Clean Energy for Resilient Communities:

Expanding Solar Generation in Baltimore's Low-Income Neighborhoods

February 2014

Report Prepared for The Abell Foundation
by Clean Energy Group

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CleanEnergyGroup
Innovation in Finance, Technology & Policy

Clean Energy Group (CEG)

CEG is a leading national, nonprofit advocacy organization working on innovative technology, finance, and policy programs in the areas of clean energy and climate change. CEG also manages the Clean Energy States Alliance, a coalition of state and municipal clean energy funds. For more information about CEG, visit www.cleanegroup.org.

Authors' Note

This paper is a product of the Clean Energy Group and was generously funded by The Abell Foundation. The views and opinions in this report are the Authors' alone.

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Lewis Milford is president and founder of Clean Energy Group (CEG) and the Clean Energy States Alliance, two nonprofit organizations that work with state, federal, and international organizations to promote clean energy technology, policy, finance, and innovation. Mr. Milford is also a nonresident senior fellow at the Brookings Institution. He works with many public agencies and private investors in the United States and Europe that finance clean energy. Mr. Milford is frequently asked to appear as an expert panelist at energy conferences throughout the United States and Europe. His articles on clean energy have appeared in *The New York Times*, *The Boston Globe*, *The Huffington Post,* and *Solar Today*.

Prior to founding CEG in 1998, Mr. Milford was a vice president of the Conservation Law Foundation, where he conducted litigation and advocacy relating to a variety of energy and environmental issues, and testified before numerous legislative and regulatory agencies. Previously, Mr. Milford was a New York assistant attorney general representing the state of New York in the Love Canal hazardous waste case, and a law professor and director of the public interest law clinic at American University in Washington, DC, where he represented Vietnam War veterans, in federal court and before Congress, who were harmed by Agent Orange. Mr. Milford is the co-author of *The Wages of War*, a social history of American war veterans, published by Simon & Schuster. He has a J.D. from Georgetown University Law Center.

Robert G. Sanders

With more than 25 years of experience in community development and energy-related commercial finance, Robert G. Sanders provides consulting services in the areas of sustainable development, clean energy and community development. Mr. Sanders was formerly the Managing Director of Energy Finance for The Reinvestment Fund (TRF), a leading innovator in the financing of neighborhood and economic revitalization with $700 million dollars under management from 800 investors. In this capacity, he served as Fund Manager for the Sustainable Development Fund, a $32 million fund created by the Pennsylvania Public Utilities Commission to promote renewable energy and energy efficiency, as well as TRF fund manager for the Pennsylvania Green Energy Loan Fund and the Philadelphia metropolitan area EnergyWorks Loan Fund–representing $80 million of new public and private resources for building-related clean energy projects. As lead for all energy investing, Mr. Sanders made loans, leases, equity investments and performance-based grant incentives and positioned TRF as a leader in energy finance among community development financial institutions (CDFIs).

He served two terms on the board of the Pennsylvania Energy Development Authority and was a director and officer of the Clean Energy States Alliance, a national organization comprised of members from 19 publicly-funded clean energy funds and state agencies. He represented U.S. clean energy fund managers and presented at meetings of the UN Sustainable Energy Finance Initiative in Bonn, Amsterdam and Paris. Mr. Sanders has provided testimony at a U.S. Congressional briefing on the respective roles that federal and state funding should play to accelerate clean energy market development. He holds an MCP from the University of California at Berkeley and a BA from Stanford University.

Executive Summary

Clean Energy for Resilient Communities:

Expanding Solar Generation in Baltimore's Low-Income Neighborhoods

This report, prepared for The Abell Foundation, makes recommendations for expanding the use of solar generation for community development in Baltimore, Maryland.

The paper concludes that the best way to do that is to expand the use of solar photovoltaic (PV) with battery storage—to enable low-income populations to benefit from the long-term savings that can be realized through the use of renewable energy, and to protect vulnerable populations from the damaging effects of power outages in severe weather events.

This report is opportunistic. It tries to steer clear of a conventional approach that argues only for long and deep subsidies for solar to reach the poor, knowing that such an approach usually does not last. Instead, it calls for use of solar in situations where policy and market trends are already emerging—to protect the vulnerable from harm in the face of increasing extreme weather events, to attract companies to deliver clean energy services with new business models, and to use public funds wisely through new financing tools.

This is the first report that has analyzed detailed policy trends and recommendations from around the country for how to use clean energy for community resiliency–a new "power resiliency" strategy for community leaders, public officials, businesses, and foundations.

The report is designed to address several "divides" in clean energy and community development. We have a technology gap between poor and the well-off where the well-off get the technology benefits first. We have a public policy gap that has largely supported financing for solar among the better off but not the poor. And we have a philanthropic gap where foundations could do much more to advance clean energy to protect vulnerable populations from more frequent severe weather events brought on by climate change.

All gaps must be closed to better serve the most vulnerable citizens in most need of basic services like electric power, particularly when it is needed the most.

The Case for Resilient Power

Last summer a prolonged, 14-day, extreme heat event affecting Maryland, Ohio, Virginia and West Virginia immediately followed a series of powerful thunderstorms that knocked out electricity for 3.8 million people for up to eight days. Thirty-two people (12 of them from Maryland) died from excessive heat exposure, which was made worse by the loss of power.

This and other extreme weather events have created a call to action for deploying more resilient power in our many diverse communities.

Toward that end, the report rests on several assumptions:

- **Building stronger and more resilient local communities has always been at the core of community development.** Community development aims to overcome poverty and disadvantage by investing in the physical infrastructure of neighborhoods, building

family income and wealth, improving access to quality education, and promoting social equity.

- **By increasing solar electricity generation, the negative health and environmental impacts resulting from the greenhouse gases and other pollutants emitted from fossil fuel electricity generation can be reduced.**

- **Increasing PV distributed generation provides an economic case** for the fixed, long-term price advantage of solar over fossil fuel-based generation with its volatile fuel prices.

- **New threats brought on by climate change are adding to the pervasive threats to community well-being**, and are especially deleterious to the most vulnerable among us—the poor, the elderly, and the disabled.

- **The definition of what a resilient community is and needs to be has changed** for the millions of people in Maryland who lost power and suffered widespread damage and harm during Superstorm Sandy and the derecho of 2012.

- **Extreme weather events and resulting power outages deprive a community of its most basic need**—the electricity that powers multiple levels of urban infrastructure and economic activity, and makes social interdependence possible.

- **Resilient communities need resilient power.** Without dependable power, a community can be brought to its knees, and the most vulnerable will suffer the most.

- **New technologies like solar with storage, with new financing tools, can be effective strategies to provide critical public facilities with more reliable power.** New businesses are emerging that can provide leasing and other financing options to bring these reliable technologies to broader markets.

Recommendations

Given these problems and opportunities, this report makes several recommendations to increase distributed solar power among low-income communities in Baltimore, with a focus on solar with battery storage.

Recommendations to open clean energy opportunity to low-income communities and protect vulnerable populations by serving critical power loads include the following:

- **City officials should implement policies to advance distributed solar generation and support the deployment of solar with storage** as a resilient power application for critical facilities that provide services to low-income communities. To advance this goal, the following should be considered:

  - The city should incorporate solar PV with other high-performance energy measures in the design and implementation of Baltimore City's 10-year plan to renovate or replace its 136 school buildings.
  - Critical facilities identified in Baltimore's Disaster Preparedness and Planning Project (DP3) report should be evaluated for their suitability for resilient solar power with battery storage.
  - The city should require that a portion of the 10 MW of solar generation that is to be developed under the Exelon/ Constellation merger agreement be represented by projects in Baltimore that provide direct benefit for low-income communities.

- A portion of casino local impact grants should be designated for solar PV community projects.
- A "resilient power toolkit" and model resilient power zoning/planning ordinances for the State of Maryland and its municipalities need to be created.

- **The city of Baltimore and its development finance agencies should utilize existing bond financing and credit enhancement mechanisms**, as well as third-party ownership and financing structures, to develop solar on public buildings and nonprofit-owned facilities.
  - Given an early integrated design process, proceeds from the $1.1 billion bond issuance for the first phase of Baltimore City's public school construction and revitalization initiative can be used to fund solar and other high-performance energy measures within normal budgets established for school construction.
  - 501(c)(3) bond financing can be provided to large nonprofit institutions with "big box" real estate portfolios for building renovations and high-performance energy measures, including solar PV.
  - Third-party ownership—financed with power purchase agreements (PPAs) or lease-financed—should be considered for solar PV on public schools, libraries, police/fire stations and other public buildings.

- **The city should support community initiatives to expand distributed solar generation as a community development tool.**
  - Parties should ensure that workforce development funds and job training programs are integrated with public funding of solar PV in low-income communities.
  - Bulk purchasing programs similar to DC SUN, which combines a consumer purchasing co-op model with consumer education for energy, should be considered for replication in Baltimore.

- **The state should enact legislation to support increased distributed solar generation benefiting low-income communities**.
  - The state legislature should increase or repurpose the system benefits charge to create an innovative public benefits fund to leverage private investment in renewable energy projects benefiting low-income communities.
  - Legislation should be reintroduced to enact community solar legislation in Maryland.

- **The city and the state should explore their legal obligations to provide greater power resiliency** to ensure that the elderly and the disabled are able to access emergency services during severe weather events. This is based on a recent federal court ruling holding the city of New York liable for violations of the Americans with Disabilities Act by not providing reliable electricity during Superstorm Sandy, resulting in the disabled not being able to equally access disaster relief.

- **The local philanthropic and policy communities should consider systematic strategies to advance resilient clean energy solutions in Baltimore, which would protect vulnerable populations from severe weather events.**

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Introduction

This paper has been prepared at the request of The Abell Foundation, a leading private foundation in Baltimore. The Foundation has asked Clean Energy Group (CEG) to assess how solar photovoltaic (PV) technologies could be used to promote community development in Baltimore, with a focus on new financing and policy strategies.

To address that challenge, this paper surveys a broad spectrum of best practices and identifies potential financing options to implement distributed solar projects in Baltimore. It serves as a call to action for developing solar PV generation to serve two related purposes: first, as a community development tool and second, as a means to make all vulnerable populations of the city more resilient in the face of extreme weather events.

Ensuring that the communities of Baltimore receive the benefits of solar power is not an easy task. The high up-front costs of solar, the lack of dedicated programs and support for clean energy among the poor, and the other obvious financial demands for community investment in the city all complicate the challenge.

That is why this report focuses on the strategy of power resiliency for community development. The concept is new to many foundations and policy makers. It represents a promising but challenging direction that seeks to combine interest in cleaner and less polluting energy with a commitment to community development.

It is an approach that tries to capture other positive economic and policy trends for solar in a community like Baltimore. They include: the recognition of the need for more resiliency against severe weather events; the emerging business models incorporating solar storage, leasing and other regulatory drivers; the best practices and new financial models of other states that could be applied here; the opportunities for protecting low-income communities in the city through investment in resiliency in schools and other facilities that could be purposed for shelter; and the leadership that the city and the state have already shown in clean energy and climate adaptation.

In this paper, we do the following:

- Summarize a set of new programs that are emerging around the country that give low-income residents an opportunity to participate in the solar market in a way that serves their needs;
- Examine new financing options like solar leasing and power purchase agreements (PPAs) that could be used to expand the use of solar in low-income communities; and
- Describe new technology and business models for solar power generation with battery storage, which could be a groundbreaking advance to provide safe and clean energy for vulnerable populations and to ensure that they do not suffer needlessly during the next derecho or Superstorm that hits the community.

Based on that analysis, we make a series of recommendations regarding programs and policies to advance the strategies that make sense for Baltimore as well as identify tasks required of different actors to bring about results—including city and state officials, foundations, and companies.

Our analysis and recommendations are based on an extensive number of interviews with leading policy and technology experts in Baltimore and around the country. This work summarizes the most current national trends in the area of clean energy for resilient communities—an emerging area of interest in cities and states around the country, as well as a focus of increasing philanthropic effort. This is the first time that such an in-depth compilation has been prepared.

Resilient Communities and Resilient Power

Building stronger and more resilient local communities has always been at the core of community development. It aims to overcome poverty and disadvantage by investing in the physical infrastructure of neighborhoods, building family income and wealth, improving access to quality education, and promoting social equity.

Adding to the well-known and pervasive challenges to community well-being are new threats brought on by climate change, which can impact especially the most vulnerable among us—the poor, the elderly, and the disabled.

For millions of people in the Maryland area, Superstorm Sandy and the derecho of 2012 have now changed the definition of what a resilient community is and needs to be.

Resilient communities need resilient power. Without dependable power, a community can be brought to its knees. Extreme weather events and resulting power outages deprive a community of its most basic need—the electricity that makes the multiple levels of urban infrastructure, economic activity, and social interdependence possible.

All infrastructure systems are vulnerable to power disruptions, whether they are buildings, utilities, gasoline, health care, telecommunications, transportation, water and wastewater, food supply, solid waste—and public safety. All rely on electricity, which is the community's lifeblood.

We have learned from recent extreme weather events that a community without dependable and reliable power is a community at risk. The consequences of losing power are stark, especially for low-income residents, the elderly, and disabled:

- Last summer a prolonged 14-day extreme heat event in Maryland, Ohio, Virginia and West Virginia immediately followed a series of powerful thunderstorms that knocked out electricity, affecting 3.8 million people for up to eight days.
- 32 people (12 of them Marylanders) died from excessive heat exposure that was made worse by the loss of power.
- More than 400 New York City Housing Authority buildings containing approximately 35,000 housing units lost power, heat, and/or hot water during Superstorm Sandy, causing untold hardship.
- The effects in New York were so severe and protracted that a federal court has ruled that the city violated the Americans with Disabilities Act: The disabled elderly were stranded in high-rise housing with no elevator service and could not access emergency services, nor did emergency shelters and other facilities have electricity to power ventilators or charge wheelchair batteries.

The damage and harm caused by storms are always compounded by poverty. Low-income areas have more difficulty responding and recovering from the destruction caused by extreme weather events and related power outages. They often lack the income, savings, jobs, access to communication channels and information, and insurance to recover from the adverse impacts of extreme weather events.

These dangers are often forgotten after the immediate damage from these events is over. But public agencies concerned with the health and welfare of their most vulnerable residents must come to realize that these impacts are not inevitable; they can be prevented.

This brings us to our focus on solar and battery storage options, where the link between clean energy and resilient communities can be found. Clean energy, especially distributed solar with battery storage, can keep solar up and running in a power outage. Solar with storage can be a useful community development tool to create community power resiliency, while at the same time leveraging public and private investment in low-income communities. (See Box 1, p. 11)

This paper will consider strategies that increase distributed solar power in Baltimore, with a focus on solar with battery storage.

There are several primary goals of this approach. One is that by increasing solar electricity generation we can reduce the negative health and environmental impacts resulting from the greenhouse gases and other pollutants emitted from fossil fuel electricity generation. Another is the economic case for the fixed, long-term price advantage of solar, with no fuel costs. And another is to provide power resiliency.

We approach those goals with one question in mind when thinking about solar generation as a community development tool for inner cities like Baltimore: **What are the needs of low-income residents who must be served?**

When it comes to power, the answers are clear. They need reliable, low-cost power to serve their daily needs, chill their medicine, keep the lights on and elevators running in a storm—and that will stabilize their electricity bills.

This focus on power resiliency comes from an examination of what are the best strategies to provide low-income communities with access to the benefits of solar power. We could affirm those policies that say it is better to completely subsidize the technology for low-income households, using deep subsidy to essentially give the poor solar at little or no cost. That strategy depends on heavy subsidies over the long run, which can prove to be an unreliable and unsustainable approach.

For that reason, we find it is better to align new business models that may be ready to serve those markets without deep subsidy. We believe this strategy to be more promising.

That leads us to focus on power resiliency as a way to tap into emerging business and technology markets for solar battery storage. That approach would give community buildings and schools and other facilities more power protection in the event of severe weather events. We think this approach makes more business, political, and economic sense for the communities of concern. Moreover, while there is an important environmental benefit, such an approach is directed to doing a basic job of government and public policy: to protect citizens from harm.

Two governors, from Massachusetts and from New York, have announced their support for just this approach by committing significant new funding to resilient power systems totaling $80 million in the month of January 2014 alone.

Governor Deval Patrick has committed more than $50 million to help communities in Massachusetts prepare for and protect themselves from the increasing number of destructive storms and rising sea levels associated with climate change. Most of the money, about $40 million, will be disbursed as grants to help cities install backup power systems using clean technologies such as advanced batteries that store energy from solar panels.[1]

In New York, the state will establish the "New York Prize," a $40 million competition aimed at jump-starting at least 10 "independent, community-based electric distribution systems" across the state. The projects will operate in conjunction with the grid most of the time. But during emergencies, the microgrids will be able to disconnect from the grid and power themselves, providing islands of resilient power for hospitals, police departments, fire stations, gas stations and other critical services.[2]

These proposed microgrids are seen as "the means to increase reliability and give local communities more control of their energy systems, while also allowing for the adoption of clean and efficient distributed energy sources such as solar or combined heat and power."[3]

Developing resilient power broadens the value proposition for solar and addresses the point that solar projects often have higher up-front costs than many competing energy options. The challenge is to find ways to provide greater value—such as power protection for vulnerable populations—to justify that added cost for solar with battery storage.

Following this market-based approach, this report is designed to explore some basic issues:

- How solar technologies can help the poor, the disabled and the elderly with their day-to-day lives, especially in the face of threats from more frequent extreme weather events in the future;
- How solar, configured with battery storage, can help protect lives by keeping the elevators running and the air conditioner on in senior centers and housing during a power outage;
- How clean resilient power can help reduce the risk of heat stroke and hypothermia in vulnerable populations during power emergencies and extreme weather events;
- How public facilities like schools can be powered by solar power with battery storage, or other forms of clean energy generation, to serve as emergency shelters;
- How cities can ensure that critical public facilities like shelters, emergency centers, and police and fire stations are equipped with more reliable power to withstand the next storm;
- How public policies and utility support programs can be targeted to provide opportunities in low-income communities for distributed solar generation and community power resiliency; and
- How these new measures to protect vulnerable populations from power outages also provide a public health benefit by reducing the environmental impacts of conventional electricity generation on low-income communities.

There is a related issue of social equity that is concerned with which neighborhoods are more likely to install solar PV and who is left behind. One commentator has remarked:

> *"As rooftop solar has become more popular among homes and businesses, installation costs have fallen, decreasing by almost 30 percent since 2007. Yet even with the lower cost, solar is still too costly for many homeowners and business owners. And, while there has been a boom in solar installation companies …in recent years, most do not target low-income households."*[4]

This strategy, which focuses on resiliency, is consistent with trends in Maryland policy. Governor O'Malley was appointed to the President's Task Force on Climate Preparedness and Resilience, which was created to "provide recommendations to the President on removing barriers to resilient investments, modernizing

Federal grant and loan programs to better support local efforts, and developing information and tools we need to prepare."

Maryland also has been a leader in the solar resiliency field, an area of innovation that can be further advanced in Baltimore.

Recently, the state provided support for the installation of 402 kW of solar PV with battery storage in Laurel, Maryland. This kind of development could be replicated to power Baltimore's hospitals, community centers, large nonprofit service organizations and public schools to serve critical loads in community facilities in the event of grid power outages.

Finally, this resilient power approach, which relies on solar storage technology, stands in contrast to standard practices that are used today to protect against power outages resulting from extreme weather events. We tend to rely exclusively on diesel-powered standby generators to provide emergency power. But conventional standby generators have had poor reliability track records, require fuel that can be difficult to obtain following a storm, contribute to local and regional pollution, and emit harmful greenhouse gases, including carbon monoxide which is hazardous in enclosed spaces.

There are other distributed generation technologies such as fuel cells and combined heat and power systems that use natural gas and require on-site applications for the considerable heat they generate. Those solutions, while promising, are often much more expensive than solar with energy storage options, and are targeted to very specialized applications like hospitals and data centers, limiting their use in wider resilient power applications.

BOX 1

Resilient Power and Solar Storage

Resilient power is the provision of electricity to critical infrastructure, so that needed services can be maintained when a natural disaster that knocks out portions of the electric grid. These critical services include food, water, shelter, heating and cooling, medical and emergency services, communications, and fueling. Facilities that can provide these services include hospitals, nursing homes, community buildings, schools, shelters, distribution centers, gas stations, and cell towers, among others.

A PV system generates electricity when the sun shines. If a cloud happens to come between the sun and the PV modules, electricity generated from the PV system will fall quickly. One way to deal with this problem is to add battery storage to the PV system. Now, when local generation of electricity exceeds local demand, the excess electricity is first used to charge the battery. When the battery is fully charged, excess power is exported to the grid.

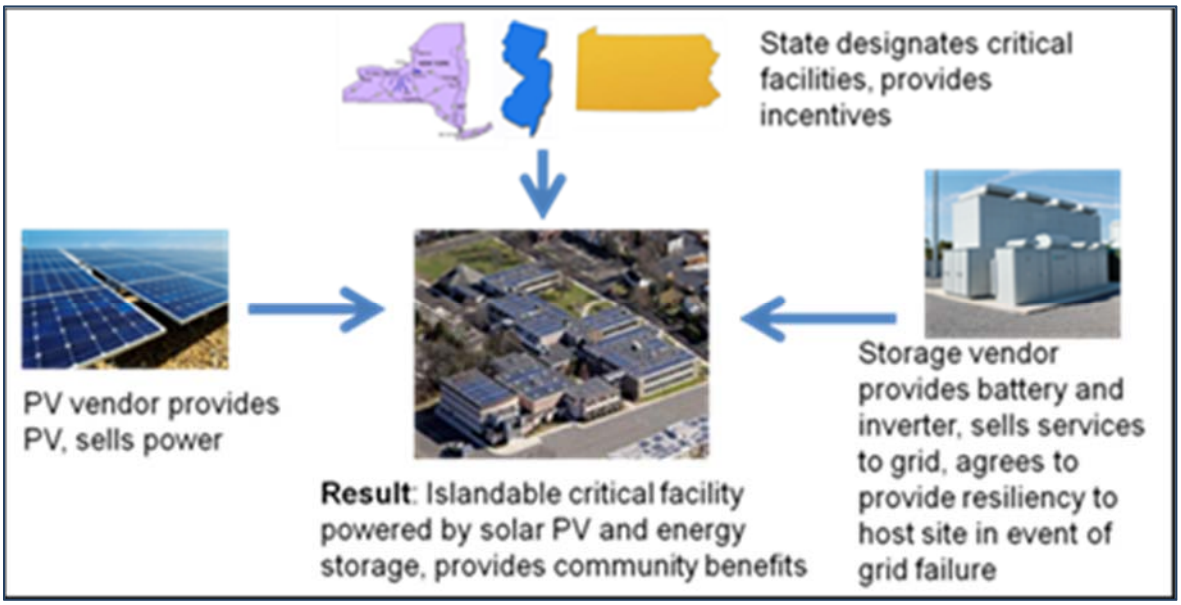
It is important to note that a grid-connected PV system cannot, by itself, provide electricity during a power outage—a fact too few know. However, solar PV with a battery-storage component can provide power if the grid goes down.

Solar energy storage refers to combining solar PV with battery storage. In order to provide a resilient power benefit to a local facility, special switches are added that can isolate (or "island") the PV/battery-storage system in case of a grid failure. When the larger grid goes down due to a natural disaster, a switch is thrown that decouples the local circuit and allows it to continue to function as an isolated unit. In this scenario, the local facility would need to drop non-essential load, keeping only its critical loads powered, in order to extend the life of the battery's charge.

For example, a university's critical loads might include lighting and HVAC equipment in buildings designated as community emergency shelters. Other loads, such as non-critical buildings (libraries, computer labs, theaters, etc.) would not be powered. The PV system would continue to charge the battery and power critical loads when the sun was shining, and the battery would power critical loads when there was not enough solar power.

This simple system becomes more cost-effective when additional revenue streams from grid services are factored in. Owners of new battery-storage equipment could earn significant revenue 24 hours a day by selling ancillary services to the grid, such as frequency regulation services. They could also engage in electricity arbitrage, buying cheap power at off-peak times and discharging it during peak demand times, when it is most valuable. Because grid-damaging natural disasters occur infrequently, this greatly improves the cost/benefit calculation for the PV/storage system. If the grid were to go down, the PV/battery-storage system would island just as before, providing valuable critical services to the community at large.

New third-party battery companies are beginning to take advantage of the revenue streams made possible by the Federal Energy Regulatory Commission (FERC) orders requiring fair compensation for grid services. These companies provide the battery and inverter free of charge, collocated with a PV or wind generator. Their business models are based on the provision of grid services—services that energy storage systems like batteries can provide very quickly and accurately. Such new business models could make it much easier for customers to add storage to existing solar systems, or to build storage into new systems, through what are essentially leasing or PPA arrangements similar to the third-party models that have made PV much more accessible and popular.



Source: Solar Grid Storage

For more information on solar energy storage and resilient power, see:

http://www.forbes.com/sites/peterdetwiler/2014/01/17/solar-grid-storage-finding-value-in-grid-frequency-regulation/,

http://theenergycollective.com/lewmilford/297551/solar-storage-new-resilient-clean-energy-technology

http://www.cleanenergystates.org/assets/Uploads/RPP-Webinar-Presentations-Energy-Storage-New-Markets-and-Business-Models.pdf

Best Practices for Expanding Solar Generation in Low-Income Urban Communities

There are a great many examples of programs that have successfully installed distributed solar PV in low-income urban communities. These programs have had to address the many hurdles encountered by renewable distributed generation such as significant first costs, an uncertain policy framework, poor or non-existing credit history of end-users, and the issue of split incentives between tenants who benefit from solar power and the building owner—who often must finance the equipment but frequently does not realize the full cost savings that would offset the financing cost.

Solar in Public Schools, Libraries, Fire/ Police and Other Government Services, and Community Facilities

It is increasingly common for public schools to include solar PV for a portion of their electric load, both to hedge against volatile utility costs and as a part of the school's educational program. A special opportunity for solar technologies occurs when school districts consider "net-zero" new school construction. A "net-zero school" is a school building that generates as much energy as it consumes. The Abell Foundation recently contracted with Doo Consulting (Towson, Maryland) to study net-zero energy schools across the United States.[5] The firm's report describes 15 net-zero schools throughout the country, virtually all of which used solar PV and thermal technologies to achieve their energy goals.

Although each of these construction projects took full advantage of utility incentives and rebates, as well as a few available grants, the primary funding for these resilient, high-performance school buildings came through the sale of conventional school construction bonds. The net-zero schools were built within normal budgets established for school construction in each region. In instances where energy investments were financed outside of the bond issuance, the payback period ranged from 5 to 12 years.[6] In Maryland, the state has established a net-zero school program managed by the Maryland Energy Administration and funded through the Constellation/Exelon merger agreement. Two new net-zero schools are currently being planned for Baltimore.[7]

The state of Massachusetts created a bond-financed renewable thermal program for public schools and public housing that could be adapted for distributed solar generation. The Department of Energy Resources launched the SAPHIRE program ("Schools and Public Housing Integrating Renewables and Efficiency") in collaboration with the Department of Housing and Community Development and the Massachusetts School Buildings Authority to promote renewable thermal heating and cooling upgrades in public schools and state public housing across the Commonwealth.

These projects combine renewable thermal heating upgrades with energy efficiency improvements—such as insulation, air sealing, and lighting upgrades—to achieve deeper energy savings and provide cost savings to schools.[8] The SAPHIRE Program leverages a $715,000 U.S. Department of Energy grant with $10 million in federal, low-cost bond financing, as well as Mass Save energy efficiency rebates.[9]

SAPHIRE projects can also supplement financing with Alternative Compliance Payments grants through the Massachusetts Clean Energy Center and the Department of Housing and Community Development. The program provides K-12 public schools and state public housing with feasibility grants for biomass and solar thermal heating, heat pumps and district heating and cooling projects. The SAPPHIRE program builds off of Massachusetts's successful Green Schools Initiative, which led to the incorporation of green building practices in state regulations governing the construction of schools by documenting the strong financial and educational case for green schools.[10]

Solar Battery Storage for Public School, Commercial and Community Applications

Most solar PV systems are installed without battery storage due to concerns regarding the additional first costs. However, an exception involving public schools has been Florida's SunSmart E-Shelter Program. Coordinated by the University of Central Florida's Solar Energy Center, the program has installed more than 100, 10 kW photovoltaic systems with battery storage on emergency shelter (Enhanced Hurricane Protection Area) schools throughout Florida. The SunSmart E-Shelter Program has added more than 1 MW of resilient photovoltaic generating capacity to Florida. Traditionally, to protect against power outages resulting from extreme weather events, many shelters typically use diesel generators to provide emergency power. But these conventional generators experience reliability issues and difficulties in obtaining fuel following a storm.

Solar PV is a good complement or replacement for fossil-fuel generators and, with battery storage, can provide resilient power for critical loads including medical equipment, food and medical refrigeration, food preparation and general sanitation. Initially funded with American Recovery and Reinvestment Act of 2009 dollars, the program has been expanded to include additional funding from private and public utilities.[11] Through the program, more than 250 Florida teachers have received professional development in the science and use of photovoltaics through a curriculum grounded in science, technology, engineering and math.

New business models are now beginning to emerge to address the high first-costs of battery storage, and to respond to market opportunities created by recent federal regulatory requirements. A series of FERC orders since 2011 has provided real support to battery storage through stream-lined interconnection processes and equitable payments for ancillary services that benefit the operation of the grid.[12]

These FERC orders revise small-generator interconnection agreements and procedures, and ensure that energy storage is entitled to fast-track interconnection procedures that are just, reasonable, and nondiscriminatory. They also ensure that grid operators' tariffs are modified to incorporate energy storage resources; and they require that grid operators pay service providers, including battery storage, equitably for fast-response frequency regulation (i.e., a performance payment for faster ramping and accurate responses to dispatch signals, as well as capacity payments).

One result of these recent FERC orders is that battery-storage companies have begun to partner with solar developers to incorporate electricity storage in their commercial solar PV installations, sell that power back to the grid when it is most valuable, and provide valuable around-the-clock frequency regulation services (charging and discharging to and from the grid) as an additional revenue generator.

The financing model for battery storage also has evolved from direct on-balance sheet financing of the equipment to a third-party PPA model

that involves no upfront costs. Instead, the solar developer is able to reduce his solar PV budget by removing the standard solar PV inverter from the project, which is then replaced with the smart inverter and battery system provided under PPA by the battery-storage company. This results in a reduction in the amount of financing needed by the end-user and an additional revenue stream from grid ancillary services—as well as the provision of resilient power for critical end user loads in the event of power outages.

This value proposition was persuasive to Konterra Realty when it decided to contract with Standard Solar to install 402 kW of solar canopies in its headquarters' parking lot in Laurel, Maryland, in conjunction with a battery storage PPA and shared ancillary services revenue agreement provided by Solar Grid Storage.[13]

Solar battery storage is a model that could be readily adopted by public schools, hospitals and other public entities that are tasked to provide emergency services, as well as large nonprofit organizations that provide services in low-income communities and that have big-box real estate properties (e.g., Goodwill Industries, Blind Industries, etc.).

For example, preliminary interest has been expressed by Johns Hopkins University in exploring solar battery storage not only for its Baltimore campuses but possibly for its "adopted" Henderson-Hopkins K-8 public school (East Baltimore Community School).[14] This newly constructed school includes a community room, daycare center, gym, library and kitchen—all available for community use. The installation of solar PV with battery storage could provide the first demonstration in Baltimore of resilient solar power in case of grid power outages serving critical community facilities.

Net Metering and Virtual Net Metering

Net metering and virtual net metering programs have provided important support for small solar distributed generation. Net metering is a billing arrangement that provides credit to customers with solar PV systems, usually for the full retail value of the electricity their system generates. With net metering, the customer's electric meter tracks how much electricity is consumed by the customer, and how much excess electricity is generated by the system and sent back into the electric utility grid. The customer pays only for the net amount of electricity consumed above the amount of electricity generated by the solar PV system, plus the usual monthly transmission, distribution, and meter service charges. Forty-three states have net metering laws (July 2013).

Virtual net metering, which shares many aspects with "aggregate net metering" or "community shared solar," is net metering that permits a single generating system to be used to offset electricity use for multiple meters, without necessarily requiring a physical connection between the system and those meters.[15] Its primary benefits are the ability to address some of solar PV's obstacles associated with site limitations (shading, deteriorated roofs, etc.), the ability to pass along to customers economies of scale in system sizing, as well as the use of underutilized roof space or land in system siting.

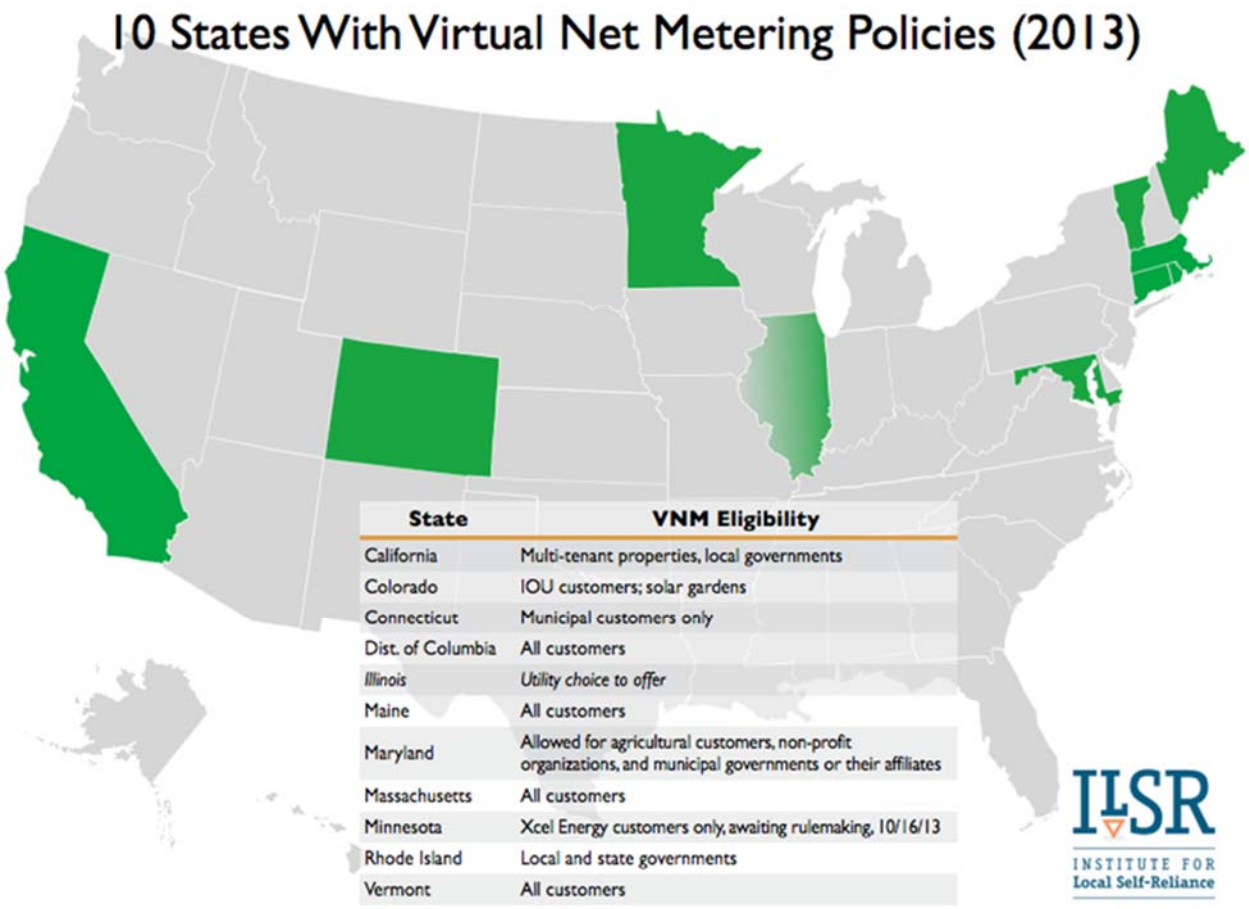
While aggregate net metering can benefit many different types of customers, it is most readily applicable to a single customer entity with multiple meters and/or electric accounts, such as a local government entity. Ten states have virtual net metering laws.

Virtual net metering is also particularly well suited to address problems related to distributed solar generation in multi-tenant

buildings, whether residential or commercial. These problems include:[16]

- Installing separate solar PV systems for each individual meter/tenant in a building is cost prohibitive and often physically impossible. Virtual net metering provides the ability to pass along to customers certain economies of scale in system sizing, as well as the use of underutilized roof space or land in system siting.
- There is the issue of "split incentives," which arises when a landlord must pay for a renewable energy system that benefits all tenants by lowering total building costs but the landlord can't easily pass on the costs of the system to tenants. Stated another way, installing one renewable energy system for a common area load cannot offset the load of the whole property and is thus not economically efficient, nor is there a means to ensure distribution of the generation to each occupant. Virtual net metering can distribute those system costs and benefits to all participating tenants.

Figure 1



One example of virtual net metering involving affordable housing is the Las Serenas Apartments project completed in 2011 in San Diego, California. Community HousingWorks (CHW), a community development corporation, installed a 67.5 kW solar PV system at Las Serenas, a 108-unit affordable multifamily development. All of the solar production is provided to tenants through virtual net metering, offsetting nearly 20 percent of the residents' annual electricity bills.

The solar PV system was funded under California's Multifamily Affordable Solar Housing program (MASH, see below). Through Helio University's Solar Contractor curriculum, Las Serenas tenants also had the opportunity to gain training and, in some cases, were placed in jobs in the solar energy industry through the solar developer's (HelioPower) "Helio University's Solar Contractor" training program.[17]

In October, 2013 Washington, DC passed its own community virtual net metering bill. The Community Renewable Energy Act of 2013 (CREA) was enacted to lower the barrier for adopting solar and other renewable technologies, as well as to diversify solar market participants. CREA allows DC ratepayers to use virtual net-metering and subscribe to power from solar facilities that are not located on their property. The D.C. Public Service Commission is now writing rules to implement the act.

CREA is built on four key principles drawn from shared community renewable energy programs around the country:[18]

- As few as two subscribers (i.e., utility customers) may share the benefits of a community energy-generating facility.
- Benefits from a community energy-generating facility are credited directly to a customer's monthly utility bill to offset electricity demand.
- For-profit, nonprofit or third-party entities may all build, own, and operate community energy-generating facilities.
- Opportunities must be created for participation by low-income utility customers.

Community energy generating facilities cannot be larger than 5 MW in capacity and can have as few as two subscribers to the power produced from eligible facilities. Subscriptions cannot be for more than 120 percent of the subscriber's 12-month electricity usage. Utilities (Pepco in this instance) may be able to require all subscribers to be on the same billing cycle.

The owner(s) of the Community Energy Generating Facility own the rights to solar renewable energy certificates (SRECs) produced from the power. In any month that subscribers receive credit for more power than they consume the excess power will be credited to the next month's electric bill; any excess power credits at the end of the annual cycle will be lost and reallocated to rate payers eligible for the District's Low Income Housing Energy Assistance Program (LIHEAP).[19]

Washington, DC has a high renewable portfolio standard (RPS) carve-out of 288 MW of solar capacity required by 2023 with annual solar RPS requirements that substantially exceed the current rate of solar development. Because of this, the Washington, DC's SREC market prices are the highest of any SREC market at $480/SREC (December 2013). These high SREC prices create an excellent opportunity to develop solar projects that are accessible to low-income utility customers.[20] However, a more rapid rate of solar development with its accompanying increased supply of SRECs could ultimately lower SREC prices.

Net metering, whether virtual or not, has created concern for utilities that residential solar customers—who generate their own

electricity—are not paying a fair share of the costs of the grid that are typically recovered through transmission and distribution charges added to the sale of electricity. Utilities have major investments in central power generation plants and the electric grid, the cost of which they recover, as regulated monopolies, from surcharges on the sale of electricity to their customers. Their concern is that eventually enough solar power will be generated from rooftop systems to undermine the utilities' business model.

To this point, in November, 2013 the Arizona Corporation Commission voted to approve a surcharge on residential customers with rooftop solar power installations who net meter their excess power back to their utility (Arizona Public Service). The $0.70-per-kilowatt monthly charge averages approximately $4.90 a month per average residential customer.[21] Similarly, in California the state legislature passed a law in October 2013 that allows utilities to bill solar customers an additional $10 a month to recover some of the costs the utilities incur to maintain backup power and the grid.[22] This is a continuing debate that will need to be addressed in any proposed community solar or virtual net metering legislation.

Community Solar Generation

In Maryland, aggregate net metering is available to non-profit customers, municipal governments, and for customers who use electric service for agricultural purposes, but generally it has not been available to residential customers. Aggregate net metering permits the electricity generated by the renewable energy system to be allocated to multiple meters all belonging to the same customer, even if those meters are not at the same building as the solar PV system.

An interesting application of the current aggregate net metering law has been suggested. Under existing law, it is feasible for a nonprofit organization (the host) to install a solar PV system and then allocate any excess solar electricity, which is not used by the host, to other electric meters, which are held under the host's account. These accounts could potentially include unrelated residential or business meters that had been transferred to the name of the non-profit organization. In this way a church, school, community co-op, or community development corporation could possibly host a primary account and allocate the excess solar electricity that it has generated to other metered accounts now titled under its name. Presently, up to 20 other meters can be aggregated for billing purposes; that number is thought likely to increase in the coming year.[23]

In Colorado, legislation was passed in 2010 to support the development of "community solar gardens." Community solar gardens allow for multiple utility customers to purchase interests in a single photovoltaic system not located on their property, and to have the electricity produced by their share of the system offset the electricity consumption of their home or business.

Xcel Energy's Solar*Rewards Community Program has provided additional support to the development of community solar gardens in its service territory by making SREC payments under its standard offer agreement. Colorado's community solar gardens must have at least 10 customer subscribers to qualify for this program, and at least 5 percent of the allocation must be attributed to income-qualified subscribers. No subscriber can own an interest in more than 40 percent of a single project.

Furthermore, subscribers are limited to subscriptions that will produce no more than 120 percent of their annual electric usage. Subscribers must be Xcel Energy electric customers in the same county as the garden.[24] Xcel is implementing a similar community solar program in Minnesota, which passed a law in the spring

of 2013 requiring that utilities generate or procure 1.5 percent of their power from solar generation by 2020, including community solar gardens.[25]

Another community solar model was created by University Park Community Solar LLC. A 22 kW solar PV system was installed on the Church of the Brethren in University Park, Maryland, but is owned by University Park Community Solar LLC, a small company owned by local community residents for the sole purpose of owning the solar PV system. The church purchases 100 percent of the generated electricity under a PPA with University Park Community Solar LLC.

The LLC in turn allocates solar revenues and tax credits (which the church, as a nonprofit institution, is unable to use) to its member-owners, who are able to make a modest single-digit return as owners of the LLC. This financial structure raised complex securities compliance issues. Filing a full securities registration with the Securities and Exchange Commission (SEC) would have been prohibitively expensive for the small solar PV project. With the help of considerable legal consultation and a generous grant, the member-owners were able to develop a structure that qualified for a securities exemption. This model's extensive transaction costs may make it difficult to replicate, which underlines the importance of developing alternatives such as virtual net metering to extend the benefits of distributed solar generation to multiple customers who are unable to purchase or lease individual systems.[26]

Comprehensive Incentive Program with Workforce Development

California has been a clear leader in dedicating solar funding for low-income housing. The California State Senate passed SB 1 in 2006, which set forth specific California Solar Initiative (CSI) program goals and requirements to be funded through legislatively mandated public benefit charges on utility bills. The State Assembly followed suit by passing AB 2723, which requires not less than 10 percent of the CSI's total $2.167 billion projected budget between 2007 and 2016 be used for installations of solar systems for low-income housing. The California Public Utilities Commission (CPUC) created individual solar programs for single-family low-income homes and multi-family low-income buildings.

Single-Family Affordable Solar Housing Program (SASH)

This $108 million program within the CSI provides higher incentives for installing solar on low-income single family homes in California. The size of the rebates is determined primarily by income; a solar PV system can be free for homeowners making less that 50% of the local median income (LMI); rebates range from $7.00 – $4.75/watt for homeowners making between 50-80 percent of LMI. More than 3,300 single family homes have had projects completed. Originally scheduled to sunset in 2015, the SASH program has been extended through 2021.[27]

GRID Alternatives was selected as the statewide SASH Program Manager. A nonprofit solar contractor and workforce training provider based in California, GRID Alternatives has focused its program on installing solar panels in low-income households since 2001, emphasizing broad community engagement and homeowner energy education. The organization operates in many ways like Habitat for Humanity in that it relies on volunteer workers and job trainees, as well as donations, in order to do its work.

GRID Alternatives provides the opportunity for volunteers and trainees from local green-jobs and workforce development programs to gain actual experience installing solar PV systems on homes throughout California and Colorado, and now in New York and New Jersey.[28]

Also important to the program model is that GRID Alternatives receives equipment donations from solar panel and inverter manufacturers such as SunPower and Enphase. Most systems are installed at little or no cost to the low-income homeowner, deeply subsidized with volunteer labor, solar rebates and local grants. The CPUC SASH guidelines do not presently allow for third party ownership of solar PV systems, thereby losing the opportunity to capture the 30 percent investment tax credit to defray the costs of the systems.[29]

Multifamily Affordable Solar Housing Program (MASH)

The CPUC MASH program, also funded at $108 million, has provided incentives for installing solar in conjunction with high levels of energy efficiency in multifamily affordable housing buildings in California. Incentives ranged from $1.90-$2.80/watt depending on whether common-area load or tenant load was offset. Fewer than 300 projects were completed statewide before the program was closed to new applications as the incentives have been fully subscribed.[30]

New Market Tax Credits – Raising Equity Investment for Solar in Affordable Housing

In Chicago, the Hispanic Housing Development Corporation (HHDC), a nonprofit community development corporation, has developed, financed, owned and managed 50 multifamily housing projects since it was founded in 1975. This provides the organization with a rich portfolio of its own properties to achieve economies of scale when financing energy efficiency retrofits and installing solar PV.

Through the organization's for-profit subsidiary, Affordable Community Energy, Inc. (ACE), HHDC recently closed on a $6.2 million New Markets Tax Credits (NMTC) financing to make efficiency retrofits to 11 of their development projects involving 18 multifamily buildings and approximately 1,300 apartments.[31] The retrofits have incorporated small combined heat and power units for their domestic hot water, as well as 600 kW of solar PV.

These measures generate energy for the common areas of the buildings and will supply 20 to 25 percent of the buildings' total energy consumption. The implementation of these building upgrades has allowed HHDC to develop the technical capabilities needed to assemble the right set of energy and water efficiency measures and renewable energy solutions for a given portfolio of properties, and then implement those improvements.[32]

Despite the highly complex transaction structures of NMTCs combined with very high legal, financial and other professional fees, NMTC projects do successfully raise considerable equity investment. When combined with other state and federal grants, the $6.2 million project required only $660,000 in hard debt to be repaid.

In Massachusetts, Boston Community Capital (BBC) has taken a similar approach to incorporating energy efficiency and renewable energy generation in affordable housing and low-income community facilities. BCC, a large community development financial institution (CDFI), established its Solar Energy Advantage (SEA) affiliate in 2008.

As a third-party owner of solar PV systems, SEA develops, finances, installs and owns solar PV systems for affordable housing, nonprofit organizations, and community and municipal facilities. SEA provides all of the upfront capital for the panels and installations, captures the value of the solar investment tax credits, and operates and maintains the systems. SEA stabilizes and reduces the host properties' utility costs through long-term, fixed-price power purchase agreements. In November,

2013, SEA closed on a $7.5 million NMTC financing of nine solar projects totaling 1.5 MW in new distributed clean energy generation.[33]

The financing involved a number of sources of capital, including debt from Boston Community Loan Fund and tax credit equity from U.S. Bank. The transaction brings BCC SEA's financed and operating portfolio of distributed solar to more than 5 MW of rooftop and ground-mounted solar, nearly all of which serves the electricity needs of affordable housing and low-income communities.

Solar in Low-Income Housing Tax Credit-financed Multi-family Projects

In Denver, the Northeast Denver Housing Center (NDHC, a community development corporation) has successfully installed PV systems on 12 existing buildings to provide solar electricity to 30 affordable housing units.[34] The Whittier Affordable Housing Project incorporated an innovative PV system financing model that combined private equity funding and utility rebates with a low-income job training program.

The small 1.88 kW solar PV systems provided 85% of the annual electricity use for each small, efficient duplex unit. A green-jobs training program was created for low-income residents that provided PV system installation training to 15 low-income residents. Several residents participated in the on-the-job training for PV system installations, leading to ongoing employment opportunities with a local solar company.

Since 1987, the Low-Income Housing Tax Credit (LIHTC) program has been the federal government's primary means of supporting affordable rental housing for low-income residents. The LIHTC program has built or rehabbed 37,506 projects and almost 2,318,000 housing units between 1987 and 2011.[35]

However, in the past, solar projects have not been incorporated into Low-Income Housing Tax Credit (LIHTC) projects because of the challenges with integrating the financing of solar PV with the covenant restrictions of the affordable housing's existing financing structure, as well as the added costs of solar PV to the project. NDHC's Whittier Affordable Housing Project is the first time solar PV was incorporated in an LIHTC housing development through third-party ownership and financing of the of the PV system.

Third-party ownership of the solar PV permitted the nonprofit community development corporation to benefit from available federal tax incentives by passing on the value of those incentives to NDHC through a lower cost of solar electricity under the power purchase agreement (PPA). The PV project received the 30% federal investment tax credit, and the Modified Accelerated Cost Recovery System (MACRS) accelerated depreciation, which were captured by the equity investor through the creation of a limited liability corporation for this project.

At the beginning of year seven, NDHC will have the option to purchase the PV systems from the investor at the fair market value of the PV systems at that time. During that year, NDHC will purchase the PV systems from the equity investor using an escrow account that is funded from the repayment of a loan made by NDHC to the equity investor using a grant from the Governor's Energy Office.

This financial model benefitted both NDHC and the low-income tenants:

- By loaning the grant proceeds to a private investment entity, the NDHC was able to capture all applicable tax and financial incentives, which it would otherwise be unable to do. Using the PPA structure allowed NDHC to avoid any up-front capital costs to

install PV systems. Lending the grant proceeds to the solar PV developer also allowed the developer to maximize the tax incentives, which permitted NDHC to install more PV systems and negotiate a lower PPA price for the solar electricity.

- The cost of solar electricity in the PPA ($0.08 per kWh) is less than initial utility-provided electric rate ($0.095), saving the NDHC money over the course of the PPA.
- In year seven, NDHC will be able to acquire the PV systems using the escrowed loan payments. At that point, NDHC will receive the $0.11/kWh production incentive from Xcel Energy for the remaining 13 years under the PPA.

Other Models

DC Solar United Neighborhoods (DC SUN) has created six active neighborhood residential bulk purchasing groups for solar PV systems in Washington DC. Under this model, DC SUN organizes neighborhood groups of homeowners interested in "going solar." The program operates similarly to the Solarize model, which is a grassroots community approach to helping residents and business owners to overcome the financial and logistical hurdles of installing solar PV systems by using discounted price bulk purchasing and an organized and streamlined development process.

There are a number of ways the DC SUN program differs from other Solarize programs. DC SUN operates at the neighborhood level, not the city or town level. DC SUN's role is that of consumer advocate throughout the development process. DC SUN pre-screens and does a site evaluation of the homes before the contractor RFP process begins. DC SUN signs letters of commitment with participating homeowners before issuing an RFP, educates the home-owners about their financing options and issues the RFP on behalf of the neighborhood group.

DC SUN allows each neighborhood group to establish its own weighting of the selection criteria for its solar contractor. DC SUN has also worked closely with the D.C. Department of Housing and Community Development (DHCD) to piggyback DHCD's roof replacement program for homeowners on DC SUN's program to help ensure greater access to solar PV for low-income residents.

A simpler although relatively untested model for investing in solar PV on commercial and community facilities is the Mosaic crowd-funding model. Mosaic, an online marketplace, connects investors to solar projects in need of financing through an internet investment platform. As the solar project produces electricity, it generates revenue by selling power to the solar customer. As the project earns revenue, investors receive monthly payments of principal and interest into each investor's online account. Each investment is documented with a Mosaic Note that specifies the amount, repayment terms and conditions of the investor's loan. Prior to investing, each investor receives a prospectus for the specific project that adheres to the Securities and Exchange Commission's disclosure requirements. Since Mosaic's inception in 2010, $5.6 million has been invested in solar PV projects throughout the country, with no late payments reported.[36]

Lastly, the Evergreen Cooperative in Cleveland, OH represents a worker-owned cooperative model for implementing solar PV projects. Launched in 2008 through the collaboration of various Cleveland-based institutions (including the Cleveland Foundation, the Cleveland Clinic, University Hospitals, Case Western Reserve University, and the municipal government), the Evergreen Cooperative Initiative is working to create living wage jobs in six low-income neighborhoods (43,000 residents with a median household income below $18,500) in an area known as Greater University Circle (GUC).

The Evergreen Cooperative has launched three cooperatives so far and plans to launch more. These cooperatives include: Evergreen Energy Solutions, Evergreen Cooperative Laundry and Green City Growers Cooperative. Incorporated in 2008, Evergreen Energy Solutions (E2S) designs, develops and installs PV solar panel arrays for institutional, governmental and commercial markets, as well as provides home performance services to make residential and commercial buildings more energy efficient. As a for-profit company competing for business, E2S is still striving to become profitable.[37]

Financing Options

Traditional financing tools are being used to incorporate solar PV into projects that benefit low-income neighborhoods. One clear example of this is the building of net-zero schools, which incorporate solar PV and other clean energy and efficiency measures so that the school building generates as much energy as it consumes. Although it is true that any school can be a net-zero school if enough solar panels are installed on or near it, the Doo Report states that the design challenge for net-zero schools is to reduce the building's energy consumption to well below 30 KBtu/SF/year. Most of the net-zero schools studied in the Doo Report received primary funding through the issuance of conventional school construction bonds, supplemented with foundation grants and utility energy efficiency incentives.

Conventional school construction bonds can be used again to implement high-performance energy measures, including solar PV, which have been integrated with a school's construction projects. The first phase of Baltimore's 10-year plan to renovate or replace 136 school buildings began in FY2014 with planning, design and predevelopment work followed by four years of construction. Funding for these capital projects will come from $69 million in dedicated annual state and city block grants, city taxes and city payments, which in turn will leverage a $1.1 billion bond issuance (first phase) through the Maryland Stadium Authority.[38]

Instead of direct ownership by the Baltimore City School District, the solar PV system could be developed and owned by a third-party entity and financed with a PPA with the School District. A PPA is a financial agreement where the solar developer sells the power generated to the host customer at a fixed rate that is typically lower than the local utility's retail rate. At the end of the PPA contract term, a customer may be able to extend the PPA, have the developer remove the system or choose to buy the solar energy system from the developer. PPAs allow the School District to implement a solar PV project without a large initial capital outlay and without being responsible for maintaining the system throughout the term of the PPA. It also allows the developer (as a for-profit entity) to take state and federal tax incentives that are not available to public entities and to pass those cost savings through to the school in a lower PPA price. Examples of national solar developers who provide solar PPAs for schools, companies and nonprofit institutions are SolarCity, SunPower, and Sungevity.[39]

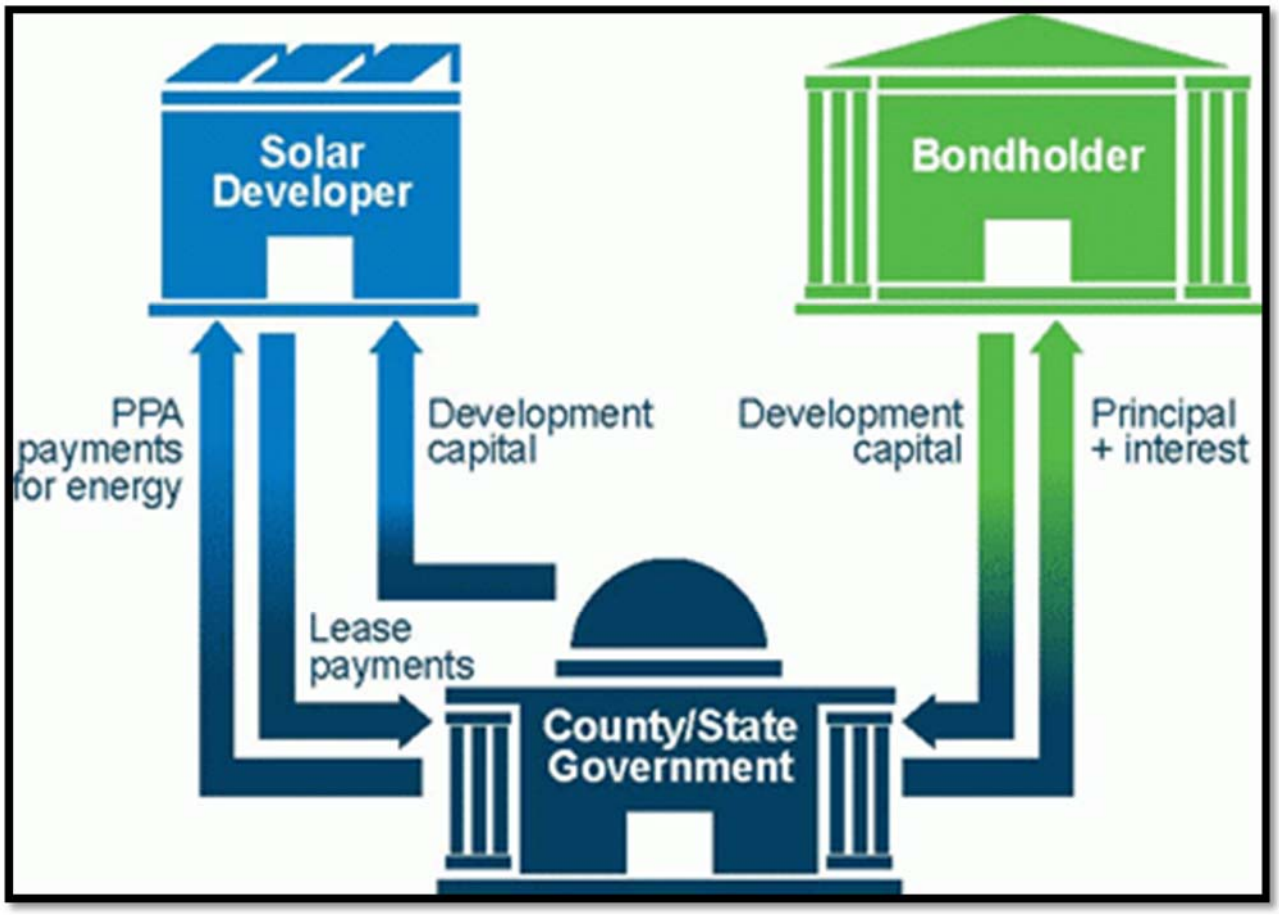
A variation on this model is the Community-Owned Power Purchase Agreement. Rather than an existing solar developer owning the solar PV system, members of a community create a third-party entity, which they own, to develop the system on behalf of the school in order to take advantage of tax incentives. The third-party entity owns and operates the solar PV system and the school pays this entity for the solar electricity produced.

Examples of this model include Sidwell Friends School in Washington, DC and a church in University Park, Maryland (see University Park Community Solar LLC above). In the case of Sidwell Friends School, community members funded the $200,000 project by purchasing solar bonds in increments of $5,000, for which they receive a modest rate of return for 10 years.[40]

A hybrid bond/PPA (power purchase agreement) financing tool that can be used for public school

solar PV projects is the "Morris Model," named for Morris County, New Jersey, where the financing structure was first implemented. Under the model, the local or state government issues low-cost pooled bonds on behalf of a private developer who uses the funds to install solar PV on multiple public facilities. The private developer owns, operates and maintains the solar PV systems, and enters into a lease agreement with the government host. By providing low-cost capital to the developer, the local or state government is able to negotiate a much lower price for solar electricity generated under the PPA.[41] Energy cost savings for the public through the Morris Model range from 35-60 percent. The bonds are backed by both project revenues and a county guarantee. Project revenues arise from the PPA, and additional project funding support is provided by existing federal tax incentives and New Jersey's Solar Renewable Energy Certificates (SRECs). The Morris County Improvement Authority is currently using the Morris Model to develop 3.2 MW of solar power for 19 public school and county government buildings with bonds guaranteed by the county and no additional debt service or out-of-pocket expenses incurred by local taxpayers.[42]

Figure 2



From: "Financing Solar PV at Government Sites with PPAs and Public Debt," NREL, https://financere.nrel.gov/finance/content/financing-solar-pv-government-sites-ppas-and-public-debt

Other conventional bond programs that can be used to implement solar PV projects include:

- ***501(c)(3) bonds.*** Qualified nonprofit organizations can access low-cost, tax-exempt bonds to finance or refinance the acquisition, construction, installation, expansion or rehabilitation of land, buildings, and equipment. A 501(c)(3) nonprofit organization can finance projects at a lower interest rate than conventional financing because the interest paid to bondholders is exempt from federal (and in some instances state) income taxes.

  Under this very flexible financing model, 501(c)(3) revenue bond proceeds may be used for capital expenditures (including for renewable energy generation), refinancing prior debt (under certain circumstances), reimbursing prior expenditures (under certain conditions), (limited) working capital, costs of issuance, capitalized interest and debt service reserve funds.[43]

  The Maryland Clean Energy Capital Program, administered by the Maryland Clean Energy Center, provides tax-exempt revenue bonds for qualified 501(c)(3) nonprofit organizations for renewable energy and efficiency projects. The energy savings, or revenue from a PPA, repays the principal and interest on the bonds issued by MCEC under this program.[44]

- ***Housing bonds for low-income multifamily and elderly housing.*** For-profit and nonprofit developers can access tax-exempt bonds for the financing of low-income multifamily and senior housing projects. The bonds may be used to finance or refinance the acquisition and rehabilitation of an existing project or for the construction of a new project, provided the developer agrees to set aside all, or a portion, of the units in a project for individuals and families with very low, low, or moderate income.[45]

New Market Tax Credits. Another tool for financing solar PV **th**at has been used by the public sector is New Market Tax Credits (NMTCs). In Denver, Colorado, a solar developer (Main Street Power) raised capital through the Rose Urban Green Fund, the Colorado Growth and Revitalization Fund (managed by the Colorado Housing and Finance Authority), U.S. Bancorp Community Development Corporation and Morgan Stanley to install 1 megawatt of solar PV on public buildings.[46]

This public-private partnership involved private ownership of the solar PV systems with private investors benefiting from a range of available tax incentives as tax-paying entities. The NMTC Program was established by Congress in 2000 to increase investment in operating businesses and real estate projects located in low-income communities.

The NMTC Program attracts investment capital to low-income communities by providing individual and corporate investors with a tax credit against their Federal income tax return in exchange for making equity investments in specialized financial institutions called Community Development Entities (e.g., the Colorado Growth and Revitalization Fund). The credit totals 39 percent of the original investment amount and is claimed over a period of seven years. Main Street Power owns and operates the PV systems and sells electricity to the city of Denver under a 20-year PPA. As a result of the low-interest loans from the NMTC structure, the City was able to realize energy cost savings of 25 percent over the life of the PPA.

The solar developer was able to stack the NMTCs with the federal solar investment tax credit (30 percent), as well as accelerated depreciation, to raise considerable

equity investment on favorable terms.[47] NMTCs have also been used for raising low-cost capital for solar installations on affordable housing (see above, in the section *Best Practices*). Self Help, a national nonprofit community development financial institution (CDFI) headquartered in Durham, North Carolina, is currently seeking NMTC project opportunities in Baltimore for renewable energy distributed generation.

- ***Tax Incentives and SRECs***. Nonprofit organizations that want the benefits of solar power can choose either to directly own a solar PV system or have a third-party entity own and operate the system. The advantage of direct ownership is that the nonprofit owns the solar renewable energy certificates (SRECs), which it can then sell to offset the cost of the system.

  However, as a tax-exempt entity, the nonprofit cannot take advantage of any of the tax incentives associated with solar energy systems (e.g., federal investment tax credits and accelerated depreciation). Third-party ownership allows the owner/developer to take advantage of the tax incentives and pass the savings through to the nonprofit through discounted pricing of the electricity sold to the nonprofit under a favorable PPA. At the end of the PPA contract (from 10-25 years) one of the following will occur: (a) the contract can either be renewed, (b) the developer/owner will remove the system, or (c) the system can be purchased by the nonprofit at the then fair market value.

  For individuals financially able to directly own solar PV systems and take advantage of the solar investment tax credit, there can be a significant additional benefit in selling the SRECs, depending on the local market.

  In Washington, DC where solar PV owners can sell SRECs for $480/SREC (December, 2013)[48] and receive rebates for solar PV equipment of$0.50/watt up to 20 kW for a maximum incentive of $10,000,[49] direct ownership combined with community bulk purchasing programs like DC SUN's (see above, in the section, *Best Practices*) can result in relatively quick equipment payback periods. Maryland's current SREC price of approximately $140/SREC (down from $360/SREC at 12/31/10) and a flat solar rebate of $1,000 for systems up to 20 kW in size increase the upfront costs of ownership and make the economics of directly purchasing solar PV more difficult than in Washington DC's subsidy-rich market.

  For this reason, homeowners and small businesses are choosing to lease solar equipment, making monthly lease payments that are often set at 10 percent less than the standard utility offer. These low lease payments reflect not only the tax incentives available to solar developers but also the low cost of capital that solar developers are beginning to access from public capital markets. For instance, in November SolarCity raised $54.4 million in low investment-grade bonds (BBB+) yielding 4.8 percent and secured by residential and commercial solar lease contracts.[50]

- ***Credit Enhancements***. Unfortunately, many low-income residents and small businesses do not qualify for lease financing because they have insufficient credit histories or do not meet the high credit scores that are required (a FICO score of 680 or greater). A pilot program could be designed to provide credit enhancement for prospective lessees with somewhat lower personal credit scores to enable them to qualify for solar leases. The credit enhancement could be in the form of lease payment reserves, loss reserves, guarantees, or prepayment of some portion of the lease payments.

Similar credit enhancement programs to help finance solar PV installations could be established for organizations that provide needed services to low-income residents, such as police and fire stations, libraries, churches, community and senior centers, and other public and private community facilities.

- **PPAs.** There are other solar technologies that benefit low-income communities that can be installed under existing financing programs. Skyline Innovations, a solar thermal developer active in Maryland, the District of Columbia, California, Florida, Hawaii and Puerto Rico installs water- and space-heating solar systems in affordable and market-rate multifamily and commercial buildings. The installations are financed under a PPA that requires no capital outlay from the customer, and the PPA contract guarantees that the price paid will always be a fixed percentage lower than the customer's utility rate. [51]

  And finally, solar power storage can be provided to customers under a PPA structure. Solar Grid Storage's model is to develop, own and operate the solar power inverter and battery system, allowing the partnering PV developer to reduce their equipment budget and financing package. The power storage system is installed without requiring any customer capital outlay and financed under a PPA that provides the end user with additional revenue from the payment of grid ancillary services, at the same time providing resilient power for critical loads in the event of power outages (see above, in the section, *Best Practices*).[52]

Costs and Benefits of Distributed Solar Generation

It is difficult to assess the precise benefits and costs of distributed solar generation, and there is no standard methodology for doing so. Part of the problem is that many of the benefits and costs are indirect or hidden.

A recent report by the Electricity Innovation Lab of the Rocky Mountain Institute (RMI, April 2013) reviewed 15 separate distributed solar PV benefit/cost studies by utilities, national labs, and other organizations, all completed between 2005 and 2013.[53] The RMI report found the following:

- No study did a comprehensive job of evaluating the benefits and costs of distributed PV.
- There is a wide range of estimated values across the various studies, largely a result of differences in local context, input assumptions, and methodological approaches.
- There is little agreement on how to estimate currently un-monetized values including financial and security risk, environmental benefits, and social value.

The report reviewed many factors associated with distributed solar PV in trying to determine whether the total net value is positive or negative. Not surprisingly, different stakeholders—solar customers, utilities, ratepayers—place different values on the various factors.

The report summarizes their perspectives in the following table:

TABLE 1
Stakeholder Perspectives Regarding Value of Distributed Solar Generation

Stakeholder Perspective		Factors Affecting Value
PV CUSTOMER	"I want to have a predictable return on my investment, and I want to be compensated for benefits I provide."	Benefits include the reduction in the customer's utility bill, any incentive paid by the utility or other third parties, and any federal, state, or local tax credit received. Costs include cost of the equipment and materials purchased (inc. tax & installation), ongoing O&M, removal costs, and the customer's time in arranging the installation.
OTHER CUSTOMERS	"I want reliable power at lowest cost."	Benefits include reduction in transmission, distribution, and generation, capacity costs; energy costs and grid support services. Costs include administrative costs, rebates/ incentives, and decreased utility revenue that is offset by increased rates.

Stakeholder Perspective		Factors Affecting Value
UTILITY	"I want to serve my customers reliably and safely at the lowest cost, provide shareholder value and meet regulatory requirements."	Benefits include reduction in transmission, distribution, and generation, capacity costs; energy costs and grid support services. Costs include administrative costs, rebates/ incentives, and decreased revenue.
SOCIETY	"We want improved air/water quality as well as an improved economy."	The sum of the benefits and costs to all stakeholders, plus any additional benefits or costs that accrue to society at large rather than any individual stakeholder.

"A Review of Solar PV Benefit & Cost Studies," Electricity Innovation Lab, Rocky Mountain Institute, April 2013, http://www.rmi.org/Content/Files/eLab-DER_cost_value_Deck_130722.pdf

Besides the most obvious financial impacts, such as the direct savings for solar customers and those direct rate impacts that are easy to identify, the RMI report argues that the following factors need to be considered in order to produce a full-cost accounting of distributed solar PV:

Energy losses. Distributed solar PV provides a benefit in avoiding energy losses due to inherent inefficiencies (electrical resistance) in delivering energy from central utility-scale power plants to the customer via the transmission and distribution system. Avoiding these losses can magnify PV's capacity and environmental benefits.

Capacity. The capacity value of PV is positive when the addition of it defers or avoids more investment in generation, transmission, and distribution assets than it incurs.

Grid support services. When combined with battery storage and control equipment, PV can benefit the grid by supplying power to meet differences in actual and scheduled generation on a moment-to-moment basis (i.e., maintaining grid energy balance), and responding automatically to frequency deviations in the power network.

Financial risk. PV provides utilities with a hedge against volatile fuel costs by fixing the cost of a portion of their electricity supply. However, over time, PV could impact prices of centrally supplied electricity and the fuel that powers those generators.

Security risk. PV increases grid reliability and resiliency by (1) reducing outages by reducing congestion along the transmission and distribution network, (2) reducing large-scale outages by increasing the diversity of the electricity system's generation portfolio with smaller generators that are geographically dispersed, and (3) providing back-up power sources through the combination of PV,

control technologies, smart inverters, and battery storage.

Environmental benefits. PV achieves net environmental benefits when it has lower environmental and health impacts than the marginal resource it displaces.

Social. PV's social value is positive when it results in a net increase in jobs and local economic development, typically measured by the number of jobs created or displaced, as measured by a job multiplier, as well as the value of each job, as measured by average salary and/or tax revenue.

Cost Trends and Targets

Although the sum of all PV's costs and benefits to ratepayers and society is uncertain, there can be no doubt that the cost of installing PV has declined rapidly in recent years. That said, solar electricity is still not cost-competitive with other non-renewable forms of electricity as a wholesale electricity source, without any credit being given to PV for its environmental benefits and indirect financial benefits.

According to U.S. Department of Energy (DOE), reducing the cost of electricity from PV to about six cents per kilowatt-hour could increase solar's share of the electricity supply from .05 percent today to 14 percent in 2030 (representing 302 gigawatts of PV) and 27% in 2050 (632 gigawatts of PV). These are the stated goals of DOE's SunShot Initiative.[54] Achieving those goals will require continued technological changes, including efficiency improvements, materials substitutions, and expanded material supplies, as well as additional manufacturing scale-up.

Most of the future cost reduction will need to come from soft costs (non-hardware costs), because the cost of the solar panels has already reached relatively low levels. The National Renewable Energy Laboratory has found that soft costs now account for well over half of all spending on U.S. solar projects, with the soft costs being highest for residential systems, followed by small commercial systems.[55] Soft costs include customer acquisition (including system design and marketing), permitting, inspection, interconnection (including typical delays and permitting fees) and installation labor.[56] To achieve DOE's overall target for 2020, it will require an 80 percent reduction in soft costs (from $3.32/watt to $0.65/watt for residential systems), which would help drive down total installed system prices to $1.50/watt by 2020.

Financing Costs

Financing is an important component of PV soft costs. The SunShot roadmap assumes that financing costs for residential systems will need to decrease from 9.9 percent in 2012 in real terms (i.e., adjusted for inflation) to 3.0 percent by 2020. For that to happen, PV projects need increased access to long-term, low-cost financing.

One essential way to reduce financing costs is to create specialized financial products that can be bought and sold on Wall Street like other publicly traded marketable securities. Bonds and other marketable securities offer access to much lower cost of capital than today's heavy reliance on the tax-equity driven, one-off transaction approach to financing clean energy. There are an increasing number of examples of distributed renewable energy generation being financed with long-term, low-cost capital (see above, in the section, *Financing Options*).

Another way to reduce overall financing costs is to reduce risk at each step of the finance value chain—from project development through the bundling and sale of securities to the institutional investor. Credit enhancement is financial risk reduction, simply stated. It involves a set of

financial measures that reduce credit risk by strengthening the credit rating of a financial transaction and providing the lender with additional reassurance that the borrower will honor its financial obligation. It can be done through the pledge of additional collateral, a third-party guaranty, establishing a cash reserve account, the purchase of insurance, or some other financing tool.[57]

Third-Party Financing

Third-party financing is an agreement whereby an electric customer hosts a PV system that is owned or leased by a separate investor, usually through a lease agreement or a power purchase agreement (PPA).[58] It can sometimes reduce the overall cost of financing, but even when it does not, it offers advantages for the electric consumer, because it does not require the same level of investment as direct ownership, both in terms of upfront capital outlay and ongoing system maintenance.[59]

Under a third-party financing arrangement, the investor monetizes available incentives for installing PV and sells the electricity generated by the PV system back to the host customer at a set rate, usually a rate lower than the customer would otherwise pay for electricity. Maryland law allows for various third-party financing arrangements, including solar leases and PPAs.[60]

PPAs have become especially common for commercial projects. Today, 43 percent of Maryland's installed solar capacity is represented by commercial projects. Such projects have grown from a cumulative 1.5 MW in 2008 to more than 60 MW in 2013, a figure that is expected to increase as a result of the Constellation/ Exelon merger agreement that included a commitment to develop 30 megawatts of solar by 2016.[61]

A key driver in the decision of commercial property owners to install PV has been the ability to negotiate PPAs that are priced at a discount to standard utility electricity prices and which require no upfront cash outlays or equipment maintenance. The ability to save some money on the solar power purchased at the same time hedging against likely utility rate increases over time is attractive to many commercial property owners. Commercial and industrial installations in Maryland include:

- Walmart – installations made at 10 Maryland stores in 2013;
- McCormick & Co. – solar on its Sparks headquarters, its Hunt Valley manufacturing complex and its Belcamp distribution center;
- General Motors – solar panels on the roof of its White Marsh transmission plant;
- Kohl's – solar powering five stores in Maryland, plus its Edgewood distribution center;
- MOM's Organic Market in Waldorf;
- Leonard Paper Co. in Baltimore; and
- Giant Food – stores in Timonium and Lusby.

Nonprofit organizations enjoy the same PPA advantages as commercial entities in terms of discounted pricing from standard utility prices and hedging against future electricity price increases. Additionally, third-party ownership enables a nonprofit to benefit from tax incentives that are not available to nonprofits, as the system owner/developer can access those tax benefits and pass the savings through to the nonprofit through discounted pricing of the electricity under the PPA.

Reducing Costs through Group Purchasing

Residential customers can choose to purchase, enter into PPAs or lease a PV system. If they choose to purchase a system, they can reduce the cost by participating in a group purchasing

program, like Solarize and DC SUN. In Washington, participants in DC SUN's bulk purchasing program can expect a discount of 20 percent on the cost of a typical system. Then, the owner of the system can reduce the amount of money needed at the time of purchase by entering into a prepaid con-tract to sell the future stream of solar RECs, typically for 5-10 years.

Combined with the bulk purchasing discount, the upfront cost of a typical 3 kW system is reduced by 48 percent, from approximately $13,500 to $7,050. At the end of the first year of owner-ship, the cost will have been reduced by another $3,240 due to the current federal tax credit (30 percent of equipment cost and labor to install) plus $480 in estimated first-year energy savings, resulting in net costs of ownership of $3,330 at the end of the first year—a 75 percent reduction in the original costs of the solar PV system. The following chart summarizes these costs for a typical 3 kW and 5 kW system located in Washington DC.

Figure 3

Cost to Go Solar for a 3 or 5 kW system (EXAMPLE, NOT ACTUAL BID)		
	3 kW	5 kW
Cost before incentives	**$13,500**	**$22,500**
Bulk Purchase Discount (~20% of system cost)	[-2,700]	[-4,500]
Solar Renewable Energy Credit Upfront Payment	[-3,750]	[-6,250]
Initial upfront cost	**$7,050**	**$11,750**
Federal tax credit (30% of system cost)	[-3,240]	[-5,400]
Estimated energy savings in one year	[-480]	[-860]
Total Cost (after one year)	**$3,330**	**$5,490**

From DC Solar United Neighborhoods (DC SUN), http://www.dcsun.org/bulk-purchases/

The Cost of PV for Low-Income Households

Even if a group purchasing program, like DC SUN or Solarize, is available, low-income households will have difficulty affording a PV system, especially if additional costs of roof repair are required prior to system installation. Lease financing and PPAs, which avoid the up-front costs, are generally unavailable to low-income residents who often have an inadequate credit history to be able to enter into a solar lease agreement.

The inability for low-income residents to access solar energy has raised questions of social and environmental equity, and has been the impetus for extending programs like Oakland, California's GRID Alternatives to new cities throughout the country. That program offers utility energy cost savings, focuses on community building, and trains community residents in career-track jobs (see above, in the section, *Best Practices*).[62]

Energy Policy and Regulatory Environment in Maryland

Market Competition and Restructuring

Traditionally, the U.S. electricity market has functioned as a natural monopoly.[63] Under this model, which still holds sway in much of the United States, state public utility commissions (PUCs) serve as the market regulators, ensuring reasonable electricity costs for consumers and preventing the kind of abuses typically associated with monopolies.[64] Without competition driving down prices or meaningful incentives to encourage utility innovation, however, the monopolistic model has come under increasing scrutiny.

The United States opened the door to wholesale electric competition with the enactment of the Public Utility Regulatory Policies Act in 1978[65] and subsequently created a broader framework for a wholesale generation market with the passage of the Energy Policy Act in 1992.[66] As the electricity generation market became more competitive, some states began rethinking traditional regulatory electricity model in the late 1990s and early 2000s.[67] Several states, including Maryland, embraced market restructuring.[68]

Electricity restructuring can take many forms, but it commonly refers to an unbundled generation system whereby utilities are forced to buy electricity on an open market; prices are dictated by competition rather than fixed by PUCs.[69] Before Maryland's electricity market restructuring, utilities owned all the state's generation resources.[70] With the passage of the Electric Customer Choice and Competition Act in 1999, the Maryland Legislature expressly sanctioned retail electric competition including localized energy sourcing (distributed generation).[71]

Solar PV in Maryland

In recent decades, grid-resiliency concerns, greenhouse gas emissions, and other environmental problems associated with traditional power production have raised a call for greater distributed generation and renewable energy deployment.[72] Increasingly, power consumers have also become power generators through the use of on-site renewable technologies such as rooftop photovoltaics (PV).[73]

In Maryland, the use of solar is growing particularly fast. The grid-connected PV capacity installed in Maryland in 2012 was more than three times that of 2011. Due to its relatively solar-friendly state regulatory framework, Maryland has become a solar PV leader among the states.[74] Maryland currently ranks 8th in the nation in the number of PV systems installed and 12th in installed solar PV capacity.[75]

While a handful of utility-scale projects have come online recently including a 16 MW installation at St. Mary's University and a 20 MW solar farm in Hagerstown, much of the growth of Maryland's solar market is due to acceleration in the development of distributed solar generation.[76] In 2012, $205 million was invested in Maryland to install rooftop PV, a 74 percent increase from the previous year.[77]

Friendly state incentive policies and increased com-petition continue to drive down solar PV prices in the state as well. Average installed PV system prices in Maryland fell by 18 percent in 2012, well exceeding the national solar PV price reduction rate over the same period.[78] Maryland's success is in large part attributed to a supportive suite of renewable incentives, including favorable clean energy policies,

financial incentives, and the availability of financing options.[79]

Background State Energy Policies

Regional Greenhouse Gas Initiative. In 2007, Maryland joined the Regional Greenhouse Gas Initiative (RGGI), a regional initiative by northeastern states and eastern Canadian provinces to reduce greenhouse gas emissions. RGGI is a cap-and-trade program to reduce carbon dioxide emissions from power plants in participating states and provinces. RGGI is designed to reduce carbon dioxide from the region's power plants by roughly 10 percent from current levels by 2019.[80]

Under RGGI, CO_2 emission allowances for fossil fuel power plants with 25 MW or greater generating capacity are auctioned off with proceeds going toward energy conservation and renewable energy. Maryland's proceeds are placed in the state's Strategic Energy Investment Fund (SEIF) administered by the Maryland Energy Administration (MEA). SEIF proceeds to go towards energy efficiency, residential energy bill assistance, renewable energy deployment, and climate change outreach. Nine states currently participate in the RGGI program.[81]

Renewable Portfolio Standard. Maryland is one of twenty-nine states to have established a Renewable Portfolio Standard (RPS).[82] An RPS is a regulatory mandate that requires electricity retailers to provide a minimum percentage or quantity of their electricity supplies from renewable energy sources.[83] To encourage the continued development of new renewable energy resources, the percentage typically increases over time. Maryland's RPS requires that 20 percent of Maryland's electricity be generated from renewable energy sources by 2022.[84]

Electricity suppliers must accumulate and use renewable energy credits (RECs) to demonstrate compliance with the RPS. The current RPS compliance schedule requires electricity retailers to source 7.95 percent of their electricity supply from a wide range of renewable energy technologies, and 0.25 percent (143.6 MW) of the total electricity sold to be sourced from solar PV specifically (i.e., "solar carve-out"). In 2014 these standards increase to 9.95 percent and 0.35 percent (201.1 MW), respectively, and will reach 16.0 percent and 2.0 percent (1,149.0 MW), respectively, by 2020.[85]

Maryland Solar Incentives

Solar Renewable Energy Certificates (SRECs). SRECs are the mechanism by which electric suppliers measure and demonstrate compliance with the Maryland RPS solar carve-out and offer a significant source of potential revenue for owners of qualified solar facilities in Maryland.[86] SRECs represent the generation attributes of one megawatt-hour (MWh) of electricity generation from a qualifying in-state solar generation facility.

Electricity suppliers must buy and retire SRECs in order to meet their Maryland solar carve-out requirements, or pay a Solar Alternative Compliance Payment (SACP) for any SREC shortfalls. The SACP operates as a price ceiling for electricity suppliers paying for SRECs to fulfill their solar carve-out requirements. Maryland has set the SACP price at $400 per MWh through 2014. The price of SACP will begin to decline thereafter ultimately falling to $50 per MWh in 2023 and beyond.[87] The current market price for Maryland SRECs is $140 per MWh (December 2013).[88]

Net Metering. Net metering enables customers to use their own on-site solar generation to offset their utility-billed electricity consumption. Net metering customers can feed the excess electricity they generate from an on-site PV system back into the grid and receive an offset on their utility bill calculated at the full retail

price of electricity.[89] Maryland is one of 43 states to have established a net-metering program. Maryland's net metering law allows residents, businesses, schools, and government entities with PV generating systems to participate in the program, and the systems may be customer-owned or third-party owned or leased. Net metering is available for PV systems 2 MW or smaller until the aggregate capacity of all net-metered systems in the state reaches 1,500 MW. All Maryland utilities are required to participate in the program.[90]

Aggregate Net Metering. Aggregate net metering allows utility customers to aggregate the electricity output from a single distributed generation system and to allocate it to multiple meters, typically in proportion to their ownership interest in the shared system.[91] Depending on the authorizing legislation, community net meeting can take many different forms. In Maryland, meter aggregation is available for nonprofit customers and municipal governments and for customers that use electrical service for agricultural purposes,[92] but is not generally available to residential customers.[93]

Grants & Rebates. The Maryland Energy Administration (MEA) provides a rebate to eligible homeowners who install PV systems. The MEA will provide a $1,000 flat incentive for homeowners who install PV systems with a capacity of 20 kW or less. In order to be eligible for this grant, the property must be the homeowner's primary residence and the PV system and component parts must be in compliance with all applicable safety standards.[94]

The MEA also offers grants to businesses, nonprofits, and local governments that install distributed solar PV systems. Under this commercial grant program, the level is set at $60 per kW for systems of less than 100 kW, and $30 per kW for systems with an installed capacity between 100 kW and 200 kW.[95]

Tax Exemptions. Maryland exempts solar energy systems from state and local real property taxes[96] and exempts solar energy equipment from the state sales and use tax.[97] Maryland also provides a sales and use tax exemption for sales of electricity from solar energy equipment to residential customers. To qualify for the exemption, the sale of electricity must be for residential use on a property owned by a net metering eligible customer.[98] Maryland also offers a production tax credit for solar electricity equal to 0.85 cents per KW against the state income tax for a period of five years for the solar electricity generated.

Interconnection. Interconnection refers to the physical connection with the utility's local distribution system. Customers wanting to install distributed solar generation systems that are tied to the grid must do so in accordance with established interconnection requirements. Maryland has created streamlined standards for interconnection that makes the interconnection process less onerous and time-consuming for smaller systems.[99] These rules and procedures include designing a standard interconnection agreement for certified, inverter-based systems of 10kW or less that clarifies that applicants are not required to obtain general liability insurance as a condition of interconnection approval.[100]

Federal Policies. The federal government provides two tax credits to encourage investment in solar PV. For homeowners, the Residential Renewable Energy Tax Credit allows a taxpayer to claim a federal tax credit of 30 percent of qualified expenditures for a renewable energy system that serves a residential unit owned and occupied by the taxpayer. The tax credit applies to solar PV systems, as well as to solar water heating systems, fuel cells, small wind-energy systems, and geothermal heat pumps. Qualified expenditures include preparation, assembly, and installation labor costs.[101]

On the commercial side, the federal government provides an Investment Tax Credit (ITC) of 30% of expenditures for a business's solar energy investments, with no maximum credit.[102] Both the Residential Renewable Energy Tax Credit and the ITC are currently in place through December 31, 2016. Eligible homeowners and business owners installing solar in Maryland may utilize these tax credits on top of any incentives offered on the state level.

Federal Energy Regulatory Commission (FERC) Support for Energy Storage. In recent years, FERC has repeatedly issued rules and orders to strengthen support for energy storage, creating expanded revenue opportunities for solar storage.[103] These orders have caused a number of significant changes, including:

- Small generator interconnection agreements and procedures have been revised to now include equipment for storage for "later injection of electricity" into the grid.
- Energy storage is entitled to interconnection procedures that are just and reasonable and nondiscriminatory.
- Regional Transmission Organization/ Independent System Operator (RTO/ISO) tariffs have been modified to include energy storage resources as a means of furthering FERC competition goals in the power markets.
- RTOs/ISOs are to pay sellers for frequency regulation: (1) performance payment for faster ramping and accurate response to dispatch signal and (2) capacity payment with opportunity costs for all energy resources including storage.
- RTO/ISO tariffs must ensure nondiscriminatory rates and procurement practices by requiring, among other things, fair and objective accounting and reporting practices regarding the speed and accuracy of regulation and frequency control services (i.e., ancillary services provided by solar storage).

Recommendations

Based on the above analysis, we present the following recommendations to help accelerate the deployment of distributed solar generation in Baltimore and provide benefit to low-income communities.

These recommendations are focused on approaches to expand access to distributed solar generation; some are specifically aimed at increasing the use of resilient solar power. Most of these approaches can be taken under existing law; others will require enabling legislation and new funding sources. Nearly all of these recommendations are supported by examples of such projects or programs developed elsewhere, so Baltimore would be following on successes of others.

Recommendation No. 1

City officials should implement policies to advance distributed solar generation by supporting the deployment of solar with energy storage at critical facilities that provide services to low-income communities.

- **Support the deployment of solar with storage as a resilient power application for critical community and government facilities that serve low-income communities during emergencies.** Extended power outages from extreme weather events disproportionately affect low-income neighborhoods. Low-income areas have more difficulty responding and recovering from the economic disruption and physical damage caused by weather-related power outages. The poor and elderly are the most vulnerable to high or low temperatures during power outages. Resilient power solutions, such as solar PV with battery storage, can help limit the dangerous consequences of power outages.

  Elderly high-rise housing, nursing homes, and public schools that could provide emergency shelter as well as emergency and distribution centers should be considered for resilient power deployment, starting with those identified on or located near the critical facilities listed in the Baltimore Disaster Preparedness and Planning Project report.

- **Identify opportunities for incorporating solar PV and storage solutions when ensuring backup power generation for Baltimore's critical facilities.** The excellent work of Baltimore's Disaster Preparedness and Planning Project (DP3) process has identified a specific list of critical facilities– fire and police stations, nursing homes, emergency and distribution centers, hospitals and dialysis centers, prisons, etc.[104] The project has also established a process for prioritizing these facilities. The DP3 report recommends that the city:

  > *"Investigate off-grid, on-site renewable energy systems, generators, and technologies for critical facilities to ensure redundancy of energy systems."*

  In addition to providing clean backup power generation, solar power with storage can generate additional revenue streams through electricity arbitrage, demand charge reduction, and the sale of ancillary services. Ancillary services include valuable around-the-clock frequency regulation

services that grid operators must now pay for, as per recent FERC orders. It is through these potential revenue streams and use of PPA financing that Baltimore can take advantage of new business models that reduce or eliminate first costs for solar storage installations.

It is recommended that the critical facilities identified in the DP3 report—and any other similar facilities that subsequently may be added to that list—be evaluated for their suitability for resilient solar power with storage.

- **Require that a portion of the 10 MW of solar generation to be developed in Baltimore under the Exelon/Constellation merger agreement directly benefit low-income communities.** The Exelon/ Constellation settlement agreement requires Exelon to develop 30MW of new solar generation, 10MW of which is set aside for Baltimore. A portion of this new generation should provide direct benefit to Baltimore low-income communities by supporting installations on elderly and single-family and multifamily affordable housing, public schools, and nonprofit institutions serving low-income communities, as well as libraries, police/fire stations and other public buildings serving these communities.

- **Designate a portion of casino local impact grants for solar PV community projects.** State legislation authorizing gaming in Maryland provided that a portion of the proceeds from each gaming facility is to be used for local impact funds to benefit the surrounding communities.[105] The local impact funds are projected to produce $7-$10 million in FY 2015 and $15-20 million in future years. These funds could be used to incorporate solar PV and other best energy practices in priority projects in the casino local impact area.

- **Create "the resilient power toolkit" and develop model resilient power zoning/ planning ordinances for the state of Maryland and its municipalities.** Numerous other toolkits exist for clean energy and energy efficiency technologies (e.g., NYSERDA's Wind Energy Toolkit, DOE EERE's Solar Powering Your Community, etc.) but there is no Resilient Power Toolkit. Such a toolkit would be a guide for the state of Maryland and its municipalities, and would cover technology basics (including solar and other clean energy battery storage), the matching of resilient power technologies to various applications and critical facilities, policy approaches for resilient power deployment; lessons learned from existing pilot projects in New York, Connecticut and Florida; zoning and planning issues; financing; resources; incentives; working with utilities; and other topics.

  Developing model resilient power zoning and planning ordinances would be useful in identifying best practices, barriers, and sample language for incorporating resilient power into municipal zoning and planning, and encouraging resilient power solutions (e.g. should Baltimore create a resilient power overlay district? Should it offer special use permits for resilient power? What are the barriers to deployment in the zoning code that may not be readily apparent?).

Recommendation No. 2

Utilize existing bond financing tools to finance solar on public buildings and nonprofit-owned facilities.

- **Incorporate solar PV with other high-performance energy measures in the design and funding of Baltimore City's 10-year plan to renovate or replace 136 school buildings.** The Baltimore City Public Schools Construction and Revitalization Act of 2013 passed in the final days of the legislative session. The Act authorizes the Maryland Stadium Authority to issue bonds for up to $1.1 billion, resulting in 30-35 renovation and replacement projects in the first phase of Baltimore City's public school construction and revitalization initiative. Construction is expected to begin in late 2015, and is anticipated to take 6-7 years to complete. Schools financed under this Act should incorporate high-performance energy measures, including distributed solar generation.

- **Consider using a third-party ownership and financing model for solar PV on public schools, libraries, police/fire stations and other public buildings.** The Morris Model is a financing option by which a public entity issues a government bond at a low interest rate and transfers that low-cost capital to a solar developer in exchange for a lower PPA price. It can substantially reduce the cost of solar power to the government entity.

- **Provide 501(c)(3) bond financing to large nonprofit institutions with "big box" real estate portfolios for building renovations and high-performance energy measures, including solar PV.** 501(c)(3) bonds may be used to finance capital costs for properties owned by nonprofit organizations and qualified government entities. These bonds provide fixed, low-interest rate, long-term financing—a capital resource that can be very useful to large nonprofit institutions that provide needed products and services in low-income communities. Nonprofit organizations such as Blind Industries and Goodwill should be approached regarding incorporating solar PV and other high-performance energy measures into their capital improvements plans. To the extent that these large community facilities also make their space available as shelters or emergency centers at times of severe weather power outages, solar PV with battery storage could provide needed resilient power to low-income communities.

Recommendation No. 3

Ensure that workforce development funds and job training programs are integrated with public funding of solar PV in low-income communities.

There will be hundreds of thousands of dollars spent in workforce development and job training funds in the years ahead in conjunction with Baltimore's investments in major construction projects (e.g., Baltimore City's 10-year plan to renovate or replace 136 school buildings, the Baltimore Horseshoe Casino project, etc.).

Civic Works is Baltimore's urban service corps and an AmeriCorps program. Civic Works manages numerous workforce development and job training programs throughout the city of Baltimore, including weatherization and energy-related training and implementation programs. Since 1997, it has provided energy efficiency improvements to more than 4,700 households.

GRID Alternatives works with teams of volunteers and job trainees to install solar PV systems exclusively for low-income homeowners, providing energy cost savings for families struggling to make ends meet, and training workers. Since 2004, GRID Alternatives has installed more than 10 MW of solar PV for more than 3,700 families, providing more than $80 million in energy cost savings, and providing solar installation work experience to more than 14,000 volunteers and

job trainees. GRID Alternatives has completed projects in New York and New Jersey and expects to open an east coast office early in 2014 to administer programs in these two states. The organization has expressed interest in establishing another office to serve the Washington, DC, Maryland, and Virginia markets.[106]

There is an opportunity to bring the GRID Alternatives program model to Baltimore, in partnership with Civic Works' existing energy weatherization and job training programs. This might be funded with casino local impact funds, philanthropic and other sources of support.

Recommendation No. 4

Support bulk purchasing programs similar to DC SUN, which combines a consumer purchasing co-op model with energy consumer education.

There are many bulk purchasing programs, often organized under the "Solarize" name. What is common to these programs is a competitive contractor selection process, and community-led outreach and education around consumer energy issues, generally, and solar issues, specifically. This combined approach has resulted in lowering the equipment and soft costs associated with small distributed solar PV systems, and significantly increasing the adoption of solar in diverse neighborhoods. Although these reduced costs will likely still remain out of the reach of low-income home-owners, it is an approach that has been useful for nonprofit organizations serving low-income communities and considering solar PV.

Recommendation No. 5

Enact state legislation that advances distributed solar generation benefiting Baltimore's low-income communities.

- **Increase or repurpose the system benefits charge to create an innovative public benefits fund to leverage private investment in renewable energy projects benefiting low-income communities.** As part of Maryland's electric restructuring in 1999, the state legislature created a Public Benefit Fund (PBF) for energy efficiency and low-income assistance. Local utilities are required to implement clean energy programs for low-income and residential weatherization programs and may charge up to 1 mil/kWh to recover costs.[107] Maryland currently has a modest PBF charge of 0.55 mil per kWh of electricity consumed. The Public Service Commission could require an increased mil rate to leverage additional investment in clean energy projects benefiting low-income communities.

- **Enact community solar legislation in Maryland.** More than 75 percent of homes and businesses cannot install a renewable energy system on their own property, whether because of shading, a deteriorated roof, lack of financing, or other reason. By allowing different customers to pool resources and invest in one shared renewable energy system, community solar projects represent an increasingly important means of expanding access to renewable energy to more electric customers.

  Ten states have community solar programs (also called shared renewable energy programs). Maryland HB 1128 (Community Energy Generating Facilities Pilot Program) was introduced in the 2013 session but not passed. A revised bill is expected to be introduced in the 2014 session.

Recommendation No. 6

Explore the legal obligations of the city and the state to provide greater power resiliency to ensure that the elderly and the disabled are able to access emergency services during severe weather events.

In November 2013, a federal court decided that New York City did not do enough to protect the disabled during Superstorm Sandy by not adequately protecting the vulnerable populations during that disaster.[108] The decision held the city liable under the federal Americans with Disabilities Act (ADA).[109] The court found that New York City failed to provide reasonable accommodation to protect these citizens during and after Sandy, to make sure the blind, deaf, and physically disabled were able to get access to post-disaster services, like emergency shelters and transportation, which were available to the able-bodied.

The lack of reliable electricity alone prevents the disabled from getting the protection of public services in a severe storm—from emergency shelters without power to stalled elevators in public housing to a lack of charging stations to power up wheelchairs and ventilators. Public agencies cannot just offer services on equal terms to the disabled, which would fail to accommodate their special needs. Rather, agencies must make affirmative accommodation to ensure that the disabled can access public services in a usable way—so that the emergency services actually reach the disabled. The court found that New York City did not make the necessary accommodations to ensure that the disabled had access to the same services as the able-bodied.

It is important to explore the legal obligations and liability of the city of Baltimore and the state of Maryland to provide resilient power so that the elderly and the disabled can access emergency services that otherwise are denied to them in power outages during severe weather events. It is important to plan now to avoid the problems that led to the lawsuit in New York City. The city and the state have existing legal obligations in this regard. They should fulfill those obligations by taking preventative action along the lines suggested by this report.

Recommendation No. 7

Foundations like The Abell Foundation should support longer-term systematic strategies to advance resilient clean energy solutions in Baltimore to protect vulnerable populations from severe weather events.

At present, there is a clear need for a working group that can serve as an ongoing learning network on policies, programs and finance strategies to create a more resilient power system. In addition, communities need new planning tools to address these resilient power issues in some systematic way. Baltimore's Office of Sustainability has led the way by describing the importance of increasing resiliency in the energy generation system by developing decentralized power generation.[110] There is a need to blend clean energy and city planning at the community level. This would help communities plan smarter resilient energy strategies to limit the harm from power outages.

In addition, information sharing and program development support are needed on technology issues and financing strategies to accelerate the implementation of specific projects that involve resilient clean power technologies. These could include more solar systems with battery storage, or combined heat and power systems for hospitals, or other forms of resilient technologies for critical public infrastructure such as police and fire stations or emergency shelters. All of these public information and advocacy areas are appropriate ones for further consideration.

In the end, these are only recommendations for action. What will be needed going forward, if these recommendations are to make a difference, is a concerted commitment to carry them out with a broad array of key supporters who are interested in making Baltimore a cleaner, more resilient community for all of its residents and for the future.

Box 2

What Can Stakeholders Do?

City

- Require that a portion of the 10 MW of solar generation to be developed in Baltimore under the Constellation / Exelon merger agreement directly benefit low-income communities.
- Prioritize resources for the development of solar resilient power projects to reinforce the critical facilities identified in the DP3 plan.
- Implement new bond financing models (such as the Morris Model) to finance solar on government buildings, including schools, libraries, fire/police and other government services
- Collocate solar with other bond-financed projects—schools, utility infrastructure upgrades, economic development and public housing bond issuances.
- Target affordable and elderly multifamily housing and large nonprofit institutions serving low-income communities (Blind Industries, Goodwill, etc.) as a strategy for meeting the 10MW solar generation goal for Baltimore under the Constellation/Exelon merger agreement.
- Designate a portion of casino local impact funds for solar PV and energy efficiency community projects.

State

- Establish or repurpose a system benefits charge to create an innovative public benefits fund to leverage private investment in CE projects benefiting low-income communities.
- Enact community solar legislation in Maryland.

Utilities

- Require that a portion of the 10 MW of solar generation to be developed in Baltimore under the Constellation / Exelon merger agreement directly benefit low-income communities.
- Target large nonprofit institutions serving low-income communities (Blind Industries, Goodwill, etc.).

Nonprofits and community organizations

- Support the expansion of the GRID Alternatives program model to Baltimore, in partnership with Civic Works' existing energy weatherization and job training programs.
- Create bulk purchasing programs similar to DC SUN, which combines a consumer purchasing co-op model with energy consumer education.

Foundations

- Provide catalytic funding support to:
  - Create a working group that serves as a learning network on policies, programs and finance strategies to create a more resilient power system.
  - Identify new planning tools to address resilient power issues in a systematic way.

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List of Interviews

The following interviews were conducted in person or by phone:

Ted Atwood, Director, Energy Office, City of Baltimore, Maryland (10/28/13).

Kristin Baja, Climate and Resilience Planner, Baltimore Office of Sustainability (10/28/13).

Wallace Baker, Director of Operations, Leadenhall Baptist Church, Baltimore, Maryland (12/17/13).

Don Bradley, Founder and Senior Vice President, Solar Grid Storage, Silver Spring, Maryland; Princeton, New Jersey, and Philadelphia, Pennsylvania (11/21/13).

David Brosch, President, University Park Community Solar LLC (10/28/13).

Terry Daly, Director of Project Finance, Maryland Clean Energy Center (10/28/13).

Ben Foster, Senior Vice President, Optony, Santa Clara CA and Washington DC (12/13/13).

Jeff Greenberger, Chief Operating Officer, Affordable Community Energy (Hispanic Housing Development Corporation), Chicago, Illionois (11/6/13).

Stanley Greschner, Vice President, Government Relations, GRID Alternatives, Oakland, California (11/6/13).

Douglas Hinrichs, Energy Program Manager (Solar), Maryland Energy Administration (11/22/13).

DeWitt Jones, Executive Vice President, Boston Community Capital and President, Solar Energy Advantage, Boston, Massachusetts (11/7/13).

Ed Kirk, University Energy Manager, Johns Hopkins University, Baltimore, Maryland (11/22/13).

Douglas Lamb, Partner, and Michael Dow, Counsel, McGuireWoods, Richmond, Virginia and Baltimore, Maryland (12/17/13).

Earl Millett, Chief Operating Officer, Civic Works, Baltimore, Maryland (10/28/13).

Joanna Pi-Sunyer, Green Schools Coordinator, and Rajeshri Bachubhay, Baltimore City Public Schools (11/22/13).

John Quinn, Senior Manager for Environmental Performance and Policy, Exelon Corporation, and Cherise Seals, Business Development Manager (Energy), Constellation (11/22/13).

Anya Schoolman, Executive Director, Community Power Network, Washington DC (11/20/13).

Dana Stein, Maryland State Delegate and Executive Director, Civic Works, Baltimore, Maryland (11/22/13).

Phillip Vanderheyden, Director, Electricity Division, Maryland Public Service Commission (11/18/13).

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