

A Theory-based Evaluation of LIPA's Solar Pioneer Program: Measuring Early Progress in the Transformation of the PV Market on Long Island

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ABSTRACT

In the application of theory-based evaluation, program designers, implementers, and evaluators work together to: identify barriers to program success, develop program activities to overcome those barriers, propose a set of resulting market effects, and establish indicators of barrier status across the full range of market actors. This paper examines the application of theory-based evaluation to demonstrate how it can be a useful tool in measuring the progress of a solar photovoltaic program, as well as provide feedback for program modification and improvement.

The Long Island Power Authority's (LIPA's) Solar Pioneer Program seeks to generate long-lasting market transformation of the photovoltaic (PV) market on Long Island. The objectives include increasing demand for PV systems among LIPA's customers, and promoting favorable changes, such as streamlined permitting requirements, across a broad range of market barriers and market actors. Theory-based evaluation is particularly well suited to programs, such as this one, that do not measure success simply on the number of immediate installations and the corresponding energy production and capacity savings. Although these benefits are certainly tracked by the program, the theory-based evaluation provides a broader context for gauging ongoing successes and challenges.

Evaluation findings show a reduction in market barriers for photovoltaic systems on Long Island attributable to LIPA's Solar Pioneer Program: the number of PV installers on Long Island has increased, the experience and professionalism of these installers has improved, seminar attendees have been educated about PV, and a Long Island customer base has emerged.

Introduction

Theory-based evaluation provides a framework for measuring the progress of an energy efficiency program in transforming the market. First, a program theory is proposed. The program theory includes a listing of the barriers to the implementation of the technology or practice, the program stimulus designed to overcome or reduce these barriers, as well as the market effects hypothesized to occur at various time frames after the beginning of the program. These items are proposed for each of the major market actor groups affected by the program. Second, a baseline study is performed to capture a snapshot of the market before (or very shortly after) the program begins. Then, periodically, new marketplace snapshots are taken in order to compare to the baseline and to suggest improvements to the program. If changes occur in the marketplace that were predicted by the program theory, there is then some confidence that these changes were potentially induced by the program. However, there are always many forces at work in any given market, many of which may not be recognized in the program theory. While using the program theory as a framework upon which to build the evaluation, care should be taken to broaden the research beyond the program theory and its predicted effects, so that causal relationships and attribution to the program can be more fully explored.

This paper will discuss: the background of the Long Island Power Authority's (LIPA's) Solar Pioneer Program, the development of the program theory, the research methodologies used for the evaluation of this program, brief results from a Baseline Study conducted in 2000, more detailed results from a Market Progress and Evaluation Study performed in late 2002/early 2003, and conclusions about how theory-based evaluation has proven valuable to the program.

Background on the Solar Pioneer Program

Introduced in 1999 as part of LIPA's Clean Energy Initiative, the Solar Pioneer Program promotes the installation of solar photovoltaic (PV) systems as an environmentally clean and viable alternative to electricity generated from fossil fuels. LIPA has committed to transforming the market for PV on Long Island by: increasing consumer awareness and market demand for PV systems; accelerating the development of a vibrant, self-sustaining local infrastructure for the delivery and maintenance of quality PV systems; reducing institutional barriers to streamlined system installations; and developing mechanisms to overcome financial barriers to purchasing PV systems. Although the original focus of the Solar Pioneer Program was on the residential market, in 2001 rebates were made available to commercial customers also.

LIPA has employed many efforts designed to raise public awareness of PV and the Solar Pioneer Program: two Lottery programs which installed 72 free systems on Long Island homes; Solar Pioneer Seminars with information on both PV and LIPA's programs, conducted at sites throughout Long Island; and media advertisements, bill stuffers, and trade shows. LIPA also hosts an extensive web site (www.lipower.org/solar) which offers information on: building a PV system, available PV incentive dollars, monitoring a customer's PV system output, building department regulations, forms & applications, a list of PV contractors, frequently asked questions, and other links/ resources. In addition, LIPA's Research & Development Department has supported the world's largest (1.01 MW) PV system on the Fala Direct Marketing buildings in Farmingdale, New York.

Solar Pioneer Program staff work closely with the Solar Energy Center at the State University of New York (SUNY) in Farmingdale, from training local contractors in the proper installation of PV systems to training of electrical inspectors, with LIPA co-funding many of these training sessions. LIPA maintains relationships with these installers, hosts a quarterly meeting for contractors and all interested parties, and publishes a list of contractors on its web site – 19 Solar Pioneer Program Contractor Allies were listed as of March 2004. Contractor Allies are encouraged to network with homeowners and businesses at Solar Pioneer Seminars. Solar Pioneer Program staff also work with the Department of Energy (DOE) on their "Million Solar Roofs" initiative, work with local building departments, attend New York Solar Energy Industry Association (NYSEIA) meetings, and participate with Renewable Energy Long Island - a local solar power advocacy group.

LIPA participates in a state-wide effort to standardize and continuously improve interconnection protocols. In fact, New York State has adopted IEEE 929 for use in ensuring safety and reliability in connecting PV systems to the electric grid. Recently, LIPA revised its requirements for isolation transformers, meaning that fewer systems will be required to have them installed.

LIPA offers its customers rebates to reduce the cost of installing a PV system. Solar Pioneer Program incentive levels have varied over time. Rebates were set at \$3.00/DC-watt in 1999 when the program began and were doubled to \$6.00/DC-watt for a six-month promotional period in 2002. Then LIPA decided to begin a controlled, predictable reduction in rebate levels. After the \$6.00/watt promotion, rebate levels were set at \$5.00/DC-watt until a 1 MW allotment was filled. The rebate level was then reduced to \$4.50/DC-watt to fill the next allotment of 1 MW, and it is now at \$4.00/DC-watt to fill the next 1 MW allotment. Customers and contractors have the ability to check LIPA's web site to see if a rebate level is still available, and if so how close it is to being filled.

In addition to the rebate from LIPA, homeowners can take advantage of the following: excess electricity generated by PV systems receives full retail credit through net metering; a New York State tax credit of 25%, up to a maximum of \$3,750; and a New York State fifteen-year real property tax exemption. Commercial customers can claim a federal investment tax credit for solar energy property of up to 10% of the investment purchase and installation amount; they can also take advantage of a five-year accelerated tax depreciation on solar energy equipment. Not-for-profit, school, and government customers are not eligible for all of the tax incentives offered to residential and commercial customers, so LIPA has begun offering these customers an additional \$1.00/DC watt, added onto the current rebate level in effect at the time of the installation pre-approval.

The number of PV systems installed on Long Island is summarized in Table 1. Incentives paid from program inception through May 10, 2005, total over \$13.5 million for the 508 rebated systems installed to date.

Table 1. PV Systems Installed through the Solar Pioneer Program

Year	Number of Systems	Total DC Watts
2000	2	2,400
2001	13	33,240
2002	184	829,263
2003	142	751,562
2004	132	767,134
2005 (through May 10)	35	214,942
Subtotal for Rebated Systems	508	2,608,541
1999 Lottery	31	19,142
2002 Lottery	41	25,318
Subtotal for Lottery Systems	72	44,060
Total	580	2,652,601

Program Theory

In developing the Solar Pioneer Program Theory, program designers created a table of market effects that included the four major market actor groups expected to be affected by the program, either directly or indirectly. To accomplish this task, they reviewed relevant literature, transferred information and experiences from other markets and technologies, and conducted informal discussions with industry experts. Program implementers and program evaluators reviewed the proposed theory and table, and together with the program designers finalized the program theory.

The process of developing the program theory normally takes place before the program has begun. For this program, the theory was developed concurrently with the earliest implementation of the first lottery in 1999. Since the program theory can (and should) change as experience is gained in the marketplace, the formal documents require periodic revision. Although a number of edits and revisions were made as a result of the evaluation work performed for this program, a more complete review and revision is planned for 2006.

Table 2 is an excerpt from the Solar Pioneer Program Theory & Market Effects Table.

Table 2. Solar Pioneer Program Theory & Market Effects Table - EXCERPT

Market Actor Group	Consumers	PV Installation Contractors	Manufacturers	Other Market Actors¹
Market Barriers	General lack of knowledge of PV technology, economics, and environmental benefits; lack of experience owning a PV system	Lack of information and experience of local contractors on PV business opportunities and system installation requirements	Underdeveloped manufacturer/installer networks and partnerships	Non-standardized technical requirements for interconnection of grid connected PV systems
Program Stimuli	LIPA comprehensive marketing effort; LIPA rebates; LIPA lottery at program kickoff	Contractor training and infrastructure development	LIPA's comprehensive five-year commitment to the development of Long Island PV market	Develop and offer PV friendly interconnection agreements
Market Effects < 1 Year	Significant public awareness of LIPA PV initiative; some customers begin to consider installing a PV system	The number of local contractors qualified to install PV systems begins to increase	A majority of PV manufacturers are aware of LIPA's comprehensive five-year commitment to PV	State government and interested parties begin to develop standardized and streamlined statewide interconnection agreements
Market Effects 1-3 Years	Increase in consumer's awareness of the environmental benefits of PV; customers begin installing PV systems	Experience with program helps integrators and contractors to streamline specification, procurement, and installation processes	Manufacturers begin to establish partnerships with PV installation contractors	State government and interested parties adopt a statewide interconnection agreement
Market Effects 3-5 Years	Customers with PV systems begin to recommend it to others or to expand their own system; increasing numbers of customers install PV	Positive reliability and serviceability experience leads to increases in consumer protection, i.e, longer warranties	An increasing number of manufacturers establish partnerships with PV installation contractors	LIPA continues to streamline interconnection requirements where possible
Market Effects 5-10 Years	Increasing numbers of customers with PV recommend it to others or add to their own system; customers install PV systems even without a rebate	Increase in the volume of business that Long Island PV contractors conduct beyond LIPA territory	Manufacturers target the LI market for independent marketing	LIPA continues to streamline interconnection requirements where possible

¹ "Other Market Actors" include electrical inspectors, electricians, building inspectors, architects, builders, utility engineers, electric system planners, utility regulators, lenders, real estate appraisers, and real estate appraisers. In this excerpt we focused on utility engineers and utility regulators.

Research Methodology

LIPA performed a Baseline Study in 2000 and a Market Progress Study in 2002/2003. The key objectives of both studies were similar: to provide values for indicators of market effects; to assess the structure and functioning of the market on Long Island, including an assessment of market barriers; and to recommend changes that could enhance the efficiency of the program or program strategies in their ability to influence long-term sustainable reductions in market barriers. In order to achieve these objectives, primary market research was performed for both studies as described in Table 3.

Table 3. Summary of Research Performed

Baseline Study (2000)	Market Progress & Evaluation (2002/2003)	Purpose
In-depth interviews with 17 PV manufacturers & distributors	In-depth interviews with 15 PV & inverter manufacturers & 2 distributors	Capture manufacturers' assessments of market barriers and the effects of LIPA's program and other programs; assess whether there are new market entrants; and assess how manufacturers market on Long Island.
In-depth interviews with 5 participating and 2 non-participating PV contractors	In-depth interviews with 8 participating and 4 non-participating PV contractors	Capture contractors' assessments of market barriers. Assess process-related issues: contractor satisfaction, coordination with LIPA, incentive payment procedures, program marketing, suggested program improvements, etc.
In-depth interviews with 21 local market actors, such as industry association representatives, architects, realtors, lenders, electrical inspectors, & electrical contractors	In-depth interviews with 17 local market actors, similar to the Baseline but with more emphasis on both general and solar industry associations	Assess awareness of and experience with PV and the Solar Pioneer Program; perceived value and cost of PV systems; perception of PV system reliability; perceptions of consumer attitudes towards PV; and for associations, perception of members' attitudes towards, & experience with, PV systems.
In-depth interview with a rep. from IEEE & the LIPA Manager of Distributed Resources	In-depth interview of the LIPA Manager of Distributed Resources & the LIPA Manager of Electric Planning	Assess perceptions of PV interconnection standards and use of PV in electric system planning.
Survey of 353 nonparticipating homeowners plus 199 non-participating homeowners obtained from a list of self-reported contributors to environmental organizations.	Survey of 250 nonparticipating homeowners plus 200 from among members of the New York League of Conservation Voters (NYLCV)	Assess awareness of PV & the Solar Pioneer Program, as well as willingness to buy PV at various pricing levels, among both the general population & those likely to be environmentalists.
N/A, program had just begun at the time of the Baseline Study	Survey of 82 participating residential customers and 5 participating commercial customers	Assess: reasons for choosing PV; reasons for choosing their specific system; satisfaction with their system, the program, the interconnection process, and the inspection process; customer loyalty; and perceptions of major selling points of PV.
N/A, program had just begun at the time of the Baseline Study	Survey of 100 non-participating homeowners who attended a Solar Seminar	Assess awareness of PV & the Solar Pioneer Program, willingness to buy PV at various pricing levels, reasons for not participating, & future intentions regarding PV.
N/A, program had just begun at the time of the Baseline Study	In-depth interviews with 6 program staff	Assess: program design compared to implementation, lessons learned and changes made, database and tracking system issues, management reporting issues, rebate payment procedures, etc.

Baseline Study Results

The following bullets provide an overview of the PV market on Long Island in June and July of 2000, when the Baseline research was conducted:

- ♦ The PV market is composed of a small but growing group of manufacturers, distributors, installation contractors, builders, realtors, architects, and customers.
- ♦ Many manufacturers serve regional markets, although a few are national in scope. Manufacturers tend to specialize either in solar panels or in inverters. Because PV continues to be an immature technology, prices are relatively high, but are falling. These price reductions have come through changes in the technology of the PV component, changes in the production process, or increases in the quantities produced (economies of scale). Several manufacturers currently work in a batch production mode, and say that a continuous production mode—allowed by higher demand—would enable them to decrease their manufacturing costs. They emphasize that reduced production costs require smooth and sustained increases in demand over time.
- ♦ Most manufacturers have relationships with distributors or installation contractors to represent them in the Long Island market. Most of these local companies are small, and have sources of revenue other than PV systems—in part because the revenue from PV has been relatively small to date. In fact, few PV contractors actually make money on the PV side of their business, giving them little incentive to expand. A changing market however—including the LIPA program, the New York state tax credit, and the fact that PV systems can now be interconnected with the electric grid and their electricity net metered—adds considerable consumer appeal and makes contractors hopeful.
- ♦ Marketing messages by these local players have focused on the environmental benefits of PV rather than economics. The biggest limitation on sales to date, however, has been economics.
- ♦ The selling cycle (time from initial contact with customer to purchase) usually takes about six months.
- ♦ Builders, remodeling contractors, and architects represent a potential avenue for PV sales, but this potential has yet to materialize, partly because of lack of demand from consumers. Likewise, the real estate and financial communities perceive no consumer demand for or interest in the technology, and so have not pushed it. Some of these groups, however, believe that the LIPA program, along with the New York State tax credit, may make PV financially attractive to consumers.
- ♦ Consumers in general have little knowledge of PV systems, and very few have installed them. Those who have, according to contractors, tend to be environmentalists with higher than average income. Consumers who appear likely to buy in the future, based on survey results, are also environmentalists with higher than average income. While the environmental message is key, so are economics. Four percent of the general population of homeowners say they are likely to buy a PV system for \$18,000, but 26% are likely to buy for \$4,800. Among strong environmentalists, 17% are likely to buy for \$18,000, compared to 53% for \$4,800. Among strong environmentalists who also happen to make \$75,000 or more per year, 32% are likely to buy for \$18,000 and 76% for \$4,800. The environmental message is a clear one, while the economics message is more complex. Making PV affordable relies on a combination of LIPA rebates, New York State tax credits, and net metering. Even with all these incentives, consumer understanding of them is key for PV sales to reach their full potential.

Market Progress & Evaluation Study Results

According to the original program theory, market effects are expected to occur over a ten-year period from 1999 to 2008. As of late 2002/early 2003 when the Market Progress & Evaluation Study

(MP&ES) research was being conducted, the program was beginning its fourth year and the third tier of market effects (3-5 years) should have been developing. Due to a low incentive at program startup (\$3/Watt), as well as other issues that needed time to work through, the program didn't really take off and accomplish a significant number of installations until 2002, when the incentive was raised to \$6/Watt. Moreover, developing a sustainable market for PV systems is proving to be more difficult than envisioned in the original program theory.

The market for PV on Long Island has experienced uneven development of the anticipated market effects in all four timeframe tiers of the original program theory. This may mean that the market is being influenced by factors other than those incorporated into the program theory or, in some cases, that hypothesized barriers in fact did not exist. Among the market effects that are showing some development, several are fourth-tier (5-10 year) market effects. For example, contractors already conduct work outside of Long Island and manufacturers already offer a variety of products through distribution channels with sufficient demand to meet market needs. On the other hand, consumer and market actor awareness and understanding of the technology remain very low—and this market effect was expected to occur in the first year according to the original program theory. Raising awareness, especially among consumers, is required to further develop the market and is likely to take more time and effort than originally envisioned.

All of the key market effects – and the indicators measuring those effects - were associated with, and grouped into, 13 market barriers. One of the thirteen barriers was shown, in both the Baseline Study and the MP&E Study, not to exist, so it was dropped from this discussion. The current status of each of the twelve remaining market barriers was then compared to its status in the baseline study, and it was found that the status of five of the barriers had improved while the status of seven of the barriers remained unchanged. Of the five barriers with improved status, two have improved due to external forces, while three have improved due to the program.

Table 4 summarizes the three market barriers reduced through the influence of the program. For the barrier “Lack of experience owning a PV system —Consumers”: 78% of residential customers who own a PV system say they would be likely to purchase a PV system again if they moved to a new home and 85% would recommend PV to a friend; commercial participants overwhelmingly report satisfaction with their PV systems; and contractors report high customer satisfaction and sales that result from direct referrals from satisfied customers. Despite these improvements this barrier is still significant due to the low numbers of systems installed in total. The next market barrier, “Lack of information and experience of local contractors on PV business opportunities and system installation requirements—Contractors”, has shown improvement: all contractors interviewed were fully aware of the Solar Pioneer Program, program features, and requirements for becoming a Contractor Ally; at least 6 additional contractors entered the PV market on Long Island since the Baseline Study in 2000; marketing efforts by contractors are progressing, but not mature – most still rely on manufacturer's literature for marketing materials although almost all contractors have their own web site; contractors are becoming more efficient at specifying, procuring, and installing PV systems as they gain experience with installations on Long Island; and contractors reported improvements in their ability to service PV systems over the past two years since the Baseline Study. For the barrier “Underdeveloped manufacturer/installer networks and partnerships on Long Island —Manufacturers”: there is widespread recognition by manufacturers of Long Island's relatively strong market potential for PV technologies and they are all aware of the Solar Pioneer Program, so they do have relationships with some distributors and installers on Long Island, but manufacturer enthusiasm for the Long Island market is tempered by the five-year commitment of funds for the program – they are looking for a time horizon of greater than 10 years.²

² In 2002 when this study was conducted, the program funding was scheduled to end in 2004, but since then LIPA has extended funding until 2009.

Table 4. Market Barriers with Improved Status Attributed to the LIPA Program

Market Barrier	Market Effects	Barrier Status ³	
		2000	2002
Lack of experience owning a PV system —Consumers	Due to satisfaction with their PV systems, customers with PV systems begin to recommend it to others or to expand their own system (3-5 years) Increasing numbers of customers with PV recommend it to others or add to their own system, driven by satisfaction with past experience. (5-10 years)	1	2
Lack of information and experience of local contractors on PV business opportunities and system installation requirements —Contractors	Local contractors are aware of LIPA’s Solar Pioneer program. (<1 year) Number of local contractors qualified to install PV systems begins to increase. (<1 year) Begin to see contractors developing and delivering consumer-oriented PV marketing and educational materials that supplement program materials. (1-3 years) Experience with program helps integrators and contractors to streamline specification, procurement, and installation processes. (1-3 years) Contractors gain additional experience on serviceability and reliability of PV units. (1-3 years)	2	3
Underdeveloped manufacturer/installer networks and partnerships on Long Island —Manufacturers	Majority of PV manufacturers are aware of LIPA’s five-year commitment to PV market development. (<1 year) Manufacturers begin to establish partnerships with PV installation contractors. (1-3 years) An increasing number of manufacturers establish partnerships with PV installation contractors (3-5 years) Manufacturers target the LI market for independent marketing. (5-10 years)	1	2

The findings point to some positive changes over the past two years in the Long Island PV market. The trends are consistent with a reduction of market barriers for photovoltaics at least in part because of LIPA’s Solar Pioneer Program. Specifically, there are more contractors offering PV installation services and they are all aware of LIPA’s program. Contractors are becoming more experienced in PV installation because of increased business volume, and a highly satisfied core of participating customers are setting the stage for word-of-mouth marketing and stimulating demand. Manufacturers’ prices for photovoltaic components are coming down, although it is unclear at what rate. Total installed costs for PV systems on Long Island are also decreasing.

While these trends show a slowly improving PV market, they do not necessarily mean that the changes in the indicators studied are solely attributable to LIPA’s Solar Pioneer Program. An alternative hypothesis would be that changes in the national and international photovoltaics markets are responsible for virtually all of the observed market effects. The evidence suggests that the main hypothesis—that LIPA’s program is responsible for positive changes in the market—is partially valid, and that the alternative hypothesis—that changes in the national and international photovoltaics markets are responsible for market changes on Long Island—is also partially valid. However, the two hypotheses are

³ Barrier Status was rated by nexus Market Research based upon the results of the Market Progress & Evaluation Report as follows: 1 = A Very Strong Barrier, 2 = A Strong Barrier, 3 = A Moderate Barrier, 4 = A Weak Barrier, and 5 = Not a Barrier.

in fact related. The Long Island market and LIPA's role in it is a microcosm of the world market: wherever a PV market is thriving (except in places where there is no electric grid in place), it is dependent on subsidies from ratepayers and/or governments. This is the case in the large PV markets in Germany, Japan, and California, and the promising markets in the Northeastern U.S., including Long Island.

The PV market on Long Island was virtually non-existent when LIPA's program began, the number of installations was very low when the incentive was \$3/Watt, and the number of installations has increased dramatically with increased rebates and other program activities. These results show that LIPA's ongoing involvement is essential for market development. Similarly, given prices for PV-generated power that are several times higher per kilowatt-hour than the prices of competing fossil fuel- and nuclear-generated power, government and utility involvement is essential for PV market development on a worldwide basis. This is a supply- and subsidy-driven market worldwide. The belief among solar power proponents is that subsidies will increase demand and gradually drive down prices. This has so far proven largely correct, although whether and when PV will become price-competitive with other sources of power has yet to be established; subsidies are still necessary and will likely remain so for several years.

In this context, the attribution of market changes to LIPA's program depends on whether a change has taken place outside or inside of Long Island. The worldwide drop in PV component prices is attributable to worldwide demand; the growth in demand on Long Island is not large enough to account for it—even though the LIPA program is part of a worldwide movement of individual programs that together are sufficient in scope to improve economies of scale and drive down prices. Likewise, the increased equipment reliability that has led to the near universality of equipment warranties is attributable to increased R&D and production experience on a worldwide scale. However, the increase in the number of installers on Long Island, the improved experience and professionalism of these installers, the education of seminar attendees, and the emergence of a Long Island customer base are clearly directly attributable to LIPA's incentives, marketing efforts, and contractor training programs. Without the Solar Pioneer Program, the Long Island PV market would likely go back to where it was before the baseline study, until other subsidized programs drive down worldwide prices to more competitive levels. Meanwhile, with the Solar Pioneer Program, LIPA is part of that worldwide process.

Process Related Issues

The Market Progress & Evaluation Study did not provide a complete process evaluation, but it addressed specific process issues to the extent that data were available. Process-related issues were summarized in the MP&ES as follows:

- ♦ Customer satisfaction from LIPA's perspective was high; customer loyalty was strong.
- ♦ Manufacturers and contractors were generally satisfied with the program.
- ♦ Participants were highly satisfied with the application, participation, and post-installation inspection process. Contractors were generally satisfied with the post-installation inspection process.
- ♦ The rebate and net metering processes scored highly with participants, although some participants were not satisfied with the timeliness of the rebates. Several manufacturers and contractors claimed the time until receiving the rebate was too long. Many contractors complained about paperwork administration issues.
- ♦ Although participants were satisfied with LIPA's promotional efforts, manufacturers and contractors believe that LIPA needs to do more to raise awareness in a meaningful way into the future. Contractors believe the Solar Pioneer Seminars are an effective direct marketing tool, but felt the web site was not promoted sufficiently.

- ◆ Participants were mostly satisfied with LIPA staff communications. Both manufacturers and contractors claimed that LIPA staff should communicate with them more on program activities and administrative issues.

Moving forward, LIPA Staff identified several lessons learned since the beginning of the program, echoed by various market actors:

- ◆ Lotteries would be more effective if consumers were required to invest even a nominal amount in the PV system. Lotteries are very expensive.
- ◆ Rebate levels need to be fine-tuned. \$3.00 per Watt was not significant enough to develop the market; \$6 is perhaps too high, encouraging some installers to enter the market without a long-term commitment to developing a PV business.
- ◆ Local permitting was a larger and more persistent barrier than envisioned. Permitting added significant costs to installations and created inefficiencies.
- ◆ The schedule for changes in rebate levels needed to be better communicated to contractors and manufacturers.

Finally, manufacturers expressed strong interest in expanding the commercial participant base in the future.

Recommendations

Based on the research findings of the Market Progress & Evaluation Study, the following recommendations, made by the evaluation contractor, suggest ways to improve the program:

- ◆ The rebate schedule should be clarified, because the uncertainty inhibits market actor commitment. One alternative would be to maintain an up-to-the-minute count of how much incentive money is left at a particular incentive level.
- ◆ Manufacturers need upstream communication to develop distribution channels and facilitate coordinated and targeted efforts to raise public awareness.
- ◆ The original program theory should be updated based upon the research studies performed and the program experience to date.
- ◆ Because many people appear willing to consider adding PV when they are building or renovating a home, and because including the cost of a PV system in a mortgage makes it more financially attractive, LIPA should more aggressively market PV to the custom home buyer market. Consider a specific new home incentive with LIPA's PV program.
- ◆ People express a greater willingness to pay for a PV system if they can do so through a mortgage refinancing or home equity line of credit—more so in 2002 than in 2000, perhaps because people do not have as much cash as before. Promote the inclusion of PV systems in mortgage costs—for the purchase of an existing home, home renovation, or refinancing, as well as for new construction.
- ◆ Find ways to target potential customers. Compared to other consumers, PV buyers tend to be strong environmentalists, to have high incomes and a lot of education, to be between the ages of 35 and 54, and to live in larger homes. To find people fitting this profile, one option is to set up information tables outside upscale natural food stores such as Whole Foods or Wild By Nature. League of Conservation Voters (LCV) members tend to be an older population and are not likely to invest in a 25-year technology, so LCV members do not represent a strong basis for customer recruitment.
- ◆ Expand outreach to commercial participants. Commercial customers purchase larger systems—priming the pump of distribution channels for LIPA's program—and provide a conduit for free advertising of the program and raising public awareness of PV technologies.
- ◆ Offer commercial net metering if proposed New York State legislation passes. Commercial net metering would improve the payback calculus to potential program participants. LIPA's Electric

Planning Manager would need to know what load is feeding into the grid and when, especially since the PV systems would be larger than residential systems.

- ◆ Make the Solar Pioneer web site easier to access from LIPA's home page and update it more frequently. The web site's resources are comprehensive and used often by potential target markets. Consider defining a "Solar Pioneer" URL as a way to help publicize the program and facilitate easy access to it.
- ◆ Expand direct marketing activities, like the Solar Pioneer Seminars, to other locations on Long Island, and increase the frequency of direct marketing activities. Clearly, the Solar Pioneer Seminars are successfully educating customers, opening the door to participation, and reducing marketing costs for contractors.
- ◆ Begin to build the infrastructure for LIPA Electric Planning and Distributed Resource business units, including mapping of PV customers and forecasting growth in PV installations.

Conclusions

Discussion of Program Refinements

There are several areas where the research results summarized above are being directly used to inform discussions on possible modifications to program strategies.

In response to the research showing that unaided consumer awareness of PV technology among the general population on Long Island remains at a low level, several broad-based marketing and education initiatives are either underway or under consideration for implementation in 2005 or beyond. These include:

- ◆ Sponsoring a Solar Sprint Competition in Long Island schools,
- ◆ Sponsoring a "Solar on Schools" element in the program,
- ◆ Sponsoring a local team (NYIT) at the national Solar Decathlon in Washington, DC, and
- ◆ Producing a consumer education video highlighting Long Island-specific content and information.

These efforts are expected to educate the general population about PV, setting the stage for the future transformation of the PV market on Long Island.

LIPA has been working to overcome several market barriers through information and education on its web site.

- ◆ Several market actor groups had mentioned that the Solar Pioneer section of LIPA's web site was difficult to navigate, and so in 2003 the web site was revised to make it more user friendly.
- ◆ When LIPA decided to revise the incentive plan for the program to pay at a certain \$/W for each MW, and then reduce the incentive level for the next MW, it became clear that customers and contractors needed to know which incentive level the customer would be receiving. So the program team developed a graph, posted on LIPA's web site, that tracks the 1 MW allotment versus the total kW in pre-approved applications at that incentive level. The information is updated at least weekly, and more often in the summer and when the allotment is close to being filled.
- ◆ In 2003, LIPA compiled and posted information on permitting issues applicable to each town and village on Long Island. The customer enters their zip code, and a checklist of permitting requirements for their home is produced.
- ◆ A plan to publish total installed costs of the PV systems rebated through the program is under development. This will provide customers with valuable information on system costs and improve their ability to shop for competitive pricing. Similar information is now being posted in California and New Jersey, with positive initial results.

As experience, research, and common sense have all shown, the cost of PV systems continues to be a high barrier, even though costs have been decreasing over the past several years as the global PV market grows. At the end of 2004, LIPA began implementing a residential new construction program called Energy Star New Homes, modeled after a program run by the New York State Energy Research & Development Authority (NYSERDA). In 2005 LIPA is developing the strategies needed to target PV to the new construction market through this program. In new construction, the installed costs can be lower than on an existing home and the financing easier to obtain. In addition, LIPA's research has shown that customers who are building a new home or renovating an existing one are more likely to consider installing a PV system

Final Thoughts on Theory-based Evaluation

The theory-based evaluation process described in this paper has allowed LIPA's program team to assess the progress of the development of a sustainable PV market on Long Island. Many energy efficiency programs rely on the number of rebates paid as the most important metric for measuring success, but for market transformation oriented programs, and particularly for those programs seeking to influence relatively new markets, it is essential to research many additional factors. Therefore, this research project has gauged the success of the Solar Pioneer Program on a number of fronts, across all relevant market actors, from residential and commercial participants, to the general population, to PV contractors and manufacturers.

Although the increase in the number of PV installations on Long Island has been dramatic - from zero or almost zero before the program began to over 150 per year for the past three years - the numbers are still small relative to the market potential, and are still lagging behind original predictions. The research performed in this study measured both successes that would have been overlooked if the focus was solely on the number of installations completed, as well as issues that still require further work. The application of theory-based evaluation to LIPA's Solar Pioneer Program has proven to be useful to the program team, and will continue to be used as the program moves forward.

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