

FINAL REPORT

City University of New York
Solar Market Analytics, Roadmapping, and Tracking NY (SMART NY)

This report outlines CUNY's efforts on behalf of New York City (NYC) under SunShot's "Rooftop Solar Challenge", to reduce the administrative soft costs of solar in the largest market in the country. As part of RSC I CUNY formed and guided, through NYC Solar Ombudsmen, Working Groups (WGs) in each of the DOE Action Areas. The NYC WGs were led by organizations with the ability to develop and implement policies and programs:

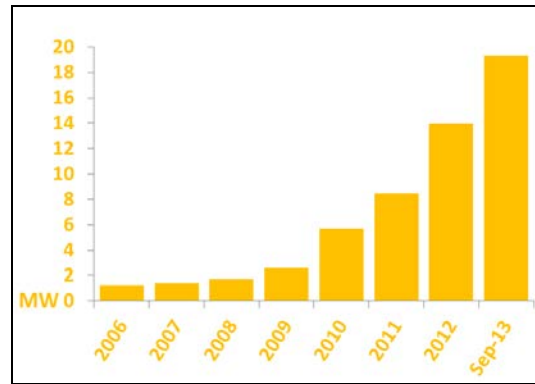
- 1) The Permitting and Interconnection Process WG led by Con Edison and the NYC Department of Buildings (DOB);
- 2) Interconnection and Net Metering Standards WG led by New York Power Authority and Con Edison;
- 3) The Financing Options WG led by New York City Economic Development Corporation and the Mayor's Office of Long-Term Planning and Sustainability (OLTPS); and
- 4) The Planning and Zoning WG led by the NYC Department of City Planning (DCP).

Additionally, CUNY partnered with IBM and worked with NYC and NYS agencies to create a solar analytics platform to analyze solar market data and create a real-time permitting feedback loop for city, state, and federal partners.

During RSC1, the NYC partners were able to achieve:

- An extension of the NYC property tax abatement allowing system owners to save up to 10% in property taxes over four years;
- Zoning amendments making solar a "permitted obstruction", saving projects that would have formerly had to apply for a variance 2-4 weeks and eliminating a review by City Planning;
- The launch of the NYC DOB program "Get It Done Together Solar Edition", saving installers 15 hours of in-person review time per project and at least \$51,000;
- The temporary implementation of a fast-track electrical inspection process, allowing at least 111 systems to meet the 2012 property tax abatement deadline and take advantage of a 20% property tax abatement rather than a 10% property tax abatement.
- The hiring of 4 additional solar Plan Examiners at the NYC Department of Buildings
- The DOB Development Hub allowing for:
 - Virtual plan exams,
 - E-filing,
 - Accelerated inspections
 - Accelerated permitting
- In October 2012, an e-permitting option with a one-day turnaround time for non-property tax abatement projects was introduced, and DOB is training 28 new inspectors.
- Publication of standard checklists for DOB electrical and building inspections
- Improved outreach documents regarding the DOB permit process
- Expansion of NYSERDA's PON 2112 from 7 kW up to 25 kW for residential systems, and from 50 kW up to 200 kW for commercial systems
- Training sessions to bring Installer community up to speed on new building, electrical, and fire code, and utility interconnection processes
- Survey of stakeholders

These efforts helped support continued market growth in the five boroughs, as seen in the chart below (current as of this report, September 2013).



NYC Solar Installed Capacity, 2006 – September 2013

TASKS

Task 1.0 Convene and Lead Action Area Working Groups

The SMART NY Action Area Working Groups (WGs), each created and guided by NYC Solar Ombudsmen, were the central platform for identifying and implementing necessary actions to reduce non-hardware balance of system costs for PV in New York City. Each group was led by NYC stakeholders who had the expertise and authority to affect change. The NYC Solar Ombudsmen held kickoff meetings (SubTask 1.1) with each group, reviewed the benchmarking scores for each Action Area, and guided the groups in creating implementation plans to meet SMART NY deliverables. Over the term of the grant, the Ombudsmen held regular calls and/or meetings with the WGs to ensure that the groups were staying on task. The Ombudsmen also conducted a mid-grant evaluation, based on an updated walkthrough of benchmarking scores, to refine any WG actions as needed.

SubTask 1.1 Kickoff Meetings

NYC Solar Ombudsmen held kickoff meetings with the leads of each WG the week of March 12, 2012. The purpose of these meetings was to review WG goals and objectives, answer any questions, and outline an implementation plan. The following agencies and organizations attended the meetings:

- Permitting and Interconnection (PI): Con Edison, NYC Department of Buildings
- Net Metering and Interconnection Standards (NMI): New York Power Authority, Con Edison
- Planning and Zoning (PZ): NYC Department of City Planning
- Financing Options (FO): NYC Economic Development Corporation, NYC Mayor's Office

Additional members of each WG attended the SMART NY kickoff meeting and are listed below.

On March 28th, the Working Group efforts were officially kicked off at the NYC Solar America City Advisory Board meeting. The Working Group leads reviewed the benchmarking results of each respective Action Area, presented their plans to the group for feedback and input, and outlined the goals of each WG. Attendees included: WG leads listed above, NYC Fire Department, Long Island Power Authority, New York State Energy Research and Development Authority (NYSERDA), NYC Landmarks, NYC Office of Environmental Remediation, NYC Department of Citywide Administrative Services (DCAS), National Resources Defense Council, The Solar Energy Consortium, Solar Energy Systems, Aeon Solar, altpower, SunEdison, Empire

State Development, Pace University Law School, Mercury Solar, Bronx Overall Economic Development Corporation, Local IBEW, Alliance for Clean Energy NY, and Solar 1.

Following the Advisory Board meeting, the Ombudsmen worked with WG leads to finalize implementation plans as described in SubTasks 1.2 – 1.6.

SubTask 1.2 Create implementation plans for permitting and interconnection improvements

In Q1 and early Q2 of the grant period, the Ombudsman worked with Con Edison and DOB to review WG priorities and finalize an implementation plan for permitting and interconnection improvements. By July of 2012, the following tasks had been listed for WG action:

- Ensure integration of solar into DOB’s multi-agency “Get It Done: Together” plan review protocols (includes FDNY, OER, DCP, Landmarks as needed per project)
- Provide data flows on permitting/interconnection status of PV jobs to CUNY for project tracking and market analytics
- Create consistency and transparency on inspection requirements by creating and posting DOB inspection checklists
- Revise DOB public material on permitting procedures and NYC Property Tax Abatement requirements and protocols
- Create solar “FAQ” document on DOB website
- Internally flag and prioritize plan reviews for solar projects at DOB
- Set up system to auto-populate e-filing forms for Property Tax Abatement projects at DOB
- Create notification system at DOB’s Inspection Hub to automatically alert staff when Property Tax Abatement projects have final inspections pending
- Work with FDNY to create more flexibility on fire code requirements for brownstone buildings
- Explore possibility of joint DOB/Con Edison inspections

Following finalization of the implementation plan, the Ombudsmen held bi-weekly meetings with WG leads, with additional members as necessary, to ensure progress on achieving all tasks. Outcomes are described in SubTask 1.8.

SubTask 1.3 Survey PPA/solar lease providers

The WG leads, the Mayor’s Office and the NYC Economic Development Corporation, crafted a survey methodology, questions, recipients, and additional research (e.g. literature reviews, market analysis) that needed to be conducted in order to present survey results that would lead to concrete recommendations for improving financing options in NYC. The WG also incorporated feedback from NYPA and DCAS, two organizations that have experience with PPAs.

The FO WG determined that phone calls and/or in-person meetings would be the most effective method of leading conversations. The Ombudsman worked with the WG to develop a list of standard questions, and the WG completed a list of survey recipients. Interviewees were: Bloomberg New Energy Finance, NRG Solar, Tangent Energy, Solar Energy Systems, BrightGrid Solar, SolarCity, Sungevity, SunRun, Solar Mosaic, Consolidated Edison, NYC Department of Citywide Administrative Services, and the Bronx Overall Economic Development Corporation.

The interviews were completed by March 2013, and the results were incorporated into a full report titled “Financing Options Working Group Final Report” that is attached to this document. The report outlines status of the existing NYC solar market, including currently available incentives and financing options, and recommendations for improving and expanding access to financing for PV.

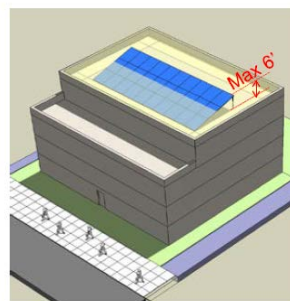
SubTask 1.4 Explore development of a Municipal Credit Union Financing program

In Q1 of the grant period, NYC Solar Ombudsman created a presentation on possible options for creating a local PV financing program. The options were largely based on a successful program implemented in San Jose.

The NYC Solar Ombudsman and University Director of Sustainability made weekly efforts via phone and email to reach a contact at the NYC Municipal Credit Union (MCU) to set up a meeting to present the outlines of a possible program and benefits to MCU. Various methods, ranging from cold calls to existing relationships with CUNY staff, were utilized to gain a response and schedule a conversation. These efforts continued on a regular basis through spring of 2013. Contacts at MCU either did not respond or failed to provide any timetable for a meeting or phone conversation, however efforts are ongoing. As the profile of solar in NYC continues to rise, we anticipate that Credit Unions and other financial institutions will establish programs and we remain available for assistance.

SubTask 1.5 Support designation of PV as a “permitted obstruction”

In the early part of 2012, CUNY Solar Ombudsmen worked with DCP staff to review and provide feedback to initial zoning proposals as related to solar that were recommended by the [Green Codes Task Force](#). The Zone Green Text Amendment was proposed by DCP and CUNY’s NYC Solar Map was able to provide information about solar energy to the public during DCP’s public comment period. On April 30, 2012, the City Council approved a text amendment to the Zoning Resolution of the City of New York (“Zone Green”) to remove zoning obstacles to installing solar PV and other green technologies on NYC rooftops, walls, and some accessory buildings. The Zone Green text eliminated a major barrier to solar in NYC. Before the Zone Green Text Amendment was passed, solar installations were not among the list of items permitted to exceed a zoning height limit, and therefore were not allowed by NYC zoning regulations to be added on top of many buildings in the five boroughs. With the approval of the Zone Green Text Amendment, solar energy systems are now categorized as permitted obstructions, and now allowed “as of right” within the context of NYC zoning regulations.



■ 6 feet height above maximum building height or finished level of roof

PV is now allowed to be installed above a building’s maximum height.

For more information on the approved NYC Zone Green Text Amendment and to view the text please visit the [Department of City Planning's \(DCP\) website](#).

The NYC Solar Ombudsman worked with DCP to create an outreach and guidance document for installers about the text amendment; that report can be found [here](#).

SubTask 1.6 Survey stakeholders on interconnection and net metering standards

CUNY and the WG members developed a survey to gauge industry understanding, functionality, and sustainability of NYS interconnection and net metering standards. The group surveyed a wide range of stakeholders to explore and identify possible improvements and changes to the Net Metering and Interconnection standards in order to support a more robust solar market. The survey was released in the fall of 2012 to 127 stakeholders, including utilities, ratepayers, advocates, and installers. After weekly email reminders, the response rate to the survey was 27%.

The survey results represented answers and input from a wide range of stakeholder types and geographic distribution. Many of the responses came in the form of comments, suggestions, and criticisms of current policy. The WG spent the first quarter of 2013 sifting through the responses to arrange the qualitative comments into appropriate categories for action (i.e., “net metered required minimums” or “billing requirements”) in order to distill 276 comments into practical recommendations. The WG also consulted with Vote Solar and Alliance for Clean Energy NY to ensure integration of best practices and additional resources.

The full report was completed in June 2013, and is available [here](#). Key short-term actions include improving transparency of progress toward utility system-wide net metering limits and clarifying billing requirements and administration.

SubTask 1.7 Present recommendations to NYC Solar America City Advisory Board and NYC Solar America City Installer Roundtable

The Solar Advisory Board meeting, originally scheduled for November 7th, was postponed due to Hurricane Sandy but met on December 4th. Meeting attendees included: NYC Department of Buildings, Con Edison, New York Power Authority, Long Island Power Authority, Central Hudson, NYSEERDA, NYC Economic Development Corporation, Mayor's Office of Long-Term Planning and Sustainability, Solar Energy Systems, FDNY, Solar 1, Natural Resources Defense Council, PACE Energy and Climate Center, Empire State Development, Sun Edison, and National Grid. Updates from all four Working Groups were presented to the group for feedback, as well as an initial list of best practices for reducing balance of system costs across the state based on work to date in NYC. CUNY and CVI also presented updates to the PV data gathering and IOC. The last part of the meeting was a discussion of ideas for statewide implementation of the SMART NY framework.

SubTask 1.8 Implement recommendations and develop preliminary list of recommendations for standardized and streamlined permitting in up to three jurisdictions

In 2Q 2013, the PI WG completed several tasks that were outlined in the implementation plan created in SubTask 1.2. The following deliverables were completed:

- Publication of DOB inspection checklists. These checklists will be used by DOB inspectors to ensure consistency and transparency of inspection requirements.
- New DOB solar PV process website. This website explains the various permitting mechanisms for Property Tax Abatement and non-Property Tax Abatement projects.

- Updated FAQ page on the DOB website. This new page outlines answers to the most commonly received questions by DOB.
- Auto-population capabilities of e-filing form for Property Tax Abatement projects. This ensures that the right boxes are filled in consistently to flag these projects as solar projects within DOB's system.
- Internal notifications of inspections at DOB. This system automatically notifies inspection staff at DOB when Property Tax Abatement projects are ready for inspection.
- Prioritization of plan reviews for solar projects
- Prioritization of plan reviews for Property Tax Abatement projects. This internal DOB system flags PV plan reviews for a 5-day timeline.
- Feedback and collaboration with FDNY on new guidelines for fire code setbacks and pathways on brownstone buildings. This proposed code change will allow more flexibility for small roofs. The proposal has been vetted by FDNY and Mayor's Office and is expected to be adopted by DOB (enforcement agency) in the coming months.
- Creation of an e-filing, one-day turnaround time for non-PTA permits

Con Edison and DOB did evaluate joint inspections (i.e., DOB would inspect both Con Ed and building sides of the electrical connection) but determined that more work needs to be done to establish appropriate training and safety checks before moving forward.

Additionally, CUNY Solar Ombudsmen worked in 4Q 2012 with over 50 projects that were impacted, either physically or administratively, by Hurricane Sandy in order to get applications completed in time for a local incentive deadline. Due to intensive, daily coordination between Con Edison and DOB, the majority of the projects reached the deadline.

The following list of recommendations for standardized/streamlined permitting was developed in 1Q 2013 after presentation to the NYC Solar America City Advisory Board in December of 2012. One crucial piece of feedback received during the meeting was that any list should be considered a "menu" of options, as municipalities across NYS are very diverse and have a wide range of resources, needs, and solar market sizes. This list was used to help create a framework of a statewide "NYSolar Smart" program that was begun with NYSERDA and NYPA support in early 2013.

- Regular installer trainings
- "Get It Done Together" type in-person plan reviews
- E-filing
- Online permit fee payment
- Outreach guides and documents: permit process, inspection checklists, FAQs
- "Zone Green" or similar solar-friendly zoning code
- Utility preliminary technical review for large projects
- Online interconnection application
- Solar process tracking (multi-agency)
- Local market tracking
- Standardized small-scale PV permit (Solar ABCs)

SubTask 1.9 Outreach Campaign

The SMART NY team focused on ongoing communications and organized events throughout the grant term to ensure that local partners and industry were educated and informed about project progress, resources, and next steps. The primary method for communications to installers was the

NYC Solar Installer Roundtable, which now has over 100 members and is convened and monitored by Solar Ombudsmen. The Ombudsmen utilized the roundtable, either through organized calls, email updates, or meetings to provide updated information as well as receive comments and requests for assistance from the industry and often serves as a liaison between installers and agencies.

CUNY also hosted and organized two events to educate the local solar industry on permitting, interconnection, and incentive protocols in New York City. On October 1st CUNY hosted an “NYC Solar Connections” event, hosted by CUNY, Con Edison and NYSERDA. This full-day conference included a morning workshop for installers with a presentation from CUNY on the SMART NY initiative and an afternoon networking event for building owners and installers. This event was highly successful, with 24 installation companies attending, each with a booth to showcase their companies. 450 building owners signed up for the event and approximately 300 – 350 attended the afternoon session to meet the installers. CUNY also displayed the NYC Solar Map on several laptops to help building owners see their solar potential.

On March 21st, CUNY co-hosted a “SMART NY” solar installer training with Con Edison, NYSERDA, DOB, and FDNY. The event was held at the Con Edison auditorium and featured presentations by CUNY, Con Edison, NYC Department of Buildings, NYSERDA, and FDNY. The presentations were aimed at installers new to NYC or to those installers who wanted a refresher course. Approximately 150 individual installers attended the full day event, including several new companies to NYC. CUNY used laptops to showcase the NYC Solar Map and representatives from each agency were available all day to answer questions. All presentations from the event are available on the Sustainable CUNY website. After the event 35 new installers signed up for the NYC Solar Installer Roundtable list-serve.

On June 4th, CUNY hosted the 7th annual New York City Solar Summit which had a record attendance of approximately 350 people. The morning of the Summit kicked off with presentations from CUNY, Con Edison, NYC Mayor’s Office, NYC Economic Development Corporation, and CUNY Ventures on the SMART NY framework and activities. Additional panels covered the launch of NYSolar Smart, CUNY’s statewide solar program, as well as a focus on efforts to integrate resiliency into solar PV post-Sandy. Several high-profile speakers were featured during the day, including: Richard Kauffman, Chair of Energy & Finance, Office of the Governor; Frank Murray, Jr., President and CEO of NYSERDA; James Laurito, President and Chief Executive Officer, Central Hudson; Kenneth Daly, President, National Grid; Stuart Nachmias, VP of Energy Policy, Con Edison, Kevin Lynn, U.S. Department of Energy, Kyle Kimball, Executive Director, NYC EDC, Robert Lurie, SVP of Strategic Planning, NYPA; and Mark Dougherty, Director of DG and Renewables, LIPA.

Task 2.0 Develop New York City Solar Process Information Hub

The creation of the NYC Solar Process Information Hub is intended to lead to institutional understanding of objective information about the status of the NYC solar market. The Information Hub links data on PV projects across Con Edison, the NYC Department of Buildings, and NYSERDA (statewide rebate authority). By breaking through agency silos, the Information Hub sets up the data framework needed for a holistic view of how the solar PV process is functioning in New York City. CUNY’s work on Task 2.0 set up the hardware and software required for implementation of Task 3.0.

SubTask 2.1 Determine solar process data points

This task involved significant coordination between NYC Solar Ombudsmen, CVI staff, and programmatic and technical staff at each partner office. CUNY and CVI worked with each partner to list relevant data points (e.g., information from DOB permit applications and inspections, Con Edison interconnection applications, and NYSEERDA rebate applications). The end result of this work was a list of 20-200 data points from each partner, including project information, installer information, permit/interconnection/rebate status, costs, and fees. Once the data points had been finalized, common elements between each list were identified so that projects could be tracked across each agency – i.e. so CUNY would know that Permit “xyz” at DOB was the same project as Interconnection Application “abc” at Con Edison.

An important lesson learned in this exercise was that data confidentiality and security needs to be addressed very early on, especially as more sensitive information (e.g. customer name) may be the information required to link projects across agencies. Any data sensitivity should be identified early on and worked through to reduce legal delays.

To finalize the data transfer format, CVI worked with IT staff at each agency to identify the feasible methods of exporting data on a daily basis. As each agency/organization tracks and gathers data differently and uses different applications to warehouse their data, defining three divergent methods of data transfer took some time. The preferred method has been a daily upload to a secure FTP site.

SubTask 2.2 Build hosting environment

In parallel with SubTask 2.1, CUNY will build a hosting environment to house the raw data. CUNY will ensure necessary security and privacy protocols are in place.

In parallel with SubTask 2.1, CUNY and CVI worked closely with CUNY Computer Information Systems (CIS) staff to set up both the hardware for hosting and the necessary software to make the hosting environment functional. As the scope, size, and interaction of the data feeds became clear, CVI and CIS were able to design appropriate servers and database support. In 4Q 2012, the server hardware (a system called “Flexpod”) was installed at CIS. By the first quarter of 2013, the software environment of the server environment was completed.

In parallel, CUNY and CVI used the data points finalized in SubTask 2.1 to define a data schema to store the data optimizing for security, data growth and anticipated reporting use. The database was then created to store and link all of the various data points together. As mentioned in SubTask 2.1, two important aspects of data coordination and delivery needed to be prioritized in this task: linking data points between three different organizations, and ensuring that private and sensitive data were appropriately stored and protected.

These issues were kept at the forefront as CVI and CIS built the database and installed the servers, especially because in this case it was the sensitive data (customer-specific information) that is critical to linking information about projects across Con Ed, DOB, and NYSEERDA. A custom data processing workflow was developed that facilitates linking of data from disparate data sources. At first, the database attempts to automatically match data records using exact and fuzzy matching. If no match is found, the system allows administrators to manually match records.

A diagram of the system architecture is attached to this report.

SubTask 2.3 Integration of data into Intelligent Operations Center™ (IOC)

In Q1 2013, CUNY and CVI sent the preliminary database built as part of SubTask 2.2 to IBM of all of the data points identified in Task 2.1. CVI also sent the data schema to IBM. This data schema includes all of the data points and the protocols for transferring the PV project data from CUNY to the CVI data warehouse to IOC. Based on the data schema, IBM has built the use cases for the IOC and they are currently being hosted at IBM's development environment in Dallas, TX. More detail is included in Task 3.0 below.

Task 3.0 Create Intelligent Operations Center™ (IOC) for New York City

The Intelligent Operations Center™ (IOC) is proprietary, licensed software developed by IBM. This software creates an online platform for real-time analytics on the NYC solar market. As described below, the IOC incorporates data from NYC PV projects, the NYC Solar Map, and data acquisition systems. The two objectives of the IOC are: 1. Allow for real-time and historical objective analysis on the status of the NYC PV market to inform a wide range of stakeholders about the impacts of PV programs and policy and 2. Create continuity of institutional knowledge about the NYC PV market.

SubTask 3.1 Determine hosting requirements

In 1Q and 2Q of 2012, IBM, CVI, and CUNY held several in-person and phone meetings to outline capabilities of the IOC, create draft use cases for project stakeholders, and determine technical hardware and software requirements for IOC functionality. IBM's assigned project manager was responsible for presenting IOC logistics and frameworks, and the CUNY and CVI teams provided insight into NYC solar market needs, available data, and use case scenarios.

The use cases (e.g., user-based scenarios of what information the IOC would provide and how) were developed by mid 2012, in parallel with the finalization of data points conducted in SubTask 2.1. CUNY and CVI ensured that the data points collected would support each use case. This task also informed the level of software support needed for IOC functionality. The IBM project manager also provided technical specifications on hardware support required for eventual CVI hosting of the IOC.

The hardware and software required for support and hosting of the IOC was installed by CUNY CIS, in consultation with CVI and IBM, in the 4th quarter of 2012 and the 1st quarter of 2013.

SubTask 3.2 Interview NYC stakeholders about specific analytics needs

In March of 2012, CUNY hosted the NYC Solar America City Advisory Board meeting to outline plans for all aspects of the SMART NY program. As described in SubTask 1.1, all project stakeholders participated in the meeting, including all IOC license users (DOB, Con Edison, NYSEERDA, NYC Mayor's Office, and NYC EDC). An overview of the IOC capabilities and objectives were presented to the full Board.

Following the full meeting, CUNY, CVI, and IBM led a small, more focused meeting with core stakeholders to get feedback on the analytics needs of various stakeholders. CVI outlined the objectives and purpose of the IOC, and IBM then led a demonstration of the IOC. The SMART NY team then went through each use case with the stakeholders. Feedback from stakeholders was generally positive and the use cases were generally accepted as being on track with partner needs. The three use cases were:

- Querying data on NYC solar market status as based on specific DOE Rooftop Solar Challenge benchmarking questions (e.g., length of permit review times)
- Analysis of aggregate PV solar market data (e.g., installed capacity in Q3 v. Q4)
- Quantifying value of PV production (e.g., tracking PV production on certain Con Ed networks)

SubTask 3.3 List necessary data from solar process agents and other sources

Once the use cases were finalized in 2Q 2012, CVI and CUNY worked with partners as described in SubTask 2.1 to list all data from solar process agents. In addition, CVI and CUNY listed out all data required from the NYC data acquisition systems. The real-time production data from these monitoring systems supports the third use case listed above. These two other sources were necessary to support the second and third use cases listed above.

SubTask 3.4 Define integration protocols and test integration of data

Once all data points and use cases had been defined, the next task for IBM and CVI was to determine how that data would be integrated from various data sources to CUNY and then to IBM. As data coming in from all sources in slightly different methods (e.g. NYSERDA uploads directly to CVI v. DOB's daily export to an FTP site), CVI had to ensure that feeds from each channel would reach CVI, be integrated properly into the CIS data warehouse, and then explored correctly to the IOC.

CVI and IBM established integration protocols for data export in Q2. In that same time period, CVI had received sample data from each partner and completed a manual test with IBM of integration. This test was successful and IBM was able to use the sample data and data schema to build the development IOC in Dallas.

Subtask 3.5 Test analytics capability

As described in SubTask 3.4, CVI delivered sample data to the IOC in Q2 2013. IBM then provided sample outputs for the use cases. CUNY and CVI conducted several team sessions in 2Q 2013 to internally review the screens. In addition, using Pyramid visualization software for support, CUNY and CVI conducted in-person or webinar meetings with the Mayor's Office, NYC EDC, NYSERDA, Con Edison, and DOB to provide them with interactive reviews of the analytics capability.

The stakeholders provided very helpful feedback on their individual needs and perspective on the screens. For example, DOB was concerned that "permit time" for projects, which typically looked to be significantly longer than other processes such as interconnection, included time that was spent by the contractor on revising plans. This time is not under DOB control, but was still included under DOB's purview as per the analytics platform and therefore misrepresented their "time spent" on each project. The NYC EDC was interested in economic development indicators, such as which installers were most active, the Mayor's Office provided feedback on what high-level reports would be useful, Con Edison provided input on the usefulness of PV production data, and NYSERDA was generally supportive of use cases as they were presented.

After the conclusion of these meetings, CUNY and CVI presented all feedback to IBM for incorporation into the final IOC as possible and within scope.

Subtask 3.6 Deliver real-time analytics to stakeholders

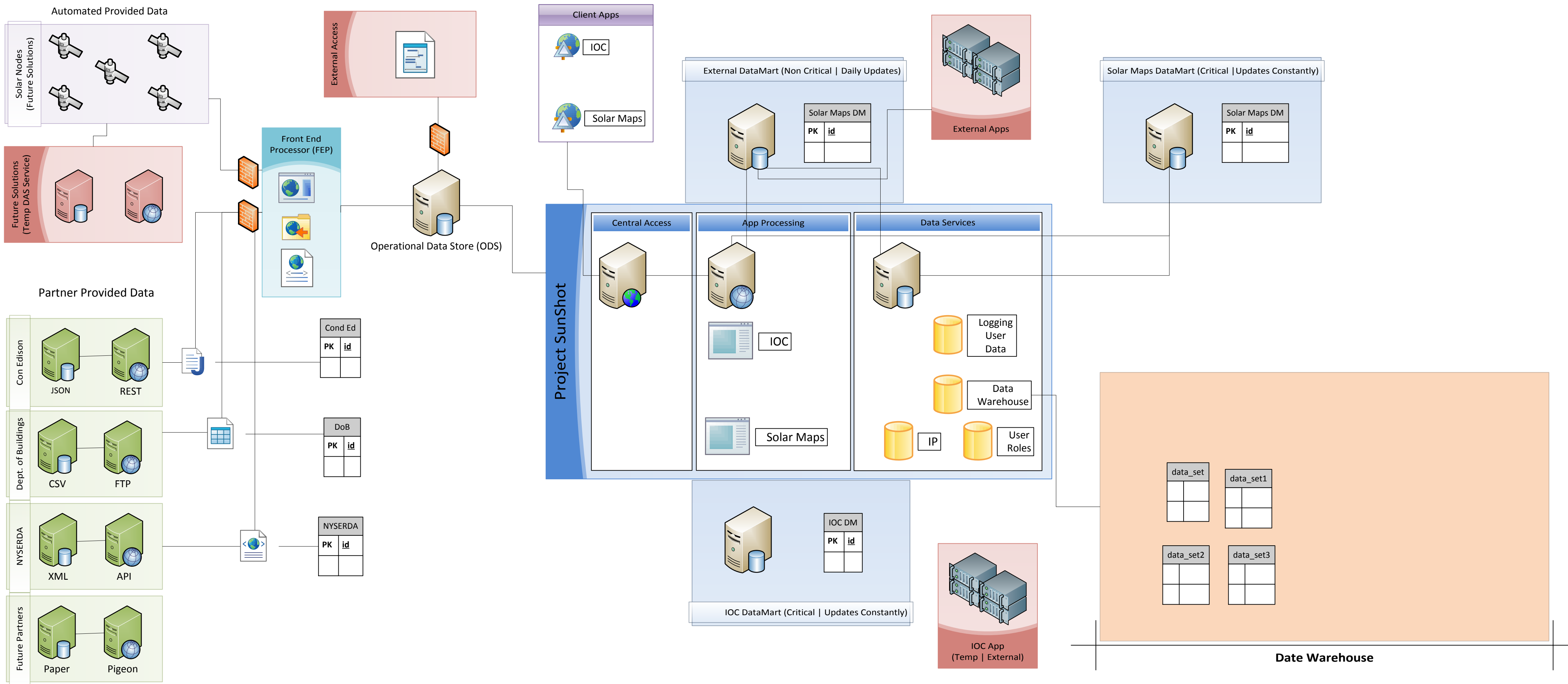
The IOC solution is built and up and running in the IBM test environment, and will be migrated to the production environment that was built in SubTasks 2.2 and 3.1 and stabilized. As with any software, some updates may be necessary. CUNY and CVI are determining the availability of one dataset before the solution is launched from the CVI environment.

Real-time analytics are available on request and are being used for analysis by partners. A recent example is a request by the Mayor's Office for information linking zip-code data on NYSERDA applications and Census data on income; CVI was able to create a spreadsheet with this information and deliver it for further analysis.

Task 4.0 - Market Assessment

The final Market Assessment for SMART NY was completed in February 2012. Due to Hurricane Sandy and the subsequent extension of the grant to June 2013, some benchmarking improvements were still in progress (e.g., DOB inspection checklists). These deliverables as completed have been outlined in this report.

Between February 2011 and February 2012, NYC benchmarking scores improved from 507 to 631, demonstrating significant improvement of market conditions with support from the DOE Rooftop Solar Challenge program. Moreover, the activities that have been completed since this benchmarking would show an even greater improvement.





U.S. Department of Energy SunShot Rooftop Solar Challenge I

City University of New York

On Behalf of New York City

Financing Options Working Group Final Report

June 2013

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Introduction

The City University of New York (CUNY), on behalf of New York City (NYC), created Action Area Working Groups in 2012 to improve the NYC solar market as part of the U.S. Department of Energy SunShot *Rooftop Solar Challenge I* program. The Financing Options (FO) Working Group team is led by the NYC Mayor's Office of Long Term Planning and Sustainability, and the New York City Economic Development Corporation, in addition to the NYC Solar Ombudsmen, the NYC Solar Coordinator, the University Director of Sustainability and additional Sustainable CUNY staff.

This working group surveyed national and local solar developers to identify the largest finance barriers to installing solar, in particular to solar lease and power purchase agreement (PPA) models in NYC. Based on these barriers, this team has developed recommendations for programs and policies to enable solar projects in NYC. Additionally, the team worked with City and State partners on legislative and regulatory changes, and the Permitting and Interconnection Working Group led by the NYC Department of Buildings and Con Edison to address and rectify specific barriers to permitting and interconnection. Lastly, the group reviewed existing and proposed local, state and federal policies that impact financing availability.

Background: New York City Solar Policy Context

NYC has been actively engaged in solar policy and initiatives since 2005, when the City University of New York (CUNY) launched the Million Solar Roofs Initiative (MSRI) in partnership with the U.S. Department of Energy (DOE). Under MSRI, CUNY worked with the City and partners from the renewable energy sector, labor, environmental and community organizations to analyze the solar market and identify the opportunities and challenges unique to the dense urban environment in NYC. This program was instrumental in supporting NYC's solar market and establishing 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.

The completion of this initial work led to the publication of two reports in 2006 and 2007: *The Market for Photovoltaics in New York City* and *Solar Energy Policies and Barriers in New York City*, both which were instrumental in laying the groundwork for local and state solar initiatives over the next several years.

2007 – 2009

In 2007, NYC released its comprehensive long-term sustainability plan, PlaNYC, setting a goal of 30% reduction in greenhouse gas emissions by 2030. PlaNYC also set a goal of installing 800 MW of clean distributed generation (DG) by 2030 within NYC, acknowledging that renewable energy has the potential to supply a significant portion of NYC's energy supply. As a part of this local policy framework Sustainable CUNY led the Mayor's Office of Long Term Planning and

Sustainability (OLTPS) and the New York City Economic Development Corporation (NYCEDC) in developing a strategic plan for large-scale solar integration and the associated business market growth.

This solar roadmap led to the June 2007 designation of NYC as one of the inaugural Solar America Cities by the U.S. DOE, and the NYC Solar America City Partnership (NYC SAC) was formed between CUNY, OLTPS, and NYCEDC. This DOE program entitled the City to funding and technical assistance from the National Renewable Energy Laboratory (NREL). Sustainable CUNY led the implementation of the NYC solar plan with a large group of academic, community, government, industry, union, and utility solar stakeholders. Under the Solar America Cities program, NYC SAC and its partners addressed barriers to solar development identified under MSRI. During this time, NYC's solar market more than doubled as key challenges to solar were addressed.

Significant activities in the local and state solar market during this time period include:

- State net metering improvements that raised the cap on systems to 2MW, and expanded net metering to commercial customers. This resulted in NYS's grade in *Freeing the Grid* from a "D" to a "B" in 2010
- The creation of the first property tax abatement for solar in the United States: this program was launched in 2008 and has been utilized by 1,530 projects since its inception.
- A 2009 study by NREL defining technical potential, barriers, and solutions for interconnecting PV on Con Edison's network grid. In 2009, Con Edison removed the requirement for a reverse-power relay for systems under 25 kW, eliminating an unnecessary cost for small systems.
- The creation of NYCEDC's solar thermal pilot program, a competitive program providing financial assistance for solar hot water projects.

2010 – 2012

In 2009, NYC was awarded \$1 million in additional funding from the U.S. 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 focused on both knocking down persistent barriers to NYC's solar market and on accelerating market growth. The goals of this initiative included streamlining the solar permitting processes, building the New York City Solar Map, promoting large-scale solar development, identifying and promoting solar empowerment zones, and building a solar thermal market in NYC. This time period continued to see exponential growth in the NYC Solar Market, including an 8-fold increase in installation companies and a growth in rooftop solar capacity from 1 MW to 14 MW, adding over \$100 million to the local economy.

The NYC Solar America City Partnership hired solar Ombudsmen dedicated to supporting the implementation of solar projects and programs in NYC. In a partnership with the NYC Department of Buildings (DOB), one Ombudsman was tasked with spending one to two days a week at DOB offices to assist with streamlined permitting initiatives. Additional Ombudsmen focused on outreach, the NYC Solar Map, data acquisition, and providing on-call policy and technical support to various stakeholders, including Con Edison, NYSERDA, and local installers. In 2010, the NYC Solar America City Partnership announced the creation of three

Solar Empowerment Zones, with two new Zones added in the spring of 2012. The NYC Solar Empowerment Zones are strategically selected geographical regions where solar power is most viable and beneficial from a technical standpoint, and where the Solar America City Partnership will focus its outreach and program development.

An advisory group consisting of representatives from several NYC agencies, Consolidated Edison, the New York State Department of Public Service, NYSERDA, and the New York Power Authority (NYPA) undertook a rigorous assessment process to select the Solar Empowerment Zones. Each of the five zones has a “day-peaking” energy usage profile that conforms closely to solar production. The five zones are also in need of capacity upgrades and/or demand reduction measures over the next several years in order to meet expected load growth. Finally, each of the zones has a significant amount of rooftop square footage to accommodate solar installations.

The NYC SAC Partnership collaborated closely with NYSERDA during this timeframe on a new incentive program for large-scale PV (initially defined as over 50kW) PV, as the New York State Public Service Commission ordered NYSERDA to develop a program for downstate New York, including NYC and Westchester County, in order to target NYS Renewable Portfolio Standard funds to this area. This program incorporated the concept of the Zones by creating a 15% “adder” incentive for any PV project located in “strategic locations” of a utility’s service territory.

In addition to a focus on the Zones, which drives solar development to the areas where it can be most beneficial, the NYC SAC Partnership worked to create other outreach and informational tools to support the NYC solar market. In 2011, CUNY launched the NYC Solar Map, a LIDAR-based interactive online tool that allows users to estimate the solar energy potential for every building in NYC’s five boroughs by inputting an address. The 15 billion points of data from the LIDAR make the NYC Solar Map the largest, most accurate map in the world. The map also highlights existing solar installations, displays real-time solar energy production citywide, and allows users to estimate the costs, incentives, and payback period for investing in solar. On the back end, the map provides granular information on the solar potential for every one of NYC’s one million buildings.

In conjunction with the NYC Solar Map, the NYC SAC Partnership deployed data monitoring systems on PV systems in the Zones. The NYC Solar Data Acquisition System (DAS) will use data from existing and future PV installations in the NYC Solar Empowerment Zones to gain real-time information on local solar production. This data can be useful on several fronts: utility planning, solar mapping, education, promotion of solar energy, and smart grid applications.

During this time period, the NYC SAC Partnership also expanded its focus to solar thermal, with the implementation of several NYCEDC solar thermal pilot projects and CUNY’s creation of a Solar Hot Water Roadmap for NYC. Using the same framework (benchmarking, roadmapping, and outlining barriers & recommendations) that has been successful for PV; the Partnership is optimistic that the roadmap can lead to similar growth in solar thermal technologies.

On a state level, Governor Cuomo introduced the NY Sun Initiative in January 2012, providing a strong platform for statewide solar market growth. NY Sun created a target of quadrupling

installed capacity by the end of 2013, and also supported expansion of the Geographic Balancing structure to a statewide program, a competitive production incentive.

2012 – 2013

In early 2012, NYC was awarded funding through DOE’s “SunShot Initiative,” a nationwide effort to make solar PV cost-competitive with traditional energy sources by the end of the decade. CUNY is leading the NYC efforts in SunShot’s “Rooftop Solar Challenge” to reduce the administrative soft costs of solar (i.e. permitting, interconnection, zoning, and financing). As part of RSC I CUNY formed and guided, through NYC Solar Ombudsmen, Working Groups (WGs) in each of the DOE Action Areas. The NYC WGs are led by organizations with the ability to develop and implement policies and programs: 1) The Permitting and Interconnection Process WG is led by Con Edison and DOB; 2) Interconnection and Net Metering Standards WG is led by NYPA and Con Edison; 3) the Financing Options WG is led by NYCEDC and the Mayor’s Office of Long-Term Planning and Sustainability (OLTPS); and 4) the Planning and Zoning WG is led by the NYC Department of City Planning (DCP). Additionally, CUNY partnered with IBM, and is working with NYC and NYS agencies to create a solar analytics platform to analyze solar market data and create a real-time permitting feedback loop for city, state, and federal partners.

During RSC1, the NYC partners were able to achieve:

- An extension of the property tax abatement (8/2012), allowing system owners to save up to 10% in property taxes over four years;
- Zoning amendments making solar a “permitted obstruction” (5/2012), saving projects that would have formerly had to apply for a variance 2-4 weeks and eliminating a review by City Planning;
- The launch of the NYC DOB program “Get It Done Together Solar Edition” (7/2012), saving installers 15 hours of in-person review time per project and at least \$51,000;
- The temporary implementation of a fast-track electrical inspection process, allowing at least 111 systems to meet the 2012 property tax abatement deadline and take advantage of a 20% property tax abatement rather than a 10% property tax abatement.
- The DOB Development Hub now allows for:
 - virtual plan exams,
 - e-filing,
 - accelerated inspections
 - accelerated permitting
- In October 2012, an e-permitting option with a one-day turnaround time for non-property tax abatement projects was introduced, and DOB is training 28 new inspectors.
- Publication of standard checklists for DOB electrical and building inspections
- Improved outreach documents regarding the DOB permit process

On-going efforts that will further reduce soft costs include installer trainings and the launch of an online solar analytics portal that will allow real-time and historical analysis of the local solar market.

It is also important to note that these collaborative efforts from 2006-2012 not only supported market growth from 1MW to 14MW, but in 2012 NYC saw several PPA/solar lease companies enter the market for the first time, demonstrating a new level of maturity in the local solar industry.

The New York City Solar Market: Growth, Potential, and Costs

A solar system producing electricity does not emit any environmental emissions and is fueled by the sun, as such; it is a clean and renewable energy resource. Compared to the average mix of electricity generation technologies for New York's electric grid, solar is emissions free. Electric generation emissions – Sulfur Dioxide (SO₂), Nitrogen Oxides (NO_x), and Carbon Dioxide (CO₂) – are from the burning of fossil fuels. Due to recent trends in emissions reductions, the U.S. EPA calculates that electricity emission rates have declined significantly since 2000. For New York State, SO₂ rates have dropped 86% since 2000, NO_x rates have declined 76% since 2000, and CO₂ rates have dropped 36% since 2000. This declining level of New York's power plant emissions is the result of air quality regulations pushing the use of cleaner fossil fuels, expanded use of renewable generation sources, as well as market mechanisms that encourage investment in power plant efficiency. As an emissions free source of electricity, continued deployment of solar should correlate with decreased emissions of grid electricity.

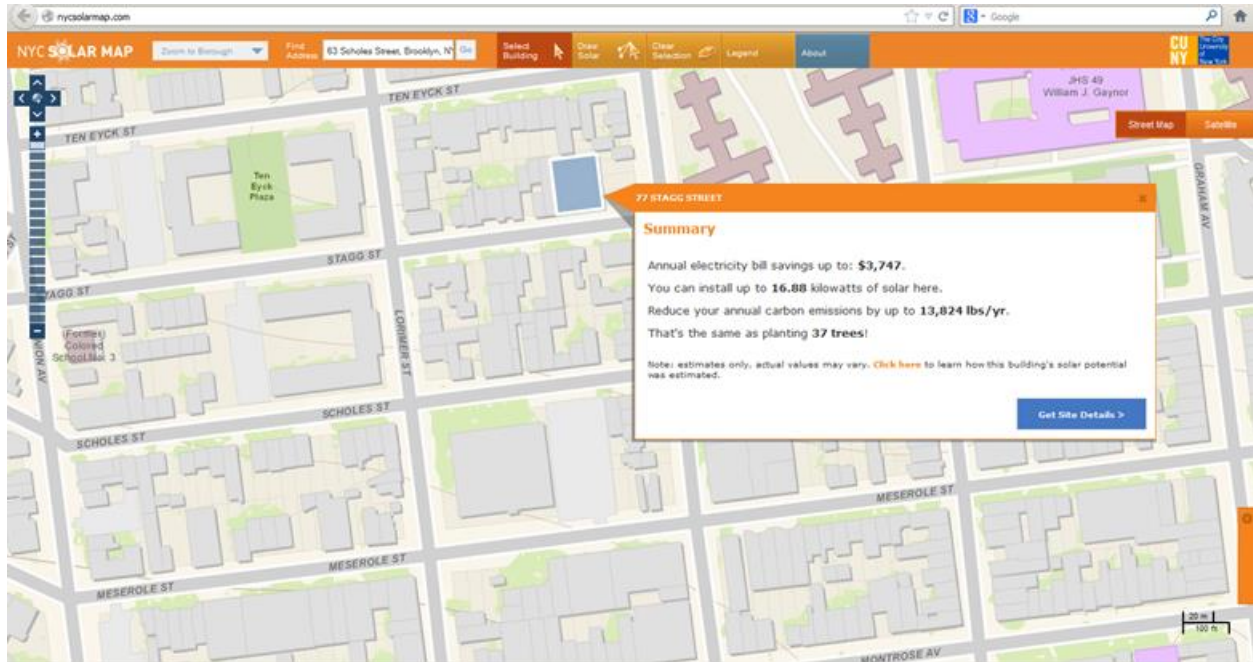
NYC's one million buildings offer a significant opportunity for solar technology. As mentioned above, installed capacity of solar in the five boroughs grew from 1MW in 2006 to 14 MW at the end of 2012. Of special note is the number of projects that have been completed: 500 of the 1750 total projects that have ever applied for interconnection to Con Edison were installed in 2012 [alone](#). Based on what is in the pipeline of projects coming through for utility interconnections, the end of 2013 could see over 30MW total installed in the city. The economic value of these projects should not be overlooked; the 14MW now installed represents approximately \$116M in investment in NYC's economy.¹

Costs of PV in New York City Costs in NYC, while historically higher than those in the rest of the state, have come down over the last several years, in parallel with PV costs across the country. According to NYSERDA, costs in NYC have declined by 24% since 2010. Dollar per watt (\$/W) prices for PV in NYC were at an average of \$7.07 in 2012, as compared to \$10/watt in 2007. The NYC Solar Map screenshots below indicate how the Map can be used as a tool to showcase the technical and financial feasibility of PV in New York City.

¹ Based on NYSERDA PowerClerk historical average of weighted installed cost in NYC's five counties.

Typical Residential Costs

The following screenshots from the NYC Solar Map (June 2013) demonstrate typical costs and payback for a 7kW residential PV system in New York City.

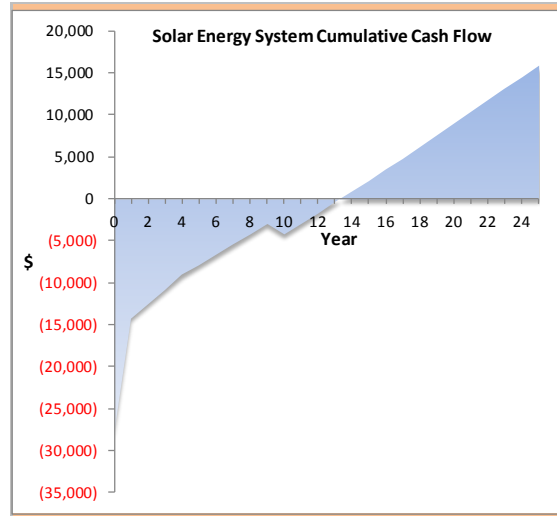


Solar Energy System Description		Building Owner Description	
System size (kW-DC)	<input type="text" value="5"/>	User type	<input type="text" value="Residential"/>
Array tilt angle	<input type="text" value="30"/>	Utility	<input type="text" value="Con Edison"/>
Array orientation	<input type="text" value="S"/>	Rate (\$/kWh)	<input type="text" value="0.24"/>
Cost (\$/Watt-DC)	<input type="text" value="7.00"/>	Avg. mo. electricity costs	<input type="text" value="200"/>
		Energy Star home, or BIPV?	<input type="text" value="No"/>

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Solar Energy System Description	
System Size (kW-DC)	5.0
Tilt Angle	30
Azimuth	180
\$/Watt	\$7.00
Building Owner Description	
User Type	Residential
Utility	Con Edison
Electricity Rate (\$/kWh)	\$0.24
Average Monthly Electricity Costs	\$200
Is this an Energy Star home, or is the proposed solar energy system building integrated (BIPV)?	No

Cost		
Total System Cost, Before Incentives		\$35,000
Cost After All Incentives and Taxes		\$13,750
<i>*Note: third-party ownership and power purchase agreements can reduce the upfront cost of installing solar to zero! Ask your installer for details.</i>		
Financial Metrics		
Payback Period (years)		14
Net Present Value		(\$2,882)
Internal Rate of Return		6%
Levelized Cost of Electricity w/Incentives (\$/kWh)		\$0.27
Electricity Bill Savings		
Annual Solar Energy Generation (kWh)		5,255
Annual Savings		\$1,261
Environmental Impact		
Annual CO ₂ Emission Reductions (lbs)		4,071
Trees Planted Equivalent		11
Incentives (detail) »		
NYSERDA/LIPA Incentive		\$7,000
Federal Tax Credit		\$8,400
NY State Tax Credit		\$5,000
NYC Property Tax Abatement		\$2,800
Sum of 5-year MACRS + Bonus Depreciation in Year 1		\$ -



- NYSERDA Breakdown of Residential Costs by NYC County – July 2012 - June 2013
 - New York: \$10.68/W – 6 systems installed
 - Kings: \$7.33/W – 49 systems installed
 - Bronx: \$7.13/W – 8 systems installed
 - Queens: \$6.80/W – 59 systems installed
 - Richmond: \$6.28/W – 36 systems installed
 - Note: These prices reflect five of the top six counties with the highest deviation from the state average installed residential price, varying from 16% in Richmond (Staten Island) to 97% above the state average for New York County (Manhattan)

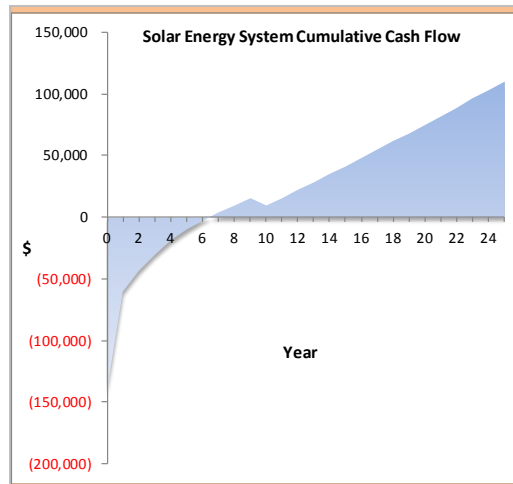
Typical Commercial Costs

The following screenshots from the New York City Solar Map (June 2013) demonstrate typical costs and payback for a 25kW commercial PV system in New York City.

Example Commercial Economics

Solar Energy System Description	
System Size (kW-DC)	25.0
Tilt Angle	30
Azimuth	180
\$/Watt	\$7.00
Building Owner Description	
User Type	Commercial
Utility	Con Edison
Electricity Rate (\$/kWh)	\$0.24
Average Monthly Electricity Costs	\$600
Is this an Energy Star home, or is the proposed solar energy system building integrated (BIPV)?	No

Cost	
Total System Cost, Before Incentives	\$175,000
Cost After All Incentives and Taxes	\$38,588
<i>*Note: third-party ownership and power purchase agreements can reduce the upfront cost of installing solar to zero! Ask your installer for details.</i>	
Financial Metrics	
Payback Period (years)	7
Net Present Value	(\$1,110)
Internal Rate of Return	10%
Levelized Cost of Electricity w/Incentives (\$/kWh)	\$0.22
Electricity Bill Savings	
Annual Solar Energy Generation (kWh)	26,277
Annual Savings	\$6,306
Environmental Impact	
Annual CO ₂ Emission Reductions (lbs)	20,357
Trees Planted Equivalent	54
Incentives (detail) »	
NYSERDA/LIPA Incentive	\$35,000
Federal Tax Credit	\$52,500
NY State Tax Credit	\$0
NYC Property Tax Abatement	\$14,000
Sum of 5-year MACRS + Bonus Depreciation in Year 1	\$52,063

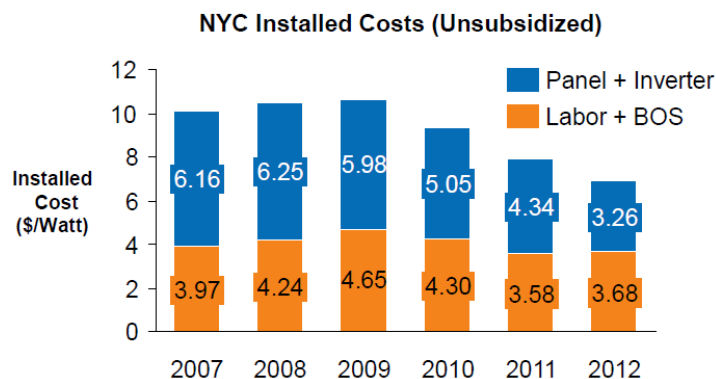


NYSERDA Breakdown of Residential Costs by NYC County – July 2012- June 2013

- New York: \$7.28/W – 12 systems installed
- Queens: \$6.62/W – 59 systems installed
- Bronx: \$6.24/W – 9 systems installed
- Kings: \$5.66/W – 34 systems installed
- Richmond: \$5.55/W – 13 systems installed
- Note: While NYC installation prices still tend to be higher than the state average, for commercial and government/non-profit systems there is in general less deviation from the state average. In this case, Richmond (Staten Island) reflects the state average installed price for commercial and government/non-profit installations.

Levelized Cost of Energy

Overall, the ‘Levelized Cost of Solar Electricity’ (LCOE) continues to decline, tracking similar performance as seen in the NYSERDA data for New York State.



Source: NYSERDA

NYC's higher installed price reflects increased costs in the Balance of System components (wires, racks, etc.), as well as the Labor (labor, design, permitting, etc.).

An additional value of solar PV has emerged over the last several months in the aftermath of Hurricane Sandy. CUNY determined that while the 672 solar arrays on NYC rooftops at that time sustained little or no damage during the storm, they were unable to supply critically needed power during the subsequent outage. While the capability exists, in order to tap into this resource on a broad scale, key issues such as system design, costs, technology integration, incentive structure, codes and regulations need to be addressed. In January of 2013 CUNY convened a working meeting for local, regional and federal agencies as well as key industry partners to discuss energy infrastructure resiliency after Hurricane Sandy, the third storm to seriously compromise NYC's power grid in less than 2 years. The result of this meeting was the formation of the "[Smart DG Hub](#)", which will foster deployment of the innovations required to realize the vision of a more resilient energy grid. An early example of this work was NYC's first ever [Inverter Workshop](#), where six inverter companies presented to over 70 installers, displaying their technology's capabilities to function off-grid.

New York City Incentive Landscape

NYC benefits from a supportive incentive structure for solar PV projects, with federal, state, and local financial incentives to support investments in installing solar energy. Incentive eligibility varies by location, type of building, and system owner.

Federal Solar PV Incentives:

Federal Investment Tax Credit (ITC)

Residential building owners are eligible to receive a [federal tax credit](#) worth 30% of the cost of the solar installation, after subtracting the New York State Energy Research and Development Authority (NYSERDA) incentive (explained below). Assuming the NYSERDA incentive is taxable income, the total installed cost of the system is the basis for calculating the federal tax credit.

Commercial PV projects are also eligible to receive the [federal tax credit](#) worth 30% of the cost of the solar installation. Assuming the NYSERDA incentive is taxable income, the total installed cost of the system is the basis for calculating the federal tax credit.

Since its 2006 implementation, the 30% solar ITC has been the main federal policy mechanism to support solar deployment in the U.S. With the ITC set to be stepped down to 10% after 2016, it is important to note its contribution to the Levelized Cost of Electricity (LCOE). For the residential example shown above, the ITC contributes a \$1.68/W reduction and is the highest residential incentive. The above example also demonstrates that NYC solar installations on average still remain more expensive than grid electricity. Given the ITC's role in the mix of incentives for solar today, its 10% reduction in 2016 likely means that State and City policy makers may want to evaluate incentive options to make up some of the ITC's former

contribution. Doing so will continue to support deployment in NYC and other jurisdictions where the installed prices continue to be above retail electricity rates.

Modified Accelerated Cost-Recovery System (MACRS) + Bonus Depreciation

Companies that invest in a commercial solar energy system may be eligible for federal income tax deductions through the Modified Accelerated Cost-Recovery System (MACRS). The IRS allows commercial solar PV system owners to deduct up to 85 percent of their tax basis. This form of depreciation can be claimed over a five year period. Additionally, until 12/31/13, PV systems may be eligible for a first-year 50% Bonus Depreciation.

State Incentives:

Residential:

- [NYSERDA Incentive](#): Con Edison customers are eligible to receive a rebate of up to \$1.40 per Watt-DC of solar PV installed on residences, capped at 7 kilowatts, for standard residential systems not to exceed 40% of the total installed system cost after the available tax credit.
- [New York State Tax Credit](#): Residential building owners who install solar may be eligible for a tax credit for the lesser of 25% of the installed cost of the solar energy system (up to 25 kW on net-metered systems) after the NYSERDA incentive, or \$5,000.
- [Sales Tax Exemption](#): New York enacted legislation in July 2005 exempting the sale and installation of residential solar-energy systems from the state's sales and compensating use taxes. The exemption applies to solar-energy systems that utilize solar radiation to produce energy designed to provide heating, cooling, hot water and/or electricity. The exemption does not apply to solar pool heating or other recreational applications.

Commercial:

- [NYSERDA Incentive \(PV size less than 50 kW\)](#): Con Edison customers are eligible to receive an incentive of up to \$1.40 per Watt for commercial systems up to a total of 50 kW per site/meter, not to exceed 40% of the total installed system costs.
- [NYSERDA Incentive \(PV size greater than 50 kW\)](#): Con Edison customers are eligible to participate in NYSERDA's price-sensitive competition to receive an incentive of up to 50% of the total installed system costs. Spanning the entire state, \$107 million is available for proposals that were submitted by the first two (2) due dates of November 8, 2012 and March 14, 2013, and for those received by the third and last remaining due date of August 29, 2013.

Local Incentives:

NYC Property Tax Abatement

In 2008, NYC created the first [property tax abatement](#) program for solar PV. This program provides a credit of up to \$62,500 per year for property owners installing solar. The incentive level was set up to decline over time to encourage early adopters and is now set at 10% of eligible PV expenditures, spread out over four years. Eligible solar electric generating system expenditures" include reasonable expenditures for materials, labor costs properly allocable to on-site preparation, assembly and original installation, architectural and engineering services, and designs and plans directly related to the construction or installation of the solar electric generating system. This program expires on December 31st, 2015.

NYC Residential PV Sales Tax Exemption

Residential systems in New York City are exempt from local sales tax. This exemption is not currently available for commercial PV in NYC.

Literature Review

In parallel with conducting interviews, the Financing Options Working Group conducted a comprehensive literature review of existing financing options for solar PV. A brief summary of the review is described here, and the resources reviewed are included as an appendix to this report.

Historically, traditional financing of PV systems faced many challenges, lowering the financeable market potential. PV developers with larger projects generally sought debt financing for projects, secured with power purchase agreements (PPAs). Residential and commercial PV, on the other hand, was generally owned by the consumer of the electricity generated by the system. After the recession in 2008, debt equity was not readily available for larger projects. Also, many property owners were dissuaded by the high upfront costs of directly owning PV systems.

However, solar PV systems have become financially attractive to investors in the US since the recession of 2008. It is estimated that there are more institutions providing third-party tax equity in the US than before the recession. The Federal Investment Tax Credit (ITC), an incentive of 30% of system costs implemented in 2006, led to tax equity investors viewing renewable energy projects favorably. Because of leaner supply chains, reduced commodity costs, and increased competition from PV suppliers, solar system costs continue to decrease, providing system owners with a long-term hedge against rising utility rates. Further, strong, long term incentives in many states, including New York, have resulted in predictable and certain sources of income for investors in the still-recovering investment environment.

Novel mechanisms used to overcome financing barriers have grown in popularity in the US. SunEdison's business model of bundling and commoditizing large PV projects pioneered the matching of the tax equity of financial institutions with PV projects, and has spawned a new generation of financing for solar systems. Developers began bundling and commoditizing smaller projects, increasing power purchase agreements and solar leasing models used in smaller systems. This reduced the barrier of high upfront costs for property owners, with some developers offering "no money down" deals, and sometime undercutting utility rates after applying incentives.

Types of Solar PV Finance Methods

Overcoming the significant upfront cost barriers remains necessary to further grow the market for and deployment of solar PV. As such, a variety of innovative financing methods have emerged, each attempting to address high upfront capital costs for solar PV. Although each shares a common goal, the financing methods vary in their approach, as outlined in the table below:

Type		Description	Market Benefits
Direct Ownership	Loans and Credit Enhancement	Debt financing with long-term payback periods	✓ Provides access to debt financing
	Property Assessed Clean Energy (PACE)	Municipality facilitates low-interest loans that are repaid through customers' property tax bills	✓ Simplifies payments ✓ Reduces cost of debt financing
Third-Party Ownership	Power Purchase Agreement (PPA)	Third-party companies sell electricity per kWh produced	✓ Removes need for project host to own system
	Solar Leasing	Third-party companies lease use of the PV system	✓ Simplifies payments, incentives and maintenance
	Crowdfunding	Individual projects gather capital from multiple small investors who receive fixed yield but do not off-take energy	✓ Increases potential pool of investors ✓ Provides access to lower-cost financing

Broadly speaking, PV financing methods can be placed into two distinct categories: direct ownership versus third-party ownership models. Direct ownership financing allows customers to

purchase and own PV systems through bank loans and other debt-based financing mechanisms, often with no upfront cost and repayment over a fixed term. In contrast, third-party ownership models enable customers to lease a PV system or purchase the power produced from a third-party who is the legal owner of the system.

Direct Ownership

Direct ownership mechanisms typically include traditional loans and credit enhancement options offered by banks, credit unions and public institutions, giving access to low cost financing for long-term payback periods. Property Assessed Clean Energy (PACE) is an innovative form of direct ownership in which local governments raise money by issuing bonds or other sources of capital to fund projects such as PV Systems on behalf of property owners. The property owners then repay their obligations through the same mechanism with which they pay standard property taxes. However, concerns by lenders such as Fannie Mae and Freddie Mac have effectively put residential PACE programs on hold within the U.S.

Third Party Ownership

Third-party ownership models include Power Purchase Agreements (PPA) or Solar Leasing options. In a PPA agreement, the customer pays for the actual power produced at an agreed fixed rate; PPA's often include the option to contribute to a portion of the upfront costs through pre-payments for the electricity. A Solar Lease agreement typically allows customers to forgo all upfront costs while paying a monthly fee to use the electricity produced by the system. As opposed to direct loans for system ownership, both approaches allow for simplifying incentives and tax benefits, as well as maintenance and performance concerns. Likewise, crowd-funding models allow individuals to invest directly in community solar projects in exchange for shares of ownership, but not to off-take any energy the PV system produces.

Innovative Methods

Additionally, innovative methods to facilitate both direct and third party ownership models are increasing in popularity. On-bill financing allows customers to make payments (either to a lender or third-party owner) directly on their utility bill, and is structured to be paid with the energy savings earned through use of the PV system. Community solar program models have also grown in use throughout the US, where utilities allow multiple customers to own a shared PV system, or to purchase energy or RECs from locally sited systems; this allows for decoupling system location and ownership, and lower installed costs. Crowdfunding also supports such models, enabling individual investors to contribute small amounts of capital to a project, in some cases as little as \$25.

Other options include reducing transaction costs or spreading investment risk through various project aggregation models. Group buying models, such as the Solarize program pioneered in Oregon in 2009, aggregate purchases and can lead to lower installed cost through economies of scale. Likewise, solar developers have begun to see the value in aggregating multiple projects together with third-party financing, as this combats high project development costs through working in higher volumes. Such developers are also exploring securitization, through which a portfolio of PV projects would be bundled into a security and sold to investors, similar to the residential mortgage market.

Emerging Transformational Financing Options

Several emerging financial options could significantly transform aspects of the solar financial market. These include possible additional revenue streams such as solar systems supporting ancillary services through dynamically controllable inverters or energy storage, to real estate investments trusts or master limited partnerships. While some of these options reflect integrating smart or resilient hardware during solar system deployment, other options reflect newly available financial instruments to support broadening the pool of investors that are addressing solar's upfront capital requirements. Taken together, these possible transformational financial options could support the solar industry's continued growth. With Sustainable CUNY's NYC Solar Map and recently the development of the NY State solar map utilizing a market analytics platform (e.g. <http://nycsolarmap.com/>), these financial mechanisms dovetail into combining deployment analytics with market aggregation and the beginnings of solar finance securitization. Introduced below are ancillary services via dynamically controllable inverters, resilient solar incentives, real estate investment trusts, master limited partnerships, and finally synthetic purchase power agreements combined with solar forecasting.

Revenue Support from Ancillary Services via Dynamically Controllable Inverters:

Beyond energy and demand bill savings from solar generation, a possible expansion of revenue assistance could come from distributed solar supporting grid ancillary services. These services ensure grid reliability and include scheduling and dispatch, reactive power and voltage control, loss compensation, load following, grid hardware protection, and load imbalance. Solar systems might support such grid services via dynamically controllable inverters that integrate distributed generation with smart grid communication and controllability. Specific opportunities await NYISO, utility and public service commission rulemaking.

Resilient Solar Incentives:

In the aftermath of hurricane Sandy, the solar industry recognized that more needs to be done to support system deployment such that solar could provide some power during emergencies or extended grid outages. Sustainable CUNY launched its Smart DG Hub to coordinate resiliency efforts across industry, agency, and regulator actors in order to address the overlapping needs in hardware, software and communications, policy and legal, and economics and finance. Initial studies and likewise pilot project deployments are underway to help inform evaluating incentive structures that will move the solar market towards resiliency. In June 2013, CUNY hosted NYC's first Inverter Workshop, which linked local installers with new resilient inverter technologies. Deploying these technologies in the five boroughs will support financial models that enable resilient solar to be cost-effective.

Real Estate Investment Trusts (REIT's):

A REIT is "any corporation, trust or association that acts as an investment agent specializing in real estate and real estate mortgages" under Internal Revenue Code section 856. REIT's are traded publicly and privately and increase the opportunity for individuals to invest in real estate. Recently one company has garnered attention due to how the IRS privately ruled that its bundled assets of real property, that included solar, was valid for the balance necessary in order to qualify for REIT designation. Further regulatory clarification is expected from the Treasury Department.

Master Limited Partnerships (MLP's):

MLP's are a limited business partnership that is a publicly traded security. Therefore it combines the tax benefits of a limited partnership with the liquidity of publicly traded securities. For the solar industry, MLP's are currently restricted due to how qualifying incomes sources mostly pertain to fossil fuel resources, such as petroleum, natural gas, and coal extraction, transportation, and processing. U.S. legislative action is required to allow solar MPL's, with recent bills introduced in the Senate and House.

Synthetic Purchase Power Agreements (PPA's) Combined with Solar Forecasting:

Following in the wind industry's shoes, the solar industry looks likely to start forming wholesale utility-scale solar agreements that rely on how the wholesale electricity market has financial mechanisms for dealing with long term contracts and short-term generation variability. Synthetic PPA's are the financial agreement for a long-term fixed generation price (e.g. \$100/MWh) that is attractive to independent power provider (IPP) investors, while at the same time employing contract-settling payments for real-time differences between hourly wholesale costs and the fixed generation price. Informing this real-time process will be the solar forecasting of regional generation via weather and solar insolation analytics. The Synthetic PPA fixed generation price provides IPP's with price confidence that can be used to attract tax equity financing.

SMART NY Financing Options Working Group Interview Findings

Industry Interview Findings

Objectives and Methodology

To better understand the current status of financing options available for solar photovoltaic in NYC, the Financing Options Working Group conducted a series of interviews with experts in the field, ranging from installers to financing firms. This included both companies that are active locally as well as national firms not yet doing business in NYC. Additionally, the Group spoke with representatives of research, advisory and community development organizations.

The objectives of these interviews were to understand:

- 1) The current availability of financing options for solar projects in NYC;
- 2) Challenges faced in financing solar deployment locally; and
- 3) Potential actions to help overcome the issues facing financing options.

Current Availability

All interviewees stated that NYC is increasingly an attractive market for solar, which is leading in turn to greater availability of financing. The recent market growth is due to supportive state and local policies, most notably NYSERDA rebates and the City's own solar property tax abatement, as well as high retail electricity rates. While NYC remains a relatively small market compared to regions such as California and New Jersey, its rapid growth is attracting both regional and national attention.

The availability of affordable, easy-to-use financing is important in all markets, given solar's up-front costs. For NYC in particular, increased soft costs, from labor to permitting, leads to relatively higher installed costs and makes effective financing options all the more important. This market structure also means that many projects fall into a relatively underserved gap between small, sub-50kW residential projects and large commercial projects over 500kW

Most solar projects in NYC have thus far been financed through traditional means, from bank loans to mortgages, but this limits the potential universe of project hosts. Over the past few years, solar developers have begun to offer additional financing options, from home equity loans to leases, but interviewees report that these mechanisms are not yet growing at scale.

Challenges Faced

In general, interviewers stated that the nature of NYC projects often makes them more difficult to finance. In many regions of the U.S., a combination of single family homes and "big box" retailers provide financiers with large portfolios of relatively uniform projects. In contrast, these national players are dissuaded from entering the NYC solar market because they see a diverse group of small projects, leading to high transaction costs.

Buildings with multiple owners and/or tenants further contribute to this complexity, as the power off-taker is often not the building owner. Other complications also caused by the nature of NYC's physical geography includes the potential for future shading from adjacent properties, which can lead to concerns by investors considering a long-term PPA.

Of significant concern to several market participants is the gap between small and large projects that, if not addressed, could prevent faster growth of the local market. Small residential systems of under 50kW (e.g., a 6kW rooftop system on a typical single-family home) are relatively well-served by existing financing options. Due to homeowners' credit scores and relatively simple technical installations, investors are generally comfortable with projects of this scale, with uniformity enabling tax equity investors to aggregate multiple projects across a broad portfolio.

At the other extreme, large, utility-scale projects of greater than 2MW are able to attract investors directly, as their size offsets the transaction costs brought about by greater technical

and financial complexity of each project. However, due to siting issues no utility-scale projects to date have been able to move forward in NYC.

However, in between these two extremes is a “middle market” of commercial projects between 50kW and 2MW. Interviewees suggested that projects in this range face the greatest difficulties in financing, being too complex compared to residential projects, while too small to justify the transaction costs or to attract tax equity investors directly. This gap is particularly significant for NYC, given the distribution of potential projects, for only a minority of residents live in single-family homes and sufficient land for utility-scale projects is less common.

Potential Actions

To help support market growth, most interviewees agreed that financing mechanisms which bundle multiple projects together, perhaps combined with third-party financing, have potential to be the most effective option in NYC. Customer acquisition costs are a significant financing-related barrier. Methods that aggregate purchasing, such as the “Solarize” group-buying model could reduce both project and financing costs. Similarly, developers are interested in multi-building projects in order to achieve economies of scale and consistency across a portfolio of projects.

Finally, interviewees expressed interest in emerging financing mechanisms such as crowd-funding and community solar. As most New Yorkers do not own their own rooftops, financing products that allow renters and other interested parties to make small investments offers a chance to expand the pool of available capital and reduce financing costs.

While all interviewees agreed that financing is among the more important issues facing solar deployment, a common theme was that decreasing capital costs have made and will continue to make solar more feasible in NYC. Some believe that the lack of financing options is not the primary issue, but rather that overall project economics, particularly soft costs such as permitting, will determine the pace at which the market grows. In this view, financing options will naturally increase both in availability and affordability as local volume increases.

In addition, while policy options regarding solar incentives may not be considered directly financing-related, they should be examined for their impact on financing methods to avoid unanticipated consequences. Key considerations for evaluating changes to incentives include applicability to middle-market-sized projects and any restrictions they impose on project ownership, such as assignability of benefits.

The results of the literature review, market research, and interviews were presented to the NYC Solar Advisory Board in December of 2012. This Advisory Board is comprised of installers, utilities, advocates, sustainability experts, and government agencies. The feedback of the Advisory Board was generally positive and was focused on the following:

- Continued efforts should be focused on permitting improvements in order to encourage a wide range of financing mechanisms to flourish in the City
- Solar lease/PPA providers are starting to “dip a toe” into the NYC market

- Additional contacts for follow-up interviews were suggested
- “Community solar” type projects were the most interesting, but not currently possible under New York State legislative/regulatory constructs

Policy Recommendations

Pilot a community solar system in New York City

Much of the city’s population and businesses have access to capital, but do not have access to the roof space required to install PV. Further, existing incentives and regulations are untested for group-owned systems. The National Renewable Energy Laboratory (NREL) has examined the best practices and different models for developing community solar projects in different areas, publishing *A Guide to Community Solar*. The City and CUNY will work with NREL, NYSERDA, the PV industry, property owners and Con Ed to develop a community solar program in NYC, piloting multiple-party ownership or energy off-taking from a single PV system. As part of this process, the City will seek to clarify the eligibility of both the personal income tax credit as well as the NYSERDA standard offer rebate for solar to account for residential ownership of “community” solar systems.

Connect customers and installers using the NYC Solar Map

The NYC Solar Map has proven to be a valuable tool for educating the general public about solar, and continues to see sustained traffic. However, installers cite difficulties in acquiring informed customers to develop PV systems. CUNY and OLTPS will work together to create additional functionality on the NYC Solar Map, taking advantage of its widespread use to connect property owners with PV developers and installers. This expansion of the map will also support a partnered effort to evaluate a customer outreach, education and acquisition program for NYC residents and businesses.

Develop informational resources for property owners interested in installing PV

While CUNY, OLTPS, and EDC, have been working closely with relevant city and state agencies and utilities to improve the process for solar deployment in NYC, new installers unfamiliar with the process can face a steep learning curve when entering this market. Lack of knowledge of the local PV installer industry, available incentives and guides, and complexities of the permitting and interconnection processes has presented a high information barrier to those property owners who are interested and financially able to install PV in the city. In February, 2013, the NYC Council passed legislation requiring the development of a website to educate property owners on the resources and guides available for installing solar PV and other renewable energy. Using information already available on the NYC Solar Map and other partner resources, OLTPS will develop this website to better inform property owners, providing them with the information needed to convert interest in PV into actual investments.

Support and expand *Solarize* programs in NYC

Group purchasing of PV systems has proven to cost effectively grow solar generation capacity on neighborhood and city scales. After success in several other cities, this model, sometimes called “Solarize” is now being adapted in the city by Sustainable Flatbush and Sustainable Kensington/Windsor Terrace (local organizations in Brooklyn) and supported by Solar 1, a green energy education group in NYC. This group purchasing model will test the permitting and interconnection processes with large volumes of applications for PV installations, and if successful can be adopted in other neighborhoods across the city. The City and CUNY will work with program organizers, Con Ed, DOB and NYSERDA to ensure that batches of application associated with Solarize programs are processed smoothly. The City and CUNY will also analyze the successes of, and challenges faced by the Solarize Brooklyn program for expansion across other neighborhoods in the five boroughs.

Evaluate low-cost financing through NYCEEC and the New York State Green Bank

Several developers have cited the inability to develop PV systems using third-party ownership models for property owners without minimum credit ratings requirements. As with energy efficiency projects and fuel switching programs, property owners’ credit ratings have led to financing barriers to investments. The New York City Energy Efficiency Corporation (NYCEEC) has been successful in overcoming these barriers by providing low-cost financing to energy efficiency, fuel switching, and distributed generation projects across the city. Further, during his 2013 State of the State Address, Governor Cuomo announced the creation of a New York State Green Bank to fill these market gaps. The City and CUNY will, therefore, work with NYCEEC and the Governor’s Office to evaluate the use of low-cost financing products to overcome these barriers and unlock new market segments for PV investments.

Conclusion

NYC presents the largest urban market for solar in the country, with almost one million rooftops. In recent years, the market has grown exponentially and is reaching new levels of maturity, including the arrival of solar lease and PPA projects within the last year. As current efforts continue to reduce the “soft costs” of solar, around permitting, zoning, or net metering, there are projects or programs that could also increase the options for PV financing for NYC residents and businesses.

The recommendations and research listed in this report are only a starting point for efforts that will unlock the potential of solar in the five boroughs. Taken in the context of recent events such as Hurricane Sandy, which demonstrated the urgent need for resiliency in NYC’s energy infrastructure, moving solar forward becomes even more important. The authors of this report look forward to continued partnership with City, State, and Federal stakeholders to achieve a strong, replicable, and mature solar market in NYC.

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News

SolarCity, US Bancorp create \$250 million financing fund (Platts, 06/15/12)

SolarCity, which installs residential and commercial rooftop solar systems, has again joined with US Bancorp in creating what it called a tax-equity fund that the San Mateo, California, firm said will finance as much as \$250 million in solar power projects. SolarCity has formed 16 funds with seven different partners that have totaled \$1.53 billion. In June 2011 Google put up \$280 million so SolarCity could create its largest project financing fund and, until then, its largest residential solar fund. SolarCity and Bancorp said the fund is aimed at financing up to \$250 million in residential solar power and commercial solar power projects for homeowners, businesses, schools and government buildings, in 14 states. The company says its services are available in Arizona, California, Colorado, Connecticut, Delaware, the District of Columbia, Hawaii, Maryland, Massachusetts, Oregon, New Jersey, New York, Pennsylvania, Texas and Washington. The company's business approach is to first buy, install and maintain solar rooftop equipment for a customer, who then pays SolarCity for the power they use from the installed system.

Solar securitization deal seen coming to market (Platts, 06/25/12)

A deal securitizing the revenue flows from solar photovoltaic rooftop installations will likely come to market this year or early next year, according to market participants. The aim of a solar securitization would be to bring down the financing costs of solar power and facilitate the expansion of the market for solar PV installations. Jonathan Plowe, head of new energy and infrastructure solutions at BofA Merrill Lynch, at a recent conference said the company is working with the rating agencies to come up with standardized documents for a renewables securitization. The capital cost barrier has been addressed in part by a model that has grown in popularity over the last decade in which the installer of the system extends financing to a homeowner. The arrangement means that the homeowner does not have to buy the solar system. Instead, a developer installs and owns the solar panels and sells the electrical output to the homeowner under long-term contract. Financiers see the flow of payments from those contracts as an opportunity to securitize those solar installations. The payments from the homeowners could be aggregated in the same way that payments from car loans, credit cards or mortgages are aggregated and securitized. The aggregated cash flow is bundled, or securitized, into a financial obligation that can be sold to a wide variety of institutional investors and that can be traded in financial markets. A solar installation funded through a securitization could deliver a levelized cost of electricity of 21 cents/kWh compared with cost of 31 cents/kWh for systems funded with tax equity from the investment tax credit, the current standard for solar funding, according to analysis from the Rocky Mountain Institute.

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VERMONT – PV Property Tax Policy Standardized.

Vermont has instituted a statewide uniform property tax policy for PV systems that is based on capacity. The rate is \$4/kW. PV systems up to 10 kW are exempt from state property taxes.

NEW YORK – PSC Removes Utility Restrictions on Net-Metered Residential PV.

The New York Public Service Commission has directed Rochester Gas and Electric (RGE) and New York State Gas and Electric (NYSEG) to modify their tariffs to remove a restriction limiting net metering of residential PV systems to “primary, legal” residences. The ruling stems from a petition from Hudson Valley Clean Energy disputing the legality of such a requirement under New York’s net metering law. The revised tariffs are scheduled to take effect July 1.

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US installs 506 MW of PV solar in first quarter (Platts, 06/14/12)

There were 18,000 photovoltaic solar power systems installed in the US in the first quarter with a combined capacity of 506 MW, the second-highest quarterly total ever, according to the Solar Energy Industries Association and a report released Wednesday by GTM Research. The number of PV installations compares with a total of almost 62,000 PV installations in 2011, which was a record year. New Jersey, with 174 MW installed, and California with 148 MW, were ranked first and second among states. The US now has 4,427 MW of cumulative operating PV capacity, the fourth most in the world after Germany, which had 29,075 MW of solar installed at the end of the first quarter. Italy is second with approximately 9,000 MW of PV installed, and Spain is third with an estimated 4,500 MW

NREL says 80% renewable generation feasible (Platts, 06/19/12)

With several significant changes to the way the power sector operates, such as a more flexible power grid with storage and demand-side technologies, the country could have up to 80% of power generation in 2050 coming from renewable resources, the National Renewable Energy Laboratory said in a study.

Wind-to-solar shift appears to be under way (Platts, 06/25/12)

As incentives to build more wind capacity expire and the incentives to build solar stay in place, enXco and other big wind farm developers are focusing more on solar. Industry analysts believe investment funds are shifting toward solar principally because the production tax credit â€” 2.2 cents/KWh of power produced â€” which goes only to wind and geothermal generation, is due to expire the end of this year. A politically stalemated Congress appears to be ill-disposed to extend the PTC. The value to the industry of the PTC has been estimated between \$1.5 billion and \$3.5 billion in reduced tax payments. That is an annual amount and has varied depending upon the number of companies who chose to use the PTC.