fuel costs. Going forward, the NYC SAC should work with city agencies like the Department of City Planning, Office of Emergency Management, Department of Education, and New York Fire Department (among others) to incorporate solar into critical facilities.
- Incorporate Solar Planning into NYC Office of Emergency Management's "Site Protocol" for Rapid Deployment of Modular Housing Units: A coordinated effort between NYC SAC and the NYC Office of Emergency Management to identify viable sites to stage emergency modular housing units within the Solar Empowerment Zones or other strategic areas (e.g. parks, ball fields, parking lots, etc.) could lay the groundwork for this concept. The two groups could then work together to incorporate

solar into infrastructure surrounding the potential modular housing sites such that the solar would be able to switch to provide power to modular units if they were deployed there in the event of a disaster. Additionally, the City should work with emergency housing unit manufacturers to incorporate solar into modular, rapidly deployable housing units.

- Emergency Solar Evacuation Route: The City could outfit its emergency evacuation routes with solar power (and battery back-up) so that evacuation route signals, lights, communications, and/or fuel pumps continue to function in the event of a blackout. This could be modeled after the emergency solar evacuation route currently underway in Boston. Identifying strategies such as this could position the City to pursue Homeland Security and FEMA grants to fund projects that incorporate solar power into emergency response planning.

Pilot Alternative Solar Storage Projects: Building off of previous work by NYPA, CUNY, and others, the City should continue piloting various technologies for storing solar electricity. In addition to battery back-up, the City, Con Edison, and NYPA should consider other technology options for solar storage. This could include storing power at sub-stations using flywheel technology, batteries, hybrid vehicle storage, or other technology. This is already taking place in Germany, where many energy planners argue that costs may prohibit "grid connected system operators [from storing] self-produced solar electricity" (e.g. in batteries). Recognizing that the country may soon bump up against grid constraints for wind and solar capacity additions, German planners are thinking about storage on a larger scale (Sollmann, 2009). As New York City's solar market develops over the coming decade, planners should also think about large-scale energy storage options, which could improve grid reliability and simultaneously benefit solar power.

5.4 Designing a Solar Hot Water Roadmap for New York City

Building on the NYCEDC's $1 million SHW grant program, the following recommendations are intended to increase the market for SHW in New York City:

5.4.1 Develop a Solar Thermal Roadmap.

As has been made clear during the past five years of PV development, New York City is a unique market that requires customized solutions in order to remove barriers and reduce transactions costs. With the inclusion of solar water heating in the RPS customer-sited tier and the development of a statewide roadmap by the New York Solar Thermal Consortium, the time is right to focus on solar thermal development within New York City. In order to reduce local installation costs and better capture state funds, NYC SAC should identify the specific strategies that New York City should pursue.

5.4.2 Incorporate SHW into the Property Tax Abatement.

In addition to extending the property tax abatement, the City could also expand the incentive to cover more technologies like SHW. New rebate funding from NYSERDA and grant funding provided by NYCEDC will certainly help stimulate SHW development in the short-term, but the local market will likely require an additional jumpstart. To this end, the City should consider making solar thermal projects eligible for the property tax abatement.

5.4.3. Clarify the Solar Thermal Permitting and Inspection Processes:

Stakeholders indicate that uncertainty exists in treating solar hot water systems under the building code. Most architects and professional engineers, for example, do not know whether they need building, electrical, plumbing, or fire permits for SHW systems. As a result, a SHW task force could collaborate with local officials to resolve this uncertainty. NYC SAC should also incorporate solar hot water projects into Solar Empowerment Zone initiatives, particularly those

relating to education and outreach efforts. Since NYSERDA only provides rebates to systems that offset electrical loads, for example, the City and Con Edison could conduct targeted marketing to the limited subset of customers within the Zones that have electric water heaters.

Identify Strategies to Support Non-electrical Solar Water Heating Systems: The new NYSERDA rebate program for solar water heating systems will help launch New York State's solar thermal market. The majority of New York State heating demand, however, is met through natural gas and oil – only a small share of the market is supplied by electricity. As a result, NYSERDA's new rebate will not allow a broad spectrum of potential solar thermal investors to participate in the market. To bridge this funding gap, NYC SAC could work to build on the momentum of the NYCEDC grant program and identify alternative ways to fund solar thermal systems, such as expanding the mandate of the RPS to fund non-electrical solar thermal applications, creating a renewable energy target specifically for renewable heating and cooling technologies, or identifying funding through the carbon markets.

5.5. Supporting New York City's Emerging Solar Cluster

Emerging, as well as established, organizations and businesses in NYC are interested in investing in the solar industry in a multitude of areas. Coordinated business support, access to new research and development, workforce training development, regional marketing support, and networking and engagement platforms are essential elements needed to support the NYC solar cluster. Sustainable CUNY, through its lead in the NYC SAC partnership, along with other key partners have already established a network and platform to fill this role: CUNY SustainableWorks, a commercialization program, and the NYC Sustainable Business Leaders Advisory Board. The following recommendations describe how it could build out its capacity as an effective solar cluster manager.

5.5.1 Cluster Analysis & Roadmap.

First, Sustainable CUNY, through CUNY SustainableWorks with support from the NYC SAC partnership and the NYC Sustainable Business Leaders Advisory Board, should analyze and report on the make-up of its emerging solar cluster. A NYC Solar Cluster Analysis and Roadmap would start by mapping the solar business cluster and value chain in New York City. Details must include the entire value chain of companies, including solar technology manufacturers and machine firms, installers, plumbing and electrical contractors, venture capital firms, consultants, engineering firms, and so forth. Such an analysis should also identify strengths and gaps in the solar business chain, which would accordingly enable the City to better identify needed resources for its business support and commercialization of emerging solar technology unique to urban environments. Finally, such an analysis should be structured to provide the City with a roadmap and best practices for more active management and support of its emerging solar cluster.

5.5.2 Business and Commercialization Support.

The City and its partners should provide comprehensive business support to emerging solar businesses in NYC. In many areas, the City's partner organizations already have infrastructure to provide support services. For example, CUNY already has established CUNY SustainableWorks, a commercialization program with both an active collaboration center and a planned commercialization center which provides technical, legal, financial, managerial, and logistical support and eventually prototyping and showcasing for clean and sustainable technology. However, as solar businesses grow, they will require greater support from angel investors, venture capital, or strategic corporate investors. The City and its partners should reach out to the greater business community to create a comprehensive cluster of businesses and organizations that can leverage resources to provide capital and strategic support as solar entrepreneurs grow.

5.5.3 Technology Development & Transfer.
The City and its partners should strengthen existing relationships with universities and colleges in and around NYC to promote solar technology transfer and commercialization. NYC already is home to several excellent engineering schools and should work with them to promote greater research and development in solar technology. For example, CUNY has a Technology Commercialization Office and, through CUNY SustainableWorks, has the ability to engage partners in a number of technologies. Within this space, the City and CUNY could focus on engaging partners in cutting edge solar technologies like building integrated PV (BIPV), and where possible, partner with entrepreneurs and established companies. The City should also engage a variety of industry, government, manufacturing, and corporate partners in collaborative efforts to drive technology transfer forward.

5.5.4 Branding.
The City should brand and market New York City as a leading U.S. solar cluster for the urban environment with a focus on innovation. This could take form in a number of ways. First, the City may consider engaging other leading solar cities and businesses to learn from their experiences and market NYC as an attractive area for investment. Second, the City should seek out corporate partners interested in partnering on specific innovative technologies. For example, the City could develop BIPV innovation centers and pilot projects with corporate building materials or roofing partners. Third, the City should report on its solar cluster initiatives on its website.

5.6. Promoting Solar Curriculum within Schools

The City and its partners are committed to a broad range of outreach and education efforts and a key recommendation from solar stakeholders has been to develop solar energy education programs. Moving forward, the City and its partners should emphasize the role of solar in schools in several key ways.

5.6.1 Partner with Schools and State Agencies.
A number of organizations are interested in promoting solar energy and curricula in New York City schools, including NYSERDA through its School Power… Naturally Program, OLTPS, CUNY, and NYPA, among others. CUNY has begun work on such a partnership with the NYC Department of Education by conducting site visits to pre-screen schools within the Solar Empowerment Zones for NYPA's 100 MW RFP, but NYC could additionally develop a plan to install solar PV or hot water projects on every public school in NYC. This could be facilitated by pre-qualifying schools through feasibility analyses and pre-site inspections. Additionally, every solar school project should publicly report real-time energy performance data.

5.6.2 Solar Curriculum in Public Schools.
As has been done with energy efficiency, teacher training and instruction should also be provided to integrate solar into the classroom curriculum. Moreover, Solar Ombudsmen should focus on promoting solar in the classroom as part of their outreach strategy in the Solar Empowerment Zones. Additionally, schools could make excellent hosts for community solar projects.

5.7 Benchmark New York City against International Best Practices

New York has a place on the international stage as one of the world's largest and most economically dynamic cities. New York City has an opportunity to benchmark its own approach to solar policy against that of its peers. Around the world, cities have pioneered the policies that have reshaped the national and international renewable energy market. The cities of Hammelburg and Aachen in Germany, for example, pioneered the first feed-in tariffs for photovoltaics in 1993 (Fell, 2009; Solarenergie-Förderverein, 1994). This model was eventually adopted at the federal level in 2000, and national solar feed-in tariffs have since spread to over 20 countries (SEMI PV Group, 2009). In 1999, the City of Barcelona, Spain, became one of the first

cities to require that all new buildings install solar thermal systems (Schaefer, 2006). The mandate initially spread to 50 other municipalities, including Madrid, before being adopted as national law in 2006 (European Solar Thermal Industry Federation, 2007). The policy was subsequently adopted by four other European countries – the most recent of which was Germany (Wustlich et al., 2008) – and Hawaii attempted to imitate the Spanish example in 2008 (Rickerson et al., 2009). Although New York City may not decide to Pursue construction mandates or feed-in tariffs, it has an opportunity to make its own unique mark on the international scene. In order to better chart its own path and to learn from other cities about how best to manage large-scale solar market growth, the City should investigate international experience.

5.7.1 Engage International Solar Cities.

As the international solar market continues to grow, New York could learn from experiences of other municipalities and position itself as an international leader in the solar market in order to attract investment and create new jobs in the clean energy economy. The City could conduct a focused international study tour, visiting places such as Barcelona, Spain; the Chinese City of Weihai, which has implemented aggressive new solar regulations and building codes; and the German city of Freiburg, which has pursued innovative urban planning solutions based on solar power in order to research costs, benefits, and best practices.

6. Conclusions

Since the first assessment of New York City's solar market in 2006 and 2007, NYC SAC has made significant progress in breaking down barriers that prevented expansion of the local solar market. In particular, by collaborating with Con Edison and other partners, NYC SAC clarified, simplified, and publicized technical and regulatory parameters for interconnecting solar PV to the New York City network grid, which has largely eliminated technical uncertainty around PV and network grid interactions. Similarly, a number of new solar policies, including the property tax abatement, the revised net metering regulation, and the newly launched Regional Program funding initiative were created. Finally, NYC SAC and its partners have developed a number of innovative local solar policies and programs, such as the recently launched Solar Empowerment Zones, the $1 million solar thermal pilot program, and the forthcoming New York City Solar Map and community solar plan. Altogether, NYC SAC's work over the past five years has positioned New York City for tremendous solar market growth. Recent projections suggest that New York City could have between 45 and 70 MW of solar PV installed by 2015, resulting in exponential market and job growth for the City's emerging solar industry.

Going forward, it is clear that several key challenges continue to constrain the New York City solar market, including a complicated solar permitting process, high installation costs, and lack of long-term financing options. NYC SAC has made some headway in addressing these issues and will need to continue addressing them if it is to successfully compete with surrounding regions and receive its fair share of state, federal, and private solar funding.

To meet its potential for solar market growth, New York City must transition from planning to full-scale implementation of its solar strategy. With the 2010 launch of the Solar Empowerment Zones, the City has clearly started this transition. The recommendations outlined in Section 5 further identify key opportunities to assist city leaders in making that transition. Through smart program and policy planning, coordination, and implementation, New York City is poised to continue its pioneering role as a Solar City.

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