NEW YORK STATE
Renewable Portfolio Standard

Customer-Sited Tier Program

Market Potential, Program Expectations and Funding Considerations

(2010-2015)

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SECTION 1: INTRODUCTION

PURPOSE

The New York State Energy Research and Development Authority ("NYSERDA") submits this Customer-Sited Tier Program Market Potential, Program Expectations and Funding Considerations (2010-2015) ("CST Assessment") in response to the Public Service Commission's (Commission) Notice under the State Administrative Procedure Act (SAPA 03-E-0188S20) regarding the Renewable Portfolio Standard ("RPS") program. Based on experience in administering Customer Sited Tier programs pursuant to the existing Customer Site Tier Operating Plan (2007 CST Operating Plan) dated February 12, 2007, NYSERDA proposes that the Commission consider the technology-specific market potential and associated costs contained herein as a reasonable basis for establishing RPS program targets and funding budgets for the years 2010 through 2015.

This CST Assessment presents, for the Commission's consideration, a rational basis for funding and realizing significant environmental and energy benefits from Customer-Sited Tier programs that could be implemented under the New York Renewable Portfolio Standard through 2015. The achievable potential described herein accounts for expected program outcomes through 2009 under the 2007 CST Operating Plan, reflects program area experience with the technical evolution and market deployment of the affected technologies, including market reaction to program incentives, and the reactions of contractors retained by NYSERDA to evaluate overall program performance pursuant to the Commission's April 15, 2004 Order. The CST Assessment does not define specific program delivery strategies or incentive payment mechanisms as, NYSERDA believes, these specifics should be addressed in a new Customer-Sited Tier Operating Plan and associated program solicitations, to be developed by NYSERDA, in collaboration with Department of Public Service Staff, based on the Commission's decisions on program goals and funding.

BACKGROUND

The Commission's September 2004 Order established the goal of the CST program to achieve two percent of the total RPS incremental megawatt-hour (MWh) target.[1] Based on the September 2004 Order and information provided by Staff, the cumulative CST target was set initially at 201,130 MWh through 2013. In its June 28, 2006 Order[2], the Commission established new capacity and energy targets for the CST through 2009, authorized incentive funding of $45 million, and directed the development of a Customer-Sited Tier Operating Plan ("2007 CST Operating Plan") for solicitation of customer-sited renewable resources.[3] The resulting 2007 CST Operating Plan set forth the specific CST programs to be implemented under the RPS Program through 2009, the expected funding levels for each technology, the

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[1] Case 03-E-0188, Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard, "Order Regarding Retail Renewable Portfolio Standard," issued and effective September 24, 2004.

[2] Case 03-E-0188, "Order on Customer-Sited Tier Implementation," issued and effective June 28, 2006.

[3] The Customer Sited Tier Operating Plan was released in February 2007 and can be found at http://www.dps.state.ny.us/CST_OP_02-12-07.pdf.

payment methods and timing of the various procurement methods, and other pertinent program design and operational details. The technologies included in the 2007 CST Operating Plan were photovoltaic systems, fuel cells, anaerobic digester gas-to-electric facilities and customer-sited small wind facilities. Table 1-1 below depicts the funding allocations authorized and established by the Commission. Based upon those allocations, the initial estimate of the cumulative MWh expected to be under contract (funding encumbered) through 2009 was approximately 50,733 MWh, (subsequently revised to 52,878 MWh). The energy production target of 52,878 MWh through 2009 represented a reasonable approximation of what program resources could achieve given the $45 million of authorized funding. The Commission further ordered that program funding would be reexamined as part of the 2009 program review, and that adjustments would be made as necessary to attain program objectives.

Table 1-1. Original Customer-Sited Tier Funding Allocations by Resource Category, 2007-2009

Resource Category	Percentage of Funds	Funding Amounts (in millions)			Total
		2007	2008	2009	
Solar Photovoltaics	30.7%	0	6.90	6.90	13.80
Fuel Cells	24.9%	3.73	3.73	3.73	11.20
Anaerobic Digestion Systems	24.4%	3.67	3.67	3.67	11.00
Small Wind	10.0%	1.50	1.50	1.50	4.50
Discretionary	10.0%	1.50	1.50	1.50	4.50
Total	100.0%	10.40	17.30	17.30	45.0

Finally, as is shown in Table 1-1, and pursuant to the Commission's June 2006 Order, 10% of the overall authorized funding for the CST program was designated as discretionary. Discretionary Funds may be used at NYSERDA's discretion at any time to supplement allocated funding for: (1) resource categories for which demand clearly exceeds their allocations; (2) eligible technologies that, in NYSERDA's judgment, would benefit from an increased allocation; and (3) for new technologies that the Commission determines to be eligible for CST support. At the end of each calendar year, funds not committed to projects within a particular CST technology category are designated "discretionary." At the beginning of each calendar year, each technology resource category starts with a new annual allocation and with access to the discretionary pool as directed by NYSERDA throughout the funding year.

CST PROGRAM PROGRESS

All four Customer-Sited Tier resource categories have active and open solicitations, offering funding support through an open enrollment, first-come, first-served process for photovoltaic (PV), fuel cell, anaerobic gas-to-electric digester technologies (ADG), and small wind installations. Within months of rolling out new CST programs, it became apparent that authorized funding for the PV and anaerobic digester programs, even after the re-allocation of discretionary program funding, would be insufficient. NYSERDA requested that program funding allocated to the Main Tier component of the RPS program,

but unused, be re-allocated to the CST to keep pace with market demand in the PV and anaerobic digester program areas.

In an Order dated October 28, 2008, the Commission approved the re-allocation of $47 million to the CST program.[4] Of this amount, the anaerobic digester program was to receive $7.6 million and the PV program $20.6 million, leaving $15.1 million for discretionary use and $3.7 million for program monitoring and evaluation.

Contemporaneously, in late 2008 federal tax incentives for PV installations became more robust. In response to the October 2008 Order, and based on an analysis of these new market developments, NYSERDA announced that program incentives, offered through its current PV program, would drop by 25%, effective January 31, 2009. This program re-direction had the effect of encouraging a flurry of market activity that exhausted total funding under the program (inclusive of the October 2008 funding authorization by the Commission and accounting for a NYSERDA re-allocation of discretionary funding pursuant to the current Operating Plan).

Table 1-2 below describes the status of CST programs as of March 31, 2009, and depicts current program funding commitments and planned expenditures. The authorizations in Table 1-2 reflect a re-allocation of discretionary funding that includes a shift in funding from the small wind program and fuel cell program areas, where market demand has lagged expectations, to the PV program area where demand has been very strong. Tables 1-3 and 1-4 below present a forecast of installed capacity and production of energy from completed and planned facilities on the basis of current funding authorizations as described in Table 1-2.

Table 1-2: Funding Status of CST Operating Plan effective March 31, 2009

	Budgeted	Encumbered	Applications in Process	Funding Balance Available for Future Contract Applications
Photovoltaics	$ 60,333,734	$ 28,199,719	$ 30,427,058	$ 1,706,957
Fuel Cells	$ 5,794,420	$ 32,210	$ 2,032,210	$ 3,730,000
Anaerobic Digesters	$ 20,100,000	$ 8,871,464	$ 7,177,542	$ 4,050,994
Small Wind	$ 2,071,846	$ 473,278	$ 110,426	$ 1,488,142
Discretionary Funds	$ 0	$ 0	$ 0	$ 0
Monitoring & Verification	$ 3,700,000	$ 1,409,400	$ 127,400	$ 2,163,200
Total:	$ 92,000,000	$ 38,986,071	$ 39,874,636	$ 13,139,293

[4] Case 03-E-0188, "Order Concerning Modification of Funding for the Customer-Sited Tier," issued and effective October 28, 2008.

Table 1-3. Actual and Expected Installed Capacity (MW) effective March 31, 2009

CST Program	Original Operating Plan: Target Encumbered Capacity by 12/31/09	Actual Installed Capacity	Pending and Planned Capacity (w/remaining funds)	Total Pending, Installed, and Planned Capacity
Solar Photovoltaics	3.5	2.9	12.6	15.5
Fuel Cells	2.7	-	1.4	1.4
Anaerobic Digesters	3.7	0.1	8.7	8.8
Small Wind	1.8	0.034	0.7	0.7
Program Total	11.7	3.0	23.4	26.4

Table 1-4. Actual and Expected Energy Production (MWh) effective March 31, 2009

CST Program	Original Operating Plan: Target Annual Generation Encumbered by 12/31/09	Actual Energy Production from Installed Capacity	Expected Production from Pending and Planned Contracts	Total Expected Production Progress
Solar Photovoltaics	4,533	3,755	16,315	20,070
Fuel Cells	18,700	-	6,496	6,496
Anaerobic Digesters	25,700	701	60,682	61,383
Small Wind	3,945	34	799	833
Program Total	52,878	4,490	84,292	88,782

PROGRAM CONTINUITY

In its June 2009 Order, based on continued robust demand, the Commission allocated an additional $15 million in funding to the PV program.[5] This increased funding will increase total installed customer-sited tier capacity to 32 MW, an increase of about of 5.6 MW over that shown in Table 1-3, and will increase total expected energy production for the customer-sited tier to about 96,200 MWh, an increase of about 7,400 MWh over than shown in Table 1-4.

This CST Assessment is predicated on continued program deployment under the 2007 CST Operating Plan until either authorized funding has been entirely encumbered or the Commission renders a decision on overall RPS program goals, duration and funding. Ideally, authorized funding allocated to the various technologies under the 2007 CST Operating Plan will be sufficient to continue programs until such decision is made. In the case of the PV program, current Commission authorization of funding is expected to be sufficient through December of 2009.

[5] Case 03-E-0188, "Order Concerning Further Modification of Funding for the Customer-Sited Tier," issued and effective June 22, 2009.

SECTION 2: ACHIEVABLE MARKET POTENTIAL AND ASSOCIATED FUNDING

The Commission, in authorizing CST Programs, made note of the importance of accelerating development of emerging technologies, such as photovoltaic systems, fuel cells, customer-sited wind facilities, and similar technologies, because of their environmental benefits and their ability to be sited in urban, heavy-load areas. Consequently, the Commission set aside 2% of the total RPS Program incremental energy requirements for the Customer-Sited Tier Program. The Commission explained that a key step in the design of CST Programs should be the application of a framework to allocate funds to program participants, and it anticipated that NYSERDA would take into account the technical and market risks resulting from implementation of each technology-specific program as program implementation evolved.[6]

NYSERDA has accumulated extensive experience with each of the affected CST technologies being supported through the CST program, including experience with product research and development, business development, manufacturing, and other market transformation activities, and has amassed a significant amount of information from routine interaction with market actors and customers. The achievable, technology-specific market potential and funding assessment contained herein reflects this experience, and includes a systematic consideration of factors essential to technical maturation and market acceptance of the affected technologies, such as, but not limited to, the following:

- available market potential by technology/location in New York;
- design of and experience with similar programs deployed nationally;
- current and expected technology performance/technical capabilities and limitations;
- commercial limitations;
- environmental benefits, reduction in harmful emissions;
- peak reduction (e.g., peak relief in load pockets);
- added fuel diversity;
- economic cost-to-benefits trade-offs to the end-user(e.g., workforce development, cost effectiveness);
- stakeholder perspectives; and
- the applicability/availability of non-NYSERDA program incentives.

As an example, the goals and funding for the Anaerobic Digester Gas (ADG)-to-Electricity and the Solar Photovoltaic (PV) Programs, in addition to considering other influences described above, incorporate an analysis of the correlation between the program incentive and economic breakeven or "time-to-payback" cycle likely required by the host-site to drive its investment decision. Unlike the PV Program, where there

[6] Case 03-E-0188, "Order Approving Implementation Plan, Adopting Clarifications, and Modifying Environmental Disclosure Program," issued and effective April 14, 2005.

are multiple vendors and installers of PV equipment, nearly unlimited host sites and multiple technology types available to the market, the Fuel Cell Program must account for more limited vendors and equipment availability and applicability in establishing program implementation parameters. On the basis of this experience, NYSERDA believes the preferred approach to allocating a portion of the overall RPS program goal, and associated funding, to the CST program is to base such allocation in part on a "bottoms up" assessment of the aggregate achievable market potential and associated costs for each CST technology, employing the criteria identified above rather than by fixing the allocation at 2% of the overall RPS goal as was initially established by the Commission.

ACHIEVABLE MARKET POTENTIAL AND FUNDING BUDGET

Based on experience with program implementation, market potential and other influential market factors, as described in more detail in Section 3 herein, NYSERDA presents in Table 2-1a below, for Commission consideration, a projection of achievable market potential, by technology, measured in terms of installed capacity and energy production for the period 2010 through 2015. The RPS funding projected to be necessary to achieve this potential is presented in Table 2-1b below.

Table 2-1a. Customer-Sited Tier Expected Results by Technology/Program 2010-2015

Resource Category	Capacity in MW Encumbered by 12/31/15	Annual Generation in MWh Encumbered by 12/31/15
Solar Photovoltaics	253.3	288,484
Fuel Cells	14.7	114,180
Anaerobic Digester Biogas	24.2	170,607
Small Wind	16.2	28,308
Program Total	308.4	601,579

Note: Funding does not include Administration, Statutory Fees, or program monitoring, verification, or evaluation costs.

Table 2-1b. Customer-Sited Tier Funding Assessment by Technology/Program 2010-2015

Resource Category	Percentage of Funds	Funding Amounts (in millions)						Total
		2010	2011	2012	2013	2014	2015	
Solar Photovoltaics	70 %	48.1	54.7	61.5	68.4	74.7	80.1	387.5
Fuel Cells	7 %	6.1	6.1	6.1	6.1	6.1	6.1	36.6
Anaerobic Digestion Systems	13 %	13.7	13.3	11.6	12.0	10.1	10.3	71.0
Small Wind	3 %	1.9	2.8	2.9	3.1	3.8	4.0	18.5
Discretionary	5 %	4.3	4.3	4.3	4.3	4.3	4.3	25.8
Monitoring & Verification	2 %	2.3	2.3	2.3	2.3	2.2	2.2	13.6
Total	100 %	76.4	83.5	88.6	96.1	101.2	107.0	552.9

Funding for technology-specific monitoring and verification (M&V)[7] of technology performance presented above should be considered an initial allocation only. In practice, NYSERDA will establish an M&V budget as a set percentage of technology-specific program funding to allow the allocation of M&V funds to change appropriately in relation to discretionary shifts by NYSERDA in funding between programs as described herein.

On the basis of the recommended funding budget of Table 2-1b, the expectation for installed capacity and energy production associated with projects under contract by the end of 2015 is approximately 308 MW and 601,579 MWh, as outlined in Table 2-1a. This represents an increase of about 505,000 MWh over the annual energy production expected to result from the 2007 CST Operating Plan as described in Table 1-4. Achievement of these targets will be measured on the basis of energy production associated with funding encumbered/contracted as of the end of program year 2015.

[7] Technology-specific monitoring and verification activities are associated with measuring on-site operating performance of installed devices necessary to support payment of performance-based incentives and should not be confused with evaluation and assessment activities associated with overall RPS program evaluation.

Table 2-2. Estimated Program Cost per MWh

Resource Category	Estimated $/MWh Cost (Over Life of Project)
Solar Photovoltaics	$67
Fuel Cells	$32
Anaerobic Digestion Systems	$28
Customer-Sited Wind	$33
Weighted Average Cost	$58

Discretionary Funding

NYSERDA believes the current practice of designating funds that have not been contractually committed to program installations as of the end of a program year as discretionary, and available for re-allocation to other program efforts, has proved successful and should continue. Discretionary funds may be used at NYSERDA's discretion at any time to supplement allocated funding for: (1) resource categories for which demand clearly exceeds their allocations; (2) eligible technologies that, in NYSERDA's judgment, would benefit from an increased allocation; and (3) for new technologies that the Commission determines to be eligible for CST support.

At the beginning of each calendar year, each technology resource category will start with a new annual allocation and with access to the discretionary pool as directed by NYSERDA throughout the funding year. The first review of funding not committed to projects in each resource category will be derived from 2009 spending, and the first possible transfer of funds to the discretionary pool will take place on or after January 2010, if such funds exist.

Program Design and Types of Incentives

Changes in program delivery strategies will be considered to account for new market conditions and technology maturation, as appropriate.

SECTION 3: TECHNOLOGY-SPECIFIC MARKET AND FUNDING ASSESSMENT

SOLAR PHOTOVOLTAIC (PV) SYSTEMS

Public Benefits

Photovoltaic generation continues to show great promise in satisfying various long-term policy objectives as articulated by the Commission during the design of the Customer-Sited Tier Program.[8] In particular, some of the benefits of PV installations include:

- Location in specific load pockets: The majority of the capacity installed, and applied for, in the PV program is in the New York City region;
- Peak kW demand reductions: The ability of solar energy to assist in reducing peak power demand is greatest in areas where peak load is driven by air conditioning demand;
- Economic development: The integrated solar program in New York State is starting to attract the attention of manufacturing companies. Also, the over 90 PV installation companies in the program are, for the most part, small businesses that hire crews to design and install systems. The incentive program is a critical tool in their ability to bring the cost down to a reachable level for the customer;
- Participation by the residential and small business sectors: In the combined SBC and RPS PV program, there have been over 2000 applications received from residential customers. Over 400 non-residential customers are participating in the program with demand almost doubling from one year to the next.

Current Status and Program Experience

National Market Development

Over the past 5 years the global growth rate in grid-tied PV has been over 40% per year.[9] The market for PV in the U.S. is driven by national, state and local incentive programs (various forms of rebates, performance payments and tax credits) that are designed to bring the financial cost of the PV installation close to the level of financial benefits the system will deliver. These programs are necessary to overcome the principal market barrier of initial high capital cost.[10] As shown in Table 3-1, California and New Jersey dominate PV markets in the United States.[11] In New Jersey, for example, as of November 30,

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[8] Id.; Order Approving Implementation Plan, Adopting Clarifications, and Modifying Environmental Disclosure Program; issued and effective: April 14, 2005

[9] Margolis, Robert, Solar energy: market Trends and Dynamics, NARUC 2009 Winter Committee Meeting, Energy Resources & Environment , Washington D.C., February 16, 2009.

[10] Hoff, T.E., Photovoltaic Incentive Design Handbook, NREL/SR-640-40845, December 2006

[11] Wiser, Ryan, Galen Barbose, Carla Peterman, Tracking the Sun: The Installed Cost of Photovoltaics in the U.S. from 1998-2007, Lawrence Berkeley National Laboratory, February 2009.

2008, there were over 63MW of PV installed in approximately 3500 projects through the RPS and public benefits programs. Of this amount, 58.6 MW received over $243 million in rebates (an average of $4.15/Watt) and 4.5 MW are part of the Solar Renewable Energy Credit-only program.[12]

Table 3-1 Summary of PV Incentive Program Data through 2007

State	PV Incentive Program	No. of Systems	Total MW	% of Total MW	Size Range (kW)	Year Range
AZ	Solar Partners Incentive Program	540	3.1	0.9%	0.4 – 255	2002 – 07
CA	Various Programs	30,963	300.5	83%	0.1 – 1,265	1998 - 07
CT	Solar PV & On-Site Renewables	311	2.7	0.7%	1.0 – 434	2003 - 07
IL	Renewable Energy Grants & Rebates Programs	166	1.3	0.4%	0.8 - 110	1999 - 07
MA	Small Renewables Initiative	702	4.7	1.3%	0.2 – 432	2002 - 07
MD	Solar Energy Grant Program	78	0.2	0.1%	0.9 – 45	2005 - 07
MN	Solar Electric Rebate program	105	0.4	0.1%	0.9 - 40	2002 - 07
NJ	Customer Onsite Renewable Energy	2,395	42.1	11.6%	0.8 – 702	2003 - 07
NY	PV Incentive Program (NYSERDA)	755	4.4	1.2%	0.7 – 51	2003 - 07
OR	Solar Electric Program	600	2.3	0.6%	0.8 – 67	2003 - 07
PA	Solar PV Grant	137	0.5	0.1%	1.2 – 1.0	2002 - 07
WI	Cash Back Rewards Program	240	0.9	0.2%	0.2 – 19	2002 - 07
	Total	**36,992**	**363.1**	**100%**	**0.1 – 1,265**	**1998 - 07**

The PV market in the US is not homogenous. There is a variation in the installed cost based, in part, on the size and maturity of the market. Table 3-2 outlines the average installed cost for installations in different states and the impact of system size on cost.[13] System cost tends to decrease with size.

[12] Fox, Jeanne M., New Jersey's Solar Transition, Solar Innovation and Investment Conference, December 3, 2008, New York, New York.

[13] Wiser, Ryan, Galen Barbose, Carla Peterman, Tracking the Sun: The Installed Cost of Photovoltaics in the U.S. from 1998-2007, Lawrence Berkeley National Laboratory, February 2009.

Table 3-2. Average Installed PV System Cost (2006– 2007)

State	Total Sample Capacity-Weighted Average Cost	Simple Average Cost ($/watt)			
		0 – 10 kW	10 – 100 kW	100 – 500 kW	>500 kW
AZ	$7.8	$7.6	$8.1	$9.1	n/a
CA	$7.7	$8.1	$7.6	$7.3	$6.7
CT	$8.4	$8.8	$8.1	$7.9	n/a
IL	$12.4	$9.8	$3.3	n/a	n/a
MA	$9.7	$9.1	$10.1	$8.8	n/a
MD	$9.8	$10.6	$8.5	n/a	n/a
MN	$8.4	$8.8	$8.7	n/a	n/a
NJ	$7.7	$8.4	$8.4	$7.6	$6.7
NY	$8.8	$8.8	$8.9	n/a	n/a
OR	$8.0	$8.4	$8.4	n/a	n/a
PA	$9.0	$8.7	$8.4	n/a	n/a
WI	$8.4	$8.7	$7.9	n/a	n/a

During the next three to seven years, solar energy's unsubsidized cost to customers in California and the Southwest should equal the cost of conventional electricity (e.g., grid parity). In addition to relatively strong solar radiation, these markets have high electricity prices and supportive regulatory regimes that stimulate the solar-capacity growth needed to drive further cost reductions.[14]

New York State Market Development

The solar/photovoltaic incentive program is the cornerstone of an integrated program to build a sustainable solar industry in New York. Other components of the program, supported through statutory and SBC funding, include the establishment of accredited training programs for PV system design and installation at institutions across the state, the implementation of a national certification program for installers, the development of a series of outreach tools and materials to educate consumers on PV, and a competitive business acceleration program to support the growth of the PV business.

New York State is the national leader in the development and implementation of accredited training programs for PV installers. There are currently six active training programs in the State, with another 23 programs under development. Four of the programs have been accredited and the rest are in the process of completing the necessary requirements. In addition, NYSERDA continues to support the North American Board of Certified Energy Practitioners in their program to provide certification to PV installers.

One of the attributes of PV generation is its high effective load carrying capacity (ELCC) when loads are driven by air conditioning demand. For most utilities servicing metropolitan areas in the northeast, the ELCC of stationary PV installations is of the order of 65% (the installation of 100 MW of PV generation

[14] Lorenz Peter, Dickon Pinner, and Thomas Seitz; The Economics of Solar Power; McKinsey & Company; June 2008.

is equivalent to installing 65 MW of peaking resource), and remains higher than 50% for grid penetrations of up to 15%.[15]

The Empire State Development Corporation (ESD) expects to see an increase in the opportunities for solar manufacturing based, in part, on the market support from the RPS.[16] NYSERDA and ESD are currently providing financial support to 3 manufacturing companies that are expected to be operational in 2010. These manufacturing facilities will create a wide variety of new skilled jobs, as well as the range of other economic benefits that come with investment in New York.

NYSERDA has administered a PV incentive program with funding from the Systems Benefits Charge program and the Customer-Sited Tier of the RPS. In order to provide a more realistic snapshot of the PV market in New York State (excluding the Long Island Power Authority franchise area), the results from the program presented in this section cover funding from both of these sources.

NYSERDA established an incentive program in 2003 as part of an integrated program to create a sustainable market for PV. Table 3-3 shows the consistent and significant growth in demand in the program. As the table depicts, the number of applications received in 2008 represented an increase of over 77% from 2007.

Table 3-3. PV Incentive Program Results with SBC and RPS (All Sectors)

Incentive Amount	Total Cost	kW	kWh	Year	Number of Applications	Annual Rate of Growth in Applications
$1,612,209	$3,061,516	377	274,037	2003	78	
$2,794,811	$5,586,633	651	602,664	2004	115	47%
$4,136,131	$8,587,799	1,018	1,096,430	2005	168	46%
$7,105,302	$15,614,629	1,756	1,851,413	2006	282	68%
$13,975,644	$29,915,858	3,457	3,590,763	2007	484	72%
$28,011,563	$61,965,864	7,209	7,829,500	2008	858	77%
$26,133,636	$55,820,479	6,778	7,267,242	2009 (3/31)	457	

Table 3-4 and Table 3-5 break out the residential and non-residential applications. Between 2007 and 2008, the number of residential applications increased over 75% while the number of non-residential applications increased slightly over 89%. Given the level of funding in the program, the upper limit of

[15] Perez, Richard, M. Kmiecik, T. Hoff, J. Williams, et. al. Availability of Dispersed Photovoltaic Resource During the August 14th 2003 Northeast Power Outage, USDOE Contract No. AAD-2-31904-0, paper presented at the ASES2004 Conference in Portland, Oregon, July 11–14, 2004.

[16] Lago, Marisa, Letter to Jaclyn A. Brilling, NYSDPS, Response to SAPA Notices 03-E-0188SA18 and 03-E-0188SA19, November 14, 2008.

installation size represented in non-residential installations is 50 kW.[17] As is shown in Table 3-2 above, 5 state programs provide funding support for systems greater than 100 kW and 2 programs for systems greater than 500 kW.

Table 3-4. PV Information - Residential Only

Incentive Amount	Total Cost	kW	kWh	Year	Number of Applications	Annual Rate of Growth in Applications
$1,205,566	$2,392,633	293	194,834	2003	69	
$1,939,021	$4,199,264	475	430,972	2004	96	39%
$3,421,103	$6,980,668	838	895,919	2005	156	63%
$5,559,334	$11,894,164	1,370	1,447,378	2006	249	60%
$8,823,488	$19,682,739	2,242	2,327,525	2007	420	69%
$15,554,221	$35,823,709	4,087	4,459,298	2008	737	75%
$6,258,898	$13,711,717	1,683	1,863,352	2009 (3/31)	288	

Table 3-5. PV Information - Non-Residential Only

Incentive Amount	Total Cost	kW	kWh	Year	Number of Applications	Annual Rate of Growth in Applications
$406,643	$668,883	84	79,203	2003	9	
$855,790	$1,387,370	176	171,692	2004	19	111%
$715,028	$1,607,131	180	200,511	2005	12	-37%
$1,545,968	$3,720,464	386	404,035	2006	33	175%
$5,152,156	$10,233,120	1,215	1,263,238	2007	64	94%
$12,457,342	$26,142,156	3,122	3,370,202	2008	121	89%
$19,883,138	$42,136,061	5,097	5,407,131	2009 (3/31)	170	

The cost of an installed PV system is comprised of variables such as PV modules, inverters, labor, balance of systems and, for some cases, permitting and inspections. For the NYSERDA program the relative cost of each of these components is presented in Figure 1. The cost of the PV modules is between 50 to 60% of the total system cost. The scale of the New York program is too small to produce any economies-of-scale influence on equipment cost. Due in part to the commitment to workforce development in New York, the labor component of installed cost has decreased by 30%, from $2.30/Watt in 2003 to $1.66 /Watt as of early 2009. On the international market, module prices dropped 2% annually between 2000 and 2008.[18] Based on an increased global supply of modules and the international

[17] Changes were made to the incentive program effective February 2, 2009. Now, incentives are available for residential systems of up to 8 kW; for non-residential, up to 80 kW; and, for not-for-profit, up to 25 kW.

[18] Englander, Daniel, Shyam Mehta, Travis Bradford, 2009 Global PV Demand Analysis and Forecast: The Anatomy of A Shakeout II, Greentech Media and the Prometheus Institute, 2009

economic downturn, it is expected that module prices will decrease at a faster rate in the near term. It is not certain, however, how this will translate to a change in the installed system cost. Figure 2 shows the simple life cycle cost of electricity[19] for projects submitting applications to the NYSERDA PV program.

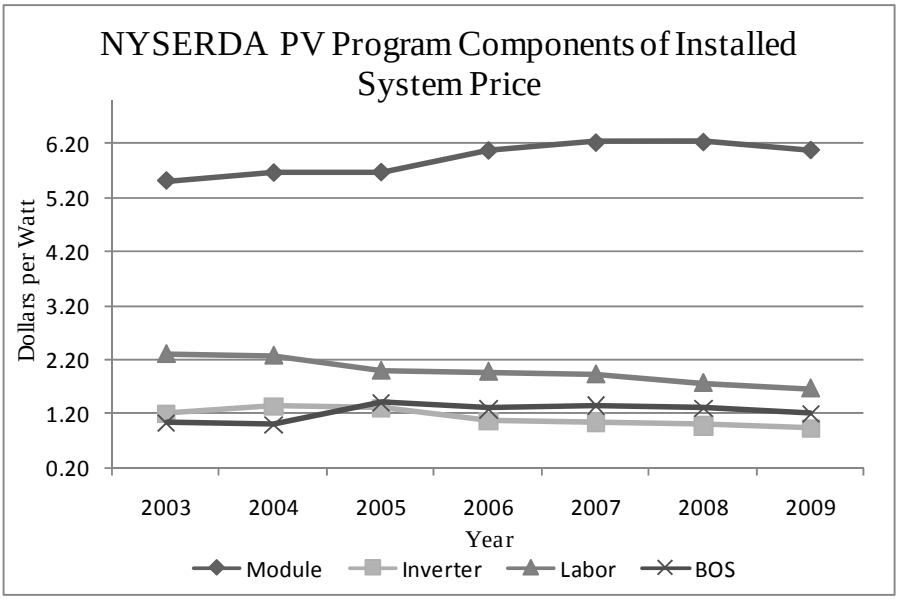

Figure 1.

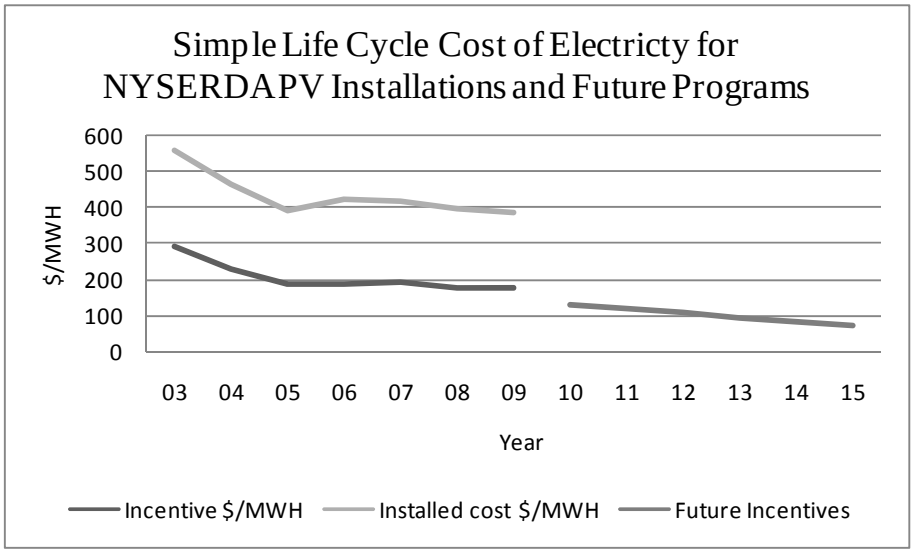

Figure 2.

[19] The values were derived using the sum of the individual system costs in the program and the sum of the expected output from each system. The expected life time of the system is 20 years. No deductions were made for performance degradation over that time period or for replacement of the inverter.

Partnerships

An important goal of the overall PV Initiative is to support the establishment of a sustainable market for photovoltaic systems in New York State. Achieving this goal requires close coordination with market participants along the value chain. The first step in the process has been to develop a qualified group of installation companies capable of designing, installing and maintaining PV systems. NYSERDA has been successful in building the installer base through programs supported with Systems Benefits Charge and RPS funding. There are currently over 90 companies involved with the installation of solar systems through the NYSERDA program.

The current PV program is focused primarily on residential and small commercial installations. Should the program be expanded to include larger scale installations, it will be increasingly important for NYSERDA to work in partnership with New York State's utilities.[20] The following three figures show the distribution of PV program activity across the utilities in New York. The figures reflect both SBC and RPS funding through the incentive program. While institutional impediments in the New York metropolitan area continue to suppress the penetration of PV systems and result in higher installed costs, these issues are slowly being addressed. Future NYSERDA program design will consider additional strategies to increase the penetration of PV and lower the installed cost of systems in high peak demand areas. As shown in Figures 3 through 5, the greatest share of the incentive funds and the expected kW are in the downstate area.

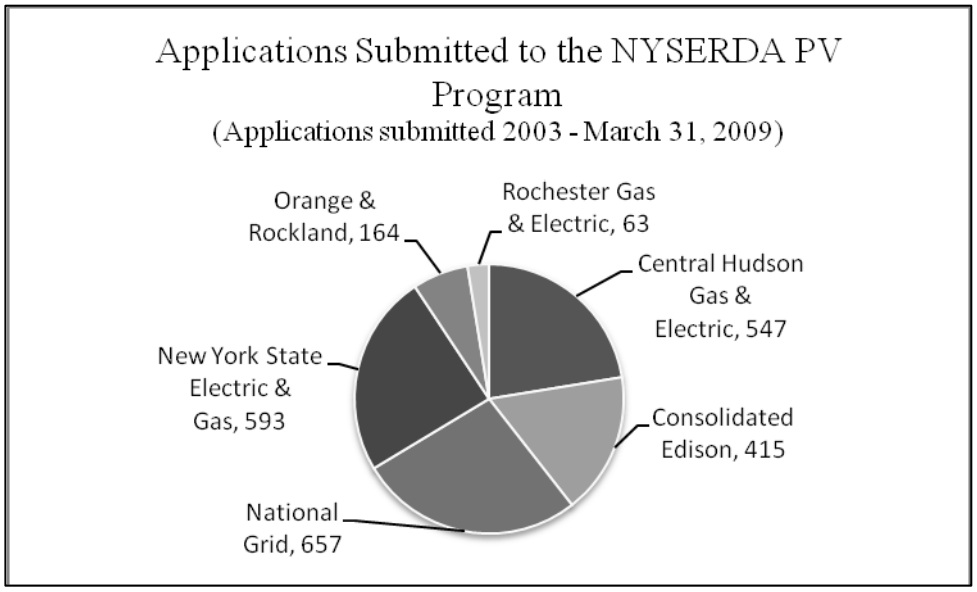

Figure 3.

[20] The utilities have expressed an interest and willingness to play a greater role in implementation of the program. For instance, see the Comments filed by Consolidated Edison Company of New York, Inc., with respect to the RPS Evaluation Report, on May 29, 2009, at p. 6.

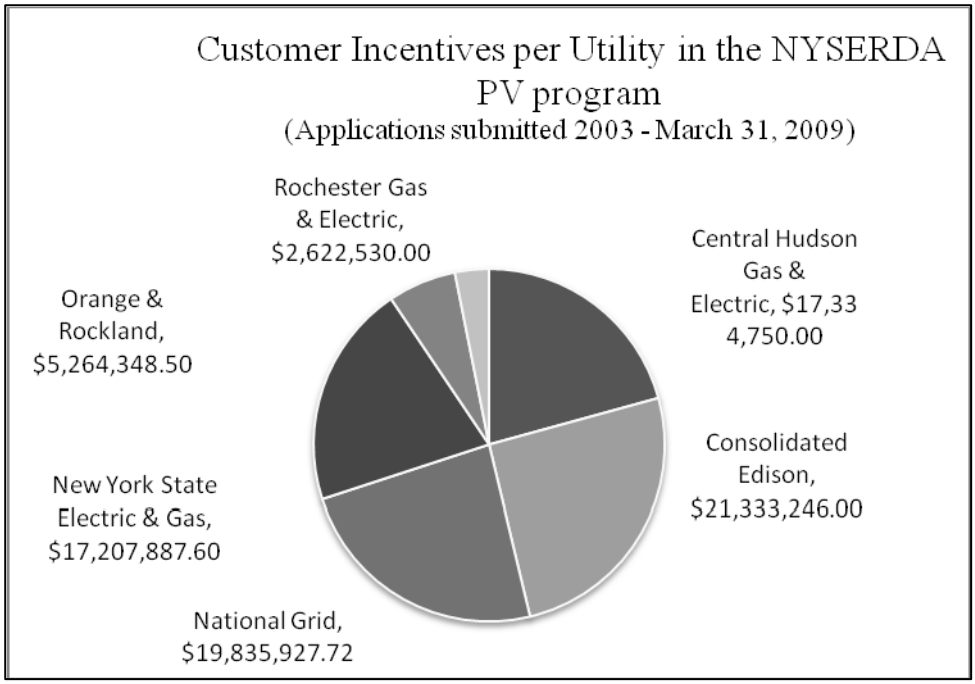

Figure 4.

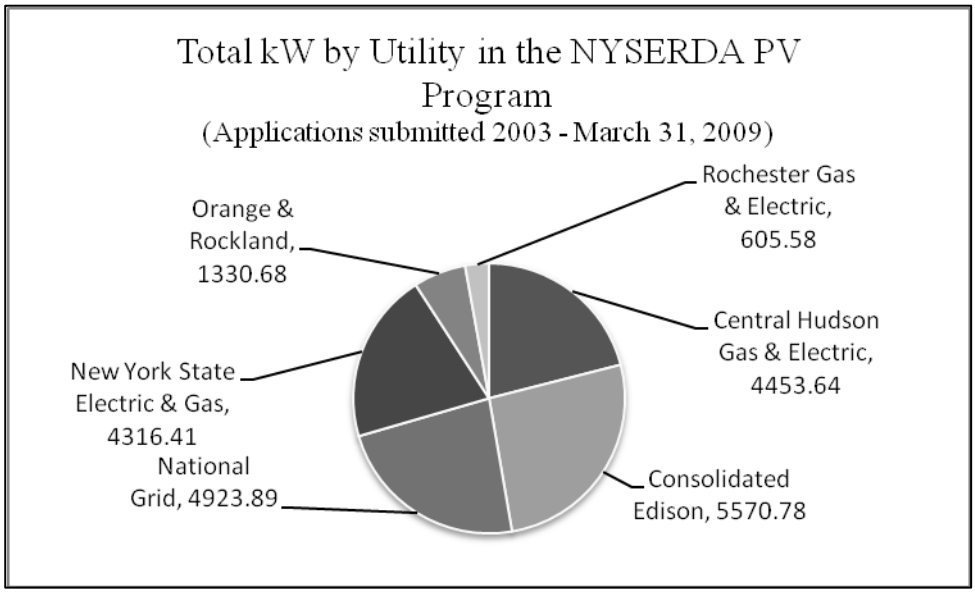

Figure 5.

Achievable Market Potential and Funding Needs 2010-2015

The current program has been successful in building the infrastructure necessary to support a broad residential and small commercial PV market. The vision for the next phase of the program is to continue the application program and add a competitive incentive program targeting larger-scale installations. Other approaches to reaching the market potential may also be added in the future. These may include different types of incentives or other ways of delivering incentives to the market.

The competitive incentive program would target larger individual installations or large blocks of installations. It is expected that the required per watt incentive will be lower than the starting point for the analysis of $3.00/watt. For the purpose of this analysis, the average size of an installation, or block of installations, was assumed to be 500 kW. The current NYSERDA program does not provide incentives for installations larger than 80 KW. This expansion of the program will open new market opportunities and attract the participation of new PV installation companies.

Experience with the current program and the national PV market was used to establish a program budget of expected energy goals and funding. Growth rates for program demand are assumed to level off at 25% per year. As mentioned previously, the global market for PV has grown over 40% per year over the past 5 years. This is a significant decrease in growth rate from previous years but still shows strong program growth under uncertain economic conditions. An assumption is made that PV module prices will start to decrease at a rate of 5% per year. This is more than the 2% annual decrease experienced since 2000 but takes into account the downward pressure on prices from additional manufacturing capacity and slowing global demand.

For the application program, incentive amounts are expected to gradually decrease to maintain a time-to-breakeven of approximately 9 years for residential and 6 years for non-residential customers. The forecast assumes that the incentive will start at the current rate of $3.00/watt and drop to $1.50/watt by 2015. For the purpose of this analysis, the average size for a residential system is 5.3 kW and 25 kW for non-residential (based on program experience and design). Operating data for PV modules in New York indicates that they have a capacity factor, on average, of 12.8%. This average capacity factor has been applied across the program to derive energy production expectations.

In addition, one of the recommendations of the Governor's Renewable Energy Task Force was to develop a program to install 100 MW of PV by 2011. This next phase of the PV program expects to install over 50 MW by the end of 2011, and that the market transformation investment made in New York will result in over 253 MW installed by the end of 2015.

On the basis of program experience as described above, the following projections of achievable market potential, measured in terms of installed capacity and annual energy production, and the associated funding requirements are presented for consideration.

SOLAR PHOTOVOLTAIC PERFORMANCE AND FUNDING EXPECTATIONS

Table 3.6a. Solar Photovoltaic Program Annual Capacity and Energy Expectations

Period	MW	MWH
2010	22.5	25,623
2011	28.1	32,029
2012	35.2	40,036
2013	43.9	50,045
2014	54.9	62,556
2015	68.7	78,195
Total	**253.3**	**288,484**

Table 3-6b. Estimate of Funding Needs for Solar Photovoltaic Program

Period	Application & Competitive Incentive Programs	Monitoring & Verification	Total
2010	$ 48.1 million	$ 1 million	$ 49.1 million
2011	$ 54.7 million	$ 1 million	$ 55.7 million
2012	$ 61.5 million	$ 1 million	$ 62.5 million
2013	$ 68.4 million	$ 1 million	$ 69.4 million
2014	$ 74.7 million	$ 1 million	$ 75.7 million
2015	$ 80.1 million	$ 1 million	$ 81.1 million
Total Incentives	**$387.5 million**	**$6.0 million**	**$393.5 million**

Exit Strategy

As the price of PV systems decline and the supply chain matures, it is expected that, at some point, the installed cost of PV systems will converge with the cost of conventional power supply. Reaching grid parity depends on a variety of factors including module price, labor cost, and the price of the electricity being offset by the PV. The next phase of the PV program anticipates a 50% decline in required incentives over the planning horizon, continuing maturity of participants in the residential and small commercial market, and an increasing presence of larger PV system integrators targeting larger scale

applications. NYSERDA will monitor how other larger solar markets (e.g., California, the Southwest and New Jersey) evolve and consider strategies and other best practices that could accelerate the pace of achieving grid parity in New York. The market structure built as a result of implementing programs described in this assessment will be capable of rapid expansion as grid parity is reached.

FUEL CELL PROGRAM

Public Benefits

The technological challenges to the wide-scale deployment of fuel cells are significant, and market transformation issues remain, but fuel cell technology represents a promising route to cleaner, more efficient energy production. Fuel cells can provide the desired societal benefits articulated by the Commission during the design of the Customer-Sited Tier Program;[21] they can be installed rapidly at locations within load pockets; sized to appeal to both residential and small business consumers; typically run base-loaded and reduce demand at all times including during system peak periods; provide process heat to the host site, deliver uninterrupted electrical service to critical loads, drive economic development in New York (new jobs, job retention, siting of new companies and manufacturing facilities, increased manufacturing output from existing facilities) and are recognized for their environmental benefits and reduction of harmful emissions.

Current Status and Program Experience

In order to provide support to all phases of the commercialization of fuel cell technologies, NYSERDA administers three fuel cell programs using statutory, SBC, and CST program funding. The statutory and SBC-funded programs seek to help New York fuel cell manufacturers invent new and improved fuel cells, components thereof, and manufacturing techniques. For several years prior to the RPS CST program, NYSERDA provided financial support for fuel cell technologies to improve the efficiency, durability, and manufacturability of fuel cell components and systems. NYSERDA has also employed programs to support the long-term demonstration of the operational reliability and effectiveness of fuel cells at end-use sites in commercially promising applications; these sites consist of predominantly large institutional customers. In addition, federal funds have been available to support the demonstration of fuel cells at end-use sites. NYSERDA is also providing funding to develop training materials at community colleges and universities in New York to build a workforce capable of installing and servicing fuel cell equipment.

Fuel cell technology shows signs of improvement and cost reduction:

- For the period 2001-2007 NYSERDA supported eight experimental fuel cell installation projects having an average total installed cost of roughly $8 per Watt. NYSERDA incentives during this period averaged about one-half of this total installed cost. Presuming a capacity factor of 85% and a five year lifespan, this equates to an incentive payment of roughly ten cents per kilowatt-hour.
- For the period 2007-2009 NYSERDA supported eight experimental fuel cell installation projects having an average total installed cost of roughly $5 per Watt. NYSERDA incentives during this period again have averaged about one-half of this total installed cost. Presuming a capacity factor

[21] Case 03-E-0188; "Order Approving Implementation Plan, Adopting Clarifications, and Modifying Environmental Disclosure Program," issued and effective April 14, 2005.

of 85%, this equates to an incentive payment of roughly four cents per kilowatt-hour. This improvement in product quality and reduction in cost is a positive trend which has been induced by the ongoing fuel cell programs in New York and elsewhere.

- The UTC fuel cell has evolved from a five-year lifespan to a ten-year lifespan. Recent SBC-funded fuel cell projects involving the new UTC 400-kW fuel cell have averaged roughly $5 per Watt total installed cost, of which NYSERDA paid roughly one-half in incentives. Presuming a capacity factor of 85% this equates to an incentive payment of roughly four cents per kilowatt-hour.
- The RPS Market Conditions Final Report (prepared for NYSERDA by Summit Blue, February 2009) indicates that, in California, fuel cells are also averaging a total installed cost of roughly $8 per Watt, and that both the New Jersey Customer On-site Renewable Energy Program and the California feed-in tariff provide more-lucrative incentives for fuel cells than New York's current CST program.

While improvement in product quality and reduction in cost is a positive trend which has been induced by the ongoing fuel cell programs in New York and elsewhere, there still are a very limited number of original equipment manufacturers (OEMs) of "mature" fuel cells. The business practices of this small group of OEMs have been the most influential factor affecting the penetration of fuel cells in the New York State marketplace, and make the circumstances of the Fuel Cell program element unique within the suite of CST programs.

Program concepts were discussed with the OEMs when the CST 2007-2009 Operating Plan was being developed, and at that time there were affirmative indications that the program mechanisms would be properly aligned with the OEMs' ability to deliver. After the CST 2007-2009 Operating Plan was issued, two major changes in OEM business practices occurred (because of these two changes in OEM business strategy, the Fuel Cell program has under-performed with respect to the 2007 CST Operating Plan):

- United Technology Corporation ceased production of their 200 kW "mature" fuel cell in favor of production of their 400 kW "experimental" fuel cell, and
- Fuel Cell Energy diminished their pursuit of "single fuel cell" installations in favor of larger "clustered fuel cell" installations.

With respect to the smaller scale fuel cell market, expectations as to customer interest have not yet materialized.

Achievable Market Potential and Funding Needs 2010-2015

The current market demand for fuel cells is driven by many non-price factors including environmental benefit and green marketing value. Projections of achievable market potential are based on reasonable assumptions of market activity and incentive structures, including recently revised business practices of the small group of original fuel cell equipment manufacturers (OEM) that are expected to define the potential penetration of fuel cells in the New York State marketplace.

The CST program will continue to be the primary venue for supporting the cost-effective acquisition of fuel cells for long-term operation at end-user sites. Specifically, the CST Fuel Cell program will be designed to inspire maximized production of electricity from fuel cells, and therefore targets "mature" fuel cells which are expected to have consistent and reliable operation. "Mature" fuel cells are those that are commercially available and have achieved certification by a nationally recognized product standard for stationary fuel cell power systems (such as: ANSI/CSA America FC1-2004 [formerly ANSI Z21.83], are covered by the original equipment vendor with a commercial warrantee for a three-year performance period, and have an MEA number for New York City sites. United Technology Corporation's 400 kW fuel cell is on track to become "mature" in August 2009 at which point it will be eligible under the CST program (though at the existing $1M funding cap).

While considered "experimental" in 2008 and early 2009, using the SBC-funded program specific for this purpose, NYSERDA has selected the installation of this fuel cell at eight (8) distinct sites for funding, indicating aggressive efforts by the OEM to sell this product into the New York marketplace and concomitant acceptance of this product by the marketplace.Fuel Cell Energy has indicated a belief that they can sell larger "clustered fuel cell" installations into the marketplace if the Fuel Cell program's per-site funding cap were to be dramatically increased (e.g., elevated from the current $1 million maximum to a desired $3 million level).

The creation of small fuel cell set-aside category under the 2007 CST Operating Plan was predicated on a concern that the large fuel cells could consume a dominant portion of program funding before the small fuel cells could make a sufficient number of sales, and that a dedicated set-aside for the small fuel cells would establish signals that would stimulate the marketplace. With respect to the smaller scale fuel cell market, customer interest has not materialized as expected, and future expectations on achievable market potential for this class of fuel cells will reflect this experience.

Achievable market potential for small fuel cells is estimated to be 5 projects per year, rated at 0.01 MW per project operating at an average capacity factor of 25%. Achievable market potential for large fuel cells is estimated to be three projects per year rated at 0.4 MW per project, plus one project per year rated at 1.2 MW, all operating at a capacity factor of 90%.

On the basis of program experience as described above, the following projections of achievable market potential, measured in terms of installed capacity and annual energy production, and the associated funding requirements, are presented for consideration.

FUEL CELLS PERFORMANCE AND FUNDING EXPECTATIONS

Table 3-7a. Fuel Cell Program Capacity and Energy Expectations

Year	Small Fuel Cells		Large Fuel Cells		Total	
	Capacity in MW	Annual Generation in MWh	Capacity in MW	Annual Generation in MWh	Capacity in MW	Annual Generation in MWh
2010	0.05	110	2.4	18,920	2.45	19,030
2011	0.05	110	2.4	18,920	2.45	19,030
2012	0.05	110	2.4	18,920	2.45	19,030
2013	0.05	110	2.4	18,920	2.45	19,030
2014	0.05	110	2.4	18,920	2.45	19,030
2015	0.05	110	2.4	18,920	2.45	19,030
Total	**0.3**	**660**	**14.4**	**113,520**	**14.7**	**114,180**

Table 3-7b. Estimate of Funding Needs for Fuel Cell Program

Period	**Small Fuel Cell Set-Aside**	**General Fuel Cell Category**		**Monitoring & Verification**	**Total**
		Standard Cap	Standard Cap and/or Elevated Cap[22]		
2010	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
2011	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
2012	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
2013	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
2014	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
2015	$0.1 million	$3 million	$3 million	$0.1 million	$6.2 million
Total Incentives	$0.6 million	$18 million	$18 million	$0.6 million	$37.2 million

[22] "Standard Cap" funding is available for small fuel cells and large fuel cell projects up to $1 million each application. Standard Cap and/or Elevated Cap funding is available to **all** fuel cell projects on a first-come first-served basis (includes large fuel cells seeking upwards of $3 million per application)

Exit Strategy

The fuel cell industry is still at a very early stage of development and substantial investments continue to be made in technology development. As familiarity with fuel cells increases, product quality improves, and costs decrease, the available federal tax credits should become sufficient to compensate for the premium price of the technology. At such point NYSERDA would consider reducing or ceasing any payment of incentives.

ANAEROBIC DIGESTER BIOGAS-TO-ELECTRICITY PROGRAM

Public Benefits

ADG systems produce a number of the desirable impacts in New York identified by the Commission during the design of the Customer-Sited Tier Program.[23] ADG systems are installed for a number of reasons: to hedge against rising electricity prices, for odor abatement, to allow for seasonal storage of manure (versus daily spreading), to produce bedding and liquid fertilizer for farms, to spur economic development, and as an alternative to land filling of sewage sludge. Ultimately, ADG systems enable farms and water treatment facilities to operate more efficiently, while also decreasing peak demand on the grid and increasing the diversity of the State's fuel mix, which has positive impacts on both the State's environment and its economy. But, cost effective systems can only be installed in a market that has broad-based acceptance of the technology – acceptance that attracts developmental expertise and may ultimately lead to declining costs.

Current Status and Program Experience

The CST Anaerobic Digester Gas (ADG)-to-Electricity Program is part of an integrated program to build a sustainable ADG industry in New York. The CST ADG-to-Electricity Program supports the purchase and installation of commercially-available ADG technologies for long-term renewable electricity generation at end-user sites. Other components of the integrated program, which use statutory and SBC funding, include cost-shared research to develop, demonstrate, and evaluate innovative ADG technologies, establishing an accredited training program for ADG system installation and operation, implementing a national protocol for evaluating system operations, and developing outreach tools and materials to educate consumers on ADG technologies.

Requests for CST ADG-to-Electricity Program funds received through 2008 exceeded the total funding originally allocated to the Program. Additional funds were subsequently added, increasing total program funding to $20.1 million. As of March 31, 2009, 22 applications had been received (see Table 1-2) representing approximately $16 million in funding. Most of these applications are from large farms. Three applications were received from municipal wastewater treatment plants (WWTPs) and one application was received for a digester project that will treat an industrial process feedstock. The 22 applications represent projects that are projected to produce over 50,000 MWh/yr of electricity. In addition, the program has attracted one of the country's major digester development companies to the State.

With funding support from a variety of sources, ten (10) farm and approximately fifteen (15) municipal WWTP ADG systems were producing electric power in New York State prior to implementation of the CST ADG-to-Electricity Program. Many of the farm-based projects benefit from net metering. Since

[23] Case 03-E-0188; "Order Approving Implementation Plan, Adopting Clarifications, and Modifying Environmental Disclosure Program," issued and effective April 14, 2005.

implementing the CST ADG-to-Electricity Program, seventeen (17) more farm projects with new generating capacity are in various stages of development.

Notwithstanding the degree of progress made to-date, continued support of the CST ADG-to-Electricity Program will make an even greater contribution toward achieving RPS goals than previously projected. The 2007 Census of Agriculture (released February 2009) shows that the potential for farm ADG power is greater than previously projected. The number of farms operating in New York with 1,000 or more milking cows has increased by78%, from 41 (2002 Census) to 71 (2007 Census). Additionally, the potential for municipal WWTP ADG power is likely greater than originally estimated. In an effort to improve municipal sustainability, several municipalities are considering the installation of digestion capacity where none exists. In the existing CST Operating Plan, estimates of generation potential from municipal WWTPs were based only on facilities having installed digestion capacity. Additionally, due to the relatively continuous supply of dairy manure, WWTP sludge, and organic wastes from food processors and other industries, most ADG-to-electricity projects can produce power with capacity factors exceeding 90%, thus providing base load power, which is uncommon for renewable technologies. In view of these greater opportunities for ADG, it is projected that by 2015 more than 234,000 MWh per year could be generated by projects supported through the Program.

However, barriers to the realization of this potential do exist, including:

Digester Capital Costs and Cash Flow: The actual costs of ADG installations associated with Program applications received to date have typically ranged from $4,000 to $6,000 per kW for projects installing both a new digester and engine generator. For on-farm applications received by the Program in 2007 and 2008, the ability to borrow the required capital to install an ADG system may have been facilitated by historically-high milk prices. Now that milk prices have fallen drastically, borrowing has become more difficult. Flat, or worse, reduced municipal budgets are also making it difficult to obtain funding for WWTP ADG systems.

Even where credit is available, the primary cash flow benefit of an ADG-to-electricity system – displacing or reducing the need to purchase power from the utility grid – is typically not sufficient to provide the required payback for proceeding with a digester project. For a typical on-farm ADG-to-electricity system the payback is projected to be more than 20 years. If on-farm generation of electricity from biogas is to become widespread, a payback of less than 5 years is likely to be necessary. A payback of less than 5 years is also preferred by municipalities; however a longer-term payback of up to 10 years may be acceptable if the intangible benefits are significant (e.g., improved sludge handling). Very few industrial facilities will accept a payback period much longer than 2 years.

It appears that some farms are selling the methane destruction credits associated with their projects through the Chicago Climate Exchange. However, at current carbon prices the sale of these credits does not significantly improve project cash flow. In the future, farms may participate in the RGGI offset program; current analysis of the potential cash benefits of this program also indicates that project cash flow will not be significantly improved. Due to a lack of credible protocols, to NYSERDA's knowledge, wastewater treatment plants are yet to sell methane destruction credits.

Lack of Three-Phase Power: In rural areas, the lack of three-phase power may limit the size of the generator that can be installed. Conversion from single-phase to three-phase power can be costly. Where this limits the quantity of biogas that can be used, the payback interval for the project is increased.

Separate Metering of Multiple Loads: Farms often expand in stages; as new buildings are added, new utility meters are installed. In New York State, net metering only applies to the load on the meter that interconnects the generator to the utility. (It can be costly to connect multiple meter loads to this meter.) Therefore, the cash benefit of the project is reduced; although more power can be sold to the utility at the wholesale rate, less power can be displaced at the retail rate. Vermont and Pennsylvania have made provisions for "virtual net metering," where excess power is used to offset retail costs from multiple meters, not just the meter interconnecting the generator to the utility.

Municipal Decision-making Process: Whereas an on-farm decision to install an ADG-to-electricity system often involves a single family or small partnership, for municipal wastewater facilities this decision, and the process of procuring, permitting and constructing the system, is typically much more complex. This may result in higher costs for installing ADG systems at municipal facilities.

Limited Eligibility of Customers That Do Not Pay RPS Charges: Generally, only customers who pay RPS charges through their utility bills are eligible to receive incentives through the RPS Program. This excludes WWTPs and farms that receive municipal power, or power from the New York Power Authority (NYPA) or the Long Island Power Authority (LIPA), from RPS incentive programs. Some of the excluded WWTPs are very large and have the potential to produce significant amounts of renewable power in a load-constrained area of the State. Additionally, they provide essential services to a large number of State residents who do pay RPS charges through their utility bills.

Limited System Providers in the Farm Sector: While the ADG-to-Electricity Program has attracted one of the country's major digester developers to the State, farmers still have few choices. Two companies are developing seventy-five percent of the on-farm projects.

Achievable Market Potential and Funding Needs 2010-2015

The CST ADG-to-Electricity Program significantly contributes to promoting the acceptance of ADG technologies, and continued support of the Program will cost-effectively help New York State achieve its RPS program goals. With support of the Program through 2015 (see Tables 3-10a and 3-10b), it is projected that development of an additional 24.3 MW is achievable, representing an additional 170,000MWh/year of electricity generation associated with ADG-to-electricity projects at farms, wastewater treatments plants, and food production facilities. These projections are based on incentives that average about $28 per MWh over the 15-year life span of a typical project, an assumption of an 80% capacity factor for each installation, and an accounting of market segmentation and associated energy production potential described as follows:

Projected Number of Installations: With the average incentive of $28 per MWh the number of farm-based ADG facilities projected to be installed using CST ADG-to-Electricity Program incentives from 2007 through 2015 is 134; this includes installations at 75% (53) of the 71 farms with greater than 1000 cows, 30% (44) of the 145 farms having between 500 to 999 cows, and 10% (37) of the 375 farms having between 200 to 499 cows. The number of wastewater treatment plant ADG facilities projected to be installed using ADG-to-Electricity Program incentives from 2007 through 2015 is 37. The number of installations projected includes 23% (3) of the 13 WWTPs in the largest category of 75 MGD and up, 79% (11) of the 14 plants between 75 and 13 MGD, 47% (8) of the 17 plants between 13 to 4.5 MGD, and 7% (7) of the 101 plants less than 4.5 MGD. For the industrial sector the number of ADG facilities to be installed has been projected at 5% (6) of the 129 candidate facilities.

Average Electric Generation Capacity: Generation capacity projections were based on estimated and historical biogas generation and energy production data from farms and WWTPs within the various size-range categories. Typically, projections were based on the assumption that generation capacity matched the full use of the potential biogas generation; except for the largest WWTPs, where the installations were more conservatively projected to use less than half of the available biogas. For farm applications, the average generation capacity projected for farms having greater than 1000 cows is 300kW, for farms having between 500 to 999 cows is 145 kW, and for farms having between 200 to 499 cows is 65 kW. For WWTP applications, the average generation capacity projected for WWTPs treating more than 75 MGD is 1,000 kW, for facilities treating between 75 to 13 MGD is 180 kW, for facilities treating between 13 to 4.5 MGD is 50 kW, and for facilities treating less than 4.5 MGD is 25 kW. For the industrial sector, the average generation capacity projected is 180 kW.

The February 2009 Market Conditions Assessment of NYS's RPS determined that ADG programs in California, Wisconsin, and Vermont offer significantly more favorable incentives than those offered in New York. Additionally the report concluded that market prices for ADG systems are lower in New Jersey and California, which "one might expect to find . . . in states . . . where incentive program and net metering rules have supported substantial customer-sited renewable energy development for a number of years." Given the significant potential of renewable electricity generation from ADG-to-electricity systems in New York State, the multiple benefits of these systems, as well as the multiple barriers to implementing these systems, the ADG-to-Electricity Program should continue to be supported with essentially the same basic structure as is currently offered. NYSERDA will continue to monitor ADG costs, barriers, benefits, and opportunities to determine whether the incentives should be modified during the program.

On the basis of program experience as described above, the following projections of achievable market potential, measured in terms of installed capacity and annual energy production, and the associated funding requirements are presented for consideration.

ANAEROBIC DIGESTER GAS PERFORMANCE AND FUNDING EXPECTATIONS

Table 3-8a. ADG-to-Electricity Program Capacity and Energy Expectations

Year	Farm-Based ADG		Industrial/WWTP ADG		Total	
	Capacity in MW	Annual Generation in MWh	Capacity in MW	Annual Generation in MWh	Capacity in MW	Annual Generation in MWh
2010	3.7	25,965	0.7	4,660	4.4	30,625
2011	3.2	22,215	1.7	11,668	4.9	33,883
2012	3.0	21,234	0.6	4,310	3.6	25,544
2013	3.0	21,234	1.4	10,056	4.4	31,290
2014	2.7	19,132	0.4	3,048	3.1	22,180
2015	2.4	17,029	1.4	10,056	3.8	27,085
Total	**18.0**	**126,809**	**6.2**	**43,798**	**24.2**	**170,607**

Table 3-8b. Estimate of Funding Needs for ADG-to-Electricity Program

Period	RPS Incentives	Monitoring &Verification	Total
2010	$13.7 million	$0.9 million	$14.6 million
2011	$13.3 million	$0.9 million	$14.2 million
2012	$11.6 million	$0.8 million	$12.4 million
2013	$12.0 million	$0.8 million	$12.8 million
2014	$10.1 million	$0.8 million	$10.9 million
2015	$10.3 million	$0.8 million	$11.1 million
Total	**$71.0 million**	**$5 million**	**$76.0 million**

Exit Strategy

The proposed ADG budget should provide sufficient incentive for the acquisition of ADG systems at nearly all of the most favorably configured New York dairy farms and a significant number of medium-to-large wastewater treatment plants. This is an aggressive market penetration strategy but given that

ADG technology is the lowest cost of the customer-sited tier technologies and a relatively mature technology, such a strategy is considered prudent. As was noted in the Order making ADG eligible under the CST, "maximum, cost effective systems can only be installed in a market that has broad-based acceptance and adoption of the renewable energy technology. Infrequent installations will not attract developmental expertise or lead to declining costs."[24] If the proposed ADG incentives are as successful as projected, there will be approximately 150 ADG-to-electricity projects in the State. The funding incentives can also be expected to bring additional digester developers and greater cost competition to the New York State farmers. The ADG program is an acquisition program. NYSERDA does not expect material reductions in digester system costs, and market-based revenues to the customer are not expected to increase materially until more stringent carbon limitations are in place and appropriately valued in the energy markets. There is no certainty as to the imposition of long-term carbon taxation or cap and trade programs at the federal level, and expected RGGI program carbon allowance valuation is not significant; these environmental market mechanisms are not expected to highly influence digester system cost effectiveness and customer acceptance in the foreseeable future. Hence, absent direct acquisition under the ADG program, New York cannot reasonably expect to capture the desirable attributes of digester gas-to-electric systems for the foreseeable future.

As the RPS Program is implemented, NYSERDA will not only monitor the renewable electricity produced but will also compile and disseminate information on digester system costs and waste treatment effectiveness, so that other facilities can make more informed decisions about the suitability of digester systems. NYSERDA will also support technology transfer efforts to widely distribute case studies and reports about digester systems.

During RPS Program implementation, NYSERDA will continue its cooperation with the New York State Departments of Environmental Conservation and Agriculture and Markets, New York State Environmental Facilities Corporation, Federal Rural Development Office of the U.S. Department of Agriculture, and the AgSTAR Program of the USEPA, to exchange information about the availability of incentives for ADG system installation. NYSERDA will also continue to track ADG incentive opportunities that may become available through the American Recovery and Reinvestment Act. Changes in the availability and impact of any such programs, as well as potential decreases in digester system costs, will be monitored by NYSERDA and may result in alterations to proposed RPS incentives and/or additional digesters installed beyond the current estimates.

[24] Case 03-E-0188, "Order Approving Request for Inclusion of Methane Digester Systems as Eligible Technologies in the Customer-Sited Tier," issued and effective November 2, 2005.

CUSTOMER-SITED WIND PROGRAM

Public Benefits

Customer-sited wind power is starting to show results in satisfying various long-term policy objectives as articulated by the Commission during the design of the Customer-Sited Tier Program.[25] With the implementation of programs to support larger customer-sited systems, the benefits of the initiative will grow. Some of the benefits of customer-sited wind program include:

- Economic development: There are currently 12 small businesses across New York State with installers that are eligible to participate in the NYSERDA program. This number is expected to increase as graduates from the 18 new small wind training programs enter the market;
- Fuel diversity and reduction in harmful emissions: wind systems reduce the amount of grid power used to meet the load at the site;
- Participation by the residential and small business sectors: The majority of customers in the current customer-sited wind program are either residences or farms. As the program expands in the next phase, there will be a greater opportunity for larger-scale commercial sector participation.

Current Market Status and Program Experience

Since 2003, NYSERDA has been operating a small wind incentive program, initially with SBC funding and, since 2007, using RPS funds through the CST Program. The program has been primarily supporting projects in the 10 kW range.

Relative to workforce development and training, New York is building a leadership role in the development of accredited training programs for small wind installers. There are currently 18 training programs under development at institutions include community colleges, universities, BOCES, and trade groups.

The Massachusetts Technology Collaborative, through the Renewable Energy Trust Fund, started a program in 2005 to support the installation of large, on-site renewable energy projects.[26] In Massachusetts, there are currently 30 active or completed customer-sited wind projects in the design and construction phase of the program with a combined capacity of 26.15 MW. Table 3-9 provides summary data of these projects. In addition, the program has 36 wind projects in the feasibility study stage. The level of activity in Massachusetts offers an indication of what may be possible in New York State.

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[25] Case 03-E-0188, "Order Approving Implementation Plan, Adopting Clarifications, and Modifying Environmental Disclosure Program," issued and effective April 14, 2005.

[26] Tyler Leeds, Massachusetts Technology Collaborative, Personal Communication, April 16, 2009.

Table 3-9. Current Wind Projects in the Massachusetts On-Site Renewables Initiative

Size (kW)	Number of Installations in Sector				Average Total Cost $/watt	Average Grant $/watt	Average Estimated Payback w/o Grant	Average Estimated Payback with Grant
	Business	Not-for-profit	Public	Residential				
50	1				5.10	2.25	29.5	12
100	3	3	3		4.89	2.79	18.85	10.06
250	1				3.46	1.70	9.2	4.7
600	4	2		1	3.26	0.77	11.89	8.91
900			1		2.58	0.44	2.2	1.8
1200			1		2.92	0.33	11	10
1500	4		2		2.33	0.34	9.5	6.08
1650			1		2.73	0.18	7	6.5
2000			1		2.44	0.20	10	8
3000	1	1			1.98	0.18	6.75	6.25

As of March 31, 2009, with the combined funding of the SBC program and RPS programs, NYSERDA approved incentives for 65 small wind systems in New York State. The majority of the installations (80%) have been 10kW machines and sizes have ranged from 1kW to 22.5 kW. A summary of the program results is provided in Table 3-10.

Table 3-10. Small Wind Installations in New York

Incentive	Total Cost	kW	kWh Output	Year	Number of Applications
$44,428	$88,854	20.0	26,496	2003	2
$189,768	$369,575	70.0	84,917	2004	7
$234,776	$369,575	75.6	78,479	2005	10
$546,557	$1,044,623	174.6	176,417	2006	19
$150,124	$291,021	40.0	66,984	2007	4
$429,826	$1,011,622	135.3	160,875	2008	14
$291,535	$545,160	105.0	182,048	2009	9

Achievable Market Potential and Funding Needs 2010-2015

Because of the scale of funding provided to the Small Wind program under the 2007 Operating Plan, the program caps the amount of incentives for any one installation, thus limiting larger scale installations. In

the next phase of the program, in addition to the application based program for small-scale systems, the program could be expanded to include larger-scale installations that are still on the customer side of the meter. Different incentives and monitoring protocols would apply for different scale installations. Detailed incentive levels, project caps, and monitoring protocols would be described in the initial open-enrollment solicitation and as appropriate in subsequent special solicitations.

As shown in Table 3-10 above, there has not been a consistent pattern in the annual number of installation of wind systems under the NYSERDA program. This may be due, in part, to local siting complexities and the relatively small number of installation companies operating in the state. According to the American Wind Energy Association,[27] the small wind market (systems less than 100kW) grew by 14% in 2007. NYSERDA believes a modest annual growth rate of 10% for small systems (10kW) in New York is attainable.

Given that there is no experience in the NYSERDA programs with larger-scale customer-sited wind projects, a conservative estimate was for a gradual growth of market demand to reach a total of 15 MW by 2015. According to discussion with wind installers active in New York, a NYSERDA wind market for systems larger than 50kW could exceed 120 MW in New York State. It is expected that larger systems (1.5 MW) would be installed in the later years of the program. These will typically have a higher capacity factor than the smaller installations.

Figure 6 shows a simple life cycle cost of electricity from the program to date, and a projection of cost per mWh of incentives under the next phase of the program. Note that the current data set is limited in size. Future projects, however, are expected to include larger capacity turbines that will require relatively smaller incentives to be built. For this reason, the expectation is that the incentive funding per mWh will decrease.

[27] American Wind Energy Association, AWEA Small Wind Turbine Global Market Study 2008.

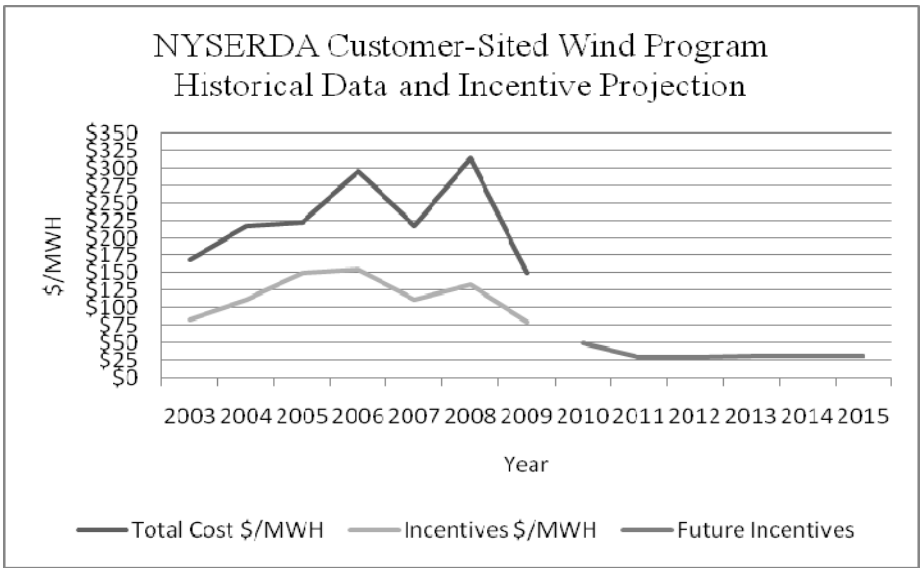

Figure 6.

On the basis of program experience as described above, the following projections of achievable market potential, measured in terms of installed capacity and annual energy production, and the associated funding requirements are presented for consideration.

CUSTOMER SITED WIND PERFORMANCE AND FUNDING EXPECTATIONS

Table 3-11a. Customer-Sited Wind Program Annual Capacity and Energy Expectations

Year	Number of Systems	MW	MWh
2010	24	1.1	1,927
2011	27	2.7	4,643
2012	30	2.7	4,739
2013	33	2.8	4,845
2014	37	3.4	6,013
2015	41	3.5	6,141
Total	**192**	**16.2**	**28,308**

Table 3-11b. Estimate of Funding Needs for Customer-Sited Wind Program 2010-2015

Period	On-Site Wind Incentive Program	Monitoring & Verification	Total
2010	$ 1.9 million	$ .3 million	$ 2.2 million
2011	$ 2.8 million	$ .3 million	$ 3.1 million
2012	$ 2.9 million	$ .3 million	$ 3.2 million
2013	$ 3.1 million	$ .3 million	$ 3.4 million
2014	$ 3.8 million	$ .3 million	$ 4.1 million
2015	$ 4.0 million	$ .3 million	$ 4.3 million
TOTAL	$18.5 million	$ 2.0 million	$ 20.5 million

Exit Strategy

The market for customer-sited wind technology applications in New York State is still at a very early stage of development. As the number of installations increase and more installers and communities have experience with siting the systems, local institutional barriers will decrease. This will likely result in a reduced installation cost and open the market to additional customers. It is not expected that the cost of energy from the systems will be competitive with retail electricity by the end of the next program phase.