Community Solar Models Nationwide and Possibilities for New York City

Senior Thesis

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May 2012

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Introduction

There is a growing consensus that for geopolitical, economic, environmental, and health reasons, the United States needs to transition to a different energy system. New York City, as the largest city in the nation, is particularly disadvantaged by our current fossil-fuel based energy system. This paper draws on literature about the great potential for solar power in New York City to make the case that community solar represents a viable energy solution for NYC. Community solar can overcome the key barriers that have prevented the solar market from dramatically expanding in New York and ensure that our future renewable energy system addresses social and economic justice issues, as well as environmental problems.

The Purpose of This Paper

This paper will analyze the existing models of community solar in the United States in order to determine which model(s) are best suited for New York City, given current policy constraints. While there is growing enthusiasm about community solar in NYC and some prospects for implementation, there are currently no community solar projects online, apart from a bulk purchase negotiated by a for-profit company. This paper is intended to be a resource for community-based organizations, neighborhood residents, advocates for renewable energy, solar developers, and local officials who are interested in planning community solar projects in New York City. I will provide an overview of different community solar models nationwide, their advantages and disadvantages, and applicability to NYC. This is not intended as a how-to guide, but rather as an outline of all the different possibilities for community solar in the hopes of finding the most applicable model(s) for NYC.

Methodology

The overview of community solar models is based on a literature review of briefing and policy papers, case studies, and news articles. I also extensively surveyed the projects' websites, especially for newer projects which have not yet been chronicled in papers or

articles. I supplement the existing body of literature and online resources with my own interviews and email and phone correspondence with the founders of several community solar projects and other community solar experts. The projects surveyed here are by no means every community solar project in existence, but it is an extensive survey of the all the projects which have generated significant interest in the past several years, and is intended to be representative of all the types of community solar. There are numerous additional projects under development nationwide, which are beyond the purview of this paper.

Why Community Solar Is Right for NYC

The importance and urgency of bringing community solar to New York as a means of lessening NYC's contributing to global warming is underscored by the fact that NYC is already starting to feel the impacts of climate change. According to PlaNYC, the sea level at the Battery has already risen a foot over the last century, which will result in more frequent flooding (133). As a coastal city, New York is also susceptible to increasingly violent storms, which many windows do not have the capacity to withstand, according to current building codes (133).

Even the most fervent climate change deniers cannot refute that New Yorkers pay the highest electricity rates in the continental US, at nearly double the 2009 national mean (Neidl, 2010, 1). This rate contributes to the high cost of living in NYC. In fact, low-income people spend an average of 20% of their income on utility bills (Hafetz, 2011, 1). This puts some low-income households in the difficult position of having to choose between paying their electricity bills and meeting other basic needs.

Low-income people are also more likely to be subjected to the health costs of living near power generation facilities. A study of the South Bronx done by Maantay in 2007 found that people living near noxious land uses, including power generating facilities, were 66 percent more likely to be hospitalized for asthma, and 30 percent more likely to be poor and 13 percent more likely to be a minority, than those outside the zones (32). Moreover, at times when our electricity usage is highest, over half of the electricity generated to meet this

extra need is produced within the City limits, from the most inefficient and outdated power plants, increasing air pollution (Watson 1). NYC is also prone to blackouts, at the inconvenience of residents and expense of the City. In 2003, the summer blackout cost the City one million dollars (Watson 1).

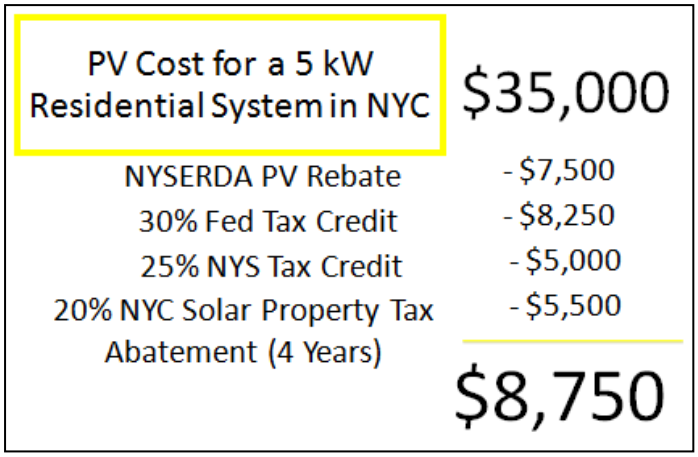
On the flip side, these consequences of NYC's energy system are huge motivating factors for the City to transition to clean energy. Mayor Bloomberg's PlaNYC sets a goal of installing 800 MW of clean distributed generation and 600 MW of other forms of renewable energy by 2030, as part of his commitment to cut the City's carbon dioxide emissions by 30% by that year (105). PlaNYC puts an emphasis on solar as the form of renewable energy with "the greatest potential to generate electricity within the five boroughs" (102). NYC has a huge asset in its nearly 1 billion square feet, or 30 square miles of roof space (Neidl, 2010, 41). Recent estimates of the city's solar potential range from 6,000 to 15,000 megawatts, corresponding to 45 to 115 percent of NYC's peak summertime demand (Neidl, 2010, 11).

However, New York City only has 8.4 MW of solar installed as of April, 2012 (Sustainable CUNY, 2012, 1). Though this is over a 800% increase from the City's solar capacity of 1 MW in 2007, NYC's solar potential has hardly been tapped (ibid 1). This is in part because NYC faces huge barriers to installing solar power in its low rate of home ownership and high rate of multifamily buildings. New Yorkers are twice as likely to rent as own, a rate double the national average (Neidl, 2010, 41). This means that the majority of New Yorkers who are renters cannot install panels on their roofs. Even of the 34% of New Yorkers who are homeowners, many live in co-ops or condominiums in large multi-unit building, where it is technically unfeasible and contractually prohibited to install solar panels net metered to an individual unit (Neidl, 2010, 41). Further, multi-unit building owners have little incentive to install solar panels if their tenants pay their own electricity (Neidl, 2010, 41).

Additionally, New York City has the highest installation costs for solar photovoltaic in the state, due to high labor, construction, and permitting costs (Meister Consulting Group, 2011, 14). Though homeowners benefit from a number of governmental programs including a statewide rebate and state and city tax credits (see Figure 1), the remaining

costs may be too great for low-income residents (Hafetz, 2011, 2). Only wealthy homeowners will be able to take advantage of the full incentives, because they will have large enough tax appetites to benefit from tax credits.

Figure 1: The Cost of Installing a 5 kW Solar System in NYC



Credit: Max Joel, "Solar Energy Incentives in New York City." April 23, 2012.

Fortunately, community solar offers a promising solution to each of these New York City-specific barriers. When community solar projects follow best practices, they increase the number of people who can participate in the economic and environmental benefits of solar power by allowing renters and multiunit building residents who cannot install solar systems on their own roofs to 'go solar'. Community solar makes solar power significantly more affordable and accessible to low-income people most burdened by current electricity costs. Community solar allows renewable energy to deliver on its promise of equity, as it facilitates participation from people of all income levels.

Defining Community Solar

Community solar has no universally agreed upon definition. It can refer to everything from community members donating to put solar panels on a school to a utility-sponsored program which allows customers to subscribe to a solar project and receive a monthly credit on their utility bill as if they had panels on their own roof. In this paper, I will take advantage of the broad understanding of community solar in order to explore the widest

range of options which might make solar power more affordable and accessible in NYC. I define community solar as projects that overcome barriers to solar power through a collaborative effort. This may lead to an installation of large solar PV systems with community members donating, owning, or subscribing to shares or a process where neighbors join together to collectively install PV systems individual homes.

For comparison's sake, Coughlin, Grove, Irvine, Jacobs, Phillips, Moynihan, and Wiedman (2010) define community solar as "solar-electric system that, through a voluntary program, provides power and/or financial benefit to, or is owned by, multiple community members" (1). Ross (2006) stresses the community aspect with the definition of "strengthening community *institutions* through community-ownership of solar and renewable energy investment" (2; emphasis mine). These definitions restrict community solar to a single large-scale system rather than neighbors assisting one another to install solar on their own homes. Coughlin, Deets, Fleming, Giardina, Gluckman, Huang, Little, Mulligan, and Nystedt (2010) offer a broader definition of projects that "involve a collective effort or pooling of resources to share in the benefits of clean energy" (9). This is similar to my definition, but implies that those giving the resources will also be those who receive the benefits of clean energy, whereas I include projects where community members donate for an altruistic purpose.

An Overview of Community Solar Models

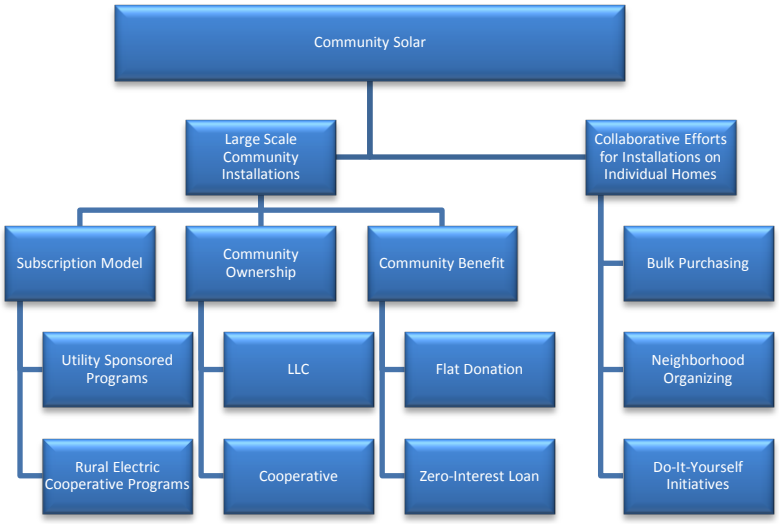
The models of community solar I examine in this paper fall into two broad categories: large scale community installations with multiple contributors, or collaborative efforts for installations on individual homes. Within the large-scale community installation category, the projects are broken down based on the benefit contributors receive from the solar project. In the subscription model, energy companies own the solar system and offer

Photo Credit: Atis Sun

customers the opportunity to subscribe to a program that finances the solar installation. In return, customers receive some sort of credit for their subscription, typically in the form of a monthly deduction from their utility bill. These subscription programs can be sponsored either by a utility company or a rural electric cooperative. The large-scale community installation category also contains a cooperative ownership subsection, in which multiple community members set up a special purpose entity in order to invest in shares of a PV system and receive a return on their investment and then annual income from the energy production. This can be done either through a limited liability company (LLC) or a cooperative business model. The final subsection of the large-scale community installation category consists of models where the project is financed through donations without an expectation of personal financial benefit. These donations can either be flat donations or donations where the donor receives their money back with zero interest over a pre-determined period of time.

Within the category of collaborative efforts to install solar panels on individual homes, one of the most popular tactics is group buying programs. Programs to bundle solar installations together under the same contractor, provide participants with a discount, support with choosing a contractor, and often assistance with technical decisions and paperwork. Other neighborhood organizing projects do not negotiate a bulk purchase but still provide community members with assistance in navigating the installation process. Finally, there are several examples of 'do-it-yourself' efforts to bring community residents together to collectively install a solar system on an individual's home in order to save money and build community. In this paper, I will provide an in-depth analysis of each of these models of community solar.

Figure 2: Overview of Community Solar Models



Criteria for Evaluation

I evaluate models of community solar according to the following standards:

1. Creates opportunities for low-income people to participate.

To accomplish its full potential, community solar must allow people who cannot afford to install panels on their own home to participate. The best community solar projects overcome the cost barrier by offering opportunities for a smaller contribution in exchange for smaller electricity bills or an annual return on investment.

2. Cheaper than individual ownership.

In order to be cost effective, the project must be less expensive than an individual installation on a private home per kW. The community element should alleviate costs, not add additional fees. This is measured by the net installed cost of community solar versus individual ownership after incentives are deducted as well as the length of the payback period for community and individual ownership.

3. Offers economic benefits to the contributors.

There are a variety of ways in which community solar benefits the community who financially contributes to the project. I operate on the premise that it is ideal for the

contributors to the project to receive some sort of economic benefit in return, either in the form of a credit on their utility bill, a monthly payment, or annual return on investment. In order for community solar to encourage the participation of cash-poor individuals, it is important for there to be a mechanism for such individuals to recoup their expenditure. Community solar projects that pay the contributors help educate all citizens that going solar is a smart economic decision, not just a charitable act.

4. Increases solar ownership.

Community solar can increase the number of people who can invest in and own decentralized solar power, including renters, residents with shady property, and those who live in large multiunit buildings. Increasing ownership means people are legal owners of their share, rather than holding a lease or license (Farrell, 10, 2011). Overcoming these barriers to renters and multi-unit building residents owning solar also opens up ownership to new demographics of people. Denis Rhoden (2009) writes that distributed generation of solar power has the capacity to particularly allow communities of color to overcome the barriers of lack of homeownership and access to capital (8). Therefore, it is ideal for community solar projects to offer an ownership stake to widen the limits of who can be a solar power owner. This is highly important for community solar to meet its ability to form "new social and economic relationships that have the potential to bring structural changes" (Rhoden, 2009, 7).

5. Built on unused space rather than green space.

It is critical for the environmental integrity of the project to preserve open green space when building community solar systems. While installing panels on rooftops is an obvious choice, brownfields can also make a good location if the land is unable to be remediated for another use (Farrell, 2010, 1). Joy Hughes (personal communication, March 20, 2012), the founder of Solar Gardens Institute in Colorado, states that the first choice is to put solar panels on roofs, the second choice to is to put them in parking lots or grayfields (failing or underutilized real estate or land), and the third choice is to put them on brownfields (abandoned industrial sites), water treatment plants, airports, or abandoned farm land.

6. Minimizes the inefficiencies of transmission.

Researchers have calculated an estimated 30% savings on electric bills from shorter distribution routes alone (Rhoden and Baron, 2009, 7). Therefore, it is important for the solar system to be as close to the point of use as possible or to maximize the amount of solar power produced that is actually used. If the solar system feeds into the grid rather than directly into the host site, the use of existing grid infrastructure is highly important, as building new grid infrastructure greatly increases the overall cost of the project (Farrell, 2010, 2). Fewer and shorter transmission lines also require less land to be appropriated to host power lines (Rhoden and Baron, 2009, 7). Rooftop systems, with few exceptions, can easily connect to the grid (Farrell, 2010, 2). It should be noted that many brownfield systems can also connect to the grid, using the infrastructure left over from its industrial usage (ibid 2).

I will now examine the models of community solar nationwide and evaluate them according to this set of criteria.

Replicable Models for New York City: Large-Scale Community Installations

1. Subscription Model: Utility Sponsored Programs

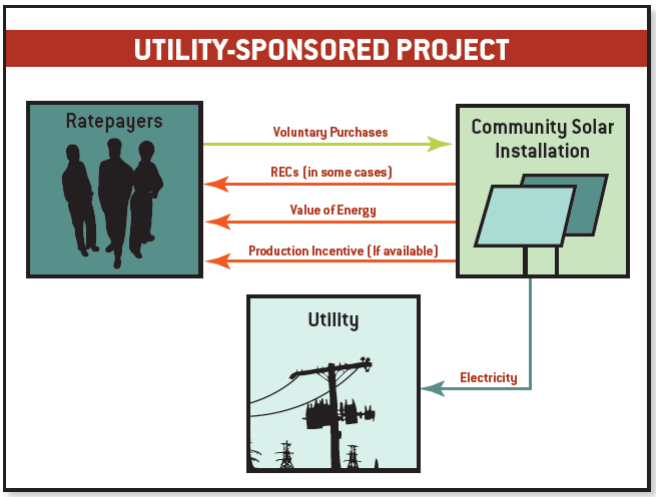
With the utility sponsored subscription model, all customers of a utility can purchase a share or subscription of a solar system and receive a deduction on their utility bill as if the resident had solar panels on their own roof. The utility company owns the system and offers utility customers the opportunity to buy a share of the solar panels, typically for a period of 20 years. The customers who buy into the program then receive a credit on their utility bill proportionate to their share of the solar system.

Most utility-sponsored programs rely on a policy called virtual net metering (or community net metering). Traditional net metering allows a household with renewable energy to spin their meter backward, receiving a reduction on their utility for every

kilowatt-hour (kWh) generated by their system (Farrell, 2011, 31). Virtual net metering allows solar share owners whose systems are not on their physical property to also spin their meter backwards (ibid 31).

Virtual net metering must be passed either at the state level, or the municipal level for municipal-owned utilities. Colorado, Maine, Massachusetts, Vermont, Oregon, Pennsylvania, Washington, Rhode Island (Farrell, 2011, 31), and Delaware allow virtual net metering (Solar Gardens Institute, 2012, 3). It is also permitted under California's Multifamily Affordable Solar Housing program in Sacramento, the new Los Angeles SunShares municipal utility program, and the St. George, UT SunSmart municipal utility program (Farrell, 2011, 31). A utility-owned subscriber model relies on such a policy or another way to attribute credits in proportion to the shares.

Figure 3: Utility Subscription Model



Credit: Coughlin et al, 2010b, 7

Ellensburg Community Renewable Energy Park

The Ellensburg Community Renewable Energy Park claims to be the first community solar project nationwide (Coughlin et al., 2010b, 15). The concept for the project was conceived of in 2003 by the City of Ellensburg, Washington State University Energy Extension, and the Bonneville Environmental Foundation (Coughlin et al., 2010b, 15). The

system is owned by the Ellensburg public utility, a non-profit entity and is positioned in a highly visible location right off of a busy interstate (ibid 15). Contributors receive "shares" (rights to the value of the power) for a minimum contribution of $250 (ibid 18). The electricity generated is credited to the contributor's utility bills at Bonneville Power Administration's (BPA) wholesale rate in proportion to their contribution for a term of 20 or more years (Farrell, 2011, 14). The use of the wholesale rate, rather than the retail rate, means that this is not actually virtual net metering, but customers may end up receiving as good a price as VNM because of the donations to the program (Coughlin et al, 2010b, 17).

The project has been constructed in six phases, with very different economics, based on the passage of a state renewable energy incentive between the first and second installation. In November 2006, the first phase of 36 kW came online at the cost of $7.91 per watt (Farrell, 2011, 14). This section was financed by 73 contributors (averaging contributions of $1,400), and grants from the Bonneville Environmental Foundation and BPA's Conservation Rate Credit (Farrell, 2011, 14). In this first model, investors were unlikely to get a return on their investment because the payback period is 54 years. Rather, investors pre-paid for a 20 year block of electricity (Farrell, 2011, 14). This mimics green pricing programs, where customers voluntarily pay a higher rate for electricity to subsidize renewable energy (Farrell, 2011, 14).

Ellensburg completed the second phase of this project, a 21.6 kW installment in February, 2009 (Coughlin et al., 2010b, 15). Most of the funding for this installment came from the Central Washington University and BPA's Conservation Rate Credit program (Farrell, 2011, 14). The payback period for this phase was remarkably reduced from 54 years to 14 years, due to uptake of a state renewable energy production incentive of $.30/kWh for community solar project until 2010 (Farrell, 2011, 15). This incentive program consists of a base of $0.15 per kWh for renewable energy projects and a multiplier of 2x for community solar projects, 1.2x for projects using an inverter manufactured in Washington, and 2.4x for

Photo Credit: City of Ellensburg

solar modules built in Washington (Farrell, 2011, 15). None of the phases have taken advantage of the Made in Washington tax credit because Phase 2 was built before the Washington-made panels were available and Phase III and IV use thin film modules, which are not made in the state, but the community solar multiplier has dramatically improved the economics of the program compared to individual ownership. With the state incentive, the customer investment for 2.1 kW of community solar is $8, 167, whereas the investment for 2.1 kW of individually owned solar is $11,760 (Farrell, 2011, 15). This amounts to a 14 year payback period for community solar compared to a 34 year payback for individually owned solar (Farrell, 2011, 15). This demonstrates the importance of government incentives in making community solar viable at this point in time.

Since then, Ellensburg has added two more phases, expanding the system to 111 kW (Gary Nystedt, personal communication, April 25, 2012). Phase III was 13.5 kW and Phase IV was 40.5 kW, both with a payback of 14 years (ibid). They are also currently working on Phase V, an installation of nine small wind turbines ranging in size from 1.2 to 10 kW, and are scheduled to install Phase VI, 28 kW of solar, by the end of the year (ibid). Ellensburg has a total of 90 contributors to date, approximately 1% of their total utility customers (ibid).

St. George's SunSmart

SunSmart is a solar farm in Utah operated by the City of St George Energy Services Department and Dixie Escalante Electric (Farrell, 2011, 12). The system started out as 100 kW and has increased to a current production capacity of 250 kW (St George, 2012a, 1). The owners plan to expand it up to 2,000 kW (Farrell, 2011, 12). It was intentionally constructed in phases so customers from the previous phase could finance the next expansions (Coughlin et al, 2010b, 22). Residents can buy 0.5 kW shares at $2,500 up to 4 kW (St George, 2012b, 2). The share is virtual net metered to the customer's utility bill and

Photo Credit: Northwest Community Energy

is guaranteed to provide at least 800 kWh annually, but the expected generation is much more (ibid 12). The system is built on green space, but easily interconnects to the grid (ibid 13).

The economics for individual ownership and community solar work out to be about the same because solar share owners are able to take advantage of Utah's 25% tax credit with a maximum of $2,000 for purchase just like individual solar panel owners (Farrell, 2010, 12). In 2011, the SunSmart customer investment for 2.1 kW was $10,600 with the state tax credit and individual ownership of 2.1 kW was just slightly less at $10,360 with the state and federal tax credit (ibid 12). This amounts to a payback of 32 years for both customer share investment and outright ownership (ibid 12). Unfortunately, this is not enough for SunSmart customers to see a return on their investment at the end of their 19 year share ownership (ibid 13).

The SunSmart model is still interesting to consider because it has a replicable upfront capital financing model (Farrell, 2011, 13). It is relatively unique in combining the financial power of two local utilities without additional funding (ibid 13). However, the model's success depends on the altruistic nature of local residents to purchase shares (ibid 13).

Solar Pioneer I and II

Solar Pioneer I and II are owned by the Ashland, OR municipal utility (Farrell, 2011, 10). In reality, only the second phase follows the subscription model, whereas the first is more of a community benefit project. Solar Pioneer I is a 30 kW solar system installed in 2000 on four separate sites on the Shakespeare Festival, Southern Oregon University, and the Civic Center (ibid 10). Over 250 citizens voluntarily added a Solar Pioneer surcharge to their utility bill of $4.00 per month to reimburse the Festival and University for solar-generated electricity until

Photo Credit: City of Ashland

their investment is fully recovered (Ashland, 2012, 1). However, these participants did not receive any power, monetary compensation, or rights to claim SRECs (Coughlin et al, 2010b, 13).

Solar Pioneer II, a 64 kW system installed on the covered parking area of the city service center, follows the standard subscription model. The total installed cost was $420,000 and it was funded by clean renewable energy bonds purchased by Bank of America at 1.25% interest and the Bonneville Environmental Foundation (Farrell, 2011, 10). Ashland residents could purchase the output of a panel for 20 years in 44 watt increments in the first year of the program (ibid 11). New customers can now purchase the output of the panel for the remaining 18 years with a minimum of a ¼ panel for $185.70 (Ashland, 2012, 1). Participants receive the credit on their electric bill annually, so participation serves as a hedge against electricity increases in the future (ibid 1). Participants do not receive Renewable Energy Credits, which can be sold to entities looking to 'go green' or meet a renewable energy standard, because the utility is holding them as a hedge against the possibility of a renewable energy standard being passed (Farrell, 2011, 11).

The lack of opportunity for participants to sell the RECs associated with their share amongst other factors makes Solar Pioneer II a significantly less economically favorable than individual ownership. In Oregon, unlike Washington where Ellensburg is located, the state and municipal solar incentives do not apply to community solar (Farrell, 2011, 11). Ashland provides solar system owners a $2.25 per watt residential rebate and a $1.00 per watt commercial rebate and Oregon provides a $3.00 per watt rebate (ibid 11). The combination of these incentives leads to payback on individual ownership occurring twice as fast as that of an investment in a community solar project- 34 compared to 17 years (ibid 11). Although the customer investment for 2.1 kW of solar is $9,000 and the upfront costs for individual ownership is $16,800, with all the incentives, individual ownership is reduced to $4,253. This is wonderful for residents who have appropriately sited roofs and possess the upfront capital, but it is a disincentive for people to invest in community solar (ibid 11).

Seattle Community Solar

Seattle City Light partnered with Seattle Parks and Recreation to create an innovative community solar project (Seattle City Light, 2012, 1). In March, 2012, they finished the construction of the first of three new picnic shelters with roofs made of solar panels in Jefferson Park (ibid 1). The panels are estimated to produce 24,000 kWh annually, and a portion of the electricity generated will be credited to members' utility bill (ibid 1). The members will be able to take advantage of the Washington State Renewable Energy Production Incentive, likely giving the project similar economics to the Ellensburg model (ibid 1). This project is notable because of its creative use of highly visible public space.

Solar Gardens Institute

The Solar Gardens Institute (SGI), based in Westminster, Colorado, serves as an umbrella group for many of the community solar projects currently under development nationwide, particularly those which follow the subscriber model, or 'solar gardens'. SGI defines 'solar gardens' as solar electric arrays with multiple subscribers connected to the utility grid, who receive a credit on their electric bill for a portion of the power produced by the array (Solar Gardens Institute, 2012, 1). SGI's mission is three-fold: to educate and learn from the public about community solar, to promote policies that support community solar at the federal, state, and local levels, and to assist local organizations nationwide in developing and managing community-owned solar projects (ibid 1). The founder of Solar Gardens Institute also launched Solar Panel Hosting, a limited liability company which hosts solar gardens. Solar Panel Hosting provides assistance with community organizing, training, financial modeling, working with vendors, subscriber management, and system maintenance to solar gardens (ibid 2). SGI particularly works in states where a solar gardens law has passed, allowing virtual net metering, but also supports other models of cooperative ownership in states with policy constraints.

Photo Credit: Seattle City Light

In Colorado, Governor Bill Ritter signed the Community Solar Gardens Act into law on June 5, 2010 (Lydick, 2010, 1). Representative Claire Levy, D-Boulder, credited her constituent, Greg Ching, who currently serves as a SGI board member, with giving her the idea for the bill (ibid 1). The bill permits virtual net metering, and allows solar garden subscribers to get the rebates and tax incentives available to individual solar system owners (ibid 1). It stipulate that a solar garden must include 10 subscribers, and can be from 10 kW, which would fit on a roof, to 2 MW, which would require up to 16 acres (Solar Gardens Institute, 2012 1).

Subscribers can choose either a power purchase agreement or crowdfunding model. With the Solar Savings Now Plan (power purchase agreement) subscribers contribute a small down payment and save 5-10% on their electric bill (Solar Gardens Institute, 2012, 3). With the Community Power Plan (crowdfunding), customers purchase one kW of solar power for $2,000-$2,500 when the system is commissioned, and receive a monthly bill credit of $150-180 annually for each kW purchased (ibid 3). Subscriptions usually last 20 years (ibid 3). In the Xcel Energy service area, the minimum subscription is one kW (4-5 panels), but in other areas, the minimum can be as low as $10. Xcel's stipulation limits the range of people who can participate in the project to those who have $2,000-$2,500 at their disposal.

Solar Gardens Institute is still waiting for Xcel to finalize a few things before they are ready to kick off their network of projects in Colorado. As of April, 2012, Xcel issued a compliance plan and an administrative law judge ruled favorably on it, so now there is just a series of appeal periods before the law takes effect. In the meantime, Solar Gardens Institute has built a small test site on their building. The test bed is 10 kW and supplies seven units in the building with electricity (Joy Hughes, personal communication, March 15, 2012). Admittedly, it is not a true solar garden as it just credits the building, but it does mimic virtual net metering as it offsets the electricity usage of each office.

Solar Gardens Institute has a long list of projects under development nationwide. In Figure 2, each of the "Power Flower" icons represents a SGI solar garden under development or an area where interest has been expressed. Each of the solar panel icons

represents a Community Owned Solar Garden, unaffiliated with SGI. Currently, SGI is responsible for 5.6 MW worth of solar power between all of its project sites (Joy Hughes, personal communication, March 15, 2012).

Figure 4: Solar Gardens in the United States

Credit: Solar Gardens Institute, 2012

In Colorado, there are at least 17 solar gardens at some stage of development. In Aravada, Solar Panel Hosting is issuing a Solicitation of Interest for solar gardens on a privately owned former mine site (Hughes, 2011, 12). In Antonito, Xcel is collecting subscriptions for a site that will probably be built in summer, 2012 (Guajardo, 2012, 1). In Fairplay, the Sanitation District voted to approve a solar garden near their waste treatment plant on December 8, 2011 (Kingsford, 2011, 1). A public-private partnership with the Town of Saguache is planning to build a 200 kW system on a former dump site (Hughes, 2011, 11). In Aurora, a group is planning a 500 kW system on a former dryland wheat farm (Solar Gardens Institute, 2011b, 1). Grand Junction has a 500 kW solar garden planned at a city water treatment plant (Solar Gardens Institute, 2011c, 1). Arapaho Ranch near Nederland High School may host a 2 MW solar garden (Potter, 2011, 1) and Lake County is

planning to build a 50-200 kW system in summer 2012 (High Country Conservation Center , 2012, 1). There has also been some level of interest and planning in Clear Creek, Littleton, Valmont, Crestone/Moffat, Salida, Fort Collins, and Durango. Clearly, the location and land use of the solar panel hosting sites varies widely.

` Nationally, people have expressed interest in creating solar gardens in California, Delaware, Iowa, Massachusetts, Maryland, Minnesota, New York, and Oregon. Luther College in Decorah, Iowa, has received approval for its site plan for a two-acre 1,250 panel solar project (Solar Gardens Institute, 2011d, 1). The Solar Gardens Institute has made leaps and bounds in utility owned subscriber model nationwide.

Advantages and Disadvantages of the Utility Subscription Model

1. Creates opportunities for low-income people to participate?

Most, but not all, of the subscription models allow customers to subscribe to the program for a small fee and start saving on their electricity bills. In some areas of Colorado, customers will be able to join for as little as $10. However, in Xcel's service area, the minimum upfront cost is $2,000-$2,500, which fails to meet this criteria entirely. Therefore, while this model theoretically offers an opportunity for cash poor people to participate, the stipulations granted by the utility may prohibit this opportunity from being met.

2. Cheaper than individual ownership?

If done well, this model can be much more affordable than individual ownership, since it removes the upfront costs of installing solar on one's own roof, typically in the tens of thousands. However, depending on the incentives available in the state, individual ownership may be more cost effective in the long run. In Ashland, Oregon, individual ownership is greatly preferable because the solar incentives do not apply to solar share owners. In St. George, Utah, individual ownership is about comparable to a solar subscription because the incentive applies to both structures. In Ellensburg, Washington, community solar is much cheaper because there is a 2x multiplier on the solar incentive of

$.15/kWh. Therefore, the affordability depends primarily on the incentive structure in the state.

3. Offers economic benefits to the contributors?

The utility subscription model again is mixed on whether it offers long term economic benefits to customers. All customers benefit from receiving a credit on their utility bills which reduces their electricity costs. However, if the payback period exceeds the time period of their share ownership, the model functions more as a green pricing program, and does not offer any cost saving benefits. Theoretically, if the incentives line up correctly, subscriber models are expected to help customers save on their electricity bills in the long term.

4. Increases solar ownership?

On principle, this model does not increase solar ownership because the solar systems are owned by utilities. However, it can greatly increase participation in solar systems by including renters, multifamily building residents, people with shaded roofs, and people who lack the upfront capital to install solar on their own roofs.

5. Built on unused space rather than green space?

The locations of utility owned community solar projects varies includes both brownfields and greenfields. The large scale nature of utility owned systems means that it is much more common to site them on greenfields or brownfields than on rooftops. However, Ashland creatively sited Solar Pioneer I on the roofs of four existing buildings and Solar Pioneer II on the roof of a municipal parking garage, and Seattle designed picnic shelters incorporating solar paneled roofs. Both of these project designs avoid the destruction of green space. Unfortunately, Ellensburg Community Renewables Park and St. George's SunSmart are located on green space, and the solar gardens under development are planned for both greenfields and brownfields.

6. Minimizes the inefficiency of transmission?

The large size of most utility owned systems prohibits them from being located on a roof where there is a demand for the power. However, Solar Pioneer I, though not a virtual net metered project, did manage to locate the solar systems on four separate roofs across the city. Therefore, with careful project design, it is possible to reduce the inefficiency of transmission between the solar system and the electricity user.

Applicability to New York City

At this point in time, the subscriber model is not appropriate for NYC because there is not a virtual net metering policy in place. Additionally, Con Edison, the local utility, cannot own solar projects in the short term (Interview, February 16, 2012). Con Edison is responsible for distribution- it owns the pipes and wires, but it is not allowed to generate energy (ibid) It has applied to the Public Service Commission for an exception and failed to receive approval (ibid).

Despite these current barriers, this model could work extremely well in New York in the future with a policy change allowing virtual net metering from other utilities to utility customers in NYC. Utility-owned community solar projects have the greatest potential to scale up to producing a significant proportion of NYC's large energy demand. Some anti-fracking activists also see community solar as an opportunity for upstate farmers to lease out their land to solar rather than to hydrofracking, thereby supplementing their income while avoiding all of the health costs of living near a well (Tim Woodcock, personal communication, 3-20-12). A utility-owned model presents an opportunity to connect NYC customers with power from solar farms in upstate New York.

2. Subscription Model: Rural Electric Cooperatives

Subscription models owned by rural electric cooperatives operate much the same way as utility-owned programs. The main difference is in the capacity of customers to advocate for community solar in an electric cooperative. Electric co-ops are owned by the members and are governed by an elected board of directors. Therefore, customers have

much greater agency to decide to start a community solar project. Some electric cooperatives even have environmental sustainability built into their mission, making the adoption of a community solar project a natural step.

Simple Solar- Florida Keys Electric Cooperative

The Florida Keys Electric Cooperative (FKEC) is one example of a co-op with environmental responsibility as part of its self-defined mission (FKEC, 2012, 1). In 2008, FKEC decided to make good on that mission created a solar leasing program. FKEC created a solar farm in two phases: a 96.6 kW array next to the Marathon office building, financed by a $1 million Clean Renewable Energy Bond, and a second 21 kW array located inside FKEC's Crawl Key Substation (ibid 1). These arrays are built on green space, though they easily connect to the grid.

Customers pay $999 to lease a 175-Watt panel for 25 years, which generates about $36 in bill credits the first year (FKEC, 2012a, 1). Assuming a 3% annual increase in the price of electricity, each panel should return around $1,280 in total credits, although this is slightly higher than the historical escalation of electricity prices from 1998-2009 of 2% (Farrell, 2011, 7). Regardless, the net installed cost for individual ownership and share ownership is about equivalent: $11,760 and $11,991 respectively (ibid 7). However, this slight difference amounts to a slightly shorter payback period for individual ownership at 22 years versus 23 years for share ownership (ibid 7). Individual ownership is predicted to offer a slight economic advantage over community solar, but the difference may be so close as to be negligible.

Sol Partners – United Power

United Power, a rural electric cooperative whose service areas surrounding Denver on three sides, owns a 20 kW solar project called Sol Partners in Brighton, CO (Farrell, 2010, 5). The solar system is on utility property for easy grid connection, but is an open field design that required additional investments to secure the system, which might have

Photo Credit: Florida Keys Electric Cooperative

been avoided with a roof-mounted system (Farrell, 2010, 6) It had a high upfront cost of $120,000 for an initial 10 kW, reflecting the high module cost, plus metering, security, and monitoring equipment (ibid 5). The cooperative was unable to receive the federal tax credit, but the upfront cost was partially offset by a one-time $50,000 grant from governor's Energy Office and the utility provided in-kind donation of labor to construct the modules (ibid 5).

Sol Partners participants buy a "license" (lease) to a 210 Watt panel for 25 years for $1,050 (Farrell, 2010, 5). The cooperative bills a lease-holding customer as usual, but then adds a credit at the community solar rate, which is slightly above the retail rate at $.11 versus $.105 (Coughlin et al, 2010a, 10). Interestingly, United Power can buy back the license at any time and that the buyback cost is the full value of the panel less 4% per year (ibid 5).

United Power estimates that a single solar panel will generate $32 annually in electricity credits or a 3% return on investment based on an assumed electricity cost escalation of 5% (ibid 5). This is significantly higher than the 2% historical national electricity price escalation or the 3% rise assumed by FKEC (ibid 5). Using the 2% figure suggests that there would be no return on investment in 25 years (ibid 5). The customer investment is slightly higher than individual ownership after tax credits of a 2.1 kW system at $10,500 versus $9,555 after tax credits (ibid 6).This gives the SolPartners lease a 26 year payback, versus the 24 year payback for an individually owned system (ibid 6). Despite these unfavorable economics, the Sol Partners' business model succeeded in developing a community solar project without using the federal tax incentives by utilizing an existing electric cooperative structure and receiving a grant from the governor's office (ibid 6).

Photo Credit: Natalie Beck Photography

Advantages and Disadvantages of the Electric Cooperative Subscriber Models

1. Creates opportunities for low-income people to participate?

Both of these electricity cooperative community solar projects require a minimum upfront fee of $1,000. This is a significantly hurdle for people who are struggling to pay their electricity bills, though it does make solar accessible to people who can spare $1,000, but certainly couldn't spend several thousand dollars on a system for their own roof.

These electric co-ops rely on their members to help front the capital for the project, in true cooperative style. Perhaps another electric cooperative could come up with a power purchase agreement that would allow members to pay little to nothing upfront and start immediately saving on their utility bills with small monthly payments for solar, like Xcel Energy in Colorado. However, no such model has yet been implemented.

2. Cheaper than individual ownership?

The member investment is just slightly higher than the individual ownership investment in both of these models. This leads to a slightly longer payback for community solar as well of one year for Simple Solar and two years for Sol Partners.

3. Offers economic benefits to the contributors?

The model is theoretically set up so that participants save on their electricity bills, but whether participants benefit economically in the long run depends on the specific economics of each project. FKEC expects that at the end of their share, participants will receive a total of about $281 worth of electricity credits back on top of what they put in, assuming a 3% increase in the price of electricity. United Power does not predict a return on investment at the end of the 25 year license.

4. Increases solar ownership?

Electric cooperative members just lease a share of the power produced by the community solar projects. However, since the cooperative is member-owned, in some ways this model does increase solar ownership.

5. Built on unused space rather than green space?

Both projects are built on cooperative-owned green space. This seems to be a decision based on convenience rather than environmental responsibility or cost reduction.

6. Minimizes the inefficiency of transmission?

Neither project directly connects to the site of power usage. FKEC's Simple Solar interconnected easily, especially as one phase was built right at a power substation. United Power's Sol Partners had to pay extra for grid interconnection, adding to the overall high cost of the project.

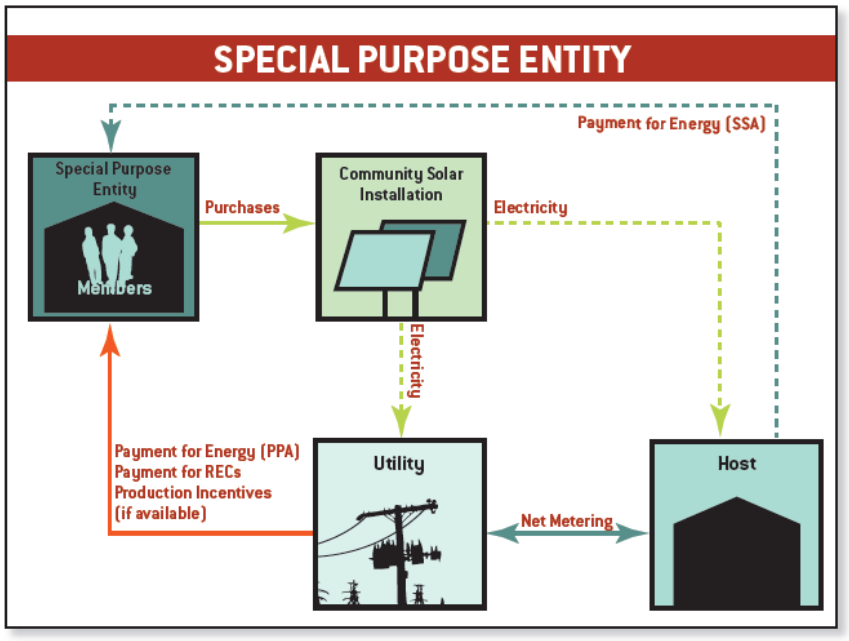
Applicability to New York City

At this time, this model is not replicable in New York City as there are no member-owned electric cooperatives in the five boroughs.

3. Community Ownership: LLC

Several groups interested in creating a community solar project have formed a for-profit Limited Liability Corporation as a Special Purpose Entity to allow contributors to take an ownership stake in the project and make money back from their contribution. Forming a for-profit entity allows the investors to take advantage of tax credits which are not available to non-profits. One challenge with adopting a LLC model in the past has been that as a private enterprise, the LLC must comply with state and federal securities restrictions on how many investors can contribute and advertising (Farrell, 2011, 9). The Jumpstart Our Business Startups Act, recently enacted on April 5, 2012, is expected to remove these barriers so Solar LLCs can advertise and have an unlimited number of investors, lowering the minimum amount each investor has to pay. This would do wonders for making the LLC model more accessible to people with little disposable income.

Figure 5: Community Ownership



Credit: Coughlin et al, 2010b, 12

Clean Energy Collective

Clean Energy Collective's (CEC) solar arrays are seen as the "first community-owned solar garden(s)" (Farrell, 2011, 4). CEC's model is to deliver solar power through medium-size facilities that are collectively owned by participating utility customers (Clean Energy Collective, 2012, 1). CEC's RemoteMeter™ system automatically calculates monthly credits for members at or above the retail rate and integrates the credits with utilities' existing billing systems (ibid 1). CEC founder Paul Spencer explains that they focus on medium-scale solar arrays because they are faster to build than large solar farms and installation and maintenance costs are relatively cheap (Solar Daily Staff Writers, 2011, 3).

CEC keeps the cost of ownership low for customers by taking the tax credits and selling SRECs upfront and then adjusting the costs accordingly. This is only possible because CEC is a LLC and therefore can collect the tax incentive unlike non-profits. CEC, as the initial owner of the array, took the 1603 Treasury Grant of 30% for projects installed before 2012 (Coughlin et al, 2010a, 16). In the first project, CEC sold rights to all future SRECs upfront, allowing them to offset a portion of the installed cost (Coughlin et al, 2010a, 16). This

simplifies the process for utility customers and allows them to own a system for as little as $525 for up to 50 years (Clean Energy Collective, 2012, 2). Owners have the flexibility to increase the size of their system whenever they want and to sell their panels at their discretion (ibid 2). A percentage of the initial purchase and a monthly credit fund the equipment insurance, operations and maintenance escrows (Coughlin et al, 2010a, 16).

Clean Energy Collective's pilot project was a 77.7 kW system in El Jebel, owned by 16-20 customers of Holy Cross Energy, a local electric cooperative (Farrell, 2011, 4). CEC leases land from the wastewater treatment plant, thereby siting their project in underutilized and otherwise undesirable space (ibid 4). The installation cost was $6 per watt or $466,000 total and, accounting for tax incentives and SRECs, the panels were sold for $725 per panel or $3.15 a watt (ibid 4). Owners were restricted to 120% of their electricity consumption (ibid 4). Each owner received $.11 per kWh produced by panel, which is slightly higher than net metering because CEC negotiated a PPA with Holy Cross for the electricity (ibid 4). This project compares favorably to individual ownership at a net installed cost for 2.1 kW of $6,615 versus $9,555 respectively (ibid 4). The payback period for the CEC pilot was 13 years, as compared to 19 years for individual ownership (ibid 4).

Photo Credit: Clean Energy Collective

Since that pilot project, CEC has installed two additional projects and is the process of developing two more. CEC built an 858-kW facility at the Garfield County Airport near Rifle, Colorado (Coughlin et al, 2010a, 17). This is currently the largest community-owned solar array in the United States (Solar Daily Staff Writers, 2011, 3). However, this title will soon be taken on by a 1 MW system in El Jebel, which will serve 200-300 community members (ibid 3). This system will be installed on a hillside bench that is shaded from view by trees and other vegetation (ibid 3). CEC is also in the process of installing a more

environmentally friendly 500 kW project on 3.5 acres of the Templeton Gap Landfill (Wineke, 2011, 2). The landfill, closed in 1980, belches methane, and therefore cannot be built on (ibid 2). There are additional costs and complications to hosting it on a brownfield, but Paul Spencer explains that the environmental benefits of reusing land outweighed the costs (ibid 2). The solar array is designed to allow a methane collection project in the future if they can find the funding (ibid 2). Finally, CEC is building a 1 MW community-owned solar garden in Paradox Valley of Montrose County (Aspen Daily News, 2012, 1). CEC finalized an agreement with the San Miguel Power Association in January to purchase power when the array is completed (ibid 1). Additionally, Clean Energy Collective is looking to expand their model nationally and is pursuing more than 22 MW of community solar opportunities nationwide (ibid 1).

The Appalachian Institute for Renewable Energy

The Appalachian Institute for Renewable Energy (AIRE) has assembled two LLCs to finance community solar projects. The Boone Community Solar pilot project was installed on The Greenhouse, an environmentally sustainable office building (AIRE, 2012, 1). Electricity is sold directly to The Greenhouse for about $0.10 per kWh under a power purchase agreement and the solar system is not grid-connected (ibid 9). It provides 80-100% of The Greenhouse's electricity demand (AIRE, 2012, 1). If it gets the interconnection agreement, the LLC would be able to sell power and SRECs to NC Green Power for $0.15 per kWh (Farrell, 2011, 9).

Photo Credit: AIRE

The 2.4 kW system is funded by investments from seven to ten individuals (Farrell, 2011, 9). The cost of a 2.1 kW share of the project would be $4,010, considerably smaller than the cost of individual ownership at $7,644 after tax incentives (ibid 10). The total installed cost of the Boone Community Solar project was reduced by the

stackable federal tax credit of 30% and a state credit of 35% (ibid 9). Additionally, it was designed as a teaching project, so there were almost no installation costs (ibid 9). This led to a payback period of 13 years, half that of individual ownership (ibid 10). Further, module prices peaked at the time the project was installed, so the economics of similar projects could be even better (ibid 10).

Indeed, AIRE's second community solar project on the First Congregation United Church of Christ in Asheville, North Carolina reduced the payback period of the investors to just five to six years (AIRE, 2012, 1). Nine people, all but one of whom are members of the church, contributed the capital investment of $50,000 needed for the 10 kW system (ibid 1). In fact, First Church Solar, LLC raised more money than was needed for the First Congregational installation, so they are planning on organizing and capitalizing another solar system on a different church in their community (ibid 1). The 10 kW system feeds right into the grid, rather than supplies electricity to the church (Brenthauer, 2011, 2). Progress Energy and N.C. Green Power pay the LLC for the energy (ibid 2). First Church Solar, LLC plans to donate the solar system to First Congregational in about six years, after most of their investors will have made their money back, and some a little more, depending on their tax appetite (ibid 1). The church will then get the money generated by the solar panels of about $2,000 annually (ibid 1).

Acorn Energy Solar One, LLC

Photo Credit: New Market Press

The Acorn Renewable Energy Cooperative is a member-owned business offering biomass heat, solar hot water, solar electricity, heating, and energy efficiency products and services to the residents of the 23 towns in Addison County, Vermont (Acorn Energy, 2012a, 1). Acorn Energy Cooperative created Acorn Energy Solar One, LLC to own and operate a community solar project (ibid 1). They located the 147.8 kW array in

the green space behind the Middlebury Police Station on land provided by the Town of Middlebury (Acorn Energy, 2012b, 5).

The total upfront cost of $660,000 was half financed by Co-operative Insurance Companies and half financed by cooperative members (Acorn Energy, 2012b, 6). The lead investor was able to take advantage of the 30% federal tax credit, depreciation tax loss benefits, and a 7.2% state tax credit (ibid 19). Subscribers, who provide the other half of funding, pay a $2,000 membership fee which draws interest at 2% annually and receive a $.02 per kWh rebate which is credit to their utility bill annually for 25 years (ibid 1). Starting in year 11, the rebate amount will increase to $.05 per kWh and a portion of the membership fee will be repaid each year until the fee is fully repaid (ibid 1). Subscribers must be existing life-time co-op members and Central Vermont Public Service utility customers (Acorn Energy, 2012a, 1). This model took about a year and a half to implement, from early conversations in June, 2010, to the first connection, and Acorn Energy Cooperative is currently planning for a 150-500 kW second array.

University Park Community Solar, LLC

Photo Credit: David Brosch

University Park Community Solar, LLC (UPCS) in Maryland began with a group of neighbors getting together to discuss how to overcome challenges to doing a solar project in the neighborhood, which is very shady, disqualifying most of the rooftops from hosting solar systems (David Brosch, personal communication, February 21, 2011). According to the founder and president, David Brosch, they decided to form a LLC to go solar because they felt it would be easier to raise money if people can make money back, and the group wanted to take advantage of a 30% federal cash grant available to for-profit entities that install solar systems (ibid). The LLC sited their first 22 kW project on the roof of the Church of the Brethren, a small congregation of 40 members with a strong value of stewardship (Brosch,

2012, 2). The LLC sells electricity to the church below the utility rate, and provides the option for the church to purchase the system before the twenty year term is up (Coughlin et al, 2010a, 15).

The total cost of the project was $133,550 (Brosch, 2012, 2). Their objective was to share affordable solar with middle income families and therefore were not looking for big investors (David Brosch, personal communication, February 21, 2011). The met this objective by recruiting a total of 35 investors, who invested a minimum of $2,000 and an average of $4,000 (ibid). One investor put in $15,000, but they tried to keep the investments low, as to make it affordable to people who could not afford to put solar on their own homes (ibid). The investors are expected to receive their money back within 6-7 years (Brosch, 2012, 9). Over the 20 year contract, investors are expected to make a 7-8% return on their investment (ibid).

The University Park Community Solar, LLC makes its money back for its members in four ways: selling electricity to the church, state and federal support, and selling solar renewable energy credits (SRECs). The LLC sells solar electricity to the Church of the Brethren for about 13% below what it would pay the utility PEPCO (Brosch, 2012, 9). This both assists the church and provides a steady income stream to the LLC. Additionally, the LLC received a US Treasury check for 30% of the cost of the project as part of the federal stimulus bill (which expired December 31, 2011) and a $10,400 demonstration grant from the Maryland Energy Administration (ibid 9). The LLC also sells its solar renewable energy credits (SREC), which were expected to generate $8,500 the first year (ibid 9). They ended up selling seven for a total of $2,450, and are holding the rest until the Maryland SREC market rebounds (ibid 12).

From July 2010 to June 2011, the actual power produced was 28,034 kWh, about 6.2% over the original estimate (Brosch, 2012, 10). The Church of the Brethren met all of its electricity needs and fed 25.3% back into the grid. Under the net metering law in Maryland, the meter runs backwards when the solar system generates more electricity than the church uses, and the utility compensates the producer for feeding energy into the

grid (David Brosch, personal communication, February 21, 2012). The utility paid UPSC about $680 for the sale of the excess electricity (ibid, 2011).

With this complicated model, it took the LLC over two years to set everything up (David Brosch, personal communication, February 21, 2012). It cost them close to $20,000 in legal fees (ibid) in addition to pro bono help from the Maryland Intellectual Property Legal Resource Center (Coughlin et al, 2010a, 15). The UPCS team is willing to share all their organizational documents to groups interested in going solar to avoid the same amount of time and money setting up the legal structure. As David Brosch so aptly puts it, "The project isn't very big, but the way we've gone about it is very significant" (personal communication, February 21, 2012).

Advantages and Disadvantages of the LLC Model

1. Creates opportunities for low-income people to participate?

The minimum investment required for the LLCs examined in this section ranges from $525 for Clean Energy Collective to $2,000 for University Park Community Solar and Acorn Energy Solar One. While $525 might be accessible for some people on the low end of the income spectrum, the upfront cost might still be a stretch for many low-income households. The state securities restrictions at play for UPCS meant that they required their investors to contribute larger shares because only 35 people could contribute. The JOBS bill will remove this restriction, so that future LLCs can require lower minimum contributions. The LLC model should be workable so that low-income people can participate.

2. Cheaper than individual ownership?

All four organizations offer community solar projects that are significantly cheaper than individually owned systems. The economics for the cooperatively-owned projects are favorable both in terms of net installed cost and payback period.

3. Offers economic benefits to the contributors?

This model inherently provides economic benefits to producers by allowing them to make a return on their investment. However, if not managed carefully, accounting and legal fees could overwhelm any return to members (Coughlin et al, 2010a, 15). UPCS and CEC incurred significant costs setting up the LLC structure. However, UPCS is willing to share its documents with any groups working on community solar projects, which should alleviate much of the legal fees and confusion.

4. Increases solar ownership?

The cooperative-ownership LLC model effectively increases solar ownership by providing opportunities to own an off-site solar system to renters, multifamily building residents, people with shaded roofs, and low-income households.

5. Built on unused space rather than green space?

LLC projects are built on a variety of land uses. The decision about whether to locate the project on a roof, brownfield, or greenfield is more about program design than any restrictions on location based on the LLC structure.

6. Minimizes the inefficiency of transmission?

The LLC examples examined above vary in terms of how they distribute power. Projects like University Park Solar, LLC and Boone Community Solar, LLC on The Greenhouse feed energy directly into their host buildings. On the other hand First Church Solar, LLC feeds right into the grid, rather than into the host church. Again, the LLC model does not define whether a solar system directly supplies energy to the host or through a transmissions system. This feature is based on the values of the designers of the program.

Applicability to New York City

Cooperative ownership through a Limited Liability Corporation holds great potential to be replicated in NYC. Given current policy constraints, such as the absence of

virtual net metering, this is one of the only options that is available to non-homeowners and provides economic benefits to the contributors. In fact, a couple groups in the South Bronx and Williamsburg, Brooklyn are considering how to replicate the University Park Community Solar model.

4. Community Ownership: Cooperative

The cooperative model allows members to collectively own a solar system, as subject to the Cooperative Law of the state. A cooperative is legally owned by its members and governed by a democratically elected board. In my research, I only came across community solar cooperative business, perhaps because of the securities restrictions of members expecting to a profit off of their contribution. The experience of this cooperative is as follows.

Edmonds Community Solar Cooperative

Edmonds Community Solar Cooperative was co-created by Sustainable Edmonds, a non-profit focused on making Edmonds, Washington more sustainable, and Tangerine Power, a for-profit C-Corporation which provides financing, marketing, and legal support to solar projects (Stanley Florek, personal communication, April 24, 2012). According to Tangerine Solar CEO Stanley Florek, the Cooperative is mostly owned by Edmonds residents and is governed by a board that is made up of local citizens, which provides local control of the project (personal communication, April 24, 2012). Once the Cooperative was launched, Tangerine Power established a service contract that provides them with community marketing support, recordkeeping, website development, accounting, and tax filing (ibid).

Members buy into the cooperative with a $25 membership fee and help fund each solar project with $1,000 SunSlices^{tm}, up to 10 per member (Tangerine Power, 2012a, 1). Members, who could be individuals, groups of individuals, or entities, receive $100 cash rewards per year for their SunSlice^{tm} (ibid). Anyone can join the cooperative, but only Washington residents can buy a SunSlice^{tm} (ibid). Member-owners who live in the Snohomish Public Utility District are also able to take advantage of the Washington state

community solar incentive (Tangerine Power, 2012b, 1). In subscription agreement, members assign a portion of the production incentive to the Co-op so it can pay ongoing maintenance costs; once operating costs are deducted, the Co-op will distribute rewards annually (ibid 2).

The cooperative's first solar installation provides discounted electricity to the Frances Anderson Community Center for at least 9.5 years, and more if the City of Edmonds decides to renew the contract (Tangerine Power, 2012, 1). The first installation was 4.3 kW and the cooperative is working up to 60 kW for the Community Center (ibid). As of April 28, 122 SunSlices^{tm} of the project have been sold (ibid).

Cooperative organizers expect that there will be money left over after everyone gets paid back up to their original purpose (Tangerine Power, 2012b, 3). The cooperative was careful to set up their solar fundraising program so members do not make a profit on their capital, thereby avoiding securities restrictions (Stanley Florek, personal communication, April 24, 2012). Tangerine Power is also very clear that "participation in the co-op is NOT meant solely as a method to generate financial returns" (Tangerine Power, 2012b, 3). After the 10 year period, co-op members have the power to decide what to do with any surplus proceeds (Stanley Florek, personal communication, April 27, 2012). The co-op can choose to sell or donate the array to the Community Center, negotiate a new contract, move the array to a different roof, or dismantle the array and sell it used (ibid 3).

Photo Credit: Solar Washington

Advantages and Disadvantages of the Cooperative Model

1. Creates opportunities for low-income people to participate?

For the example of the Edmonds Community Solar Cooperative, the minimum investment is $1,025, which is pretty steep for some low-income families, but much more affordable than any possible individual ownership. It is possible other cooperatives could lower the minimum contribution if they were confident they could attract more members, but I was unable to locate any other examples of functioning community solar cooperatives.

2. Cheaper than individual ownership?

As the Edmonds Community Solar Cooperative members are able to take advantage of the Washington State 2x multiplier for community solar, the project is more affordable than individual ownership. The affordability of other models of community solar cooperatives will likely depend on how the state and local incentives affect the economics of the project.

3. Offers economic benefits to the contributors?

The Co-op offers $100 cash rewards per year up until the initial investment is recouped, but does not allow individuals to make a profit on the project, in order to avoid securities restrictions. Therefore, Co-op members will not gain any economic benefits, but will likely not lose any money either.

4. Increases solar ownership?

The cooperative model allows members to be owners of their portion of the solar array. In the case of the Edmonds Community Solar Cooperative, the co-op is the owner, and members are part-owners (Tangerine Solar, 2012b, 1). Members' names are even promoted on the solar array they are supporting (Tangerine Solar, 2012a, 1).

5. Built on unused space rather than green space?

The Edmonds Community Solar Cooperative installation is on the rooftop of the Frances Anderson Community Center. As with most models, the project design will determine the location of the project, but cooperatives seem to be more likely to be sited on a rooftop, as they are typically not as large-scale as solar farms.

6. Minimizes the inefficiency of transmission?

The Edmonds Co-op certainly minimizes transmission as it provides power directly to the host site. Other cooperative models will need to factor in transmission into their decisions about the host site.

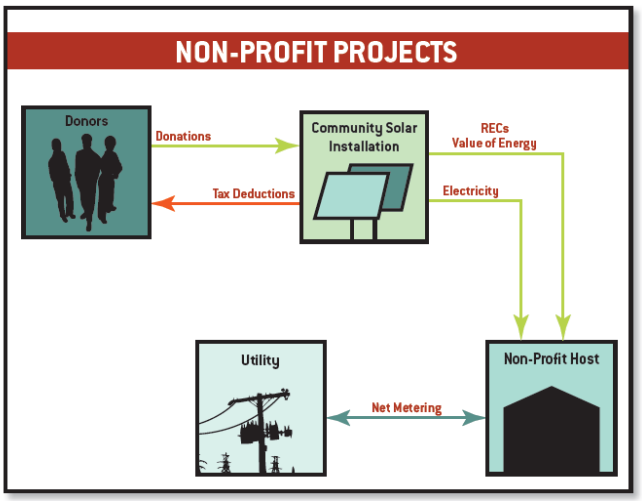
Applicability to New York City

This model could be adapted for New York City, particularly if there was no intention to provide investors with financial return. Further research is necessary to determine the possibilities for providing economic value to member-investors under New York Cooperative Law.

5. Community Benefit: Flat Donation

In this model, people donate to install a solar system on a community institution with no expectation of return. The donation is intended to help the community center, organization, or school reduce their carbon emissions and save money on electricity in order to focus their funding on fulfilling their mission and/or educate their clients or customers about renewable energy.

Figure 6: Community Benefit Model



Credit: Coughlin et al, 2010b, 16

Solar for Sakai

In 2008, Bainbridge Island, Washington residents Joe and Tammy Deets created a plan for community solar on a public building (Coughlin et al, 2010b, 24). However, this plan was developed before community solar was eligible for the Washington State Production Incentive, and the project's economic model was not feasible (ibid 24). The Deets devised an alternative approach and formed a non-profit called Community Energy Solutions to raise funds for solar projects that do not provide value to the contributors, but provide other values to the community (ibid 24). Sakai Intermediate School on Bainbridge Island was the first to partner with Community Energy Solutions (ibid 24). In 2009, a 5.1 kW system was installed on the school (Farrell, 2011, 16). The total project budget was $50,000, which is relatively expensive, at $9.80 per kW (ibid 16). Twenty six individuals and organizations donated $30,000 and Puget Sound Energy provided the remainder with a $20,000 solar in schools grant (ibid 16). Sakai owns the system and all the power and environmental attributes, and donors qualify for tax deductions (Coughlin et al, 2010b, 24). The school received a net metering credit and the state's production incentive, but did not qualify for the community solar incentive (Farrell, 2011, 16).

Community Energy Solutions highlights the educational benefits of the solar system. The information on energy output and carbon emissions avoided is available online, providing the teachers with an opportunity to teach more about local renewable energy (Community Energy Solutions, 2012, 2). Teachers have been implementing energy education lessons and a 5th grade teacher had a Science Fair focused on sustainable energy (ibid 2).

Photo Credit: Community Energy Solutions

"Rays the Roof" Project on Linden Hills Cooperative

The "Rays the Roof" project started in 2004 with state representative Frank Hornstein looked into putting solar on his roof, but found his property was too shady (O'Regan, 2011, 1). He decided instead to put the money he would have donated into an installation on the Linden Hills Food Cooperative, where he is a member, and partnered with the co-op's general manager, Paula Gilbertson, to start fundraising (ibid 1).The co-op put up signs at their registers, sent out mailings to their members, held a benefit concert with local folk musicians and convinced local businesses to contribute thousands of dollars in matching grants (ibid 1).

The 54-panel system was installed on June 8 (O'Regan, 2011, 2). It generates up to 9.8 kWh of electricity and is expected to save the co-op 10-15% on electricity costs (ibid 2). A monitor with real time data and the history of solar production is displayed inside the store (ibid 3). The biggest benefit, according to Gilbertson, is "'educating more people about solar power'" and "'having the conversation with the 800-900 customers who come in a day'" (ibid 3).

New Generation Energy

New Generation Energy is a Boston-based non-profit that helps other non-profits nationwide fund energy efficiency and renewable energy projects (New Generation Energy, 2012a, 1). It operates a listing site that allows donors to pick a green project and community they want to contribute to (New Generation Energy, 2012b, 1). All projects have measureable carbon and energy savings and as of April, 2012, New Generation Energy has saved 5,948,831 pounds of carbon since 2006 (ibid 1).

Photo Credit: New Generation Energy

New Generation Energy has fully funded one solar project and is in the midst of funding a second one as of April, 2012. It raised $21,000 to place 3.9 kW of solar power on

Aruna's Place, a preschool and child care center in Sudbury, MA (New Generation Energy, 2012c, 1). The project was managed by SolSolution, a non-profit dedicated to generation renewable energy in underprivileged schools (ibid 1). New Generation Energy is at the beginning stages of funding an installation on Falmouth Service Center in Falmouth, MA, whose mission is to "ease stress, reduce hunger, and improve the quality of live for neighbors in need" (New Generation Energy, 2012d, 1). They are hoping to raise $19,829 to fund a 4.32 kW system (ibid 1). New Generation Energy projects this will save the Service Center $45,000 in energy costs and reduce their carbon footprint by 225,896 pounds over the panels' lifetime (ibid 1).

Advantages and Disadvantages of the Flat Donation Model

1. Creates opportunities for low-income people to participate?

The donation-based model allows contributions at any amount, so anyone who feels inclined to support community renewable energy can participate.

2. Cheaper than individual ownership?

In theory, the model should be no different than individual ownership, as the systems are either owned by the host or by a third party that provides power to the host. There is no element of collective ownership or subscription to change the economics of the project.

3. Offers economic benefits to the contributors?

The flat donation model explicitly does not offer economic benefits to the contributors, just value to the community of the host institution.

4. Increases solar ownership?

This model does not create ownership prospects for contributors. However, it may create an opportunity for the host site to own a solar system when they would not have been able to afford one on their own.

5. Built on unused space rather than green space?

This model is intended to provide clean and cheaper energy directly to a non-profit organization or school, so the system is installed on the roof of the host site.

6. Minimizes the inefficiency of transmission?

As the aim of this model is to provide electricity directly to the host site, there is no transmission to account for.

Applicability to New York City

This would be a relatively simple project to implement in New York City, given a school or organization with good sun exposure. With 'going green' becoming increasingly hip in NYC, is likely that New Yorkers, particularly in the wealthier neighborhoods, would be willing to contribute to an initiative to help a school or organization they care about install solar.

6. Zero Interest Loan

This model uses crowdfunding to finance a solar project and then pay contributors back to the amount invested out of the savings in electricity. This avoids securities restrictions, but also allows donors to recoup their investment. This is important as it demonstrates the positive cash flow of solar projects.

Solar Mosaic

Up until summer 2012, Solar Mosaic has operated using the zero-interest loan model in which contributors give in $100 increments, which are paid back over a period of 10 years (Solar Mosaic, 2012a, 1). Solar Mosaic uses Solar Lease Agreements, in which the host site leases the solar panels, which allow hosts to save money due to lower electricity bills from day one (ibid 2). After the project is installed, the host will save thousands on their utility bills, which goes towards paying investors back (ibid 2). Solar Mosaic covers administrative and management costs by a standard developer fee from installers and a small percentage of the lease revenue and lead generation fees from solar developers (ibid

2). They are able to cover costs without adding onto the overall cost of projects by negotiating a lower cost from installers (ibid 2).

As of April, 2012, Solar Mosaic has fully funded five projects with zero-interest loans. The first project was on the Asian Resource Center in Oakland, which addresses community issues including affordable housing, healthcare, youth programs, and environmental justice. Solar Mosaic installed 28.8 kW which save the Center $112,684 over the panel's lifetime of the lease (Solar Mosaic, 2012b, 1). The $98,000 project was funded by 134 contributors (ibid 1). Their second project was an 8.6 kW system on the People's Grocery in Oakland, a food justice organization that offers locally-grown affordable food (Solar Mosaic, 2012c, 1). The 70 investors who contributed $38,800 to the project will help the People's Grocery save $31,554 (ibid 1). Solar Mosaic recently funded an 8 kW system on the Murdoch Community Center in Flagstaff, Arizona, which hosts pre-school, provides classes and community access to community members of all ages, and offers space for events and meetings (Solar Mosaic, 2012c, 1), and a 25.7 kW system on St. Vincent de Paul in Oakland, which provides job training programs and hot meals to those in need (Solar Mosaic, 2012d, 1). They also funded a demonstration project on the home of Shonto Begay of the Navajo Nation in Arizona (Solr Mosaic, 2012e, 1). Shonto lived in one of the 18,000 homes in the Navajo Nation that lacked running water and electricity before 18 investors came together to fund a 1.5 kW system (ibid 1).

Solar Mosaic is planning to unroll a model in summer 2012 that allows people in Arizona, California, Colorado, Nevada, New York and Oregon to invest in a solar project and receive a 5-10% return on investment (Lisa Curtis, interview, May 1, 2012). They are planning to offer two different types of loans: construction financing loans that finance the installation and could be as short as two months, and long term loans that begin after interconnection and last for five years (ibid). The returns are expected to be about 5-10% per project (ibid). Although this will fundamentally change the model of Solar Mosaic by allowing the investors to receive an economic benefit, Solar Mosaic will not fall into

Photo Credit: Solar Mosaic

another category because it will not offer ownership to the investors, as Solar Mosaic as a registered C Corporation will be the owner of the projects.

Advantages and Disadvantages of the Zero Interest Loan Model

1. Creates opportunities for low-income people to participate?

The model that Solar Mosaic has been using until summer 2012 offers loans in $100 increments, which is accessible to most individuals who prioritize donating. The guarantee of money back may also help people feel like they are making less of a sacrifice by donating.

2. Cheaper than individual ownership?

Solar Mosaic negotiates a lower price with installers so the fees the installers pay the company do not add onto the overall price, but this probably does not make the projects significantly less expensive than individual ownership.

3. Offers economic benefits to the contributors?

Contributors just receive their money back over a period of ten years, so they neither lose nor gain from their investment.

4. Increases solar ownership?

The zero-interest loan model as practiced by Solar Mosaic does not increase solar ownership either for the host sites or for the contributors.

5. Built on unused space rather than green space?

As the projects are intended to help organizations and individuals save money on the electricity bills, the projects are placed right on the host sites' roof. This sidesteps this issue of green space.

6. Minimizes the inefficiency of transmission?

As the aim of this model is to provide electricity directly to the host site, there is no transmission to account for.

Replicable Models for New York City: Collaborative Efforts for Installations on Individual Homes

1. Bulk Purchasing

Community solar can also take the form of aggregating homeowners to go solar together. Bulk purchasing projects, also known as community purchasing plans, customer aggregation plans, group purchasing plans (Hafetz, 2011), or cooperative buying groups, negotiate reduced module and installation costs and simplify the installation process for a group of residents who individually install solar on their property (Farrell, 2011, 17). The aggregation of customers addresses a number of barriers in bringing solar to scale:

- Installation costs are high- solar is not standardized so it can be expensive for solar installers to research the solar potential and negotiate a contract for each site (Goodward et al, 2011, 16)
- The installation process is confusing for residents- potential buyers have to take time and effort to learn about PV modules and inverters, contractors and incentives, etc, which can be daunting for those with little technical experience (ibid 16)
- The installation process is slow- it usually takes two years for customers to go from first inquiry to installation (Irvine et al, 2011, 8)
- There is a lack of trust between potential customers and installers (ibid, 16)
- The demand is fragmented, with different locations developing opportunistically (Goodward et al, 2011, 16)

Bulk purchasing simplifies the installation process for the residents and creates competition which reduces prices and accomplishes community goals faster (Goodward et al, 2011, 6). Savings can range from $2,000-$5,000 per home (Hafetz, 2011, 7). Aggregation can also create better visibility for a project, prompting other community members to consider solar as well (Goodward et al, 2011, 7). Additionally, bulk purchasing can be applied to direct purchase or solar lease or another financing model, which makes it inclusive of a wider range of residents (ibid 8).

Hafetz (2011) discusses the benefits of using a community based organization (CBO) as an aggregator. CBOS pre-select the contractors through a request for proposal (RFP) process, so the residents do not have to shop the market if they trust the CBO (Hafetz, 2011, 8). CBOs can also assist the homeowner in filling out applications for incentives and ensure quality control in the installation process (ibid 8). Organizations can also combine solar installations with retrofits to save more money on electricity bills and can capture community benefits such as using local labor, and creating apprenticeship programs to teach local workers how to install and maintain solar (ibid 7). Finally CBOs acting as aggregators can learn from the best practices and mistakes of previous aggregations (ibid 8).

Solarize Campaigns

The first Solarize campaign started with Stephanie Stewart, a resident of Southeast Portland who wanted to install solar power, but did not know whom to trust or where to begin (Irvine et al, 2011, 7). She thought that if she could organize a group to install solar together, they could collectively make an informed purchase and possibly negotiate a bulk discount (ibid 7). The local neighborhood coalition Southeast Uplift was willing to help and approached the Energy Trust, a non-profit that helps utility customers benefit from energy efficiency and renewable energy, for technical and program planning support (ibid 7). The Energy Trust developed a volume purchasing program and thus the Solarize Southeast Campaign was born (ibid 7).

Within six months, Solarize Southeast signed up over 300 homes and installed solar on 120 homes, which added 350 kW of solar capacity of Portland and helped provide 18

professional wage jobs (Irvine et al, 2011, 7).). It has already completed a second round of 109 homes and 358 kW (ibid 13). The Portland Bureau of Planning and Sustainability helped other neighborhood organizations adopt the Solarize model, producing another 400 installations in 2010, increasing the total installations almost 400% of the previous year (ibid 7).

The Solarize campaign has been replicated, across, the city, the state, and the nation. In Northeast Portland, 204 homes installed a collective 549 kW of solar power (Irvine et al, 2011, 12). The Northeast Coalition of Neighbors facilitated the project and negotiated an agreement with a solar contractor to create an apprenticeship program to train local people in construction, leading the contractor to hire 18 community members who completed the program (Hafetz, 2011, 7). This is a good example of the role of a CBO in negotiating additional community benefits. Northeast Portland is now working on a second round (Solarize Northeast Portland, 2012, 1) and Southwest Portland took up the model with 168 homes and 450 kW of solar power. In other areas of the state, Salem, OR installed 165 kW on 52 homes and Pendleton installed 135 kW on 55 homes (Irvine et al, 2011, 14).

Photo Credit: The Oregonian

Nationwide, organizations in Massachusetts, Washington, and California have taken on the Solarize campaign. In April 2011, the Massachusetts Clean Energy Center (MassCEC) adopted the Solarize MA campaign in the towns of Harvard, Hatfield, Scituate, and Winchester (MassCEC, 2012, 1). They calculate that the solar capacity installed through the first round will save 651 metric tons of CO_2 annually, and 13,000 metric tons over the course of their lifetimes, equivalent to the annual emissions of more than 2,500 cars (ibid 1). In spring 2012, MassCEC is accepting applications from Green Communities who want to participate in the second round of Solarize Massachusetts (ibid 1). In Washington, Northwest SEED, a non-profit dedicated to promoting clean energy across the Northwest, installed 295 kW of solar on 71 homes in Northeast Seattle, Stanwood/Camano, and

Thurston (Solarize Washington, 2012, 1). This resulted in $1.5 million dollars invested in the local solar economy (ibid 1). Additionally, the Community Environmental Council ran a Solarize Campaign in the summer of 2011 and got 28 homeowners to sign contracts with solar installers (Community Environmental Council, 2012, 1).

The Solarize model has also been adapted for the workplace. The Energy Trust developed the Solarize model for Columbia Sportswear who had installed solar on their headquarters and wanted to offer a program to their employees (ibid 14). The "Lighten Our Load" campaign installed 14.3 kW on 5 homes and offered a "Home Energy IQ" series to educate employees on energy efficiency and conservation as well as renewable energy (ibid 14). Similarly, the San Jose Credit Union in California offered a group buy program to its employees and retirees. It offered a choice between solar PV and thermal, and a 3.99% interest home equity loan (Irvine et al, 2011, 16).

Solarize demonstrates the effectiveness of bulk purchasing at addressing the barriers mentioned above. The Solarize campaign cut costs by 30-35% and reduced the "dizzying array of technical choices to one simple question for participants: yes or no?" (Irvine et al, 2011, 8). It helped overcome customer inertia and decreased the time from first inquiry to installation to 3-6 months (ibid 8). Finally, it offered "safety in numbers", so that participants did not feel like they were making a complicated and expensive decision on their own (ibid 8).

Every neighborhood based Solarize campaign looks slightly different, but the essential common elements are the same. Solarize campaigns use a competitive contractor selection process led by community volunteers (Irvine et al, 2011, 8). This offers the homeowner the ease of a pre-selected contractor, builds trust in the contractor, and provides a transparent process for both the customer and installer (ibid 8). Solarize campaigns rely on community-led outreach and education (ibid 9). Neighbors distributed flyers, built and updated websites, spoke at workshops, and directly asked friends. This allowed neighbors to become invested in the project, and allowed contractors to save money on marketing costs (ibid 9). Finally, Solarize campaigns have a limited-time offer (ibid 9). This creates a "sense of urgency among residents who don't want to miss a good deal" and mitigates the

concern that a monopoly is being awarded to the contractors selected for the project (ibid 9).

One Block off the Grid (1BOG)

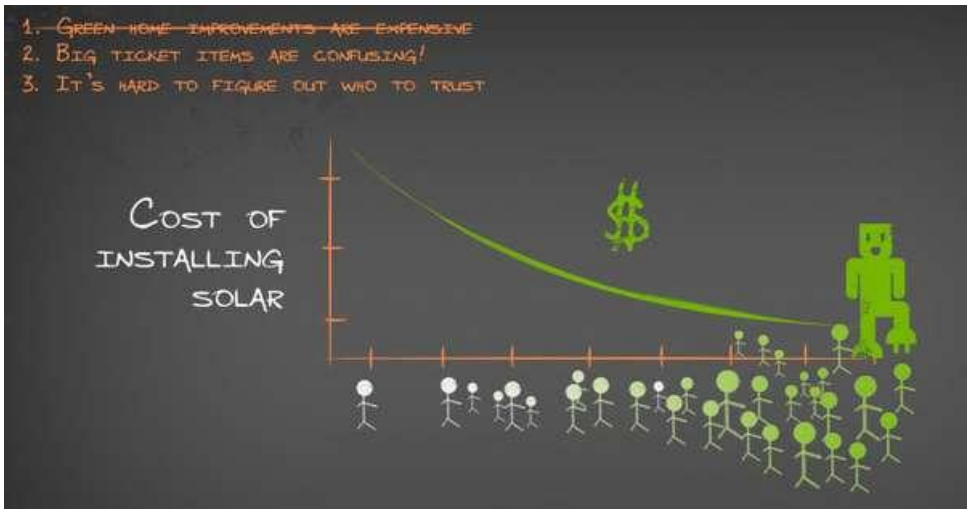


Photo Credit: 1BOG

Like the Solarize campaign, One Block off the Grid addresses the barriers to individual ownership of solar power but operates with a for-profit model, organizing group discounts in exchange for referral fees from installers (Farrell, 2011, 17). 1BOG is based in San Francisco, but operates nationwide in states with relatively mature incentives (Shannon Coulter, interview, May 2, 2012). In the spring of 2012, they offered deals in regions and cities in Arizona, California, Colorado, Hawaii, Maryland, Massachusetts, New Jersey, New York, and Oregon (1BOG, 2012, 1). According to Shannon Coulter, the Vice President of Marketing, there was a "decent" amount of interest in New York City, because of the high electricity rates (interview, May 2, 2012). Unsurprisingly, they found more eligible homeowners in the outer boroughs of NYC (ibid). As of January, 2011, 1BOG had already installed 7,800 kW of solar on 1,300 homes nationwide (Irvine et al, 2011, 16).

To initiate a campaign, 1BOG issues a RFP to local contractors who offer a flat rate low price and residents can sign up at that given price for a three month period (Irvine et al, 2011, 16). 1BOG charges an installation fee of $0.25 per Watt to solar contractors, which adds about $1,250 on to the price of a 5 kW system (5% the overall system cost), which is

built into the flat rate offered by the contractor (Irvine et al, 2011, 17). Even with the referral fee, 1BOG typically achieves a 15% discount for members (Farrell, 2011, 17).

Solar Thermal Bulk Purchasing in the Twin Cities

Unlike many community solar projects, two bulk purchasing initiatives in the Twin Cities, Minnesota focus on solar thermal, rather than solar photovoltaic. In the spring of 2006 the Southeast Como Neighborhood Improvement Association (SECIA) initiated the Southeast Como Neighborhood Solar Thermal Pilot Project with the goal of helping to jump-start solar thermal in the Twin Cities by installing twenty residential solar hot water systems (Nelson, Stiever, and Kearney, 2007, 8). A local installers agreed to give a bulk purchase discount for 16 single-family homes and one multi-family building who signed up (ibid 9).

Photo Credit: District 10 Como Community Council

Similarly, Make Mine Solar is an ongoing bulk purchasing project for solar hot water, solar air heat, and solar photovoltaic (MN Renewable Energy Society, 2012, 1). An initiative of MN Renewable Energy Society, Make Mine Solar provides free workshops, site assessments, installation, equipment and structural engineering visits at a reduced cost, recommends approved installers and provides advice and guidance throughout the process (ibid 1). Over a twelve month period, they installed twelve solar hot water, one solar hot air, and three PV systems (Laura Cina, personal communication, April 30, 2012). These 16 installations resulted from 259 Google assessments, and 102 site assessments (ibid). The program ended when incentives for solar thermal ran out at the end of 2011, but Make Mine Solar recently received grant to run the program in Southeast Minneapolis and are planning to launch again this month (ibid).

Advantages and Disadvantages of the Bulk Purchasing Model

1. Creates opportunities for low-income people to participate?

The bulk purchasing model has limited opportunities for low-income people to participate, because it is mostly geared towards homeowners, who, especially in New York, are primarily middle- and upper-class people. There are options for bulk purchasing to include solar leases, which don't require the large upfront cost of solar ownership, but none of the models surveyed above explicitly integrate non-ownership opportunities. Participants in bulk purchasing programs may save significantly, but are still required to front several thousand dollars to participate. Thus, the program is not accessible to people with limited disposable income.

2. Cheaper than individual ownership?

By definition, solar aggregation is more affordable than individual installations. All participants receive a discount as negotiated with the solar contractor. This is a win for the contractor as well, as they are able to save on marketing, assessing site potential, and negotiating individual contracts.

3. Offers economic benefits to the contributors?

In this case, contributors directly receive the economic benefits and environmental credits as they are the sole investor and owner of their own system.

4. Increases solar ownership?

Bulk purchasing increases solar ownership within the category of people who are eligible for individual solar ownership: single-family homeowners with good sun exposure and access to capital. It helps people within this category overcome the barriers of cost, complexity, and inertia in the solar installation process. However, bulk purchasing does not expand who is eligible to own solar power. Renters, multi-family building residents, people with shady property, and people who lack access to capital are still excluded from solar ownership.

5. Built on unused space rather than green space?

Bulk purchasing programs work with solar installations on residents' roofs, so they by default are built on unused rather than green space.

6. Minimizes the inefficiency of transmission?

Bulk purchasing encourages the distributed generation of power, in which the energy is consumed and produced by the same residence. This is much more efficient than feeding energy from large solar farms into the grid.

Applicability to New York City

Bulk purchasing is certainly applicable to NYC, as 1BOG even conducted a solar deal in the New York Metro area. However, the low percentage of single family homeowners in the five boroughs means that bulk purchasing is not addressing the needs of the majority of potential solar owners. Additionally, the low rate of eligible participants would make a bulk purchase difficult to coordinate at a neighborhood scale for most neighborhoods in NYC. The benefits of aggregating customers who live in proximity to one another would likely have to be diffused. However, for areas in the outer boroughs with a particularly high concentration of home owners, which could be located using census data, this may be a great model indeed.

2. Neighborhood Organizing

The neighborhood organizing model brings together community members to make going solar more affordable and convenient for everyone. The organizers may not necessarily negotiate a bulk purchase, but they do help people through the process of going solar, including finding, evaluating, and selecting an installer, understanding tax incentives and filling out rebate forms. Like bulk purchasing, solar neighborhood organizing initiatives help people feel like they are not alone in making difficult decisions.

DC Solar United Neighborhoods

DC Solar United Neighborhoods is the umbrella group of "solar cooperatives" in Washington, DC. Each cooperative brings neighbors together to navigate solar installation and ownership collectively. The first solar co-op in the Mt Pleasant neighborhood began at a dinner table conversation between Anya Schoolman and her son Walter, then age 12, and his friend Diego, who had just seen *An Inconvenient Truth* (Schoolman, personal communication, December 4, 2011). They asked if anyone was going to do anything about climate change, and they came to the decision that they would take action and try to go solar (ibid). Schoolman did some research and quickly learned that installing solar was much more complicated than they had originally though. She told her son that if they were going to go solar, they were going to do the whole neighborhood, because it was way too much work to do for one home. The boys made flyers knocked on all their neighbors doors and a surprising number of people turned up for the first interest meeting, wanting to know what they could do, and the Mt Pleasant Solar Cooperative was born (ibid).

Today, there are 110 solar homes in Mt Pleasant (Robert Robinson, personal communication, April 29, 2012). As people across DC heard about what they were doing in Mt Pleasant, they wanted to learn how they could go solar as well. Mt Pleasant Co-op started assisting other neighborhood groups to form, first in Capitol Hill, and then in twelve other neighborhoods. Currently, there are cooperatives in some stage of development in the neighborhoods of Mt Pleasant, Shaw, Georgetown, Palisades, Connecticut Avenue, Cleveland Park, Petworth, Shepherd Park, Brookland, Brightwood, Bloomingdale, Capitol Hill, Ward 7 and Ward 8 (Robert Robinson, personal communication, April 29, 2012). In 2010, the co-ops came together to create DC SUN. DC SUN estimates that over 2/3 of the 430 solar installs representing 2.3 MW under the Renewable Energy Incentive Program since 2009 are DC solar co-op members (ibid).

Solar co-ops are responsible for so many installs completed because they allow neighbors to share information on pricing, incentives, deadlines for forms, and District Department of Energy requirements during the installation process (Mt Pleasant Solar Coop, 2012, 2). According to Schoolman, installing solar is just the beginning (Tranovitch,

2011, 1). Once the panels are installed, the solar cooperatives help solar owners share knowledge about net metering rules, their experience with utility meters and bills, new incentives, and new opportunities (Mt Pleasant Solar Coop, 2012, 2). DC Solar Coops go beyond encouraging individuals to go solar- they actively lobby their council members to protect solar budgets and pass new legislation (ibid 2). In 2009, the co-ops helped pass a bill that created a long-term incentive for solar (Anya Schoolman, personal communication, September 25, 2011). Currently, DCSUN is advocating for solar garden legislation that would include a special incentive for low-income residents (ibid). Overall, solar co-ops allow individuals and organizations to build confidence that they are making wise decisions as solar buyers and owners by learning from the experience of neighbors who have already gone solar and sharing information with neighbors who are negotiating the solar installation process at the same time.

Solar co-ops spread the message that there are a variety of economic options that make solar available to almost everyone. Co-ops share information about solar lease and power purchase agreement programs, in addition to ownership financing. Solar co-ops encourage people to take advantage of the opportunity to sign a lease or power purchase agreement with Solar City. Solar City offers homeowners and businesses the chance to get solar panels on their roof for zero down payment. With a solar lease, homeowners or businesses pay by the month, whereas with a PPA, they pay per kWh (Solar City, 2012, 1). People who sign the SolarPPA have the option of purchasing their system anytime after year five (ibid 1). Skyline Innovations operates a similar model for solar thermal on businesses (Skyline Innovations, 2012, 1).

Photo Credit: Dowser

Additionally, solar co-ops spread the word that residents can own their system for as little as $800 per kW after taking advantage of all the incentives. In DC, solar costs about $5,000 per kW, and solar owners qualify for the 30% federal tax credit, a $1,500/kW rebate up to 3 kW (though there is currently a long waiting list), about $1,200/kW if they sell their SRECs upfront, and the energy savings from net metering (Mt Pleasant Solar Co-op, 2012, 2). As the solar co-ops excitedly share, this means that a homeowner can get a 4 kW system, enough to power the average home, for as little as $3,200 (Robert Robinson, personal communication, April 29, 2012). New Generation Energy even offers a dollar for dollar fundraising match, but Anya says they want to limit the amount of fundraising they do because they want to spread the message that "solar makes economic sense" (personal communication, September, 25, 2012). DC SUN is also coordinating its first bulk purchase, aggregating projects from churches and non-profits, who cannot take advantage of the tax credits, to bundles of 250 kW or more, which they think will knock the price down to $2 or $3 per watt (ibid).

DC SUN is finding that forming a solar cooperative is also any incredible way of building community. Robert Robinson, a founding member of the Mt Pleasant Solar Cooperative, reports that "it's not just about solar. It's about helping a community to be more closely knit than it has been. It's a way for us to help bring people together who really need to come together to built things in their community" (interview, April 29, 2012). For instance, Robinson describes how going solar is a lifeline for African American churches in DC, who are struggling to keep their doors open with an aging membership (ibid). Going solar is one of the few ways to bring costs down without compromising other services an institution provides (ibid).

Advantages and Disadvantages of the Neighborhood Organizing Model

1. Creates opportunities for low-income people to participate?

The neighborhood organizing model, as practiced by the DC solar co-ops, is focused on creating an opportunity for people who are struggling to pay their electricity bills to cut costs. They see solar as a means to make ends meet.

2. Cheaper than individual ownership?

As none of the DC SUN co-ops have negotiated a bulk purchase up until this point, going solar with a co-op is not actually cheaper than going solar on your own if you have access to the same information. However, the solar co-ops do play a valuable role in ensuring that members have the best information about the best priced contractors and how to take advantage of the range of incentives that can bring the cost of solar down to $800 per kilowatt.

3. Offers economic benefits to the contributors?

The contributors, in this case the residents or organizations who have solar panels on their roof, receive the benefits of lower or no electricity bills for as long as they are in that building.

4. Increases solar ownership?

Neighborhood organizing does not expand the categories of who can go solar, but it does encourage eligible people who might not install solar on their own to move in that direction.

5. Built on unused space rather than green space?

Neighborhood organizing helps residents and organizations install solar on their roofs, so the issue of building on green space is avoided.

6. Minimizes the inefficiency of transmission?

The panels installed through neighborhood organizing provide electricity directly to the host, so such a model is as efficient as possible.

Applicability to New York City

Much like bulk purchasing, neighborhood organizing does not face any technical barriers in New York City, but would likely bump up against the challenge of low single-

family ownership. This may be a useful model for select neighborhoods in Brooklyn, Queens, the Bronx, and Staten Island with high rates of home ownership. In fact, a neighborhood organizing initiative might just give New Yorkers the support they need to make the switch to solar. However, as solar costs are about $7,000 per kW in NYC compared to $5,000 per kW in DC, NYC neighborhood organizers should expect to initially have a harder time making the case that solar is a smart economic decision for low-income households (Joel, 2012, 11). Neighborhood organizing initiatives in NYC may want to incorporate a bulk purchase to lower upfront costs as well.

3. Do-It-Yourself

This model brings community members together to collectively install a solar system on a home of a neighbor or person in need. Volunteers participate hands-on in the installation process, thereby reducing the costs of installation, as well as gaining technical skills. Additionally, using people power rather than machinery reduces the amount of energy used in the installation process (PAREI, 2012a, 1). This model either includes an expectation that volunteers will be able to call on the recipients of their labor to return the favor, or that volunteers are simply doing a good deed.

Plymouth Area Renewable Energy Initiative's Energy Raisers

The Plymouth Area Renewable Energy Initiative in Plymouth, VT is a non-profit formed in 2004 in response to concerns about an "increasingly energy constrained world" (PAREI, 2012b, 1). One of PAREI's projects is to coordinate "Energy Raisers", a neighbor-helping-neighbor concept of installing solar energy on homes based on the tradition of Amish barn-raising (PAREI, 2012a, 1). The idea started with two members making a deal to help each other put up solar panels on their homes (ibid 1). The first official Energy Raiser was then held in 2005 (ibid 1). Twenty seven people came together to install a solar water heating system in one day (ibid 1). The Energy Raiser volunteers join one of teams to make the installation process as orderly and effective as possible (ibid, 1). These teams have specific functions, such as the electrical team, the tube team, and the pipe insulation team (ibid, 2). PAREI ensures that those who benefit from the program also contribute, as people who are interested in hosting an Energy Raiser for their home must help with two or three

Raisers so the favor will be returned to them. PAREI finds the Energy Raisers have a powerful role in bringing neighbors together and building a sense of community (ibid 1).

PAREI is interested in having others replicate their model, but only for a fee. It offers a PAREI Introductory DVD for $36 and a Community Partnership for $150, including the DVD and documents and a partnership advisor who will offer advice over email and phone (PAREI, 2012, 1). PAREI clearly feels that the value of their model is worth paying for.

Grid Alternatives

Grid Alternatives, a non-profit and licensed solar installer, offers a Solar Affordable Housing Program, which trains and leads volunteers and job trainees to install solar systems on low-income households (Grid Alternatives, 2012a, 1). Volunteers and participants in their job training program work under the experience of construction professionals on the project and are therefore not required to have any experience to participate in the solar installation (Grid Alternatives, 2012b, 1). Grid Alternatives works all across California, and has worked on 1,811 homes with over 4.9 MW installed as of April, 2012 (Grid Alternatives, 2012c, 1). These projects trained 8,595 volunteers, some of whom have been profoundly impacted by their participation in the program.

For instance, the Grid Alternatives website tells the story of Tom King, who used to work in produce distribution, but found that he lacked passion for his work (Grid Alternatives, 2012d, 1). He volunteered with GRID Alternatives, without any prior experience in solar, and found it very fulfilling (ibid 1). After volunteering on several installations, he took classes in solar and got a job at Phat Energy (ibid 1).

Photo Credit: Get Solar

Grid Alternatives also highlights how much their Solar Affordable Housing Program means to their clients. In one moving story, Grid Alternatives worked with Elmer Rankin, a 70-year old Navy Yet who is disable and living with congestive heart failure and undergoing chemotherapy for prostate cancer (Grid Alternatives, 2012e, 1). Rankin uses an electric wheelchair and needs an in-home oxygen system (ibid 1). Last winter, he could not afford to pay for the electricity for these life support systems and run his heater. His body began to shut down as a result of the cold and he was hospitalized (ibid 1). Grid Alternatives helped Rankin apply for and receive a solar electric system that provides up to 80% of his energy needs (ibid 1). The 9.2 kW system, the largest single system Grid Alternatives has worked on to date, was made possible by state incentives and donations from individuals (ibid 1). Rankin proclaims, "This is literally going to save my life" (ibid 1).

Advantages and Disadvantages of the Do-It-Yourself Model

1. Creates opportunities for low-income people to participate?

The Do-It-Yourself model creates opportunities for low-income residents to participate, though only if they are a homeowner. Grid Alternatives' Solar Affordable Housing program is explicitly focused on making it possible for low-income households who are struggling to pay their electricity bills to reduce their costs by going solar. On the other hand, PAREI seems to have a more middle-class membership base, given the geographic region it serves, and does not include any funding opportunities within the Energy Raisers program.

2. Cheaper than individual ownership?

Do-it-yourself projects are certainly more affordable than conventional individual ownership. The installation costs are greatly reduced because there is no need to pay for labor.

3. Offers economic benefits to the contributors?

The contributors, in this case the volunteers, are not expected to get any sort of financial return, but they do receive the benefits of free training and in some cases, exposure to a new field of interest.

4. Increases solar ownership?

The do-it-yourself model increases solar ownership for those who are already eligible for solar, but cannot afford to pay for a solar installer or do not have the impetus to go through the process on their own. However, it does not expand the opportunity to renters, multi-family building residents, and residents with shady property.

5. Built on unused space rather than green space?

Do-it-yourself programs install solar on residential roofs, and so avoid using green or open space.

6. Minimizes the ineffiency of transmission?

As the electricity generated by the do-it-yourself installations is intended to be used by the homeowner, any inefficiency in transmission is avoided.

Applicability to New York City

Though technically permitted in NYC, the do-it-yourself model would likely face the challenge of the small percentage of single-family homeowners. Additionally, New York does not have the tradition of 'barn raisings' within its recent memory, which the Energy Raisings model draws on to have neighbors help neighbors. New Yorkers may be more inclined to volunteer to install panels on the home of a needy family, as community service is more in the NYC culture than building community with neighbors. The do-it-yourself model is another option for making solar affordable for New Yorkers.

Conclusion

A Budding Community Solar Movement in New York City

Community solar is taking off in cities nationwide, and New York City is just beginning to break onto the community solar scene. There are three groups at the beginning stages of developing a community solar project in the Bronx, Brooklyn, and Queens. Representatives from these groups as well as about ninety other individuals including solar installers, community development specialists, clean energy advocates, and local residents came together for the New York Community Solar Confluence on April 23, 2012 to discuss how to bring community solar to New York. The event was organized by the author and included presentations from Joy Hughes of the Solar Gardens Institute, David Brosch of University Park Solar, and speakers from four other solar support organizations- The Vote Solar Initiative, CleanPath, Sustainable CUNY, and Solar One. The confluence was part of a series of four events happing in Boston, Denver, and San Francisco, demonstrating how networked the community solar field is becoming.

Community solar is also gaining traction at the municipal level. Sustainable CUNY, who manages the NYC Solar America Cities Partnership, has developed several tools which will make community solar project development easier. One such tool is the NYC Solar Map, which provides the solar potential for any property in the five boroughs, empowering community members to figure out where in their neighborhood would be a good location for a community solar project. Additionally, Sustainable CUNY has done research into community solar and, according to Allison Kling, is considering the idea of funding a pilot project on a community organization where the community receives the benefits (Interview, February 12, 2012). Kling says they had put community solar on the backburner for some time because of the barriers with the lack of virtual net metering policy (ibid). This emphasizes the need for New Yorkers to work on policy change at the same time as local organizing.

New York does have a remote net metering policy, which allows property owners who own multiple properties to net meter energy production on one property to any

account in their name (Allison Kling, interview, February, 12, 2012). It's indeed for upstate agriculture and commercial owners, but it brings New York a "baby step" closer to a community solar policy (ibid). A simple text edit would make the remote net metering policy a virtual net metering policy (Tim Woodcock, personal communication, May 2, 2012).

Recommendations for Community Solar in New York with Current Policy Constrictions

While working towards a virtual net metering policy, New Yorkers who are interested in developing community solar projects in the meantime should consider the LLC model. As shown in Figure 6, the LLC and Cooperative models are the own community solar models that meet or could meet all six criteria presented in this paper. Since there are no replicable models of Cooperatives which offer a return on investment to contributors, the LLC model will be the easiest to adapt for New York City. The example of University Park Solar is especially useful to consider given the open access to the LLC's founding documents. This model would allow New Yorkers who rent their homes, live in multifamily buildings or on shady properties, or lack access to capital to become solar owners, which leads to a long term personal revenue stream from solar. This revenue stream can eventually assist families who are struggling to pay their own electricity bills, especially if investors can contribute just a couple hundred dollars under the new JOBS bill. All four examples of LLCs got the cost of solar much lower than individual ownership, which provides hopeful prospects for similar projects in New York City.

Figure 7: Analysis of Community Solar Models

Model		Creates Opportunities for Low-Income People to Participate?	Cheaper than Individual Ownership?	Offers Economic Benefits to the Contributors?	Increases Solar Ownership?	Built on unused space?	Minimizes the inefficiency of transmission?	Applicable to NYC?
Subscription	Utility-owned Subscription	Maybe	Maybe	Yes	No	Maybe	No	No
	Electric Co-op Subscription	Maybe	Maybe	Yes	Yes	Maybe	No	No
Community Ownership	LLC	Maybe	Maybe	Yes	Yes	Maybe	Maybe	Yes
	Cooperative	Maybe	Maybe	Maybe	Yes	Maybe	Maybe	Yes
Community Benefit	Flat Donation	Yes	Maybe	No	No	Yes	Yes	Yes
	Zero-Interest Loan	Yes	Maybe	No	No	Yes	Yes	Yes
Collaborative Efforts on Individual Homes	Bulk Purchasing	No	Yes	Yes	No	Yes	Yes	Yes
	Neighborhood Organizing	Yes	Maybe	Maybe	No	Yes	Yes	Yes
	Do-It-Yourself	Yes	Yes	No	No	Yes	Yes	Yes

Key:

Yes
Maybe
No

While there is much to be learned from how community solar developed across the country, any of the models will need to be adapted and made to fit the specific constraints and opportunities of NYC's solar market. As Allison Kling says, "it's good that community solar has popped up in various forms, all of which are complicated in various ways, but it's also tough because you can't just plop it here" (interview, February 16, 2011).

Once New Yorkers start to adapt these models to NYC, the impacts could be profound and far-reaching. Community solar could be the key to overcoming the barriers of low rates of home ownership and single family residences. Community solar has the potential to unlock the 30 square miles of roof space in NYC to create a democratic, healthy, affordable, and sustainable energy system.

Appendix A: Guides for Starting a Community Solar Project

California Interfaith Power and Light's *Solar Resource Guide: An Overview for Congregations*- http://interfaithpower.org/resources/solar-resource-guide/

National Renewable Energy Laboratory's *The Solarize Guidebook: A community guide to collective purchasing of residential PV systems*- http://www.nrel.gov/docs/fy11osti/50440.pdf

Solar Gardens Institute Solar Gardeners Trainings Webpage- http://www.solargardens.org/solar-gardener-training/

Solar Minnesota's *Creating and Implementing Your Community Solar Plan*- http://www.communitypowernetwork.com/sites/default/files/Department%20of%20Energy_Implementing%20Solar%20in%20Your%20Community.pdf

Solar Mosaic's *Community Solar Guide*- http://solarmosaic.com/guide

University of Oregon's Community Solar Tool- http://communitysolar.dyndns.org/index.php

World Resources Institute's *Purchasing Power: Best Practices Guide to Collaborative Solar Procurement*- http://pdf.wri.org/purchasing_power.pdf

Appendix B: Solar Incentives in New York City

SOLAR PV
INCENTIVES AND TAX CREDITS

RETROFITNYC

CATEGORY	BUILDING TYPE	INCENTIVE SUMMARY
Federal	RESIDENTIAL	**Residential Renewable Energy Tax Credit** **Contact 1.800.829.1040** A 30% personal tax credit for purchasing solar electric system with no maximum credit. Systems must be placed in service on or after January 1, 2006, and on or before December 31, 2016. www.dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=US37F&re=1&ee=1
	COMMERCIAL	**Business Energy Investment Tax Credit** **Contact 1.800.829.1040** Tax credit equal to 30% of expenditures, with no maximum credit. Eligible solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. www.dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=US02F&re=1&ee=1
		Modified Accelerated Cost-Recovery System **Contact 1.800.829.1040** For renewable energy systems placed into service between September 8, 2008 and December 31, 2012, the owner is entitled to deduct a significant portion of the adjusted basis of the property during the tax year the property is first placed in service. The allowable first year deduction is 50% of the adjusted basis. Applies to all types of solar energy systems. www.dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=1
New York State	RESIDENTIAL	**NYSERDA Solar PV Incentive Program** **Contact:1.877.697.6278** $1.50 per watt up to a maximum of 7 kW per site/meter, and not to exceed 40% of the total installed system costs. For 1-4 family homes, New York State ENERGY STAR® Labeled Homes and Building Integrated PV systems are still eligible for a $.50 per watt added to these above incentives, not to exceed 40% of the total installed system costs. Residents located in a Solar Empowerment Zone will be eligable for an additional 15%. www.nyserda.org/funding/2112pon.asp
		New York State Solar and Fuel Cell Tax Credit **Contact: 518.457.5181 or 800.225.5829** Credit equal to 25% of cost of equipment and installation capped at $5000; 10 kW maximum for solar-electric (PV) systems. www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NY03F&re=1&ee=1
	COMMER-CIAL	**NYSERDA Solar PV Incentive Program** **Contact:1.877.697.6278** For commercial buildings: $1.50 per watt up to a maximum of 50 kW per site/meter, and not to exceed 40% of the total installed system costs. For non-profit buildings: $1.50 per watt up to a maximum of 25 kW per site/meter, and not to exceed 40% of the total installed system costs. www.nyserda.org/funding/2112pon.asp
	LARGE SCALE (OVER 50kW)	**NYSERDA Customer-Sited Tier Regional Program** **Contact:1.877.697.6278** NYSERDA has incentives for large-scale solar PV installations of 50kW or more in NYC. The first recommended step is to consult the NYC Solar Ombudsmen at 212.346.8582 or nycsolarcity@mail.cuny.edu for a site assessment and information on how to connect to incentives and NYSERDA eligible installers. http://tinyurl.com/87wo9yh
New York City	ALL	**NYC Property Tax Abatement** **Contact: 212.566.4769** For systems placed in service between Jan 1, 2011 – Dec 31, 2012: 5% tax abatement for 4 yrs (20% of system cost). Maximum: $62,500 annually or the amount of real property taxes owed during a year. www.nyc.gov/html/dof/html/property/property_tax_reduc_individual.shtml#solar

4/26/12

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