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# 7

## ***Research and Development Programs***

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### **7.1 Overview of the R&D Programs**

The **New York Energy \$mart<sup>SM</sup>** programs support research, development, and demonstration of products, technologies and provide data and information to public and private sector decision-makers. The projects are administered through the following six funding categories:

**Wholesale Renewables:** Funds projects designed to increase the supply and demand for green power in the wholesale market.

**End-Use Renewables:** Funds projects designed to impact the growth and maturation of the New York market for customer-sited renewable energy technologies—specifically, photovoltaic (PV) and wind systems. Over time, the program—along with other programs promoting PV throughout the world—is expected to bring down the cost of PV systems

**Distributed Generation/Combined Heat and Power (DG/CHP):** Funds projects that promote the development, demonstration and operation of distributed generation systems (on-site power). The program has a product development component, which supports the development and commercialization of innovative power system technologies manufactured in New York; and a demonstration component, which supports the demonstration of available DG/CHP technologies and new and innovative applications that can be replicated in other parts of the state.

**Environmental Monitoring, Evaluation, and Protection:** Funds projects that support research to address environmental issues related to the generation of electricity.

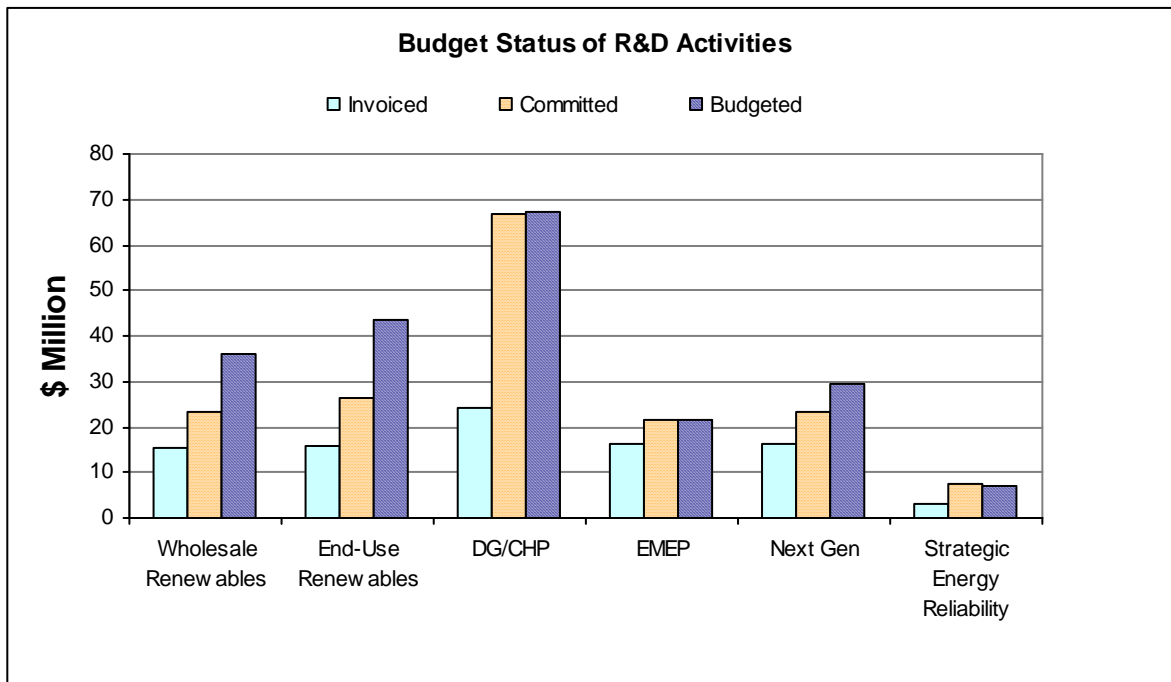
**Next Generation of End-Use Technologies (NextGen):** Funds projects that accelerate the demonstration and commercialization of emerging energy-efficient and environmentally friendly technologies that do not fall under existing research & development (R&D) programs, enhance power quality and management, and accelerate price-responsive demand.

**Strategic Energy Reliability:** Funds project that support the development of technologies and fuels that enhance electricity system reliability and increase end user options for reliable energy sources.

## 7.2 R&D Programs Budget Status

The funding status for the R&D Programs is shown in Figure 7-1. Shown are funds invoiced, committed, and budgeted for six R&D funding categories. As of year-end 2005, approximately 82% of the R&D budget was committed and 44% was invoiced. Approximately \$57 million was uncommitted as of year-end 2005. The six funding categories consist of: Wholesale Renewables, End-Use Renewables, DG/CHP, Environmental Monitoring, Evaluation, and Protection (EMEP), Next Generation of End-Use Technologies, and Strategic Energy Reliability.

**Figure 7-1. Budget Status of R&D Program**



## 7.3 R&D Programs Evaluation Activities

The evaluation activities conducted from mid-2003 through the early part of 2006 with respect to the R&D portfolio are shown in Table 7-1. Over a two-year period, the Wholesale Renewables Program, the End-Use Renewables Program, and the DG/CHP Program (DG/CHP) received a complete analysis from the program theory and logic (PT&L) contractor, the measurement and verification (M&V) contractor, and the market characterization, assessment, and causality (MCAC) contractor. The End-Use Renewables and DG/CHP Programs also received a process evaluation from the process evaluation contractor. In addition, two cases studies were conducted, one on the Environmental Monitoring, Evaluation, and Protection Program and one on the Next Generation of Energy-Efficient End-Use Technologies Program. In early 2006, a preliminary logic model was developed for EMEP. The general evaluation contractor and the PT&L contractors have also worked together to develop a portfolio-level logic model and to develop a portfolio-level evaluation methodology called the value/cost analysis. This analysis incorporates a peer review assessment which is underway.

**Table 7-1. R&D Programs Evaluation Activities in 2003-2006**

	Theory and Logic	M&V	Process Evaluation	Mkt Charact., Assessment & Causality	Case Study	Peer Review Assessment
Wholesale Renewables	2003	File review 2003, Complete 2004	-	2003	-	-
End-Use Renewables	2003	File review 2003, Complete 2004, Update 2005	2004	2003, Update in 2004 and 2005	-	-
DG/CHP	2004	File review 2003, Complete 2004, Update 2005	2003	2004	-	2005
EMEP	Preliminary Logic Model in 2005	-	-	-	2003	2004, 2005
Next Generation of End-Use Technologies	-	-	-	-	2003	2004
Strategic Energy Reliability	-	-	-	-	-	2005

## 7.4 Key R&D Programs Evaluation Findings

Four types of projects were identified in the logic model developed for the R&D programs:

- Predeployment: Projects that install commercially available products with high costs and risks.
- Demonstration: Projects that install commercially available technologies that involve a high degree of design and other risks.
- Product Development: Projects that involve proof of concept, development of a new prototype, testing of prototypes, or development and implementation of a commercialization or manufacturing plan for a new product.
- Research and Support: Projects that involve research, as in the Environmental Monitoring, Evaluation, and Protection Program, or involve market potential or assessment studies, or other activities designed to influence stakeholders such as policy makers, the research community, and the general public.

Analysis of the portfolio has led to the following observations:

- The CHP demonstration projects are a large part of the overall portfolio. The CHP Demonstration Program and will result in over 100 MW of peak demand reduction when all currently planned systems are operational.
- The financial support of other organizations is being enlisted to share risks. Co-funding from other organizations is higher for demonstration projects than for product development projects due to the lower risk for demonstration projects. Co-funding from other government entities is highest for the research projects.
- Knowledge is created through a variety of mechanisms including feasibility studies, demonstration projects, policy analysis, environmental monitoring, and other forms of applied research.
- Knowledge is disseminated to both the research and end-user communities.
- Installations of PV systems have resulted in 1.9 MW of installed capacity (1.3 MW of on-peak reduction) and nearly 3,000 MWh of annual production.
- The EMEP Program was successful in contracting most of its funding early in the program life and is now positioned to reap the benefits of the multi-year research projects.
- The Next Generation of Energy-Efficient End-Use Technologies Program has become more targeted in the solicitations in recent years by issuing technology-specific solicitations rather than casting a wide net.
- The wholesale market for renewable energy has been advanced through the support of a green marketing program and by increasing the availability of wind resources.
- Renewable energy generation and electricity generation from CHP total over 185,000 MWh per year.

The following are program-specific findings:

- The DG/CHP Program is comprised of two components. The first is Demonstrations which provide funding for site-specific demonstrations that contribute to the growth of CHP in New York. To date, the demonstration component has achieved a co-funding ration of 4.5 and annual electricity generation of 82,000 MWh. In addition, the outreach effort has produced significant increases in awareness and knowledge among both end-use customers and developers.
- The second component of the DG/CHP Program is Power Systems Technology which aims to develop and field test innovative distributed generation technologies that enhance the environment and improve grid reliability. In recent years, greater emphasis has been placed on hydropower and DG aggregation and reduced emphasis on microturbines. As new businesses and products developed in this program emerge as viable commercial options, they have become eligible for supported under the deployment programs. Two recent examples of this pass-off to deployment are the commercial introduction of the “ecoJoule 3000” inverter and Plug Power’s GenCore 5T, a backup generator fuel cell product designed for the telecommunications market.
- End-Use Renewables (EUR) Program is designed to develop and grow the New York market for customer-sited renewable energy technologies. Since 2003, the number of participating installers has increased 128% and the average full-time equivalents employed by PV installer firms has increased 142%. It has been estimated that NYSERDA-funded PV systems account for 29% of the total PV installed capacity on record with the New York State Public Service Commission (PSC) and

NYSERDA's small wind installations represent 25% of the State's total small wind energy capacity on record with the PSC.

- The Wholesale Renewable Energy Market Development Program is designed to develop the supply and demand for green power. Significant progress has been made in increasing awareness of residential customers with 66% having some understanding of green power. As of 2004, nearly 14,000 residential customers, 140 commercial customers and eight industrial customers have contracted to purchase green. As of 2005, over 205,000 MWh was being sold by three green power marketing companies.
- The Environmental Monitoring, Evaluation, and Protection (EMEP) Program is designed to provide objective and policy-relevant research that results in: 1) enhanced understanding of the nature and characteristics of energy-related pollution and its impact on the environment and human health, 2) characterization of sources of energy-related pollution, and 3) identification of opportunities for emissions reduction. Its research efforts are split almost evenly between air quality and ecosystems with a small percentage devoted to crosscutting research. A total of 49 projects have been initiated, and 11 have been completed. Environmental monitoring data from hundreds of field sites throughout New York State have been collected to support program goals. Achievements in knowledge dissemination have been significant with over 125 articles published in peer-reviewed journal. A citations analysis was conducted in mid-2005 revealed that the number of citations of articles published by EMEP researchers have been increasing steadily, from 3 citations during the 1996 to 2000 time period to 272 during the 2000 to 2004 time period. Finally, EMEP projects have affected energy-related environmental policy and research such as the development of Governor Pataki's Acid Deposition Reduction Initiative.
- The Strategic Energy Reliability Program aims to enhance the reliability of electric power by developing technologies and fuels that can provide grid support and end user reliability options during times when the electric system is operating at peak capacity or having power quality problems. Energy storage, liquefied natural gas, and truckstop electrification represent the top three areas in terms of funding. To date, 21 projects have been initiated and nine being completed with a co-funding ratio of 1.2.
- Next Generation of Energy-Efficient End-Use Technologies Program seeks to accelerate the demonstration and commercialization of emerging technologies such as smart sensors, superconductivity, innovative controls, and advanced diagnostics. For example, time-sensitive pricing projects encourage residential and small to medium-sized commercial/industrial customers to participate in demand response programs.

NYSERDA's M&V contractor assessed the energy and peak demand savings reported for the End-Use Renewables Program, Wholesale Renewable Energy Market Development Program, and the DG/CHP demonstration projects. Methods used in this assessment included on-site verification of equipment installation and functionality, and review of NYSERDA's files for reasonableness and accuracy. Based on this review, the M&V contractor adjusted the savings reported by NYSERDA. In turn, the MCAC contractor further adjusted these figures to account for freeridership and spillover. Table 7-2 to Table 7-4 summarize the estimated savings for these programs.

**Table 7-2. Electricity Savings/Clean Generation from Renewables and DG/CHP**

Program	Program-Reported Savings (MWh/year)	Realization Rate	Adjusted Gross Savings (MWh/year)	Net-to-Gross Ratio	Net Savings (MWh/year)
Wholesale Renewables	99,995	1.0	99,995	1.0	99,995
End-Use Renewables	2,724	1.04	2,833	1.0	2,833
Distributed Generation/Combined Heat and Power	84,906	0.90	76,706	1.07	82,152
<b>Cross Sector Overlap removed</b>	<b>6,289</b>				
<b>R&amp;D Programs Total</b>	<b>193,914</b>	<b>-</b>	<b>179,534</b>	<b>-</b>	<b>178,691</b>

**Table 7-3. Peak Demand Savings/Clean Generation from Renewables and DG/CHP**

Program	Program-Reported Savings (MW)	Realization Rate	Adjusted Gross Savings (MW)	Net-to-Gross Ratio	Net Savings (MW)
Wholesale Renewables	6.3	1.0	6.3	1.0	6.3
End-Use Renewables	1.6	0.85	1.3	1.0	1.3
Distributed Generation/Combined Heat and Power	17.1	0.98	16.8	1.07	18.0
<b>Cross Sector Overlap removed</b>	<b>1.3</b>				
<b>R&amp;D Programs Total</b>	<b>26.3</b>	<b>-</b>	<b>25.7</b>	<b>-</b>	<b>24.3</b>

**Table 7-4. Research and Development Programs Non-Electric Savings Summary**

Program	Program-Reported Savings (MMBtu)	Realization Rate	Adjusted Gross Savings (MMBtu)	Net-to-Gross Ratio	Net Savings (MMBtu)
Distributed Generation/Combined Heat and Power	-640,513	0.89	-568,289	1.07	-608,638
<b>R&amp;D Programs Total</b>	<b>-640,513</b>	<b>-</b>	<b>-568,289</b>	<b>-</b>	<b>-608,638</b>

<sup>1</sup> Fuel savings are negative, reflecting a net increase in usage at the facility to operate the DG/CHP system.

## 7.5 Distributed Generation/Combined Heat and Power (DG/CHP)

The goal of the DG/CHP Program is to contribute to the growth of combined heat and power and other distributed generation applications in New York. The CHP Demonstrations component of the program, discussed in Section 8.7.1, provides funding for site-specific feasibility studies and demonstrations that contribute to the growth of CHP in New York. The Power Systems component of the program, discussed in Section 8.7.2, provides funding for the development, advancement, and commercialization of

technologies that improve the environment, reduce energy use, and lead to increased manufacturing activity in the State.

### 7.5.1 CHP Demonstrations

#### Program Description

##### Program Purpose

The CHP Demonstration Program provides funding for feasibility studies and demonstrations that contribute to the growth of CHP in New York. Eligible technologies include large turbines and micro-turbines, fuel cells, and reciprocating engines. Eligible fuel sources include natural gas, bio-derived methane, and propane. Application areas include load following, base load, peaking shaving, power quality, and grid support.

<u>Program Milestones</u>	
Dec. 2004	PON 914 , Round 5
Dec. 2003	PON 800, Round 4
Jan. 2003	PON 750, Round 3
Jan. 2002	PON 669, Round 2
March 2001	PON 536 Power Systems, Distributed Generation, and Combined Heat and Power Round 1
Aug. 2000	PON 554 Combined Heat and Power or District Energy System Application

##### Program Resources

The CHP Demonstration component is funded at \$47 million over eight years.

##### Targeted Customers

The Program targets facility owners, manufacturers, energy service companies, performance contractors, designers, and energy consultants.

##### Program Barriers

Key supply-side barriers that affect upstream actors such as installers, contractors, utilities, R&D organizations, developers, and manufacturers include:

- Issues with fuel cell development
- Cost and complexity in some microturbine applications
- Lack of installers/contractor experience of with these technologies
- Need for reciprocating engines to operate in a “cleaner” manner. Other DG/CHP power system technologies need to be more efficient, cost-effective and offer higher levels of power reliability
- Limited private investment in DG/CHP project development
- Resistance to DG/CHP installations because utilities have not found a way to benefit from them

Key market structure and policy barriers that affect midstream actors such as utilities, energy governmental units, policy makers, architects, engineers, designers and service companies include:

- Interactions with the utilities

- Utility perspective that DG/CHP projects are revenue-eroding threats
- Stand-by Rates, particularly on small projects, remaining as barriers to cost effectiveness
- Interconnectivity between DG/CHP installations and the utilities' distribution grids
- Emission regulations since the New York State Department of Environmental Conservation (DEC) emission limits differ by technology and fuel (*e.g.*, promoting different standards for different fuels makes compliance of dual fuel DG systems difficult)
- Lack of knowledge and skills among architects and engineers (A&Es) needed to specify DG/CHP systems leading to a lack of A&E credibility to attract potential clients (A&E firms need experience with DG/CHP to get customers and A&E firms need customers to get DG/CHP experience)

Key demand-side barriers that affect downstream actors such as consumers in areas of commercial, industrial, municipal, institutional, and other underserved populations and owners of facilities that have both electric and thermal energy loads include:

- Lack of end-user/facility owner awareness and knowledge of DG/CHP technologies and their potential applications
- Limited private investment in DG/CHP project installations
- Facility owners (potential host sites) don't see the value of DG/CHP or don't know how to approach the integration

#### Implementation Approach/Activities

PONs are released annually. Projects are selected to achieve the following objectives:

- Produce near-term savings in terms of reduced peak demand for grid supplied power (and associated improvement in grid reliability through participation in New York Independent System Operator's (NYISO) peak load reduction programs)
- Demonstrate new and innovative technologies that can reduce energy costs and provide economic expansion through replications of CHP systems throughout New York State
- Document performance characteristics to predict system performance
- Develop tools to model the environmental impact of CHP systems
- Translate data that is currently being collected into knowledge that will help grow the CHP market in New York
- Improve energy efficiency through installation of systems designed to satisfy thermal load to achieve highest overall energy efficiency
- Increase utilization of renewable fuels
- Address institutional impediments, including the absence of applicable codes and standards for installation of fuel cells and micro-turbines

- Support training of installers, service technicians, and the establishment of service centers
- Demonstrate and evaluate opportunities for aggregation of DG system and the resulting impacts on utilities, the NYISO, and distribution system reliability and power quality

Table 7-5 presents the projects status, NYSERDA funding, and co-funding. In total, 81 demonstration projects have encumbered funds, of which 35 are completed. A total of 15 feasibility studies have been initiated and seven are completed. The co-funding for ongoing projects is higher than that of completed projects. The co-funding ratio for feasibility studies is about 1 to 1.

**Table 7-5. CHP Demonstration Projects Funding and Co-Funding**

Type of CHP Project	Status	Number of Projects	NYSERDA Encumbered Funds	External Co-funding	Co-funding Ratio <sup>1</sup>
Demonstration	Completed	35	\$12.0 Million	\$41.4 Million	3.2
	In-progress	46	\$32.4 Million	\$163.1 Million	5.0
Feasibility Study	Completed	7	\$0.5 Million	\$0.7 Million	1.3
	In-progress	8	\$0.6 Million	\$0.7 Million	1.1
<b>Total</b>	-	-	<b>\$45.6 Million</b>	<b>\$205.0 Million</b>	<b>4.5</b>

<sup>1</sup> Discrepancies exist due to rounding of funding numbers.

### Program Evolution

As of December 31, 2005, there were 93 active<sup>1</sup> SBC-funded CHP demonstration projects in our portfolio, of which 35 were operational and resulted in a peak load reduction of nearly 17 MW. When fully-operational, these 93 projects will result in a peak load reduction of over 100 MW.

Important trends for 2005 are as follows:

- Larger-sized systems: As project developers became more familiar with the New York marketplace, their proposals included designs for larger-sized CHP Demo systems. Analysis of the portfolio shows that proposals received in the early rounds of the program (i.e., projects which have progressed through the design/construction/commissioning phases and are now operational, consisting of 35 projects representing 16,941 kW) have an average size of approximately 500 kW, whereas proposals received in recent rounds of the program (i.e., typically, projects which are not yet operational, consisting of 58 projects representing 85,322 kW) have an average size of approximately 1,500 kW. A larger-sized project can leverage some economies of scale to pursue a greater margin for profit, leading to increased attraction of private capital as investment funding, and this is one small step toward self-sufficiency/sustainability in the marketplace.
- Stand-alone capability: A greater percentage of proposals received in recent rounds of the program represent projects that can operate in parallel with the grid as well as during a power outage. This

<sup>1</sup> Includes contracted projects and projects in contracting phase.

heightened interest in stand-alone capability is partially a result of the August 2003 blackout, as well as improvements in grid interconnection technologies.

- **Better quality proposals:** In recent rounds of the program, the number of proposals received has decreased, but the quality (percentage of proposals deemed to be technically meritorious) has increased. This indicates an improvement in the prospecting that project developers are doing to find and focus on viable candidates for CHP systems.
- **Increased use of renewable fuels:** In recent rounds of the program, the number of proposals received which included designs for use of renewable fuels has increased.
- **Recognition of the value of NYSERDA participation:** DG-CHP marketplace participants, such as project developers and host site owners, have expressed recognition that NYSERDA provides “value added” contribution to the project by assisting with interactions with utility, DEC, and PSC staff.

### **Program Market Progress**

This section highlights the findings on CHP Demonstration Program progress in influencing the market in New York. Table 7-6 presents a sample of key indicators of program success, as tracked by the evaluation and program activities. They indicate the most important ways that the program progress is being measured, and report how those values are changing due to program activities.

The program has increased the awareness and knowledge of CHP. For example, during the period from October 1, 2005 through March 6, 2006 the website <http://chp.nyserda.org> averaged 51 visits per day with the typical site visitor viewing six pages. This website was designed to show the performance and reliability of CHP systems by having performance data from individual systems uploaded to the website daily. The site also allows creation of customized reports based on the data stored at the site. The most frequently visited page is the facilities page listing the various operational projects and giving limited descriptions of the projects.

In addition, the website (<http://www.nyserda.org/programs/dgchp.asp>) has marketing information and links allowing the download of the 2002 market potential study and single page case study descriptions. This web page was visited 2,715 times from April 2005 to March 2006, resulting in an average of 226 visits per month or about ten visits per day.

In addition to the quantifiable measures, the program has influenced regulatory policies. When the program began, New York City’s unique network-type system posed a barrier for CHP. Since then, the New York Standard Interconnection Requirement was modified to include the network-type system. Flex rates were also a barrier at one time. Since then, the New York Public Service Commission ruled that flex rates could not be used by a utility as a mechanism to discourage CHP installations.

**Table 7-6. CHP Program Indicators and Progress**

Topic	Indicator	Data Value--2004	Data Value -- 2005
<b>Short Term Outputs and Indicators</b>			
General Outputs	Number of operational DG/CHP systems	28	35
	Total funds awarded for operational DG/CHP systems	\$8.9 million	\$12.0 million
	Total cost of operational DG/CHP systems	\$39.4 million	\$53.4 million
Energy Savings	Net MWh, MW and MMBtusavings	60,784 MWh, 13.1 MW	82,152 MWh, 18.0 MW, -608,638 MMBtu
Environmental Impacts	NOx reductions	-	0.83 lbs. per MW
Awareness and Knowledge	End-use customer familiarity with DG/CHP systems	83% of participants and 100% of partial non-participants said they were at least somewhat familiar	-
	Increase in customer familiarity with DG/CHP systems	67% of participants reported an increase in familiarity and 25% of those attributed it to the NYSERDA project	-
	Developer familiarity with DG/CHP systems	90% said they were extremely familiar, and all developers considered themselves at least somewhat familiar	-
	Increase in developer familiarity with DG/CHP systems	75% said their familiarity increased	-
	Web site hits		2,715 visits to the DG/CHP page ( <a href="http://www.nyserda.org/programs/dgchp.asp">http://www.nyserda.org/programs/dgchp.asp</a> ) between April 2005 and March 2006.
<b>Intermediate and Long Term Indicators</b>			
Market Share and Sales	DG/CHP Program penetration in terms of base case and accelerated case estimate of market potential	7% of base case 3% of accelerated case	-
Change in practices	Role of energy efficiency in consideration of DG/CHP systems	More than half of program participants and 85% of partial non-participants noted an increase in the role of energy efficiency	-
Other indicators	Importance of reliability	30% of system owners mentioned reliability as the primary reason for installing their system	-

<sup>1</sup> Fuel savings are negative, reflecting a net increase in usage at the facility to operate the DG/CHP system.

## **Program Impact Evaluation**

### **Gross Savings**

Nexant, Inc., the Measurement and Verification (M&V) Evaluation contractor for the **New York Energy Smart<sup>SM</sup>** Program, has conducted an independent review of the savings impacts reported by NYSERDA for the System Benefit Charge funded Distributed Generation – Combined Heat & Power (DG/CHP) Demonstration Program. The objective of the review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2005, the program resulted in cumulative annual<sup>2</sup> electric and non-electric energy impacts and summer on-peak coincident demand reductions shown in Table 7-7.

As shown in Table 7-7, the program has resulted in a cumulative annual electric energy savings of 76,706 MWh/year, a coincident on-peak demand reduction of 16.76 MW, and cumulative annual non-electric energy usage at the project sites of 568,289 MMBtu/year in imported fossil fuel. Because the electricity saved by the DG/CHP projects replaces electricity formerly purchased from the grid, the program has reduced fuel used at central generating stations<sup>3</sup> by 688,875 MMBtu/year, for a net decrease statewide of 120,586 MMBtu/year due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. Furthermore, at additional projects such as waste water treatment plants, electricity generation is powered fully or partially by digester gas produced on site. Such fuel switching achieves natural gas conservation above and beyond the 120,586 MMBtu/year described above as achieved through efficiency alone. While the exact number of such projects is unknown, it is estimated these additional savings, i.e. the amount of fuel formerly imported switched to digester gas, is in the range of 110,000 to 285,000 MMBtu/year. The uncertainty in this estimate is due to two observations; only one such project was present in the M&V sample, with a disproportionately high electricity production level, and this project used a mix of purchased natural gas and local digester gas due to operational problems.

The results in Table 7-7 are Nexant's best estimates of the program's impacts based on a reconstruction of the DG/CHP database. The estimates use the findings from reviews and inspections of a sample of eight projects investigated in 2004, plus reasonable engineering assumptions about typical operations based on experience with similar projects. Because of the need to employ assumptions to create a part of the program tracking record, Table 7-7 data may include greater uncertainty than implied by the small confidence interval.

Since completing its first project in 2001, the program has resulted in an estimated cumulative program<sup>4</sup> electric energy savings of approximately 106,369 MWh and has used approximately 729,785 MMBtu of imported fuel, primarily natural gas. The electricity generated by the projects installed under the program has allowed central electric power plants to avoid burning about 927,537 MMBtu in fossil fuels during the same period.

Prior to 2004 the program reported capacity (kW) impacts only and did not explicitly track generated kWh or input energy. In 2004, the M&V evaluation review added electric and non-electric energy

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<sup>2</sup> *Cumulative annual savings* impacts are the savings realized in a single calendar year from all measures installed to date.

<sup>3</sup> The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations.

<sup>4</sup> *Cumulative program* savings impacts are the sum of the savings realized across the life of the program. A measure completed in January of 2001 and that delivers 100 kWh/year annual savings, will have delivered 400 kWh cumulative program savings as of December 31, 2004. The measure still delivers an annual savings of 100kWh/year at the close of 2004.

impacts to the cumulative annual savings. This M&V evaluation report details the electric and non-electric energy impacts realized for the program's projects that were operating as of December 31<sup>st</sup>, 2005.

**Attribution and Net-to-Gross Ratio**

Attribution was last evaluated in 2004. This evaluation consisted of 18 surveys with participating customers, 34 surveys with DG/CHP system developers, 13 surveys with partial non-participating customers (those who applied to the program but were rejected), 20 surveys with manufacturers and dealers of DG/CHP systems, and interviews with five program staff. These surveys achieved confidence/precision levels of 90/8 to 90/11, depending on the audience. Findings from the 2004 evaluation suggest that NYSERDA should use a net-to-gross ratio of 1.07. This net-to-gross ratio is derived using the following inputs from the MCAC surveys responses:

- Freeridership = 15%
- Inside Project Spillover = 7.3%
- Outside Project Spillover = 3.1%
- Non-Participant Spillover = 16%
- Total Spillover = 26%
- $NTG = (1-FR) \times (1+SO) = 1.07$

Adjusted savings are shown in Table 7-7.

**Table 7-7. CHP Program Cumulative Annual Energy and Peak Demand Savings (Through December 2005)**

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freerider -ship Factor	Market Effects/ Spillover Factor	Net-to-Gross Ratio	Net Savings
MWh/year	84,906	0.90	76,706	0.85 (0.75-1.0)	1.26 (1.14-1.39)	1.07 (0.88-1.26)	82,152 (67,501 – 96,649)
MW	17.1	0.98	16.8	0.85 (0.75-1.0)	1.26 (1.14-1.39)	1.07 (0.88-1.26)	18.0 (14.7–21.1)
MMBtu/year <sup>1</sup>	-640,513	0.89	-568,289	0.85 (0.75-1.0)	1.26 (1.14-1.39)	1.07 (0.88-1.26)	-608,638 (-500,094 – -716,044)

<sup>1</sup> Fuel savings are negative, reflecting an increase in fuel at the facility required to operate the DG/CHP system, net of thermal heat recovered.

**Overlap with Other Programs**

The DG/CHP Program works closely with the TA Program. Two out of the 35 projects, comprising approximately 15% of DG/CHP savings, have also had a TA study performed. Overlapping savings have

not been removed from the table above. However, this overlap amount is netted out of the overall savings reported for the **New York Energy \$mart<sup>SM</sup>** portfolio.

**Non-Energy Impacts**

Non-energy impacts were examined by the MCAC Team in 2004. The analysis examined the array of NEIs that participants associate with their involvement in the DG/CHP Program. The estimated NEIs from DG/CHP range from a low of approximately 64% to a high of 128% of the annual energy savings for the projects.<sup>5</sup> Determining a value for these benefits poses challenges, but the methods applied indicate that the magnitude of these benefits could be substantial, *i.e.*, add as much as another 32% to 64% to benefits that are based on electric energy and peak savings.

**7.5.2 Power Systems Technology – Product Development**

**Program Description**

**Program Purpose**

This program aims to develop and field test innovative technologies and products that can provide improved energy efficiency, environmental performance and reliability to electric grid customers. Eligible technologies include: fuel cells, turbines, reciprocating engines, generators, inverters, power conditioning, power generation from waste heat, and tidal hydro.

<b>Program Milestones</b>	
April 2005	PON 914 30 proposals received, 11 project awards
April 2004	PON 800 34 proposals received, 12 project awards
April 2003	PON 750 49 proposals received, 16 project awards
March 2002	PON 669 34 proposals received, 11 project awards
May 2001	PON 536 33 proposal received, 17 project awards

**Program Resources**

The program is funded at \$20 million over eight years. In total, 31 NYSERDA contractors work on this program.

**Targeted Customers**

The program focuses on directly assisting New York State developers and manufacturers developing and introducing new products that advance power generation and distribution performance and provide cost effective options to grid customers.

**Program Barriers**

Barriers the program is working to overcome include:

- DG-Utility interconnection issues
- Fuel Cell durability/cost
- Low- impact hydro permitting issues

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<sup>5</sup> For this report, the assumption is that the multiplier will be applied to the net electric energy savings. Although respondents were asked to report the benefits relative to their energy savings (which may have elements of “gross” savings), the application to net savings is the more conservative assumption.

### Implementation Approach/Activities

The program is implemented through annual PONs, budgeted at \$4 million of the **New York Energy \$mart<sup>SM</sup>** Program funds in conjunction with the DG-CHP Demonstration solicitations. Projects are selected to achieve the following objectives:

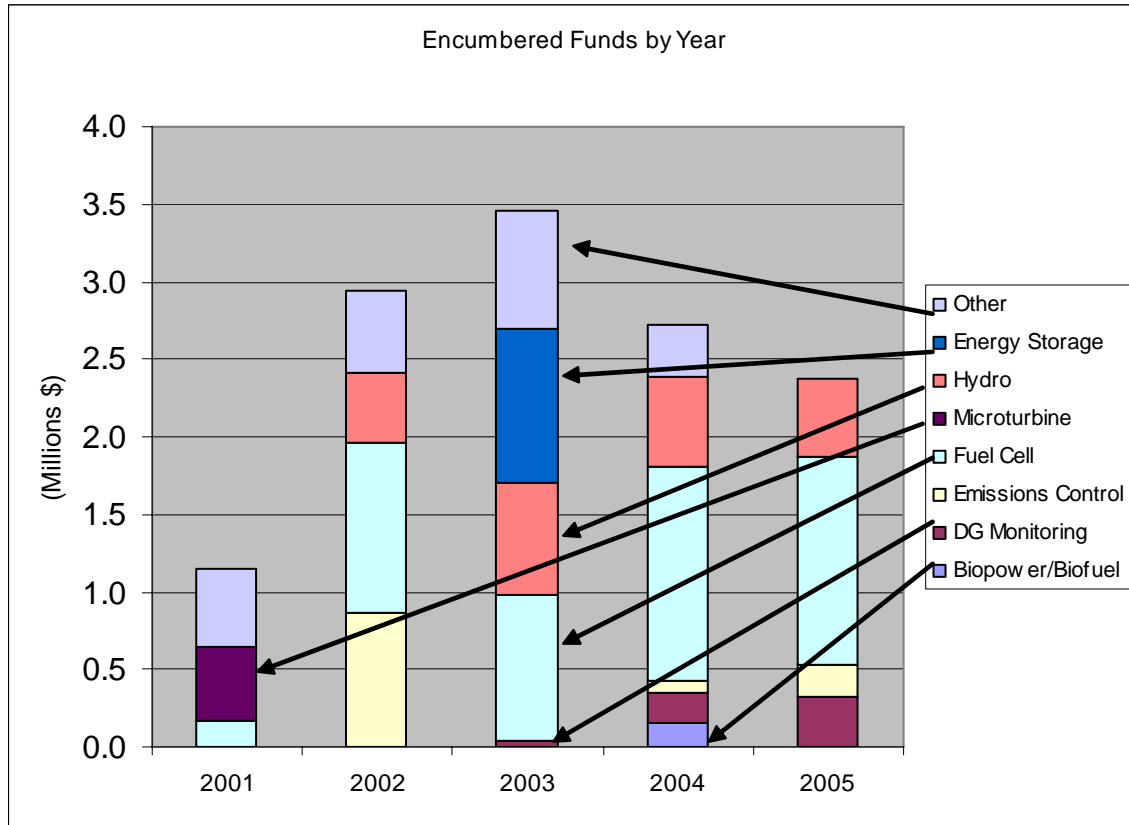
- Develop and field test environmentally preferred distributed generation technologies and products that advance end user power quality and reliability
- Develop technology and business models that reduce peak load and improve grid utilization off-peak
- Document the performance of emerging products
- Address regulatory and institutional barriers
- Provide economic benefits to New York State in terms of lower cost options and new businesses and jobs

This program supports the development new products that when fully commercial are eligible for continued NYSERDA support through the Combined Heat and Power (CHP) Demonstration program, NYSERDA's solar PV and Renewables Program as well as deployment programs offered by Energy Services and REAP. The program additionally supports performance monitoring and testing of CHP demonstration projects.

### Program Evolution

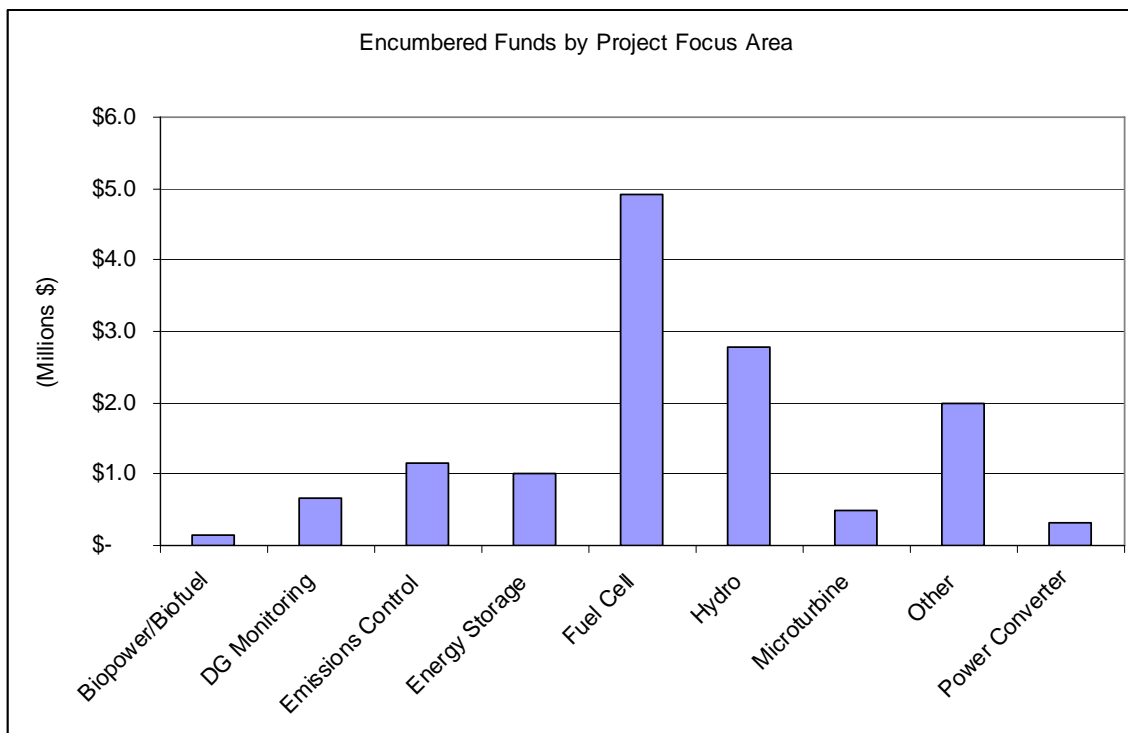
The distribution of focus area by year is depicted in Figure 7-2. In recent years, monitoring of distributed generation systems has received greater emphasis. Renewable technologies, including fuel cells and hydropower, continue to play an important role. The microturbine projects in the early years resulted in a number of lessons learned.

Figure 7-2. Power Systems Technology Projects by Year



The projects distributed by technology focus area is presented in Figure 7-3. Fuels cells, energy storage, and hydropower are the top three area in terms of encumbered funds. Fuel cells, hydropower, and emissions control projects represent the top three categories with the highest number of projects.

**Figure 7-3. Power Systems Technology Projects**



**Program Progress and Impacts**

As new business, such as the aggregation of emergency generators and the fuel cells market developed, products demonstrated in the Power Systems Technology Program emerged as viable commercial options, becoming eligible for incentives from other **New York Energy Smart<sup>SM</sup>** programs. An example of this pass-off to deployment is the commercial introduction of the “ecoJoule 3000” inverter for grid connected residential and small commercial PV systems. This product, manufactured in Malta, New York, provides high- efficiency conversion of DC power from photovoltaic cells to AC power in a design that reduces installation cost to the customer.

A second commercialized product that emerged this past year from work conducted through the Power Systems Technology Program is Plug Power’s GenCore 5T, a backup generator fuel cell designed for the telecommunications market. This product received Network Equipment-Building Systems (NEBS) certification and the first commercial order was shipped. Testing for this product, originally developed under the Power Systems Technology Program, was conducted by Verizon at a terminal hut at the Albany County International Airport.

In another project, with the University at Albany and Electricity Innovation Institute (E2I), an affiliate of Electric Power Research Institute (EPRI), an analysis was conducted to support power quality and reliability requirements of the expanded Albany nanotechnology facility. The project identified best practices and technologies for achieving optimal power quality and reliability. Although specific to the Albany nanotechnology facility, the report and its conclusions are expected to be applied at other high semiconductor and nanotechnology research and manufacturing centers that require stringent power quality and reliability.

## 7.6 End-Use Renewables

### 7.6.1 Program Description

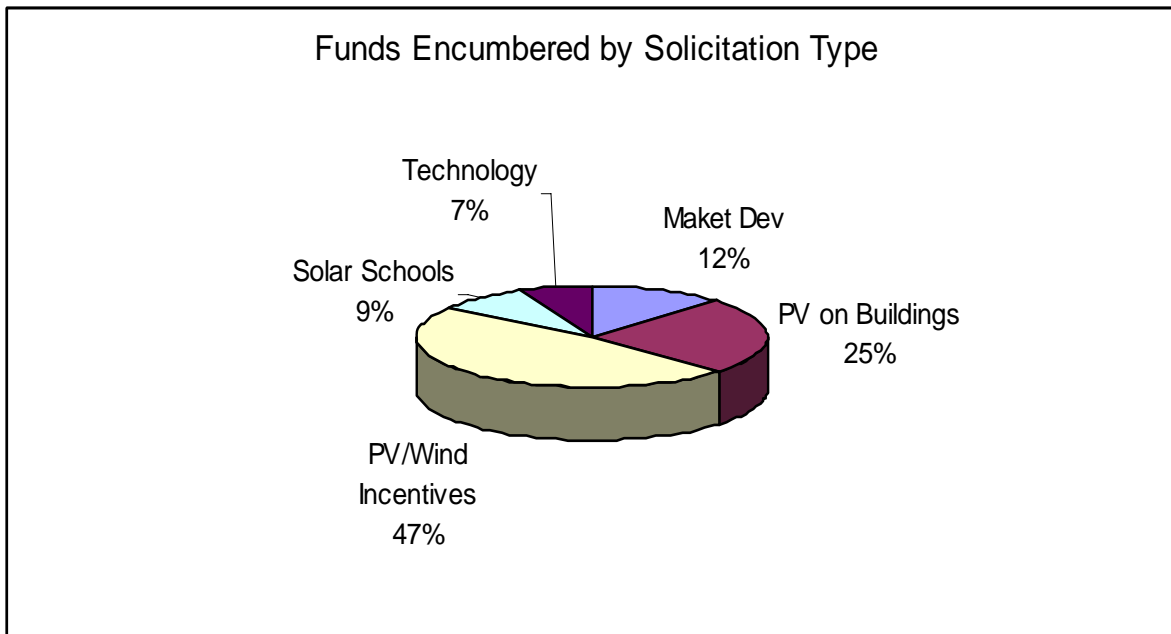
#### Program Purpose

End-Use Renewables (EUR) Program is designed to develop and grow the New York market for customer-sited renewable energy technologies. The program seeks to stimulate and develop both the demand for, and the supply of reliable customer-sited renewable technologies. In stimulating both demand and supply, the program further seeks to contribute to a reduction in installation costs of customer-sited technologies.

#### Program Resources

The program is funded at \$43.7 million over eight years. To date, \$26.2 million has been committed, \$24.4 million has been encumbered, and \$16.0 million has been expended. Program activities and distribution of funds by activity type are shown in Figure 7-4.

**Figure 7-4. End-Use Renewables Program Activities**



Program Milestones	
Nov. 2004	PON 792 Small Wind Incentives
Aug. 2004	PON 885 Accredited PV Training Programs
May 2004	PON 827 Renewable Energy Technology Manufacturing Incentive Program
Dec. 2003	PON 791 PV on Buildings
Sep. 2003	PON 717 Market Development Support for Photovoltaic and Wind Systems
Aug. 2003	PON 737 Renewable Energy Technology Options Program
Dec. 2002	PON 691 PV on Buildings
Oct. 2002	PON 716 Small PV Incentives
Sep. 2002	PON 689 Training for Renewable Energy Practitioners
Sep. 2002	PON 690 PV and Wind Tech. Support
Dec. 2001	RFP 655A NY Energy Star® Labeled and PV-System Homes Demo
Nov. 2001	RFP 622 NY Solar Schools
June 2001	PON 590 Renewable Energy Technologies: Technical Training and Market Support
April 2000	PON 524 High-Value Wind/PV
Oct. 1999	PON 449 PV on Buildings
Mar. 1999	PON 448 Residential PV

To date, almost half of the End-Use Renewables spending has been used to support the installation of PV systems through PON 716 PV Incentives Program and PON 792 Small Wind Incentives and earlier PV incentives program; 25% has been used to support the PV on Buildings program to install large PV systems on commercial and institutional facilities, 13% on market development and training, 9% on Solar on Schools program to support installation of PV systems on K-12 schools; and 6% on the Technology Manufacturing and Technology Options programs to support New York manufacturers in the development and manufacturing of renewable energy technologies.

**Targeted Customers**

The End-Use Renewables Program provides incentives, training, and information to stimulate the demand for and supply of renewable systems among home owners, facility owners (commercial, institutional, agricultural), installers, installation trainers, inspectors, distributors/manufacturers, and technology developers.

**Program Barriers**

The End-Use Renewables Program is designed to promote adoption of customer-sited renewable energy equipment, provide incentives for small wind and PV installations, and support a number of training, education, outreach, and support activities in niche markets. In combination, these activities are working to help build a business infrastructure for end-use renewable generation and to increase the experience of early adopters.

Key demand-side barriers that affect market actors such as residential and commercial end-use consumers, PV and wind system installers, inspectors, builders, developers, realtors, bankers, K-12 schools and regulatory and policy makers include:

- Higher first-cost for equipment relative to standard power options
- Higher installation costs
- Intermittency of small wind and PV power sources limiting viable applications
- Lack of awareness of technologies, financial

assistance, and benefits

- Uncertainty relating to equipment performance (savings claims, reliability, need for battery back-up if the grid experiences difficulties)

- Need for businesses to be shown innovative ways to incorporate renewable technologies to meet energy and non-energy objectives
- Insurance costs and related difficulties
- Lack of access to real-time pricing or time-of-use pricing (would benefit PV)
- Lack of net metering for non-residential PV and lack of net metering for non-farm wind systems
- Impact of potential standby rates and utility back-up charges on project economics

Key supply-side barriers that affect market actors such as PV and wind system installers, inspectors, builders, developers, realtors, bankers, contractors, architects and regulatory and policy makers include:

- Lack of familiarity with technologies among Architectural and engineering (A&E) firms
- Lack of inspectors delaying projects several months (also lack of inspector understanding of the technologies)
- Limited amount of support for installation, operation, and maintenance as market for End-Use renewables still immature
- Reliability (*e.g.*, long-term performance, inverter performance, etc.)
- Cumbersome interconnection processes (*e.g.*, long lead-times, costly utility safety and protection requirements)
- No established methods for valuing renewable energy in resource planning
- Limited market experience affecting resale appraisal

### **Implementation Approach/Activities**

Program activities to increase market demand for end-use renewable systems include:

- Providing incentives to reduce the installed cost per kW paid by purchasers of renewable technologies<sup>6</sup>
- Demonstrating the reliability, performance, and economics of end-use renewable technologies by monitoring energy-output data and making that information available to the public
- Demonstrating innovative applications of customer-sited renewable technologies
- Contributing to the identification of appropriate sites for renewable technologies by making publicly available the Clean Power Estimator tool
- Educating the public about renewable technologies by installing PV systems on schools, developing school curricula related to renewable energy sources and providing it free to the public, assisting schools in educating their communities, and developing consumer information about PV and wind technologies (*e.g.*, brochures, websites)

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<sup>6</sup> The program offers incentives up to 60% of the installed cost of systems up to 50 KW in size (encompassing both residential and nonresidential applications). The incentives are paid to the installer, who contracts with NYSERDA and the customer to lower the customer's cost by the amount of the incentive. NYSERDA offers these incentives only to installers that have been approved for program participation.

- Encouraging the builders of new homes to install PV systems

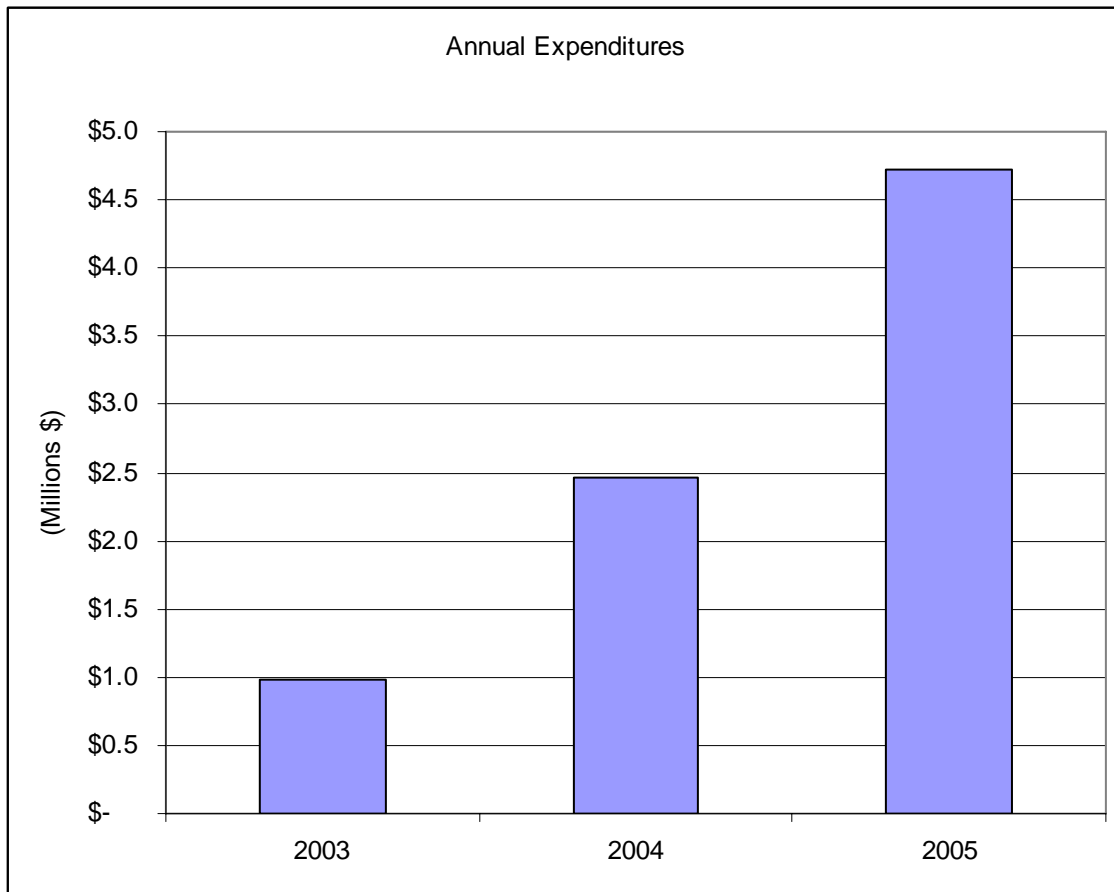
Program's activities to increase the supply to the New York market of reliable end-use renewable technologies and technology installers include:

- Developing and implementing a training program to prepare PV installers for national certification
- Contributing to the development of the national PV certification program
- Offering incentives to distributors/manufacturers
- Offering incentives for innovative applications of renewable systems
- Increasing market demand to support an increased number of installers
- Providing funds to support the development of new technologies, new applications of existing technologies, and new business and manufacturing endeavors in New York
- Providing marketing support to installers through workshops, software tools, brochures, and the credibility of a NYSERDA end-use renewable effort
- Inspecting installations, requiring installers to meter performance data and provide it to NYSERDA, and monitoring reported data
- Contributing to the development of New York interconnection standards

To date, almost half of the End-Use Renewables spending has been used to support the installation of PV systems through PON 716 PV Incentives Program and PON 792 Small Wind Incentives and earlier PV incentives program; 25% has been used to support the PV on Buildings Program to install large PV systems on commercial and institutional facilities, 13% on market development and training of renewable energy technology installers, 9% on Solar on Schools Program to support installation of PV systems on K-12 schools; and 6% on the Technology Manufacturing and Technology Options Programs to support New York manufacturers in the development and manufacturing of renewable energy technologies.

- The annual spending for PV systems under PON 716 increased from \$1.0 million in 2003 to \$4.7 million in 2005 (see Figure 7-5). Through Year-end 2005, 241 systems had been installed representing about 1.3 MW. The total cost of these systems was \$10.3 million and incentives totaled \$5.4 million, approximately 50% of the cost. An additional 100 systems were in progress.
- The curricular materials created for the solar on schools program include 60 lessons that meet learning standards for New York State students in grades five through 12. Many of the lessons make use of the performance data from the fifty schools participating in the program that have PV systems and data monitoring equipment. To date, 47 out of the 50 systems have been installed.
- The PV on Buildings Program has funded 19 projects representing 865 kWac with 610 kWac in the New York City area. Seven projects are completed resulting in 530 KW of installed PV with 122 kW in the New York City area.

**Figure 7-5. PV Incentives (PON 716)**



- To date, 39 training programs with over 1,300 attendees have been held for PV and Small Wind installers.
- Two organizations have been accredited by the Institute for Sustainable Power to provide training to renewable energy technology installers.
- Twenty-two installers have been certified by the North American Board of Certified Energy Practitioners (NABCEP).<sup>7</sup>
- One instructor has been certified by the Institute for Sustainable Power.

**Program Evolution**

The program has attempted to increase the availability of installers. The cost of PV systems is still too high for customers to install systems without financial incentives. Recent solicitations have targeted in-state manufacturing of PV components.

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<sup>7</sup> The North American Board of Certified Energy Practitioners is a volunteer board of renewable energy stakeholder representatives. Its mission is to support, and work with the renewable energy and energy efficiency industries, professionals, and stakeholders to develop and implement quality credentialing and certification programs for practitioners.

## 7.6.2 Program Market Progress

This section highlights the findings on End-Use Renewables Program progress in influencing the market in New York. Table 7-8 presents a sample of key indicators of program success, as tracked by the evaluation and program activities. They indicate the most important ways that the program progress is being measured, and report how those values are changing due to program activities.

**Table 7-8. End-Use Renewables Program Indicators and Progress**

Topic	Indicator	Data Value--2003	Data Value -- 2004	Data Value -- 2005
<b>Short Term Outputs and Indicators</b>				
General Outputs	Number of PV and small wind systems installed (PON 716)	49	140	241
	Dollar value of incentives paid for PV and small wind systems installed (PON 716)	\$1.1 million	\$2.9 million	\$5.4 million
	Total cost of installed PV systems (PON 716)	\$2.1 million	\$5.5 million	\$10.3 million
	Average cost per PV system (PON 716)	\$42,606	\$39,382	\$42,834
Energy Generation	Net MWh and MW generated from installed systems	1,012 MWh and 0.6 MW	2,012 MWh and 1 MW	2,833 MWh and 1.3 MW
Availability of Services	Number of participating installers	14	27	32
	Average full-time equivalents employed by PV installer firms	3.3	7.7	8.0
Awareness and Knowledge	Installer estimates of residential and commercial customer awareness of PV systems	Residential – 18% Commercial – 6%	Residential – 5% Commercial - 4%	Residential – 6% Commercial - 7%
<b>Intermediate and Long Term Indicators</b>				
Market Share and Sales	EUR Program installations as a percentage of total capacity of PV and small wind systems installed in New York	-	-	NYSERDA-funded PV systems account for 29% of the total PV installed capacity on record with PSC NYSERDA's small wind installations represent 25% of the state's total small wind energy capacity on record with PSC
Pricing/Cost	Average total PV system cost per watt (PON 716)	\$8.26/watt (DC) \$9.75/watt (AC)	\$8.31/watt (DC) \$10.20/watt (AC)	\$8.43/watt (DC) \$10.32/watt (AC)
	Installer estimate of market sustainable price for PV systems	\$4/watt for both residential and commercial customers	\$3/watt for residential and \$4/watt for commercial	-

### 7.6.3 Program Impact Evaluation

#### Gross Energy Generation

In 2004, Nexant, Inc. conducted a review of the savings impacts reported by NYSERDA for the End-Use Renewables (EUR) Program. The objective of the review was to verify the estimate of the program’s cumulative savings. Based on Nexant's review, as of December 31, 2005, the program has resulted in energy generation and peak demand reductions shown in Table 7-9. Since beginning in 1999, the program has resulted in estimated cumulative program generation of 5,017 MWh.<sup>8</sup>

#### Attribution and Net-to-Gross Ratio

The Summit Blue MCAC team addressed attribution as part of the in-depth evaluation conducted in 2003. The 2003 evaluation involved surveys with 23 PV installers, 32 PV system owners, two PV training institutions, and others. In both 2004 and 2005, the aspects of the in-depth evaluation were revisited through an Integrated Data Collection (IDC) approach whereby surveys are administered to PV system owners at the time of project completion and PV system installers at the time of program application. Both evaluation updates, in 2004 and 2005, corroborated the original results and suggest that NYSERDA should use a net-to-gross ratio of 1.0 for the End-Use Renewables Program. Net energy generation is shown in Table 7-9.

**Table 7-9. End Use Renewables Program Cumulative Annual Clean Generation (Through December 2005)**

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freeridership Factor	Market Effects Spillover Factor	Net-to-Gross Ratio	Net Savings
MWh/year	2,724	1.04	2,833	1.0	1.0	1.0	2,833
MW	1.6	0.85	1.3	1.0	1.0	1.0	1.3

#### Non-Energy Impacts

The Summit Blue team examined NEIs for the End-Use Renewables Program in 2003. The results imply that total NEIs could be 3.6 times as valuable as the displaced generation. The methods used to develop use values for NEIs represent the current state-of-the-practice, but the MCAC study team has taken a conservative approach in applying these values to renewable energy investments and recommends a value on the order of one-half the estimated value for NEI use values, or 1.6 times the value of the displaced generation.

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<sup>8</sup> Cumulative program savings impacts are the sum of the savings realized across the life of the program. A measure completed in January of 2001 and that delivers 100 kWh/year annual savings, will have delivered 500 kWh cumulative program savings as of December 31, 2005. The measure still delivers an annual savings of 100 kWh/year at the close of 2005.

## **7.7 Wholesale Renewables**

### **7.7.1 Program Description**

#### **Program Purpose**

The Wholesale Renewable Energy Market Development Program is designed to develop the supply and demand for green power. Activities include the following: (1) provide funding for wind plant construction, (2) provided funding to developers of wind sites, (3) provided incentives to green power marketers to market electricity from renewable energy, (4) provide financial assistance to local communities and landowners to help them make informed decisions regarding wind energy development and to proactively seek wind developers, and (5) support the commercialization of willows to feed provide wood to biomass power plants.

#### **Program Resources**

The program is funded at \$36.1 million over eight years. To date, \$23.5 million has been committed, and \$16.0 million has been expended.

#### **Targeted Customers**

The program targets wind developers, power generators, green power marketers, and local communities.

#### **Program Barriers**

Key supply-side barriers that affect market actors such as renewable power plant developers, renewable technology and equipment manufacturers, green power marketers and independent system operators (NYISO) include:

- Potential real or perceived performance and operational issues and New York Independent System Operators (NYISO) market and operating rules impacting supply
- Local opposition to development hindering development
- Difficulty in obtaining financing
- A lack of buyers in the market willing to enter into long-term power purchase agreements (PPAs)

Program Milestones	
December 2003	PON 796 - Financial Assistance for Communities to Facilitate Wind Power Plant Projects. Made three awards at \$50,000 each.
October 2003	RFP 825 - A \$425,000 contract was awarded. This project is funded out of the Institutional Barriers Program.
September 2003	RFP 825 - Study the Effects of Integrating Wind Power on Transmission System Planning, Reliability, Operations
	PON 796 - Financial Assistance for Communities to Facilitate Wind Power Plant Projects.
October 2002	PON 732 - Alternative Fuels Power Generation and Energy Storage issued. Involved multiple programs.
September 2002	PON 731 - Green Power Marketing Incentives issued.
March 2002	PON 672 - Funding for construction of wind power plants.
January 2002	Under PON 599 - CEI Inc. achieved eight MW in sale of wind energy.
December 2001	Fenner Plant completed.
October 2001	PON 607 - Renewable Energy Credit Accounting and Trading System.
August 2000	PON 529 - Wind Prospecting.
September 2000	Madison wind plant completed.
November 1998	PON 437 - Wind power demonstration.

Key demand-side barriers that affect market actors such as green power marketers, end-use customers, regulatory and policy makers include:

- Many customers (depending on context) unwilling to pay a premium to purchase power from renewable sources<sup>9</sup>
- Customers not switching electric power providers in general, making it difficult to get them interested in switching to a green power supplier
- Immaturity of the green power marketing sector and the need to build a customer base
- Consumers generally unaware of the environmental consequences of their power purchase selections

**Implementation Approach/Activities**

Wholesale Renewables Program activities include support for increasing the supply of green power, support for green power marketers, and development and dissemination of information related to green power. Program activities within these three areas are summarized below.

**Green Power Supply Development**

Under this activity, production incentives are provided to owners of renewable energy facilities over a multiple-year period. This activity is making wind power available in

New York, contributing to improved regional air quality, and providing economic stimulus to communities in New York.

**Support for Green Power Marketing**

Under this activity, incentives are provided to green power marketers to encourage active marketing of green power products. The marketers Incentive payments are based on kWh sales. The incentives are used to build and strengthen the market infrastructure and demand for green power. The incentives are

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<sup>9</sup> There is a discrepancy between the expected and actual commitment in paying a green power premium based on surveys and actual contracts.

not used to lower the price to the customer; rather the marketer builds a customer base willing to pay the price premium.

### Information, Analysis and Outreach Activities

This program element is helping to build the knowledge infrastructure for green power by disseminating technical and policy analyses through guides, atlases, and workshops. Activities include: (1) development of a prediction model capable of representing physical properties of near-surface winds to help generators predict and schedule energy production, and estimate power sales revenues; (2) surveying developers and project participants on their experiences with wind power to describe local ordinances, positive and negative experiences, benefits, concerns, and potential issues; (3) a study of the impacts from large amounts of intermittent power on the electric grid; and (4) studies on other policy issues such as cross-border trading and hedge value of renewable energy resources. These analyses inform policy discussions and influence wholesale renewable program design and delivery. In addition, activities in this area have been supporting the development of an accounting and trading system for renewable energy. Key elements from these activities include:

### Community-Based Wind Power Development.

This initiative targets local communities, providing assistance in increasing awareness and knowledge and creating favorable conditions for the development of wind power. Activities, designed to help communities prepare for the siting and construction of wind farms, include:

- Identifying and creating zones where wind development is encouraged.
- Organizing landowners for the purpose of negotiating land use rights.
- Organizing community-based wind power cooperatives.
- Educating the local community about wind power.
- Assessing wind resources at particular locations.
- Technical Training, Education, Outreach, and Market Support. Initiatives funded through this effort include:
  - Commissioning research papers to address institutional and market barriers to the adoption of renewable energy technologies.
  - Conducting technical and analytical research necessary to reduce barriers to market development.
  - Analyzing and verifying performance data.
  - Developing materials such as brochures, literature, videos, and handbooks to educate a variety of audiences on a broad range of topics related to renewable technologies and green power markets.
  - Commissioning of a project to develop an attribute certificate accounting and trading system. Two business plans have been developed and are poised for deployment in New York. If New York regulators were to decide to adopt such a system and make the necessary rule changes, the system could be adopted within a year and a half and would provide a credit system.

**Program Evolution**

The Wholesale Renewables Program is designed to increase the supply and demand for green power in the wholesale market. The program supports efforts to increase the availability of, and demand for, power generated from renewable energy resources. The wholesale renewable energy market in New York has grown successfully in the last several years, building from a previous base of hydroelectric- and biomass-based power to now include substantial amounts of utility-scale, grid-connected wind power. Future growth in wholesale wind power will depend on how the market develops as driven by a variety of factors. Some factors are of particular importance: production tax credits, general wholesale power market development, associated power purchase agreements, and a possible renewable energy portfolio standard.

**7.7.2 Program Market Progress**

This section highlights the findings on Wholesale Renewables Program progress in influencing the market in New York. Table 7-10 presents a sample of key indicators of program success, as tracked by the evaluation and program activities. They indicate the most important ways that the program progress is being measured, and report how those values are changing due to program activities.

**Table 7-10. Wholesale Renewables Program Indicators and Progress**

Topic	Indicator	Data Value--2003	Data Value -- 2005
<b>Short Term Outputs and Indicators</b>			
General Outputs	Number of wind plants constructed	2	2
Energy Generation	Net energy generation	99,995 MWh and 6.3 MW	99,995 MWh and 6.3 MW
Awareness and Knowledge	Residential customer understanding of green power	66% of residential customers have some understanding of green power	-
Availability of Services	Number of green power packages available to residential and business customers	6 residential 6 business	-
<b>Intermediate and Long Term Indicators</b>			
Market Share and Sales	Number of customers buying green power by type	13,860 Residential 140 Commercial 8 Industrial 14,008 Total	-
	Contracted green power sales by customer type	73,189 MWh Residential 26,599 MWh Commercial 28,115 MWh Industrial 127,904 MWh Total	224,724 MWh Total
Pricing	Installed cost of wholesale wind	\$1,000 - \$1,400 per kilowatt	-

Topic	Indicator	Data Value--2003	Data Value -- 2005
	Green power price premium for residential and business customers	Depending on the package: 0.5 – 2.5 cents per kWh for Residential 0.5 – 2.0 cents per kWh for Business	-

### **7.7.3 Program Impact Evaluation**

#### **Gross Energy Generation**

Nexant, Inc. reviewed the basic savings calculations and data records for the Wholesale Renewable Energy Market Development Program. The objective of the review was to verify that the algorithms and engineering assumptions used to report the program’s impacts were reasonable and conform to accepted practice and that the data tracking record confirms the reported impacts.

Based on this review, the estimated cumulative annual<sup>10</sup> energy production and capacity credit for wind power generation plants promoted by the program are shown in Table 7-11. Since the program began in 1998, it has resulted in an estimated cumulative program energy production<sup>11</sup> of 418,348 MWh. The program’s impacts are based on production records from the two wind power generation plants that have been enrolled in the program. The data and the data tracking tools are deemed reliable.

The program does not require plant operators to report summer on-peak period capacity. Using past production records provided by NYSERDA, Nexant estimated this metric in 2003, as part of the M&V review for the program. No additional projects were completed in 2004 or 2005; therefore the estimated energy savings and peak demand reduction impacts are unchanged from 2003 levels.

#### **Attribution and Net-to-Gross Ratio**

In 2003, the MCAC Team examined attribution as part of a larger evaluation effort. Interviews with wind developers/operators (5), green power marketers (4), ESCOs (6), and NYSERDA staff formed the basis of this analysis. Surveys with various end-use customer groups including a residential mail survey, and surveys with New Construction and TA Program participants also informed this effort. In summary, this preliminary analysis showed that little or no adjustment was needed in the gross energy generation claimed for the Wholesale Renewables Program. Therefore, the recommended net-to-gross ratio is a 1.0. See Table 7-11.

<sup>10</sup> *Cumulative annual* savings impacts are the savings realized in a single calendar year from all measures installed to date.

<sup>11</sup> *Cumulative program* energy production is the sum of the electricity produced across the life of the program. A facility that produces 100 kWh/year, will have produced 500 kWh after five years.

**Table 7-11. Wholesale Renewables Program Cumulative Annual Clean Generation (Through December 2005)**

	Program-Reported Generation	Realization Rate	Adjusted Gross Generation	Freeridership Factor	Market Effects Spillover Factor	Net-to-Gross Ratio	Net Generation
MWh/year	99,995	1.0	99,995	1.0	1.0	1.0	99,995
MW	6.3	1.0	6.3	1.0	1.0	1.0	6.3

## 7.8 Environmental Monitoring, Evaluation, and Protection (EMEP)

### 7.8.1 Program Description

#### Program Purpose

The New York Energy \$mart<sup>SM</sup> Environmental Monitoring, Evaluation, and Protection (EMEP) Program is designed to provide objective and policy-relevant research that results in:

- Enhanced understanding of the nature and characteristics of energy-related pollution and its impact on the environment and human health
- Characterization of sources of energy-related pollution
- Identification of opportunities for emissions reduction

The specific objectives of EMEP are to:

- Support baseline studies of ecosystems to support monitoring and assessment of electricity-related pollution
- Increase understanding of fate and transport of electricity-related pollutants and impacts of transboundary pollution (i.e., pollution originating outside of New York)
- Support studies that place electricity-related pollution in the context of other sources and exposure, including indoor versus outdoor
- Provide science-policy integration in energy-related environmental areas such as acid deposition, mercury contamination, fine particles, and ozone

Program Milestones	
Dec. 2004	Program review meeting with program advisors focusing on outreach and science policy communication strategies
Oct. 2003	Third EMEP conference and program planning meeting with program advisors
May 2003	PON 682 Fourth round of environmental research projects
Mar. 2003	Project review meetings with researchers and program advisors (air quality and health-related projects)
Oct. 2002	Project review meetings with researchers and program advisors (ecosystem- related projects)
Sep. 2001	Second EMEP conference
Jul. 2001	Program review and development of a plan to fill critical gaps and identify research priorities
Sep. 2000	Project review meetings with researchers and program advisors
Mar. 2002	PON 594 EMEP Program Outreach and Science-Policy integration
Mar. 2001	PON 586 Third round of environmental research projects
Apr. 2000	PON 540 Second round of environmental research projects
Dec. 1999	First EMEP conference
May 1999	PON 497 Second round of instrumentation projects
Nov. 1998	PON 446 First environmental research projects solicitation
Nov. 1998	PON 444 First instrumentation projects solicitation

**Program Resources**

The program is funded at \$21.5 million over eight years. To date, \$21.5 million has been committed, and \$16.1 million has been expended.

**Targeted Market Actors**

The program is designed to influence environmental research scientists, policy makers, analysts and other stakeholders including: the New York State Departments of Environmental Conservation, Health and Public Service, the Adirondack Park Agency, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, utility organizations, , other public interest organizations, university-based, federal and non-profit researchers, and industry.

**Program Barriers**

Key barriers include:

- Limited resources available to serve the environmental research needs of New York State and others
- Lack of stable funding stream, previously provided by New York’s electric utilities, for environmental research – since utilities are no longer in the generating business and thus aren’t obligated to sponsor environmental research
- Limited synthesis and communication activities in addition to traditional scientific pursuits
- Lack of an effective interface between scientists and policymakers based on reliable and timely “translation” of information and views between the two communities – impacts sound environmental decision making
- Lack of periodic knowledge assessments that can provide scientists and policymakers with reliable and timely “state of the science” reports on the environment as a whole as well as on particular topics
- Need for more interdisciplinary and multidisciplinary approaches to increase likelihood of successful environmental decision making
- Limited coordination of the missions and efforts of

organizations involved in environmental decision making – resulting in the likelihood of voids or duplications in necessary programs

### **Implementation Approach/Activities**

- *Research planning.* NYSERDA, with the assistance of more than 30 external scientists and policy experts, developed a multiyear research plan for the EMEP Program at the initiation of SBC II (available at [www.nyserda.org/programs/environment/emepplan.pdf](http://www.nyserda.org/programs/environment/emepplan.pdf)).
- *Competitive solicitations and science/policy review.* EMEP periodically issues Program Opportunity Notices (PONs) to seek proposals that address research areas identified in the research plan. Projects are reviewed and selected through a competitive process. The program is guided by a steering committee of major stakeholder groups. In addition, a separate science advisory committee provides technical review and project input.
- *Collaborative research.* The program supports an interdisciplinary approach to environmental research and seeks to build research capability in New York State to address critical energy-related environmental issues. EMEP has catalyzed numerous multi-institution collaborative efforts, bringing different perspectives and expertise into many projects.

*Information exchange.* EMEP places a premium on information exchange. The program seeks to accelerate the process of introducing the latest scientific findings into the realm of policy formulation, ultimately to increase the effectiveness of environmental control strategies and improve environmental quality. EMEP sponsors conferences and workshops to bring stakeholders, scientists, and policy makers together to discuss environmental research issues in New York State and the region. EMEP produces a variety of technical reports, publications, and web-based resources (see [www.nyserda.org/programs/environment/emep.asp](http://www.nyserda.org/programs/environment/emep.asp)).

The number of projects initiated and completed are shown in Table 7-12. Also shown are the number of monitored sites. The distribution of funds encumbered by research area is shown graphically in Figure 7-6. The funding was approximately evenly split between air quality and ecosystems with 5% allocated to crosscutting projects. The number of projects initiated by year is shown in Figure 7-7.

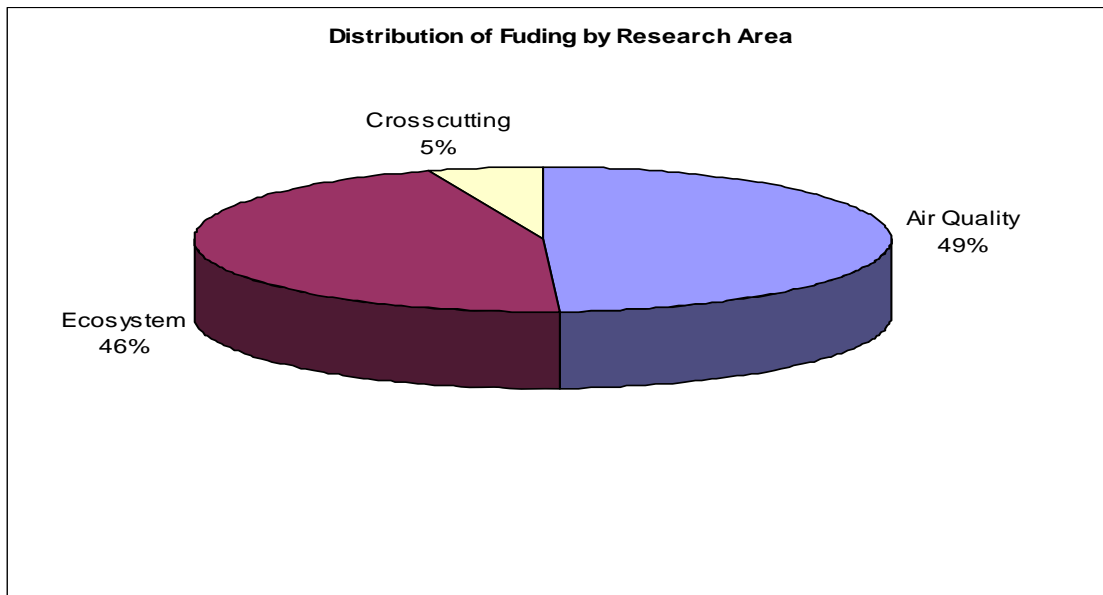
**Table 7-12. Distribution of EMEP Projects, Through December 2005**

Research Area	EMEP Funding (\$ Million)	Total Project Investment (\$Million)	Projects Initiated	Projects Completed	Number of field sites
Ecosystem (Acid Rain/Mercury)	\$9.4	\$20.0	21	3	Over 130 acid deposition sites <sup>1</sup> Over 245 mercury deposition sites <sup>2</sup>
Air Quality (Ozone/Particulate Matter)	\$9.8	\$20.0	18	8	14 field stations 2 research labs
Cross-cutting	\$1.1	\$1.6	7	-	10 wet deposition sites 6 watershed sampling sites 10-20 dry deposition sites
<b>Total</b>	<b>\$20.3</b>	<b>\$41.6</b>	<b>49</b>	<b>11</b>	

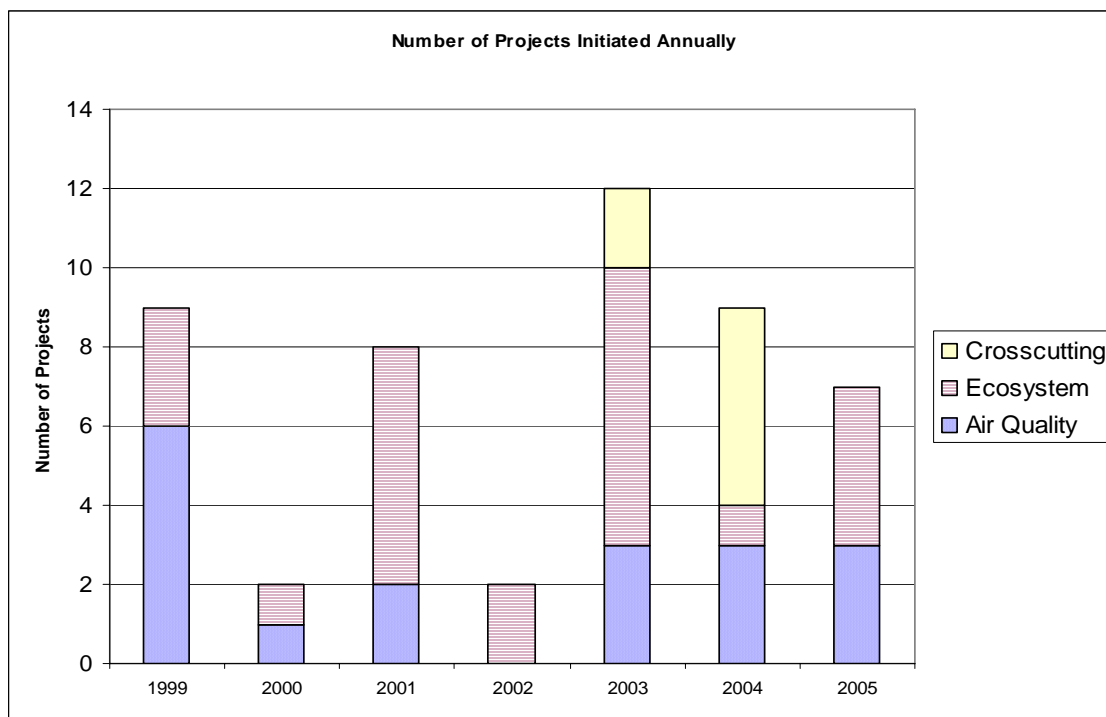
<sup>1</sup> Includes 52 long-term lake monitoring sites and 70 soil sampling sites.

<sup>2</sup> Includes 200 fish survey sites and 40 loon/fish survey sites.

**Figure 7-6. EMEP Research Areas**



**Figure 7-7. EMEP Projects Contracted**



### 7.8.2 Program Results

EMEP is currently supporting a diverse research portfolio in three major areas:

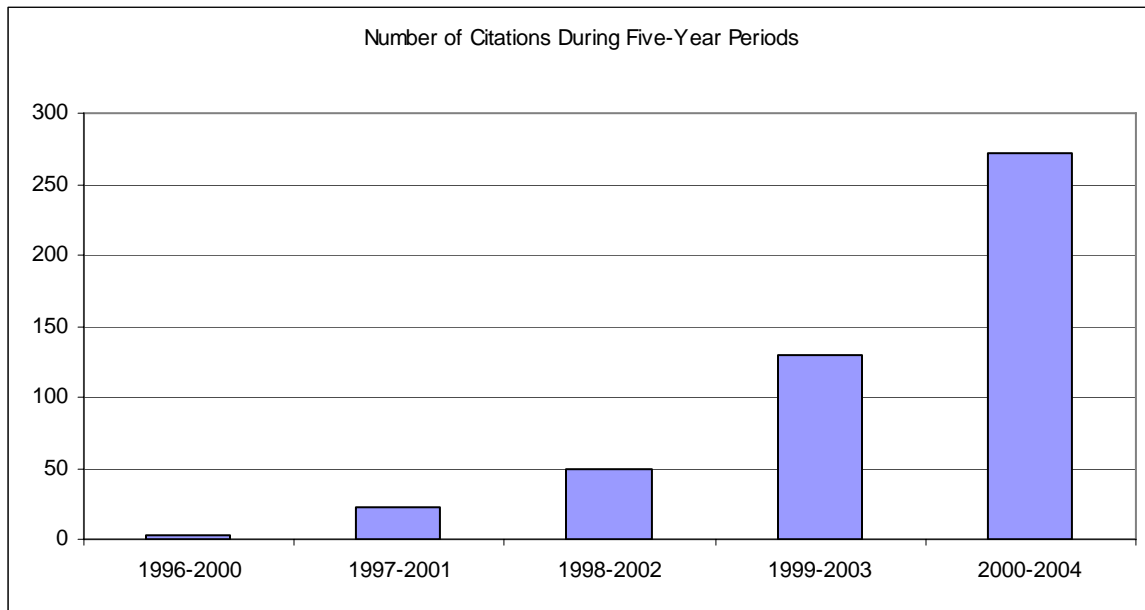
- Ecosystem response to deposition of sulfur, nitrogen, and mercury.
- Air quality and related health research associated with particulate matter, ozone, and co-pollutants.
- Crosscutting environmental science, technology, and policy projects.

In 2001, NYSERDA brought together a group of experts to identify critical gaps and further define research needs in the area of energy-related environmental research, building on the goals/objectives above. A detailed EMEP Research Plan was developed (refer to [www.nysERDA.org/programs/environment/emep](http://www.nysERDA.org/programs/environment/emep)) and has been used to guide and target subsequent EMEP research solicitations.

Significant progress has been made on all of the primary EMEP objectives as described below.

- A total of 49 projects have been initiated, and 11 have been completed. Environmental monitoring data from hundreds of field sites throughout New York State have been collected to support program goals. Table A-11 shows project status.
- Over 125 peer-reviewed journal articles have been published based on research supported by the EMEP Program. A citations analysis was conducted in mid-2005. As shown in Figure 7-8, the number of citations of articles published by EMEP researchers have been increasing steadily, from 3 citations during the 1996 to 2000 time period to 272 during the 2000 to 2004 time period.

**Figure 7-8. Citations from Articles Published by EMEP Researchers**



- EMEP funds to date have attracted an additional \$22 million in project co-funding, and have provided the State match necessary for the DEC to procure \$7 million of federal funds for related air quality monitoring and research. This EMEP leveraging is helping to establish a vibrant, world-class environmental research capability in New York State.
- Technology development efforts supported under the program are providing economic development opportunities for New York firms, with new instrumentation products developed under EMEP already exceeding \$1 million in annual sales.
- Researchers supported by EMEP have provided dozens of briefings to State and federal policymakers in a variety of forums including Congressional briefings/testimony, one-on-one briefings, and workshop and conference briefings.
- EMEP has organized and sponsored three major conferences, several workshops, and dozens of technical project review meetings which have provided a forum for scientists and policy makers to exchange information and increase the value of New York’s environmental research investment (see Section 8 of the report).
- EMEP projects have affected energy-related environmental policy and research as described below:
  - Data from the Adirondack Lakes Survey Corporation's Long Term Monitoring project, of which EMEP is the primary funder, has been instrumental in the development of Governor Pataki's Acid Deposition Reduction Initiative.
  - Several EMEP research projects are providing the scientific foundation for the development of a PM2.5 State Implementation Plan, which will ultimately affect utilities and other fossil fuel combustion systems in New York.

- EMEP research on transboundary pollution led the U.S. Environmental Protection Agency to change its guidance for complying with ozone air quality standards.
- EMEP research was the first to advance the concept of an “airshed” for ozone and PM management - a concept that has now been embraced in a recent National Academy of Science report which recommends that new regulations consider how air pollution travel from state-to-state.
- EMEP support of the two Mercury Deposition Network stations in New York State, as well as mercury surveys on common loons and fish, are providing an environmental baseline that will be used to evaluate effectiveness of new mercury emission reductions soon to be enacted/promulgated affecting utilities.
- EMEP research has brought to light the vast extent of mercury contamination in fish in waters across New York State. EMEP monitoring data have resulted in one of the largest changes in the fish consumption advisories by the Department of Health in over a decade.

## **7.9 Strategic Energy Reliability**

### **7.9.1 Program Description**

#### **Program Purpose**

This program aims to enhance the reliability of electric power by developing technologies and fuels that can provide grid support and end user reliability options during times when the electric system is operating at peak capacity or having power quality problems.

#### **Program Resources**

The program budget is \$7 million. In total, 15 NYSERDA contractors work on this program.

#### **Targeted Customers**

This program targets companies that develop, test, or evaluate power systems and electric energy storage technologies, and utilities, companies, PSC and NYISO that have an interest in evaluating demonstrated energy storage technologies.

#### **Program Barriers**

High system cost combined with unfavorable utility rate structures and interconnection requirements are the primary barriers to widespread use of electric storage technologies. Real-time pricing combined with documented project benefits and best practices are seen as approaches to overcome these issues.

#### **Implementation Approach/Activities**

A PON, budgeted at \$2 million per year, is released annually. Maximum funding per project is \$500,000 for alternate fuels projects, \$1 million for energy storage projects, and \$100,000 for feasibility studies. PON 846 made \$3.5 million available for electric energy projects allocated as follows: up to \$1 million for demonstration projects; \$500,000 maximum for new product development projects; and up to

\$100,000 for market analysis/feasibility studies. This program is integrated with renewable energy generation and peak-load management programs.

Program Milestones	
September 2004	Eight (out of 11) Projects approved for \$2.6 million
March 2004	PON 846 Electric Energy Storage
February 2003	Nine (out of 17) projects approved for \$2.1 million funding
October 2002	PON 732 Alternative Fuels Power Generation and Energy Storage (Round 2)
January 2002	Four (out of eight) projects from approved for \$1.8 million.
September 2001	PON 616 Alternative Fuels Power Generation and Energy Storage (Round 1)

**Program Evolution**

Program focus shifted away from alternative fuels for power generation exclusively towards the development and demonstration of electric energy storage technologies. Over the five year period of the program several projects which began as product development efforts have phased to field tests and demonstrations of product that are now commercial.

**7.9.2 Program Progress and Impacts**

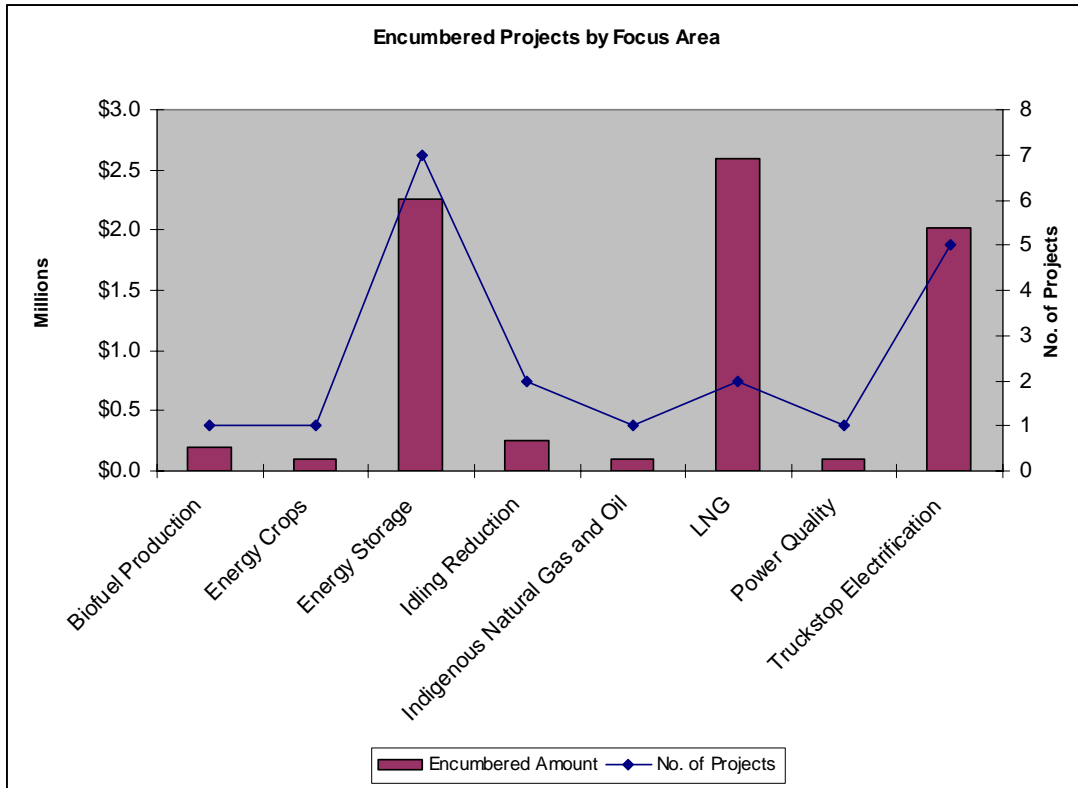
To date, a total of 21 projects was contracted through the program. The distribution of these projects in amounts encumbered and number of projects for major focus areas is shown in Figure 7-9. Energy Storage, Liquefied Natural Gas, and Truckstop Electrification represent the top three areas in terms of funding. Funding activity by year is shown in Figure 7-10. Energy Storage projects predominated in 2005. The status of the projects, and funding and co-funding amounts are shown in Table 7-13. A sample of projects and their descriptions are provided below.

- *Distributed Load Leveling Device with Utility Control.* In this project GAIA Power would develop a modular stationary power system (MSPS) for both residential and commercial applications. The MSPS will consist of a battery based

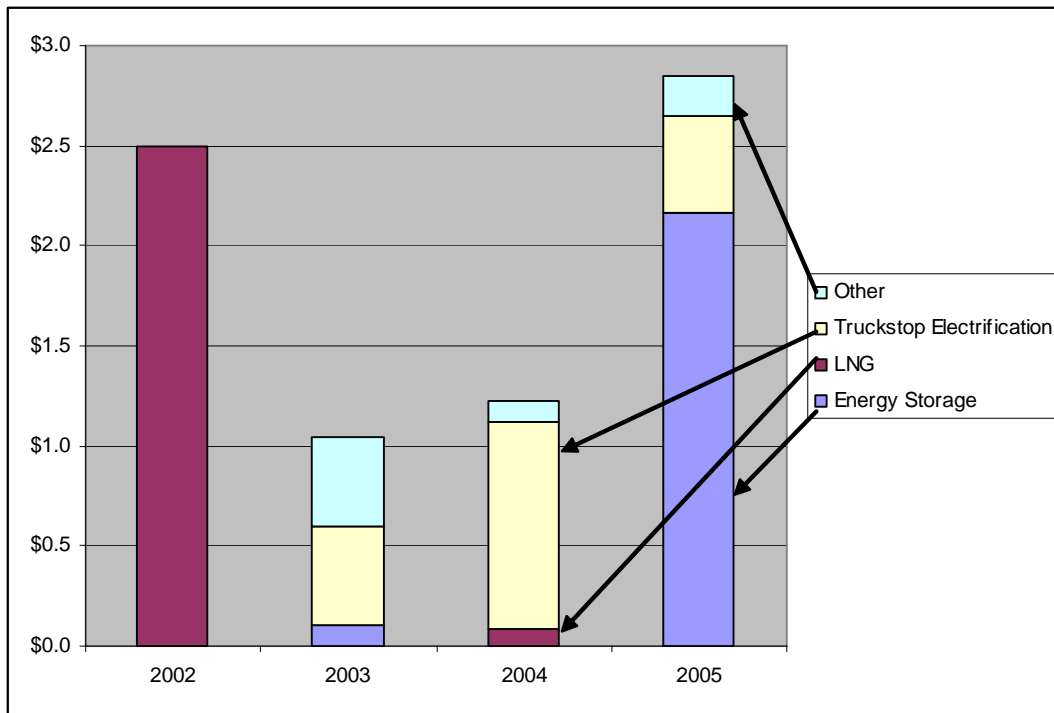
distributed energy storage system for peak shaving, load leveling, and providing uninterruptible power supply (UPS) than typical UPS systems. The system will also have the unique feature of a built-in communications and control capability that can be interfaced to building load management and also be used for utility monitoring and control. This product would improve power quality and reliability both on the grid and at the consumer's site, as well as providing potentially substantial demand charge reductions.

- *Demonstration of Commercial Energy Storage Device.* Gaia Power Technologies, Inc. installed an 11-kW, 10-kWh capacity PowerTower modular energy storage device at a private residence served by the Delaware County Electric Cooperative (DCEC) in Delhi, NY. The installation included system instrumentation and communication equipment/software to enable automatic data collection and remote monitoring. The US Department of Energy through Sandia National Laboratories is funding the services of Enernex, Inc. for data acquisition and analysis. After correcting initial data acquisition problems, the PowerTower system is now commissioned. Initial operations with the Plug Power propane fuel cell indicated usually acceptable performance in meeting most of residence's electric loads. Annoying light flicker problems are observed as a result of the high-current draw of an electrically-connected hot tub located outside the building. After investigation, Gaia concluded that this problem is caused by the electrical wiring and fuel cell interconnections used for this demonstration. This is not expected to be a problem when the PowerTower is connected to the grid. In accordance with contract provisions, long-term performance testing with and without the fuel cell is in progress. DCEC presented project results at the international Electric Energy Storage Applications and Technologies (EESAT) 2005 Conference in San Francisco, CA in October.

**Figure 7-9. Strategic Energy Reliability Projects**



**Figure 7-10. Strategic Energy Reliability Projects Initiated by Year**



**Table 7-13. Strategic Energy Reliability Projects Funding and Co-Funding**

Focus Area	Number of Projects Initiated	Number of Projects Completed	NYSERDA Encumbered Funds	External Co-funding	Co-funding Ratio <sup>1</sup>
Biofuel	1	0	\$0.2 Million	\$0.3 Million	1.5
Energy Crops	1	1	\$0.1 Million	\$0.1 Million	1.0
Energy Storage	7	1	\$2.3 Million	\$3.4 Million	1.5
Idling Reduction	2	1	\$0.3 Million	\$1.4 Million	4.7
Natural Gas and LNG	3	1	\$2.7 Million	\$1.7 Million	0.6
Power Quality	1	1	\$0.1 Million	\$0.0 Million	0.2
Truckstop Electrification	5	3	\$2.1 Million	\$2.6 Million	1.3
Other	1	1	\$0.5 Million	\$0.5 Million	1.0
<b>Total</b>	<b>21</b>	<b>9</b>	<b>\$8.1 Million</b>	<b>\$9.9 Million</b>	<b>1.2</b>

<sup>1</sup> Discrepancies in the ratios due to rounding of funding values.

- NYS LNG Development Program.* A multi-phased project to site, permit, design, and construct a small-scale natural gas liquefaction facility in New York State. After significant team building, the first phase has been structured into three distinct efforts: 1) providing technical assistance to DEC in the drafting of Regulations for the post-moratorium siting of new LNG facilities, 2) drafting new Legislation to modify Article 17-Title 23 of the Environmental Conservation Law, which requires DEC siting oversight, and 3) outreach and safety training information designed for the local authorities that will ultimately be dealing with the new LNG facilities. Later phases of the project will focus on the engineering design, permitting issues, and facility construction.
- Grid Frequency Regulation by Recycling Energy in Flywheels.* Beacon Power, Inc. is assembling the seven-flywheel “Smart Energy Matrix” energy storage system at their Wilmington, MA facility. Most of the components for the system are produced in-house with the exception of the electronic control modules (ECM) for each of the flywheels. Beacon modified the design of the ECMs because of lessons learned from the demonstration of a similar “Smart Energy Matrix” demonstration system installed and undergoing performance testing at the Distributed Utility Integration Test (DUI) Substation Test Facility of Pacific Gas & Electric Co. in San Ramon, CA. Concurrently, Beacon began site preparation at Power and Composite Technologies, Inc. in Amsterdam, NY for the site demonstration. A concrete bed for the container housing the flywheel energy storage system demonstration was put in place, as well as wires for system communication, remote monitoring and data acquisition. A summary of this project was included in a presentation by Beacon at Electric Energy Storage Applications and Technologies (EESAT) 2005 conference. The “Smart Energy Matrix” system is now installed at PCT on the customer side of the meter and is undergoing preliminary testing.
- Sodium Sulfur (NAS) Battery Energy Storage Demonstration.* NYSERDA executed a contractual agreement with NYPA for the project. Instead of a turnkey contract with ABB (Asea Brown Boveri) to furnish and install a 1-MW, 7.5 MWh NAS Battery Energy Storage System (BESS) at the Metropolitan Bus Terminal in Garden City, Long Island. NYPA decided to prepare and execute two

separate contracts, one with NGK Insulators, Ltd. For the battery system, and another with ABB for the power electronics and control system. NYPA gave a presentation of the project at EESAT 2005. It is anticipated that the NAS BESS will be operational for the summer 2006 electric load.

- *Electric Energy Storage Market Analysis Studies.* EPRI Solutions, jointly with Customized Energy Solutions, investigated the market potential for several advanced electric energy storage technologies in New York State's competitive electric markets. Several meetings were scheduled and held with New York Independent System Operator (NYISO) personnel to obtain electric market data, updates of changes to market rules, critical reviews of the study's progress, and guidance for additional project work. A draft final report was prepared and circulated for review. Preliminary conclusions of the study indicated that electric energy storage could be competitive in certain specific existing electric markets in the New York City/Long Island NYISO Control Area Load Zones. Customized Energy Solutions presented the study at EESAT 2005.
- *Mini-Compressed Air Energy Storage (Mini-CAES) for Transmission Congestion Relief and Wind Shaping Applications.* Ridge Energy Storage and Grid Services performed a feasibility study for adapting a high-pressure natural gas storage technology, based on manifolded pressure vessels, for storing compressed air and combining it with CAES energy conversion equipment to provide a geologically independent energy storage option in New York State. The "mini-CAES" concept can be suitably sited to enhance the value of intermittent and unpredictable energy sources such as wind power generation. The study is nearly completed and a draft final report is in preparation. Preliminary results seem to indicate that the concept may not be competitive in the current New York electric market. Ridge Energy gave a presentation about the study at EESAT 2005.
- *New York State Energy Storage Market Analysis.* Distributed Utility Associates will develop a methodology for characterizing the potential benefits of grid-interactive, modular electric energy storage technology, and will evaluate the market potential for a range of applications in New York State. It is anticipated that study results will be used for developing future energy storage research and development project solicitations.
- *Electric Energy Storage Market Analysis Studies.* ElectricPower Research Institute (EPRI) Solutions will develop an analysis methodology that will allow calculating quantitative economic benefits of electric energy storage applications in New York State, given current market rules. The study will evaluate if energy storage technologies will be cost-competitive with the technologies and strategies currently in use to provide frequency regulation, arbitrage, equipment upgrade deferral, peak shaving, power quality, etc. The study will identify multiple value streams arising from electric energy storage, especially those benefits that cross institutional and organizational boundaries.

## **7.10 Next Generation of Energy-Efficient End-Use Technologies**

### **7.10.1 Program Description**

#### **Program Purpose**

This program seeks to accelerate the demonstration and commercialization of emerging technologies such as smart sensors, superconductivity, innovative controls, advanced diagnostics, and end-use technologies that reduce load and/or facilitate price responsive demand. Projects will result in increased energy efficiency, improved power quality, demand and peak-load management benefits, and higher reliability of

the electricity grid. Projects also address the dissemination of objective information, which helps improve decision-making and the selection of technologies and energy services.

### **Program Resources**

The eight-year budget for this program is \$30.1 million.<sup>12</sup> Approximately \$6 million has been awarded for superconductivity; approximately \$4.8 million has been reserved for Time-Sensitive Pricing Demonstration solicitations, and the rest for the remaining solicitation. Currently, 50 different companies/firms participate in this program. The co-funding ratio for all projects is 2.5. That is for every dollar committed, \$2.5 is provided by the contracting party.

### **Targeted Customers**

Emphasis is on market allies that are producers of energy-efficient technology which would be commercially available to end users. Demonstration solicitations are open to all end-use customers, particularly those with high electric loads.

### **Program Barriers**

Innovative emerging technologies that have diffuse or uncertain returns and/or markets such that private investment is not forthcoming.

### **Implementation Approach/Activities**

Two types of solicitations are issues. One type of solicitation casts a wide net whereas the other type specifies a narrowly defined technology area.

### **Program Evolution**

In 2001, the program name was changed from Energy Efficiency R&D and Strategic R&D Programs. At that time, transportation and power generation projects became ineligible for this program and separate solicitations were created and funded for those areas by the second round of SBC funding. Since then time, the program has expanded to other areas including demand response technologies and superconductivity.

In 2005, a residential control technologies solicitation was issued for the first time. In 2006, a second round of this residential controls technology will be issued as well as a third round of Energy Management & Power Quality and a third round of Time-Sensitive Pricing. A new solicitation focusing on advanced building technologies will also be issued in 2006.

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<sup>12</sup> Includes \$455,000 for projects transferred from the Empire State Electric Energy Research Corporation (ESEERCO).

Program Milestones	
June 2005	PON 929 Next Generation Energy Efficient Residential Control Technologies
Jan. 2005	PON 907 Energy Management & Power Quality Round 2
Nov. 2004	PON 886 Next Generation Energy-Efficient Technologies Round 5
Sep. 2003	PON 803 Time-Sensitive Pricing Round 2
Sep. 2003	PON 808 Energy Management & Power Quality Round 1
Jan. 2003	PON 724 Next Generation Energy-Efficient Technologies Round 4
Oct. 2002	Workshop on Time Sensitive Pricing
Aug. 2002	PON 671 Time-Sensitive Pricing Round 1
Aug. 2001	PON 608 Next Generation Energy-Efficient Technologies Round 3
June 2001	PON 612 Super-conductivity
Oct. 1999	PON 509 Energy Efficiency R&D Round 2
Sep. 1998	PON 438 Energy Efficiency R&D Round 1

### 7.10.2 Program Progress and Impacts

Program goals include:

- Developing and commercializing the next generation of high-efficiency products.
- Developing and commercializing components or systems that enhance energy management and power quality.
- Supporting the development of technologies that provide long-term solutions to the State's energy needs.

The program supports development and/or commercialization of components or systems that enhance energy management and power quality such as control and automation technologies, peak-load management technologies, advanced diagnostic and self-commissioning control and automation technologies, advanced variable-speed drives and advanced motors, advanced metering, and remote measurement and monitoring systems. The distribution of encumbered funds by year for major solicitation areas are shown in Figure 7-11. A few of these areas are discussed below. Figure 7-12 shows the number of projects by selected focus areas.

Figure 7-11. Next Gen Solicitations

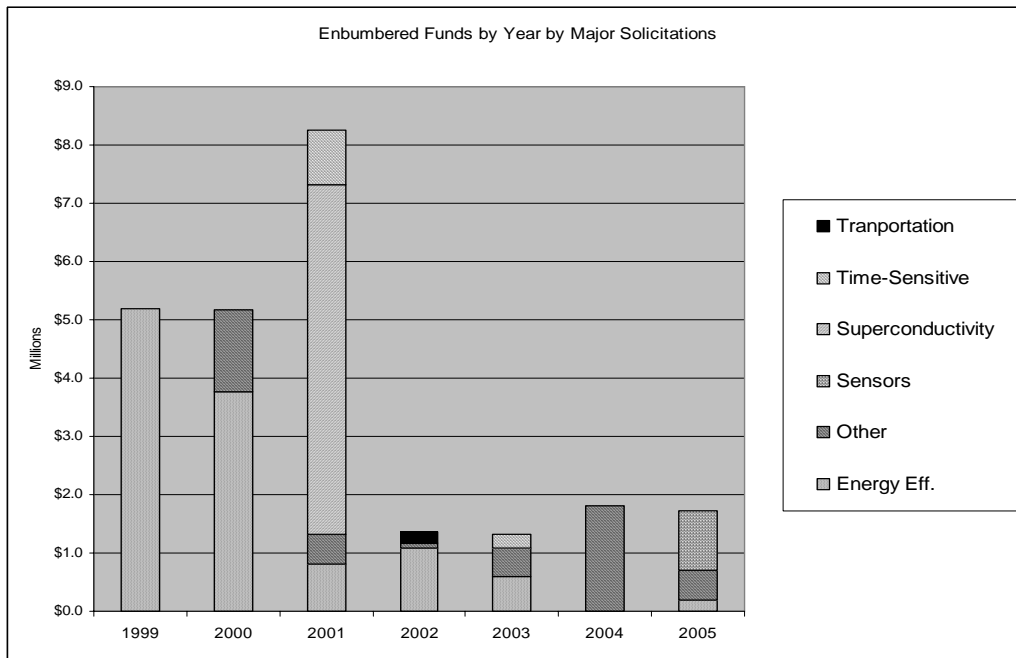
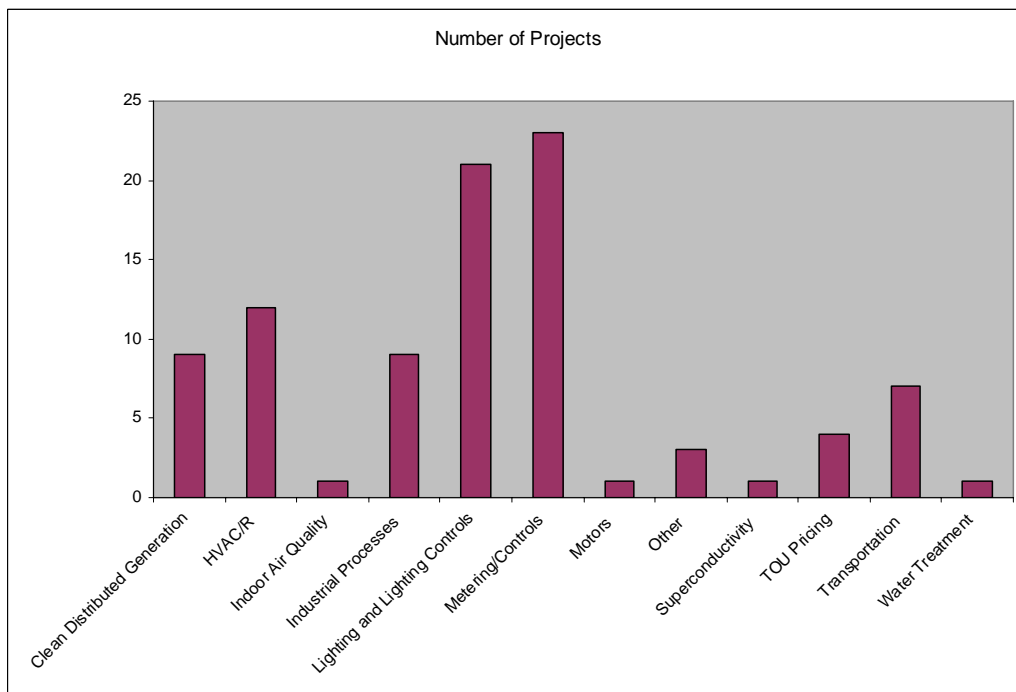


Figure 7-12. Next Gen Projects by Technology Focus Area



## **Energy Efficiency R&D**

These projects are predominately focused in three areas: heating and cooling; lighting; and meters and controls. One example of the several heating and cooling projects is Brookhaven National Laboratory development and commercialization of residential heating systems which reduce power consumption for burners, pumps, and circulating blowers by an average of 75% below conventional systems. These systems would also increase heating reliability since they will be capable of operating during power outages with only an automotive-type 12-volt battery supply. Various system components have been evaluated, and specific components will be submitted for UL listing. A limited production run of approximately ten units will be conducted for the purpose of extended field trials and for distribution to potential wholesale customers.

Another example of Energy Efficiency R&D projects is cleaning technologies. The Rochester Institute of Technology's (RIT) National Center for Remanufacturing and Resource Recovery (NCR3) has helped more than 30 New York re-manufacturers become more productive and reduce their energy use and hazardous chemicals by identifying environmentally-friendly cleaning technologies that work equally or better than existing processes at reduced cost.

## **Superconductivity**

A 350-meter high-temperature superconducting (HTS) cable was installed in Albany, New York and performance of the cable will be monitored for one year. Second generation (yttrium barium copper oxide) HTS conductors that are needed for the widespread commercialization of HTS technology will be developed simultaneously. Advantages of high-temperature superconducting underground cables (compared to conventional copper cables) are: 1) increased power delivery by a factor of three to five in the same diameter duct, 2) avoidance of environmentally hazardous oils, 3) lower operating and life cycle costs, 4) improved power quality due to increased bandwidth, 5) need for fewer cables in existing ductwork, and 6) avoidance of additional rights-of-way.

## **Time-Sensitive Pricing and Enabling Technologies**

These projects are designed to increase small customer participation in retail and wholesale programs to reduce peak electric load. Although residential and small commercial customers make up a significant portion of the State's total electric load, they are unlikely to participate in load control program offered by the New York Independent System Operation (NYISO). Furthermore, these customers do not have access to time-sensitive electricity rate structures nor access to commercially available end-use devices necessary to take advantage of price-responsive demand opportunities.

The Time-Sensitive Pricing solicitations sought to create and demonstrate time-based electric rates that reduce demand during peak periods of the day. Six teams were competitively selected to demonstrate time-sensitive electricity rates and technologies such as advanced meters, gateways, direct load control, and display mediums. Team members include load serving entities, load curtailment technology vendors, and energy service consultants. Residents in multi-family buildings in New York City and other commercial and single family residential customers are currently participating in demonstration projects that are expected to last for two years. Presently, 1,000 apartments in a multi-family housing complex are on a pilot rate, and over the next year, 4,000 apartments and sixty commercial customers are expected to be added. The demonstration project in the pilot program include the following components: provision of a time-sensitive electric rate; meter installation; meter reading and billing services; customer acquisition and education workshops; and provision of load control technology. Funding from Energy Efficiency Services and the Residential Energy Affordability Program created economies of scale that permitted a larger pilot program. Approximately 20 contractors participate in this program.

The Enabling Technologies solicitations seek to increase small customer participation in the New York Independent System Operator (NYISO) demand response programs. Past projects focused on reducing the costs of aggregating and managing small load curtailment resources that are geographically dispersed. After four rounds of solicitations, the program has resulted in the participation of 293 small customers providing 138 MWs of load curtailment resources, principally located in the New York metropolitan area.

### **Energy Management, Power Quality, Advanced Sensors and Controls**

Building controls have the technical potential to reduce a building's total energy use by 6%. Through the use of controls and sensors, both ESCOs and customers will be able to monitor and manage energy use. In addition to the technical challenges, the program addresses first-cost and several non-economic barriers preventing greater market penetration.

Greater use of electronic equipment has increased the importance of power quality. Some estimates put the annual cost of U.S. power outages and power quality disturbances at \$119 to \$188 billion. The program seeks the development and demonstration of end-use technologies that improve power quality or mitigate disturbances.

Three solicitations were issued resulting in 79 proposals. Of these, 22 were selected to receive awards totaling \$4.5 million. Examples of program accomplishments include:

- The development and commercialization of a Fresnel lens array for passive infrared sensor. The lens has applications in security, lighting controls, and environmental controls.
- The development and soon to be commercialized Load Shed Ballast and Control System. The Load Shed ballast, a low cost one step dimming fluorescent ballast, controlled via a signal imposed on the power line (power line communication) enables facilities to manage peak demand and participate in NYISO load curtailment programs. Lighting is ideal for load shedding, the load can be quickly and easily shed and restored and a temporary lighting load reduction of ten to 30% has been shown not to affect productivity. A demonstration of the technology was the first in the nation.
- Use of broadband over power line technology (BPL) to detect faults (ex. failing insulator) on power distribution lines was successfully demonstrated on a Consolidated Edison distribution network. The technology offers the ability to detect and locate failures, power quality issues, and incipient faults on power lines from a remote location.

## **7.11 Value/Cost Analysis**

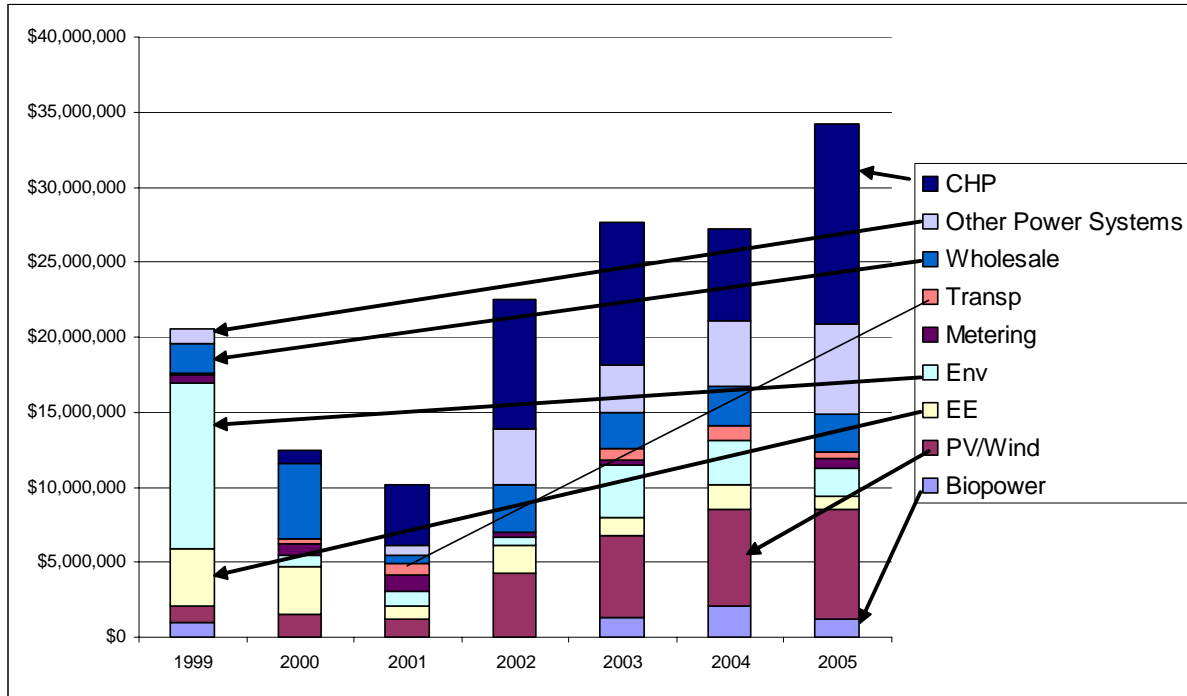
The value/cost analysis is designed to assess the value of R&D programs relative to its cost. The methodology underlying the analysis is one that is evolving and continues to be improved. In its current version, the value/cost analysis consists of two major activities: (1) an aggregate analysis and (2) peer review of major subprograms.

### **7.11.1 Aggregate Analysis**

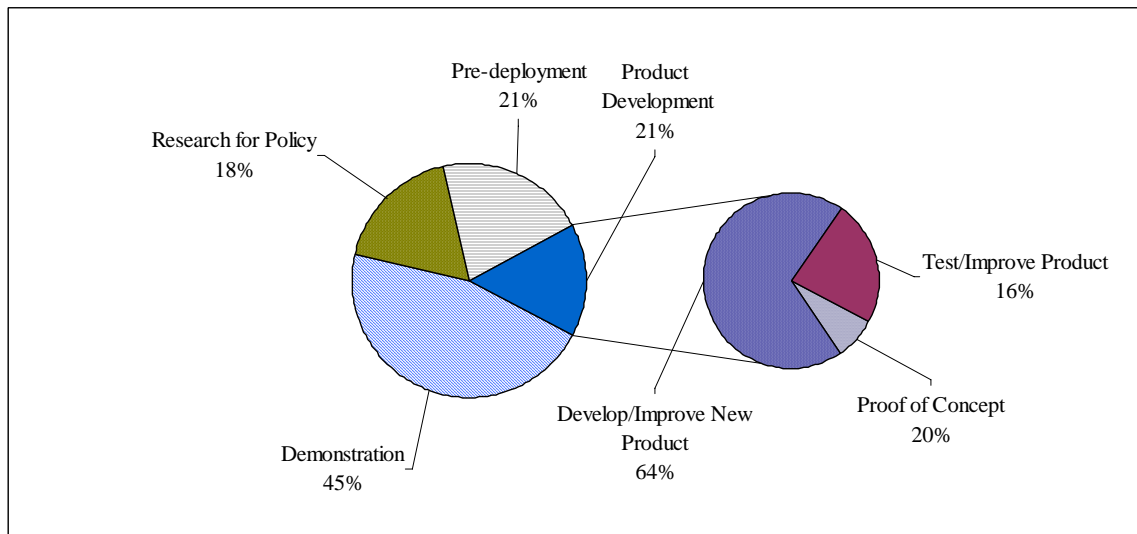
The distribution of encumbered funds by year and technology focus area is presented in Figure 7-13. The results indicate that PV/Wind deployment program ramped up in 2002 and continue to have increased funding through 2005. The CHP demonstration projects also is a large part of the portfolio and has increased in funding in recent years. The environmental program spent most of its funding in 1999 and

funds were encumbered at a much lower rate in subsequent years. Most of the energy efficiency R&D was also conducted in the early years and ramped down in later years.

**Figure 7-13. Projects in R&D Program Portfolio**



**Figure 7-14. R&D Portfolio Funding by Type of Project**

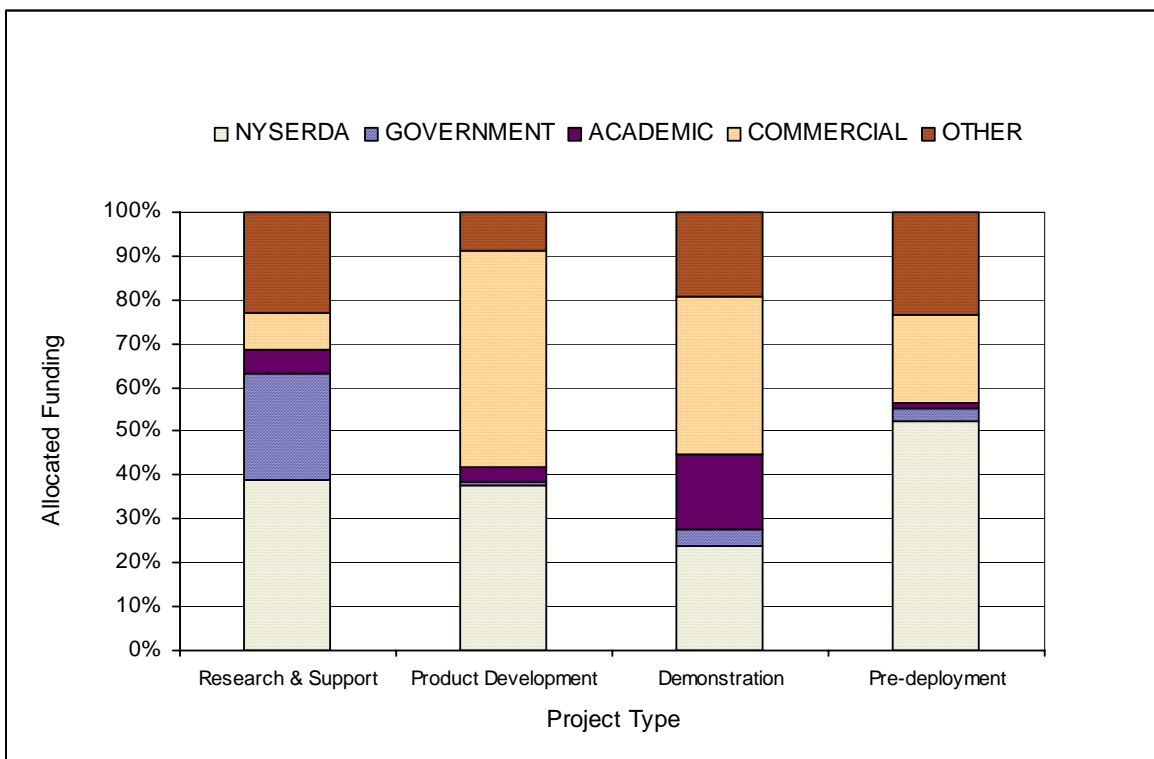


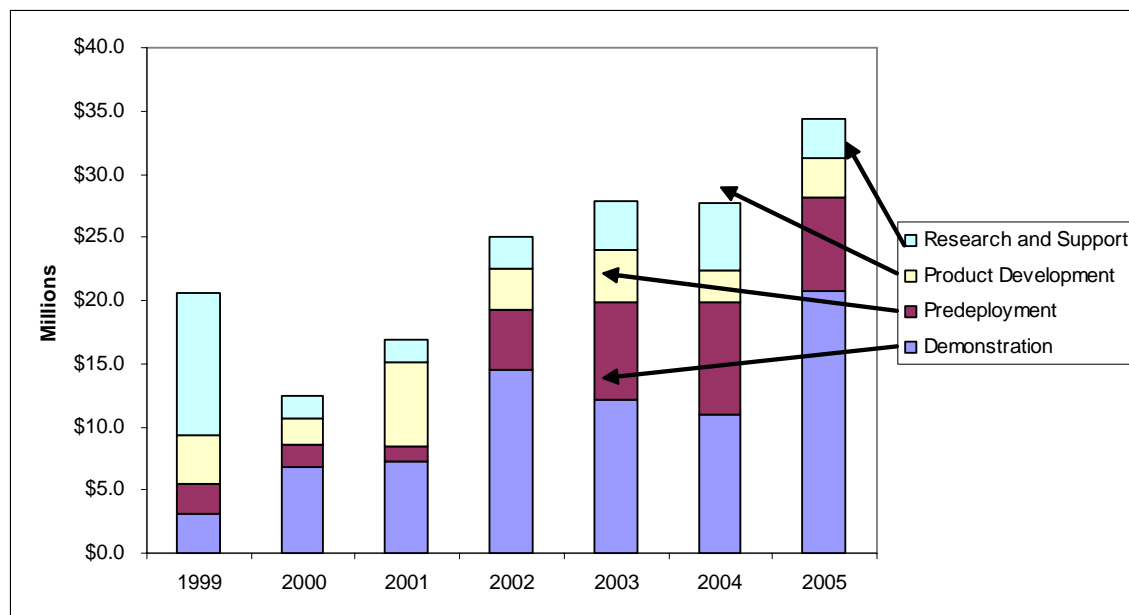
The distribution of projects by type of project is shown in Figure 7-14. The four types of projects are:

- Pre-deployment: Support for installation of projects that are commercially available but still involves risk and high costs.
- Demonstration: Projects that are installed at an end-user site using commercially available technologies that involve a high degree of design and other risks.
- Product Development: Project that involve proof of concept, development of a new prototype, testing of prototypes, or development and implementation of a commercialization or manufacturing plan for a new product.
- Research and Support: Projects that involve research, as in the Environmental Monitoring, Evaluation, and Protection Program, or involve market potential or assessment studies, or other activities designed to influence stakeholders such as policy makers, the research community, the general public to encourage adoption of innovative technologies.

The sources of co-funding is presented in Figure 7-15 for the different types of projects. Co-funding from other government entities is highest for the Research and Support category of projects. The share of NYSERDA funding is lower for demonstration projects than for product development projects due to the lower risk for demonstration projects compared to product development projects. The NYSERDA funding for the deployment projects is about 50% of the cost. This category of projects consists mostly of PV projects. The distribution of projects by encumbered amounts by year is shown in Figure 7-16.

**Figure 7-15. Co-funding Sources**



**Figure 7-16. R&D Portfolio Projects Initiated**

### 7.11.2 Peer Review Assessment

This year, the peer review assessment will be conducted at the subprogram level. The first step in the assessment is to compile information that provided evidence to support achievement in six primary outcomes. These outcomes are :

- Knowledge gained
- Knowledge disseminated
- Progress toward commercialization
- Energy benefits
- Economic benefits
- Environmental benefits

In order to compile data pertaining to each of these outcomes, key success indicators are identified for each subprogram and mapped into these six outcomes. Once the indicators are selected, information is gathered on each indicator to be rolled up to the six outcomes. The information on the outcomes are then compiled into information packets that are sent to reviewers who provide their assessment of the significance and value of the accomplishments. For each indicator variable within the six outcomes, reviewers assign a 0 to 4 rating scale where 0 = “no progress towards achieving a particular benefit” and 4 = “significant progress towards achieving a particular benefit.”

For the 2005-2006 evaluation year, a peer review assessment will be conducted for the CHP Demonstration Program, the DG Product Development Program and the EMEP Program. In addition to

reviewing the information packets, reviewers will participate in a webcast presentation by program staff. Prior to the web cast, reviewers are expected to have reviewed the materials and assigned their initial scores. After the presentation, there will be a question and answer period. Finally, because all reviewers can benefit from seeing the scores provided by other reviewers and their rationale, an executive session of reviewers will be held within the webcast. Within one week, reviewers will submit their final scores to HMG for analysis.

Using logic models, key indicators have been identified for DG Product Development, CHP Demonstration, and EMEP Programs and mapped into the six impacts. As in the past, reviewers will be asked to assess the six impact categories as follows:

1. Knowledge Creation

- Quantity: the number of technical papers, articles, citations, patents (both filed and granted), licenses, and prototypes passing requirement tests.
- Significance: contributions and relevance of the knowledge created.

2. Knowledge Dissemination

- Availability of Knowledge Products: Any knowledge that has been codified in some form represents an opportunity for dissemination since it can be shared with others. Other indicators of dissemination are conference presentations, conference proceedings, websites, fact sheets, brochures, etc.
- Target Audience Reach: For knowledge to have an impact, it must reach a sufficient number of appropriate individuals, companies, and institutions in the targeted markets.

3. Commercialization Progress

- Capital Attraction: The extent to which the project has attracted capital for advancing commercialization objectives, including resources provided by the partners.
- Technical Achievement: The extent to which the project has accomplished important technical achievements, including the development of prototypes.
- Market Advancement: The extent to which the project reduced key market barriers, demonstrated new products at customer sites, led to the development of sustainable business models, produced employment changes within the companies leading the projects, increased the number of business recognition awards, and produced sales of the new product.

4. Realized and Potential Energy Benefits

- Realized and potential kWh, kW, natural gas, propane, fuel oil and water savings associated with the program

5. Realized and Potential Economic Benefits

- Realized and potential job gains, manufacturing activities, and sales revenues

6. Realized and Potential Environmental and Health Benefits

- Realized and potential reductions in nitrogen oxide, sulfur dioxide, carbon dioxide, and other pollutant reductions and/or health benefits.

The peer review assessment packets are currently being developed.

## **7.12 R&D Sector Level Program Theory and Logic**

Working with the NYSERDA R&D program staff, a portfolio-level logic model was developed for the R&D program area. The model identified four types of projects:

- Information for policy makers and R&D community: Includes research projects such as those conducted through the Environmental Monitoring, Evaluation, and Protection Program, assessment and market potential studies, development of interconnection protocols, and information dissemination on emerging topics.
- Product development: includes proof of concept, improving, developing, and testing or a new product.
- Demonstration: Includes on-site demonstration of emerging technologies.
- Pre-deployment: Supports commercialized products that are close to becoming part of a deployment program.

Identifying these distinct project types was an important first step in developing a framework for R&D evaluation because progress and success will be different for each type and separate measurement indicators may be needed to assess progress. The logic model, presented in Figure 7-17 shows indicators of progress for each type (read down the columns). Some of these indicators are quantifiable (number of papers and patents, amount of additional investment) and others are qualitative (changes in behavior, changes in procedures). The portfolio logic model has benefited from the program-specific logic models developed earlier for the Wholesale Renewables, End-Use Renewables, and the DG/CHP Programs.

**Figure 7-17. R&D Portfolio Logic Model**

