5

Research and Development Programs

5.1 Overview of the Research and Development Programs

NYSERDA's Research and Development (R&D) activities are organized into five primary program areas: energy resources, transportation and power systems, environment, industry, and buildings. Projects in each of these program areas address technologies and mechanisms that affect the energy supply and meet the needs of end users. As a result, crosscutting areas such an environmental protection, waste management, energy product development, and renewable energy technologies are addressed in several programs.

Public Benefit Power Transmission and Distribution Research. The new Public Benefit Power Transmission and Distribution Research Program will support transmission and distribution (T&D) research that has broad statewide benefits. Projects will provide improvements to power reliability, quality and security, and reduce the cost of energy and energy delivery. The New York State Independent System Operator (NYISO) and the New York State Reliability Council (NYSRC) are key stakeholders in the T&D research program, and NYSERDA will coordinate with both of these entities.

Clean Energy Infrastructure. The previous End-Use Renewables (EUR) Program has provided the foundation for the creation of the Clean Energy Infrastructure Program. Clean Energy Infrastructure efforts will be closely integrated with other SBC-funded efforts, such as Distributed Energy Resources, to develop and commercialize clean energy technologies. The ultimate goal of these programs is to reach a point where the value of the technology is worth the investment required by the consumer, and the market infrastructure is in a position to deliver and support the technology over the long term. This program will also complement efforts under the Renewable Portfolio Standard (RPS) by supporting training, education and market development for RPS-eligible technologies such as photovoltaics. The Clean Energy Infrastructure funds may also be used to reduce the installation and operating cost of systems not eligible for RPS funding.

Power Systems Product Development. The goal of this program is to work with New York technology companies to develop distributed generation and storage products and expand the number of marketable competitive products that reduce peak load, improve power quality, and provide improved cost-effective environmental performance. The Power Systems Product Development Program supports New York State business in all aspects of product development necessary to create and commercialize power generating products that are clean, efficient, reliable, and cost effective, as well as other products that reduce peak demand or improve end user power quality. Additionally, the program focuses on New York State specific issues such as economic development and job creation in the State; targets technologies and opportunities that are not being addressed by the market; addresses regulatory barriers to the adoption of

superior new technologies; and, emphasizes the development of economically competitive options for end users.

DG-CHP Demonstration. The DG-CHP Demonstration Program will contribute to the growth of combined heat and power and other distributed generation applications in New York. The program provides funding for site-specific feasibility studies and demonstrations and seeks to improve awareness of end-users and project developers of DG-CHP. The program also seeks to address DG-related issues such as DG permitting; Standard Interconnection Requirements (SIR); utility standby service; tariffs; technology risk; renewable fuel options such as anaerobic digester and landfill gas; and the impact of fluctuating prices of natural gas. The program uses financial incentives to encourage customer-sited DG using commercially available DG technologies such as reciprocating engines. The program will be coordinated with similar offerings from RPS Customer-Sited tier and Consolidated Edison's System Wide Demand Reduction programs.

Demand Response and Innovative Rate Research. This new initiative supports participation by small customers in the NYISO's wholesale demand response and time-sensitive retail electric pilots. Residential and small commercial loads constitute a small percentage of participants in these programs because of their relatively small loads, the high cost of aggregation, and the lack of flexible metering options and other load control technologies. The program promotes the development, demonstration, and use of end-use technologies that have flexible load capabilities, such as air conditioners and lighting that are enhanced with features that allow remote access and group control for easier load reduction in response to peak demand and price signals. Additionally, the program's time-sensitive pilots promote the development of innovative electric service rates by energy services companies. The program concentrates on the New York City metropolitan area where capacity is particularly constrained and value propositions for load reductions are most desirable.

Electric Transportation. The program supports emerging technologies from inception through field testing and pre-commercial deployment. The benefits of the electric transportation program will include peak load reduction in the New York City load pocket and permanent energy use reductions. These reductions will result in cost reductions to the subway and commuter rail systems and reduced transmission congestion in the region. Additionally, many projects are expected to reduce transportation costs and emissions from petroleum fueled vehicles.

Environmental Monitoring, Evaluation, and Protection. The Environmental Monitoring, Evaluation and Protection Program (EMEP) commenced in the late 1990s in an effort to increase understanding of the environmental impacts of electricity production. EMEP initiatives are building on past efforts and evolving to support research in three primary areas: ecosystem response to sulfur, mercury and nitrogen deposition; health and energy-related research on air quality, particulate matter, ozone and co-pollutants; and crosscutting environmental science, technology and policy projects. The program is guided by a steering committee comprised of major stakeholder groups. In addition a separate science advisory committee continues to provide technical review. The program has maintained a robust science and policy communication component to deliver program findings to policy-makers, scientists, and the public. The EMEP program closely collaborates with regional and national entities to leverage funds for pertinent research projects.

Industrial Research, Development, and Demonstration. The Industrial Research, Development, and Demonstration (IRDD) program supports feasibility studies and technology demonstrations that: (1) improve energy productivity and competitiveness of New York manufacturers (minimize cost per unit output), (2) encourage capital investment and employment growth in New York State facilities, (3) introduce New York State-manufactured goods into new markets, and (4) encourage adoption of process changes that minimize waste. Cost-shared demonstration projects reduce risk and encourage

manufacturers to adopt innovative and underutilized process alternatives. IRDD is a collaborative effort of Industrial and Environmental R&D and Energy Efficiency Services.

Municipal Water and Wastewater Efficiency. The Municipal Water and Wastewater Efficiency initiative is a collaborative effort between NYSERDA's R&D and Energy Efficiency Services programs. Since 2000, the ongoing water and wastewater initiative has supported projects that accelerate the use of energy-efficient and innovative technologies by municipal water and wastewater systems in New York through demonstrations, technology transfer, and feasibility studies. The program's latest solicitation is a sector-based initiative, under the Energy Smart Focus Program, where municipal water and wastewater is one of the five sectors selected to receive services. All activities to date have had strong technology transfer components, and municipal water and wastewater treatment is also integrated with the Enhanced Commercial/Industrial Performance program.

Next Generation and Emerging Technologies. This program emphasizes discrete and integrated end-use technologies for buildings; daylighting applications; solar thermal applications; and emerging technologies for industry and buildings not covered elsewhere in NYSERDA's **New York Energy $mart**SM portfolio of programs. The bulk of funds for this program are being administered through narrowly defined competitive solicitations possibly focusing on advanced building demonstrations, discrete building technologies, solar thermal applications, daylighting applications, and emerging technologies. The program emphasis is on funding developers and 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.

5.2 R&D Program Evaluation Activities

The R&D program evaluation activities conducted this year are shown in Table 5-1. The table includes only new evaluation activities conducted in 2006. However, findings from earlier evaluations are also discussed in this section to the extent that they contribute to the cumulative assessment of these programs.

Table 5-1. 2006 R&D Program Evaluation Activities

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
Public Benefit Power Transmission and Distribution Research		-	-	-	-
Clean Energy Infrastructure	End-Use Renewable Energy Market	-	Database review for End-Use Renewables	-	-
Power Systems Product Development		-	-	-	-

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
DG-CHP Demonstration	Distributed Power Generation/CHP CHP Demonstrations Power Systems Technology – Product Development Strategic Energy Reliability	Value/Cost (Peer Review) Assessment	Database review for DG/CHP	-	-
Demand Response and Innovative Rate Research		-	-	-	-
Electric Transportation		-	-	-	-
Environmental Monitoring, Evaluation and Protection		Value/Cost (Peer Review) Assessment	-	-	-
Industrial Research, Development and Demonstration		-	-	-	-
Municipal Water and Wastewater Efficiency		-	-	-	-
Next Generation and Emerging Technologies	Next Generation of Energy-Efficient End-Use Technologies	-	-	-	-

5.3 R&D Program Evaluation Findings

Significant progress is being made as the Research & Development portfolio transitions to the new set of program offerings. This section summarizes key evaluation findings from the latest set of evaluation activities, and from the cumulative body of work conducted by NYSERDA and its evaluation contractors over the past several years.

5.3.1 Energy, Peak Demand and Fuel Savings and Clean Generation

NYSERDA's Measurement and Verification (M&V) contractor assessed the energy and peak demand savings and clean generation reported for its R&D programs. 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 Market Characterization, Assessment & Causality (MCAC) contractor further adjusted these figures to account for freeridership and spillover. Table 5-2 summarizes the estimated

electricity savings and clean generation for each of the applicable R&D programs. Table 5-3 summarizes peak demand reductions. Table 5-4 shows other fuel savings for the R&D programs.

As reported earlier in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the R&D sector should be adjusted as follows:

- Electricity savings were adjusted upward by 2%.
- Peak demand savings were adjusted downward by 29%.[1]
- Other fuel savings were adjusted downward by 5%.

These adjustments include changes in program reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership and spillover. Most of the adjustment, however, is due to the measurement and verification work since any freeridership that exists is outweighed by spillover on all but one R&D program.

Table 5-2. R&D Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Energy Savings (GWh)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program[1] (ConEdison)	82.7 (42.0)	96.7 (42.0)
Renewable Energy Production (ConEdison)	103.8 (0.5)	104.6 (0.5)
Overlap Removed	6.6	7.7
ConEdison R&D Total	**42.5**	**42.5**
Statewide R&D Total	**179.9**	**193.6**

[1] 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, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as wastewater 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 what is achieved through efficiency alone.

[1] The Demand Response and Innovative Rate Research Program does not require that enabled demand reductions be maintained. This large downward adjustment for the R&D programs is due to M&V results indicating the portion of enabled demand reduction that has been maintained.

Table 5-3. R&D Program Peak Demand Reductions through December 31, 2006 and Progress toward One-Year Goals

Program	Demand Reductions (MW)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program (ConEdison)	18.1 (8.5)	21.1 (8.5)
Demand Response and Innovative Rate Research (ConEdison)	137.2 (68.6)	137.2 (68.6)
Renewable Energy Production (ConEdison)	8.1 (0.3)	8.4 (0.3)
Overlap Removed	1.3	1.5
ConEdison R&D Total	77.4	77.4
Statewide R&D Total	162.1	165.2

Table 5-4. R&D Program Fuel Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Fuel Savings (MMBtu)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program[1] (ConEdison)	-571,310 (-266,937)	-738,327 (-296,521)
ConEdison R&D Total	-266,937	-296,521
Statewide R&D Total	-571,310	-738,327

[1] 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, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as wastewater 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 what is achieved through efficiency alone.

5.3.2 Summary of Other Key Program Impacts

Across the programs, numerous near-term goals were set for other key metrics besides energy savings such as: the number of solicitations, studies, and projects; the number of workshops; the number of companies doing business in New York; new products developed and launched; and other important logic model-driven knowledge creation, information dissemination and commercialization progress metrics. Overall, the programs are also performing well with respect to these other goals. Results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Key areas of progress in the past six months include the following:

- Contracts are being negotiated with four firms intending to manufacture clean energy products in New York.
- The Power Systems Product Development Program awarded five contracts for product development.
- Performance data on 21 DG/CHP projects is now available on the Internet, allowing performance monitoring and promoting technology transfer.
- Thirteen publications (including research reports and peer-reviewed journal articles) resulted from the Environmental Monitoring, Evaluation and Protection Program activities.
- Four Technical Assistance projects were completed for water and wastewater facilities.
- Seven solicitations were issued for the Next Generation and Emerging Technologies Program, and the new Public Benefit Power Transmission and Distribution Research Program identified priority research areas and will release its first solicitation in the first quarter of 2007.

5.4 Public Benefit Power Transmission and Distribution Research

5.4.1 Program Description

The new Public Benefit Power Transmission and Distribution Research Program will support T&D research that is not utility specific and has broad statewide energy efficiency and reliability benefits. Projects will be selected to provide improvements to power reliability, quality and security, and reduce the cost of energy and energy delivery. Examples of such T&D projects funded through the R&D program include:

- The Albany High Temperature Superconducting (HTS) Cable Project resulted in the world's first demonstration of a superconducting cable operating underground in a live utility grid. The demonstration continues to operate as part of the National Grid system between its Riverside and Menands substations located in Albany, New York. Because HTS cables are able to carry three to five times more power than conventional cables of the same size, they offer the potential to serve the growing electricity demands in high density urban areas without the need to build more power lines. The project is on schedule to replace a 30-meter section of the existing HTS cable with a 2nd generation HTS cable capable of higher performance.
- A manufacturer of power line carrier (PLC) technology is demonstrating an application to provide real-time monitoring of a utility distribution system to identify incipient faults and avoid interruption of customer service. PLC technology allows transmission and reception of high frequency signals over power lines. The interpretation of the noise in such communications can be used to detect conditions that may precede failure of lines, transformers and other equipment. The technology has been installed on several miles of feeders serving Con Edison residential and commercial customers in Westchester County.

The NYISO and the NYSRC are key stakeholders in the T&D research program. NYSERDA will coordinate with the NYISO and the NYSRC to implement projects that provide significant statewide benefits for electric ratepayers. A T&D strategic plan was recently prepared by Electric Power Research Institute (EPRI) and identified several projects that should be initiated in cooperation with the NYISO and the NYSRC. These include:

- Developing fast simulation modeling systems to rapidly assess grid stability and anticipate and respond to power disturbances,
- Analyzing system modeling data, phasor measurements, and historical trends to develop real-time grid performance indices that can be displayed through a simplified graphical user interface,
- Monitoring of electric power frequencies to pinpoint and analyze disturbances, and
- Creating business models to promote sustainable investment in transmission and distribution infrastructure.

The five-year budget for this program is $10 million.

5.4.2 Recent Program Accomplishments

The recent program accomplishments are presented in Table 5-5.

Table 5-5. Public Benefit Power Transmission and Distribution Research Program Goals achieved from July 1, 2006 through September 30, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Strategy and coordination meeting	Identification of priority R&D areas by spring 2006	Priority areas in two tracks — Policy and Technology — have been identified. Policy aspects could include business strategies, regulatory issues, public policy, and advanced concepts. Technology aspects could include monitoring and diagnostics, data processing and analysis, optimized visualization, secure communication, and improved control and system performance.
Issue annual solicitations	Select and fund five or more projects and studies aimed at the priority R&D areas by fall 2006	Staff anticipate issuing solicitation PON 1102 in the first quarter of 2007. Current efforts are devoted to harmonizing concepts with the recently-launched M&V logic model.

5.4.3 Program Logic[2]

Problems and Barriers

New York faces a range of T&D system security, reliability and power quality issues that affect the country's entire northeast region and in some cases, much of the Eastern Interconnection. These include:

- Lack of long-term T&D planning
- Increased stress due to load growth in certain areas and potential load growth from clean technologies such as electrified vehicles

[2] The program logic is a work in progress. The final program logic will be available in the March 31, 2007 quarterly report.

- Lack of incentives for private investment

Other issues related to the above include the following:

- New York is importing more electricity and exporting less electricity. At the same time, New York has a desire to be less dependent on other States for its power.
- Power system operational issues, such as the need to improve situational awareness of operators, cut across New York's boundaries.
- An increasing need for reactive power reserves and voltage support, and a need for improved power system integrity protection.
- Shifting wholesale power transfer patterns that have resulted from industry restructuring.
- The Federal Energy Regulatory Commission (FERC) has entrusted independent system operators (ISOs)/regional transmission organizations (RTOs) such as the NYISO with significant regional planning responsibilities.[3] [4]
- The Energy Policy Act of 2005 has also made fundamental changes to the investment incentives related to many types of energy resources and the T&D infrastructure.
- The adoption of the RPS and RGGI may require changes in the transmission system due to the requirement for increased renewable power.
- In addition, the importance of maintaining high T&D system reliability will increase with the formation of the Electricity Reliability Organization (ERO), which will have legal authority.
- As the industry continues to change, research plans must be developed and implemented to address these issues and must adapt to the changing conditions.

Program Outputs

Table 5-6 identifies near-term accomplishments anticipated to come directly from program activities. Associated measurement indicators are also presented. The source for this information should come directly from program records.

[3] After transmission developers obtain approvals from the NYISO, these developers must also apply for approval from the New York State Public Service Commission under Article VII of the Public Service Law [1].

[4] Third paragraph from EPRI Plan

Table 5-6. Anticipated Near-Term Accomplishments

Anticipated Accomplishments	Indicators	Data Sources and Potential Collection Approaches
Policy, Planning and Coordination Activities		
R&D gaps identified, priorities specified, projects leveraged (i.e., identification of policy-relevant, interdisciplinary/multi-media critical research usable for New York State that takes advantage of related national research plans and programs to address regional/State needs, with research projects supported at various New York Institutions)	Planning documents created. Technical reports.	Program records
Coordination of stakeholders	Dates and locations of meetings. Names of participants and organizations represented. Topics of discussion.	Program records
Studies funded	White papers, recommendations.	Program records
Technology Development Activities		
Product development projects funded	Innovative solutions	Program records
New technologies demonstrated	Credible data on performance, cost and impacts	Program records
Technology Transfer and Information Dissemination Activities		
Information dissemination	Dates and locations of meetings. Names of participants and organizations represented. Topics of discussion.	Program records
Synthesis and translation of results into forms useful for a broad audience. Data and technical findings made accessible to the public.	Magazine articles and conference presentations. List of web site addresses to enhance technology transfer.	To be determined.

5.5 Clean Energy Infrastructure

5.5.1 Program Description

The success of the previous End-Use Renewables Program has provided the foundation for the creation of the Clean Energy Infrastructure Program. Clean Energy Infrastructure efforts will be closely integrated with other SBC-funded efforts, such as Distributed Energy Resources, to develop and commercialize clean energy technologies. The ultimate goal of these programs is to reach a point where the value of the technology is worth the investment required by the consumer, and the market infrastructure is in a position to deliver and support the technology over the long term. This program will also complement efforts under the RPS by supporting training, education and market development for RPS-eligible technologies such as photovoltaics. The Clean Energy Infrastructure funds may also be used to reduce the installation and operating cost of systems not eligible for RPS funding.

The former End-Use Renewables Program placed significant emphasis on training renewable energy professionals, establishing voluntary certification standards for photovoltaic system installers, establishing and promoting accredited training programs in New York, establishing an internship program to give students from the training programs the experience necessary to sit for the certification exam, developing a series of specialized workshops and training tools, and creating a program to integrate photovoltaic systems on schools with lesson plans that meet New York State learning standards for math, science, and technology. The Clean Energy Infrastructure Program will continue the work begun under the End-Use Renewables Program to develop a vibrant, sustainable market for renewable and clean energy technologies using the following strategies:

- Market actor education, consumer awareness and market development,
- Targeted research, analysis and education to address technical and information barriers to renewable and clean energy market development, and
- Clean energy technology business development and manufacturing.

The 13-year program budget is $77.5 million.

5.5.2 Recent Program Accomplishments

Several near-term annual goals have been set for the new Clean Energy Initiative Program. These goals and progress for the six month period ending 12/31/06 are presented in Table 5-7.

Table 5-7. Clean Energy Infrastructure Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006	
Education, Consumer Awareness and Market Development			
New accredited training institutions	1	0	Workshops held: 4 KidWind Teacher Training workshops 2 small wind training 1 NABCEP[1] prep
New certification exams	1	0	
Training workshops	5	7	
Renewable Resource Applications			
Stakeholder workshops	2	0	4 solicitations were issued 2 focused on wind generation and wildlife interactions 2 promote business expansion
Competitive research solicitations	3	4	
Clean Energy Technology Manufacturing and Business Development			
Companies expanding renewable business networks	5	7	Contracts are being negotiated with 4 firms intending to manufacture clean energy products in New York.
Companies expanding manufacturing	2	4	

[1]North American Board of Certified Energy Practitioners (NABCEP).

Other program highlights include:

- A Renewable Energy Workforce Conference in November 2006, sponsored by NYSERDA, attracted 200 attendees from 30 states and four countries, to learn and share innovative workforce activities.
- A Technical workshop on wind energy's impacts on wildlife brought together national experts and stakeholders to develop siting guidelines for wind energy resources.
- Several programs provided support for local governments and communities including a wind workshop, a wind toolkit, and outreach to local organizations.

5.5.3 Long-Term Program Accomplishments

This section highlights key program outputs, as identified through earlier logic model development work, and related market progress. All values reported are cumulative since program inception. Thus, they include accomplishments of the farmer Wholesale Renewables Program, as well as from the End-Use Renewables activities both prior to and after the adoption of New York's RPS. Table 5-8 presents the key

outputs for the Clean Energy Initiative through December 31, 2006. Table 5-9 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 5-8. Clean Energy Infrastructure – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of PV and small wind systems installed (PON 716)	438 PV/15 Wind
Dollar value of incentives paid for PV (PON 716) and small wind systems installed (PON 792)	$9,929,611 PV/ $333,712 Wind
Total cost of installed PV systems (PON 716)	$20,110,235
Average cost per kW DC of PV installed per sector	$8,601 Residential, $8,093 Commercial, $9,101 Industrial

Table 5-9. Clean Energy Infrastructure – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Data Value--2003	Data Value -- 2004	Data Value -- 2005	Data Value -- 2006
Energy Generation	Net MWh and MW generated from installed systems	1,012 MWh 0.6 MW	2,012 MWh and 1 MW	2,833 MWh and 1.3 MW	4,619 MWh 2.1 MW
Availability of Services	Number of participating installers	14	27	32	26
	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%	-
	EUR Program installations as a percentage of total capacity of PV and small wind systems installed in New York *(Data in this row represent only SBC-funded projects. NYSERDA, NYPA and LIPA have supported other projects outside of the SBC program.)*	-	-	EUR Program has funded 29% of the total PV installed capacity on record with PSC EUR Program has funded 25% of the state's total small wind energy capacity on record with PSC	-

Topic	Indicator	Data Value--2003	Data Value -- 2004	Data Value -- 2005	Data Value -- 2006
Pricing/Cost	Average total PV system cost per watt (PON 716)	$8.26/watt (DC)	$8.31/watt (DC)	$8.43/watt (DC)	$8.52/watt (DC)
	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	-	-

5.5.4 Program Impact Evaluation

Gross Energy Generation

In 2004, Nexant, Inc. conducted a review of the savings impacts reported by NYSERDA for the former EUR Program. The objective of the review was to verify the estimate of the program's cumulative energy generation. Based on Nexant's review, as of December 31, 2006, the program has resulted in energy generation and peak demand reductions shown in Table 5-10.

Net Energy Generation

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 EUR Program. Net energy generation is shown in Table 5-10.

Table 5-10. Clean Energy Infrastructure Program Cumulative Annual Clean Generation (through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Energy Generations	Net-to-Gross Ratio	Net Energy Generation
MWh/year	4,441	1.04	4,619	1.0	4,619
MW	2.5	0.85	2.1	1.0	2.1

Non-Energy Impacts

The MCAC team examined non-energy impacts for the EUR Program in 2003. At that time, customers valued the non-energy impacts at approximately 1.6 times the value of the displaced generation from their PV systems.

5.6 Power Systems Product Development

5.6.1 Program Description

The goal of this program is to work with New York technology companies to develop distributed generation and storage products and expand the number of marketable competitive products that reduce peak load, improve power quality, and provide improved cost-effective environmental performance.

The Power Systems Product Development Program supports New York business in all aspects of product development necessary to create and commercialize power generating products that are clean, efficient, reliable, and cost effective, as well as other products that reduce peak demand or improve end user power quality. Additionally, the program focuses on New York specific issues such as economic development and job creation in the State; targets technologies and opportunities that are not being addressed by the market; addresses regulatory barriers to the adoption of superior new technologies; and, emphasizes the development of economically competitive options for end users.

The program areas of focus include:

- Developing products with superior performance relative to decreased grid-supplied energy consumption, peak demand and improved environmental impact
- Addressing New York-specific issues such as economic development and job creation in the state
- Targeting those technologies and devices that are not currently being addressed by the market
- Reducing environmental impacts of energy production
- Providing economic development opportunities for New York power system firms
- Improving system-wide reliability and peak demand reduction
- Addressing institutional impediments including absence of applicable codes and installation standards

Activities supported under this program element include:

- Product development from concept studies to prototype production and product testing
- Technology transfer through conferences, papers and internet accessible data
- Market sector research and support addressing institutional barriers to commercialization

The five-year program budget is $25 million.

5.6.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Power Systems Product Development Program. These goals and progress for the first six month period ending 12/31/06 are shown in Table 5-11.

Table 5-11. Power Systems Product Development Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Product development contracts awarded	10	5
New products commercially launched	1	-
Successful new product field tests and demonstrations	2	-
Projects successfully completing milestones	4	6
Assessments and studies of new technologies completed	3	1

5.6.3 Long-Term Program Accomplishments[5]

This section highlights key program outputs and program benefits since program inception through June 2006. The projects summarized here were initiated during a five year period ending June 2006.

Starting in June 2006, the Power Systems Product Development Program shifted the focus to include solar and wind product development activities previously funded from other programs. The program will emphasize ultra-clean and other renewable technologies and deemphasize fossil fuel efficiency and emission improvement technologies previously encouraged.

Key program outputs for the time period 2001 to 2006 are presented in Table 5-12.

Table 5-12. Power Systems Product Development Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of Solicitations	12
Number of proposals reviewed/Recommended for funding	248/102
Number contract actions	85
Number of unique projects	52
Funds Encumbered	$22 million
Co-funding by Project Participants	$34 million

[5] The information contained in the Long-Term Accomplishments Section was obtained from the Power Systems Program Accomplishments Packet developed by GDS Associates in 2006.

Key logic model-driven program outcomes, or indicators of program benefits, are presented in Table 5-13.

Table 5-13. Power Systems Product Development Program – Key Outcomes

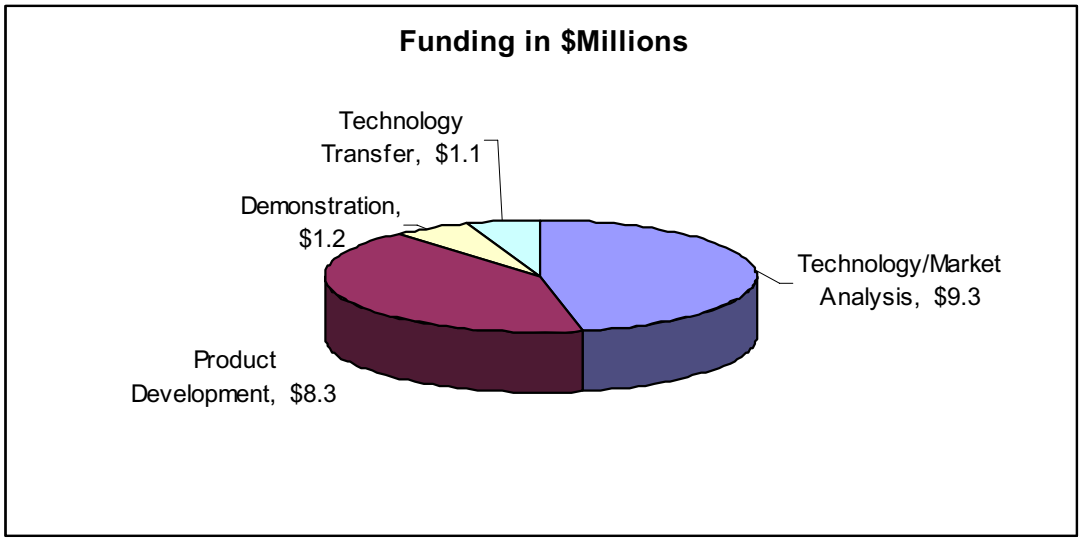
Outcomes	Value (Cumulative through December 2006)
Knowledge Creation and Dissemination	
Number of completed final reports	18
Number of published articles	86
Number of Conference Presentations	52
Field tests initiated/completed	65/63
Lab tests initiated/completed	71/69
Web sites where reports are available	TBD
Commercialization Progress	
Number of projects with recoupment provisions	20
Number of projects with enhanced business plans/ UL or other listings/patents	16/5/6
Number of New Products Developed	6
Economic Benefits	
Number of projects with sales/jobs/investments	6 projects with sales 16 projects with job creation 7 projects with known new investments

Program Portfolio

Projects funded through the program can be categorized as (1) Technology/Market Analysis Studies; (2) Product Development, (3) Demonstration, and (4) Technology Transfer. The Technology/Market Analysis Studies consists of projects that analyze market potential and technological feasibility, designed to benefit policy makers and supply-side market actors. Product Development projects are focused on a clearly defined product and benefits New York manufacturers. Product Development activities include prototype development, product testing, and development of commercialization plans. Demonstration projects consist of projects that demonstrate the performance of products that are commercially available. Technology Transfer projects provide information to the general public and other market actors and are designed to support the market infrastructure.

The cumulative encumbered funding by project type is presented in Figure 5-1.

Figure 5-1. Power System Program Funds Encumbered through 2005



The program was implemented through a total of 11 solicitations. Six solicitations having broad based eligibility in power systems, and five solicitations directly focused on alternative fuels for secure power generation and electricity storage. A total of 216 proposals were received with 88 recommended for funding with 80 completed contract actions. In many cases proposals were received for second or third phases of a product development effort, as projects were required to recompete for funding of additional phases based on progress to date. A total of 47 unique product development or individual study efforts were funded.

Technology development projects were funded at an average of $5 million per year ($4 million from the SBC and an additional $1 million from NYSERDA's Statutory program). The portfolio of SBC funded projects evaluated here has a total value of $50 million with $20 million provided via NYSERDA and $30 million provided as project cofunding primarily by contractors.

Knowledge Creation and Dissemination

Data were collected for each project in the Power Systems portfolio regarding the knowledge creation indicators. The number of field and lab tests are shown in Table 5-14 by technology area. A total of 63 field tests have been completed and 69 lab tests have been completed.

Table 5-14. Number of Field and Lab Tests Initiated and Completed

Technology Area	Field Tests Initiated	Field Tests Completed	Lab Tests Initiated	Lab Tests Completed
Emissions	0	0	8	8
Energy Storage	11	10	11	11
Engine	2	2	3	3
Fuel Cell	10	10	31	31
Hydropower	1	1		
Inverter	1	0	15	15
Motor Generator	0	0	2	0
DG Performance Testing	20	20	1	1
Remote Monitoring	20	20		
Total	65	63	71	69

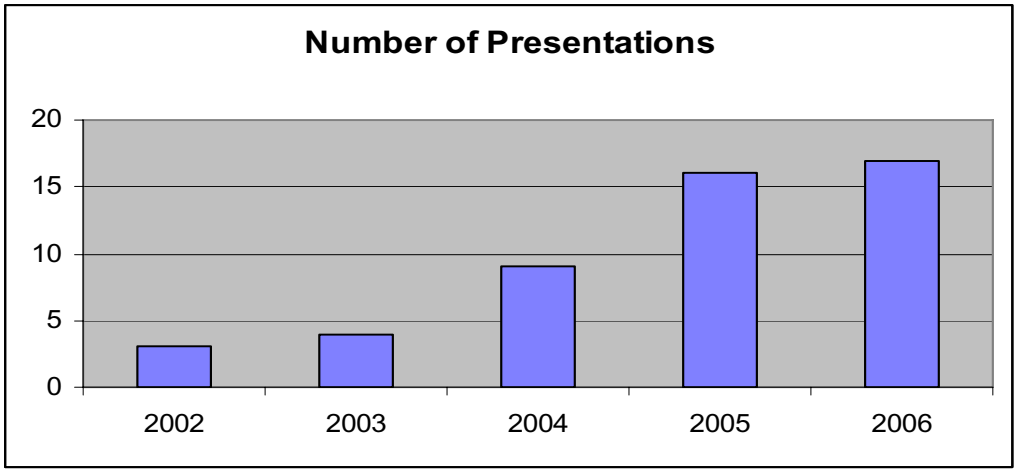
A total of 86 articles and news stories are associated with the portfolio of projects. The number of articles and stories by technology area is presented in Table 5-15. The majority of publications resulted from the hydropower projects. Articles were published in conference proceedings, print magazines, internet magazines, journals and newspapers.

In addition, final reports have been completed for 18 power systems projects. Conferences and presentations is another pathway for dissemination information. Presentations regarding NYSERDA's power systems projects have been given at various conferences and forums, including those sponsored by: the American Society of Mechanical Engineers (ASME), American Solar Energy Society, Association of State Energy Research and Technology Transfer Institutions (ASERTTI), Association of the United States Army (AUSA), CleanTech, Electrical Energy Storage Applications and Technology (EESAT), Electrical Storage Association (ESA), Mid-Atlantic Renewable Energy Fair, Midwest Renewable Energy Fair, and Next Generation Energy. The number of presentations at conferences has increased over the past five years, as shown in Figure 5-2.

Table 5-15. Number of Articles by Technology Area

Technology	Number of Articles/News Stories
Energy Storage	4
Fuel Cell	8
Hydropower	70
Inverter	1
Other	3
Grand Total	86

Figure 5-2. Conference Presentations



Commercialization Progress

The number of projects with commercialization progress by technology area is presented in Table 5-16.

Table 5-16. Number of Projects with Commercialization Progress

Technology Area	Business Plans Enhanced	UL or Other Listings	Patents
Aggregation	1		
Emissions	1		
Energy Storage	3	1	1
Engine	1		
Fuel Cell	5	3	4
Hydropower	2		
Inverter	1	1	1
Motor Generator			
MSW	1		
Remote Monitoring	1		
Total	16	5	6

Products developed include:

- 2.5 kVA inverter
- Computer controlled monitoring and control system
- Central Operation Management System (COMSYS)
- Direct Methanol Fuel Cell

- GAIA Power Tower
- DC Backup Fuel Cell System
- Motor generator component

Economic Benefits

Economic benefits include sales, jobs, and new investments. The number of projects with these benefits is shown in Table 5-17. Six projects have produced sales, 16 projects have resulted in jobs, and seven projects have resulted in new investments.

Table 5-17. Number of projects with Economic Benefits

Technology Area	Sales	Jobs	Investments
Aggregation		1	
Emissions		1	
Energy Storage	1	4	1
Engine		1	
Fuel Cell	3	5	4
Hydropower		1	1
Inverter	1	1	1
Motor Generator		1	
MSW			
Remote Monitoring	1	1	
Total	6	16	7

Examples of economic development achieved through the program's activities include:

- The fuel cell research and development resulted in the development of 320 jobs at the new headquarters R&D and manufacturing facility constructed in New York by Plug Power. There was also $217 million of cash investment from Interros and Norilsk Nickel.
- The Direct Methanol Fuel Cell project brought in $1 million dollars in capital investment from Samsung and Gillette/Duracell. Additionally this product resulted in a 6% equity investment by E.I. Dupont. The Samsung investment was to develop this technology for their portable cell phone product line.
- The 2.5 kVA Utility-Interactive Inverter study has provided subcontracts to New York vendors for manufacturing of various components such as printed circuit boards, enclosures, and Certification testing by Itertek Testing Service.
- The Energy Storage Distributed Load Leveling with Utility Control product - GAIA Power Tower has resulted in four investments in New York for a total $3 million. GHO ventures invested $2.25 million, and three separate $250,000 investments were provided by NY Community Investment Company, NJTC Venture Fund and the Small Business Technology Investment Fund of the Empire State Development Corporation.

- The Roosevelt Island Tidal Energy Project: resulted in setting up of an office at the Cooper Union in New York City.

5.7 DG-CHP Demonstration

5.7.1 Program Description

The goal of the DG-CHP Demonstration Program is to contribute to the growth of combined heat and power and other distributed generation applications in New York. The program provides funding for site-specific feasibility studies and demonstrations and seeks to improve awareness by end-users and project developers of DG-CHP. The program also seeks to address DG-related issues such as DG permitting; SIR; utility standby service; tariffs; technology risk; and renewable fuel options such as anaerobic digester and landfill gas; and impact of fluctuating prices of natural gas.

The program uses financial incentives to encourage customer-sited DG using commercially available DG technologies such as reciprocating engines. The incentive approach will co-exist along with similar offerings from RPS Customer-Sited tier and Consolidated Edison's System Wide Demand Reduction programs.

The total program budget is $67.1 million.

5.7.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the DG-CHP Demonstration Program. These goals and progress for the six month period ending December 31, 2006 are shown in Table 5-18.

Table 5-18. DG-CHP Demonstration Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Initiate DG-CHP incentive program	Develop and implement a CHP incentive program in cooperation with other DG-CHP programs	Staff are observing activity under NYSERDA's recently launched CHP subscription program using ConEd System Wide Program funds.
Issue annual solicitations and incentive offers	Fund up to 10 CHP demonstration projects with a cumulative capacity of 20 MW and with 10 MW downstate	PON 1043 was issued, and thirty-four proposals were received by the due date of August 22, 2006. Seven demonstration projects were selected for funding with a total of 38.2 MW installed capacity (1.8 MW of which is in ConEd territory).
Technology transfer	Require performance monitoring of all demonstration projects and export data to the CHP website	Data for 21 projects are posted on http://chp.nyserda.org.

5.7.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception, unless otherwise noted. Table 5-19 presents the key outputs for DG-CHP Demonstration through December 31, 2006. Table 5-20 presents a sample of key logic model-driven indicators of program success, especially those

related to market progress, as tracked by the evaluation and program activities and documented most recently as part of a value/cost peer review assessment conducted specifically for this program. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 5-19. DG-CHP Demonstration Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of operational DG/CHP systems	28
Total funds awarded for operational DG/CHP systems	$8.9 million
Total cost of operational DG/CHP systems	$39.4 million

Table 5-20. DG-CHP Demonstration Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2004, unless noted)
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
	Developer familiarity with DG/CHP systems	90% said they were extremely familiar, and all developers considered themselves at least somewhat familiar
	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

Funded Projects[6]

Seventeen feasibility studies have been funded of which eight are completed. In addition to natural gas, the studies address various fuel sources including bio-waste, coal gasification, and wood.

[6] Except for Figures 5-3 and 5-4, the analyses contained in this section are from the Accomplishments Packet for the CHP Demonstration Program which was developed by GDS Associates and HMG Group, Inc. as apart of the Peer Review Assessment conducted in 2006.

Figure 5-3 presents the peak capacity of projects in the portfolio by prime mover type. Figure 5-4 shows the same by utility service area.

Figure 5-3. Peak KW Reduction by Prime Mover for Encumbered Projects (through 2006)

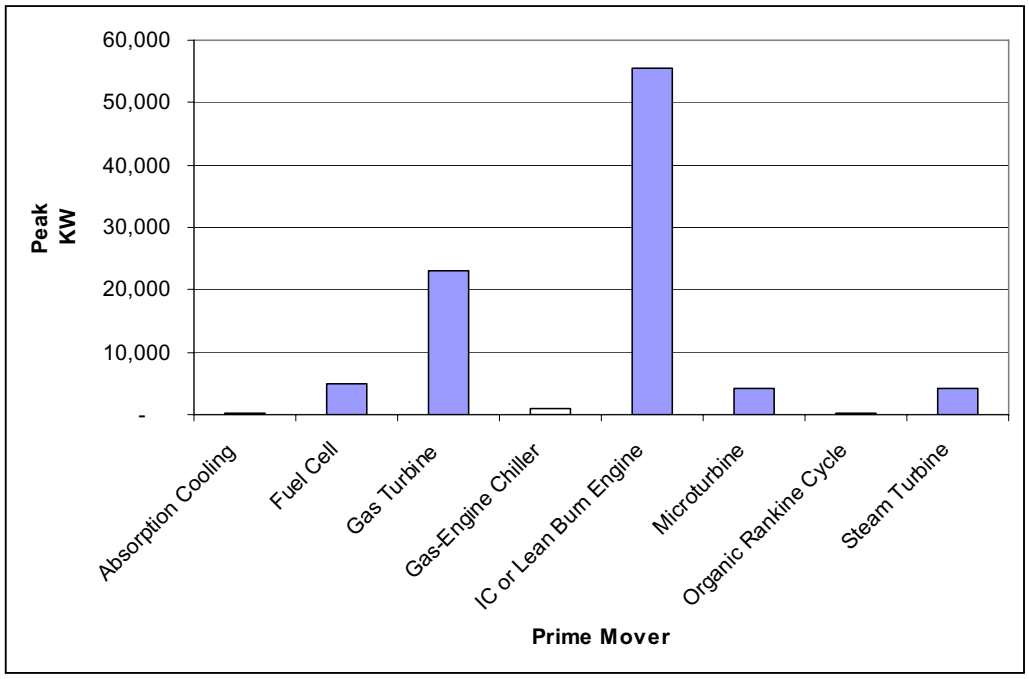
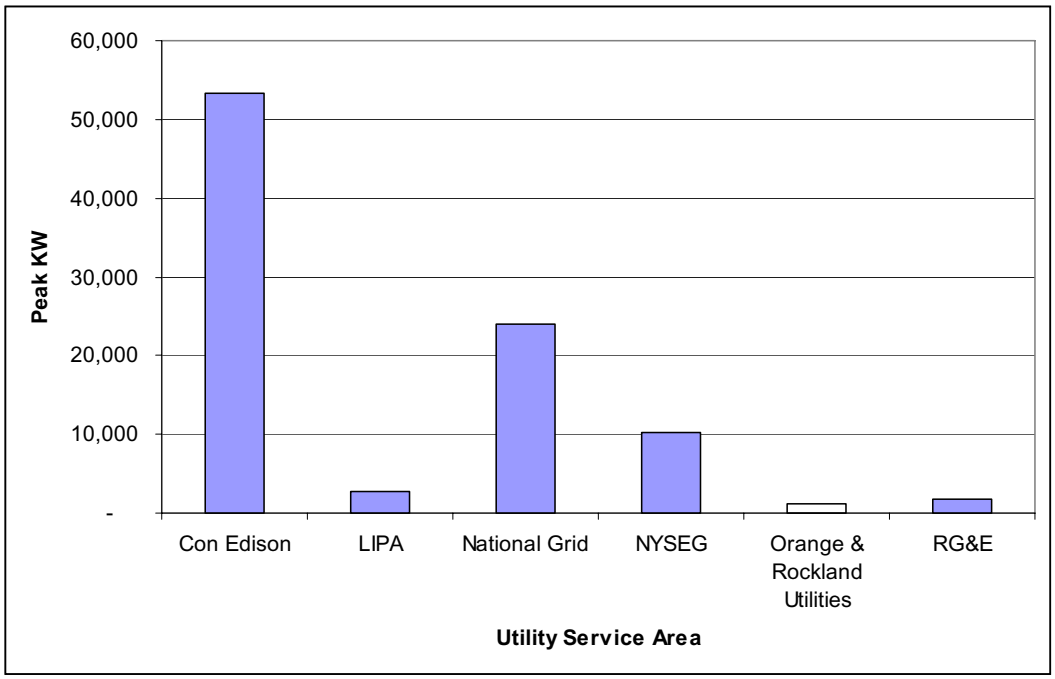


Figure 5-4. Peak KW Reduction by Utility Service Area for Encumbered Projects (Through 2006)



Progress toward Commercialization

Capital Attraction

- Private investment in CHP has increased in New York. The total project cost for all projects funded through the CHP program as of December 2005 is $273.5 million. Of this total, 80 percent represents funds from project participants.

Technical achievements

- As a result of the program, demonstration of innovative electrical interconnection designs has occurred. The system installed at Equity Office Properties at 717 5th Avenue in Manhattan was the first installation of a synchronous interconnection system in New York City.

- As a result of the program, several grid-connected CHP systems that have dual-mode operation (operates in grid-parallel mode during normal conditions and operates in stand-alone mode during grid outage) were successfully demonstrated. For example, during the Northeast Blackout of 2003, the CHP system installed at Greater Rochester International Airport operated in stand-alone mode. The project received an award from the U. S. Environmental Protection Agency (http://www.epa.gov/chp/awards/winners2004.htm).

- As a result of the program, effective use of non-standard fuel sources (e.g., anaerobic digester gas) for CHP has been demonstrated.

- As a result of the program, third-party financing for CHP is being demonstrated in several settings, including New York City at 230 Park Avenue.

Market Progress

Market progress, such as increased awareness and knowledge of CHP and increased promotion by CHP trade allies, was measured in 2004. Details of the findings are presented in the "DG-CHP Market Characterization and Market Assessment and Causality Study."[7]

ECONOMIC AND ENVIRONMENTAL BENEFITS

Economic Benefits

- Economic benefits to facility owners include lower energy costs as well as economic impacts from non-energy benefits such as increased reliability and cleaner air. Economic benefits to New York arise when dollars saved on energy are available to spend on other goods and services, promoting economic growth. Past research by ACEEE[8] has shown that savings are retained in the local

[7] "DG-CHP Market Characterization and Market Assessment and Causality Study," by Skumatz Economic Research Associates, Inc., Summit Blue Consulting, LLC, and Quantec, LLC, Project Number 7721, May 2005.

[8] Elliot, R. Neal and Mark Spurr. Combined *Heat and Power: Capturing Wasted Energy*. American Council for an Energy–Efficient Economy. May, 1999.

economy and generate greater economic benefit than the dollars spent on energy.[9] Recovery and productive use of waste heat from power generation is a critical component of energy efficiency.

Environmental and Other Benefits

- The program has produced ambient air emission reductions. Every proposer is required to submit an emissions analysis and undergo the State Environmental Quality Review Act (SEQRA) process. NOx emissions information was compiled for a subset of projects representative of the program's portfolio of projects. For each project, the NOx reduction was estimated based on (1) the NOx emissions for the installed prime mover, (2) the NOx emissions of the generation facility serving the facility, and (3) the NOx emissions of the thermal equipment. On average, each facility reduced NOx emissions by 50%, or nearly 13,000 lbs. per year, or 1.1 lbs. per megawatthour of electricity produced.

- The program supports the use of renewable energy sources. Of the 115,000 MWh per year currently being generated by operating facilities funded through NYSERDA's DG-CHP program, approximately 29,000 MWh per year are from renewably fueled systems.

- The program has supported efforts to improve the reliability of New York's electric transmission and distribution system. New York Independent System Operator Zones J (New York City) and K (Long Island) are considered key in terms of congestion and system reliability.[10] Table 5-21 shows that approximately 43% of the CHP capacity that has been installed or in progress are in Zones J and K.

Table 5-21. Location of NYSERDA CHP Projects by New York Independent System Operator Zone

Location by NYISO Zone	Number of Projects*	Capacity (kW)
Zones J or K	30	12,635
All Other	28	17,264
Total	58	29,899

* Projects beyond the design phase.

5.7.4 Cumulative Impacts

This section presents cumulative impacts for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy

[9] Spurr, Mark. 1999. *District Energy Systems Integrated with Combined Heat and Power: Analysis of Environmental and Economic Benefits*. Report to the U.S. Environmental Protection Agency. March. Minneapolis, Minn.: International District Energy Association.

[10] *NYISO Electric System Planning Working Group Meeting April 15, 2004, Draft Minutes.*

savings and demand reductions shown in Table 5-22. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 5-22.

Table 5-22. CHP Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freeridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
MWh/year	100,054	0.90	90,391	15%	26%	1.07	96,718
MW	20.0	0.98	19.7	15%	26%	1.07	21.1
MMBtu/year[2]	-777,721	0.89	-690,025	15%	26%	1.07	-738,327

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

[2] 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, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. 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 what is achieved through efficiency alone.

Non-Energy Impacts

The MCAC team examined non-energy impacts for the DG-CHP Program in 2004. At that time, customers valued the non-energy impacts at approximately 32-64% of the value of the energy savings from their systems.

5.8 Demand Response and Innovative Rate Research

5.8.1 Program Description

Demand Response and Innovative Rate Research Program, a new initiative, supports participation of small customers in the NYISO's wholesale demand response and time-sensitive retail electric pilots. Residential and small commercial loads constitute a small percentage of participants in these programs because of their relatively small loads, the high cost of aggregation, and the lack of flexible metering options and other load control technologies.

The program promotes the development, demonstration, and use of end-use technologies that have flexible load capabilities. Flexible load technologies are end-use devices, such as air conditioners and lighting, enhanced with features that allow remote access and group control thereby allowing easier load reduction in response to peak demand and price signals. Additionally, the program's time-sensitive pilots promote the development of innovative electric service rates by energy services companies with the ultimate goals of:

- Realizing load shifting and reductions during peak and expensive time periods,
- Creating cost avoidance opportunities for customers, and
- Creating sustainable businesses for providers.

The program concentrates on the New York City metropolitan area where capacity is particularly constrained and value propositions for load reductions are most desirable.

The program budget is $10 million.

An R&D initiative begun in 2000, Enabling Technology for Price-Sensitive Load Management (ET), was a precursor to this new R&D program, Demand Response and Innovative Research. ET, a series of projects in the Next Generation Program has ended; however, energy savings are still being realized from its projects. ET sought projects that demonstrated advanced technologies and commercialized new methods of aggregating load. The advanced technologies enabled electricity load reduction in response to emergency and market-based signals.

5.8.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Demand Response and Innovative Rate Research Program. These goals and progress for the first six months are shown in Table 5-23.

Table 5-23. Demand Response and Innovative Rate Research Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Increase small customer participation in wholesale and local demand response programs (MW)	33	Modeled buildings using advanced window air conditioner control technology to determine the impact on load.
Increase the number of multifamily apartment units participating in real-time and other time-sensitive electric rate pilots	500 apartment units	Finalized a pilot program plan to demonstrate real time pricing rates and advanced load technologies in multifamily buildings in New York City. The solicitation will be released as PON 1151 in 2007.

Additional program highlights from the last six month period ending December 31, 2006 include:

- Time Sensitive Price Pilots, a time-based, behind-the-master-meter rate, is being implemented in New York City at three multifamily building sites containing 3,000 apartments. The current short-duration shadow-bill trial will be followed by education and training pending acceptance of the new rate plan by renters and management.

5.8.3 Program Impact Evaluation

This section presents cumulative annual energy savings for Enabling Technologies, the precursor to Demand Response and Innovative Rate Research. Savings are from program inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 5-24.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 5-24. All ranges reflect 80% confidence intervals.

Table 5-24. Demand Response and Innovative Rate Research Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realiza-tion Rate	Adjusted Gross Savings	Net-to-Gross Ratio	Net Savings
MW	208.1	0.69	144.4	0.95	137.2

5.9 Electric Transportation

5.9.1 Program Description

Analysis has shown that development, qualification, and deployment of advanced technologies for the electrified rail system could reduce peak load by as much as 100 MW in the highly constrained New York City T&D load pocket. New York's electrified commuter rail and subway system alone uses over 2 billion kWh a year and represents a 1,100 MW demand on the Consolidated Edison distribution system.[11]

The program will fund projects in all stages of technology advancement; and higher risk projects will be funded in phases. Successful completion of milestones will be required before beginning the next phase. Two competitive solicitations are anticipated. The first will target improving energy efficiency in the State's current electrified transportation infrastructure. This solicitation will be administered in collaboration with the New York City Metropolitan Transit Authority and the New York Power Authority. Activities will target conductor rails, regenerative braking systems, and propulsion efficiency. The second will target improving energy efficiency through the use of off-peak power in the transportation sector. This solicitation will target electrified anti-idling, plug-in hybrid vehicles, and reduced on-peak demand associated with producing and fueling alternative fuel vehicles.

The program supports emerging technologies from inception through field testing and pre-commercial deployment. Once a product is commercialized and has reliably demonstrated energy benefits, continued support is frequently available through deployment programs and from State and Federal tax allowances. Helping to develop products that will make this transition is a fundamental goal of the program.

[11] The subway system pays an SBC fee as do the private sector suppliers.

The ultimate goals of the program are:

- Improve the energy efficiency of the New York's current electrically powered commuter rail and subway system in the New York City load pocket.
- Reduce costs of power transmission by allowing unused off-peak capacity to generate revenue and reduce transportation petroleum use, green house gases, and criteria emissions.

The benefits of the electric transportation program will include peak load reduction in the New York City load pocket and permanent energy use reductions. These reductions will result in cost reductions to the subway and commuter rail systems and reduced transmission congestion in the region. Additionally, many projects are expected to reduce transportation costs and emissions from petroleum fueled vehicles.

The program budget is $5.0 million.

5.9.2 Recent Program Accomplishments

Six months of accomplishments toward the program's one-year goals are shown in Table 5-25.

Table 5-25. Electric Transportation Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Solicitations released	2	1
Proposals reviewed	N/A	11
Projects funded	N/A	5
Funding/Co-funding	$1,000,000/$1,000,000	$807,097/$1,000,000

5.9.3 Long-Term Program Accomplishments

Long-term success indicators and goals are presented in Table 5-26.

Prior SBC-funded projects focused on improving the State's energy efficiency through the use of off-peak power to reduce the use of petroleum-based transportation fuels. The Electric Station Car Project leased small neighborhood electric cars to the public and provided charging stations in reserved parking slots at commuter rail stations. Demand for the vehicles exceeded supply by nearly three to one. Thousands of gallons of gasoline consumption were replaced by off-peak power.

A second successful project, the Truck Stop Electrification Project, developed infrastructure technology, sponsored initial demonstrations and created a New York State based business that allows long haul trucks to eliminate sleeper cab engine idling during mandatory rest periods. Systems developed for the program are currently being sold nationally and are eligible for State and federal incentives.

Table 5-26. Long-Term Success Indicators

Activity	Achieved through December 31, 2006
Number of projects contracted/Completed	4/0
Funds Encumbered/Associated Co-funding	$157,600/$237,600

5.10 Environmental Monitoring, Evaluation, and Protection

5.10.1 Program Description

The EMEP commenced in the late 1990s in an effort to increase understanding of the environmental impacts of electricity production. EMEP initiatives are building on past efforts and evolving to support research in three primary areas:

- Ecosystem response to deposition of sulfur, nitrogen, and mercury, including continued support of the Adirondack Lake Water Quality monitoring program with the Adirondack Lake Survey Corporation and the NYS Department of Environmental Conservation.
- Health and energy-related research on air quality, particulate matter, ozone and co-pollutants to support continued development of sound air quality management plans for attainment of new ozone and fine particle standards.
- Crosscutting environmental science, technology and policy projects, such as research on regional climate change, environmental impacts of alternative energy resources (e.g., wind and tidal), and mitigating environmental impacts of electricity generation critical for fuel diversity.

The program is guided by a steering committee comprised of major stakeholder groups. In addition a separate science advisory committee continues to provide technical review. The program has maintained a robust science and policy communication component to deliver program findings to policy-makers, scientists, and the public. As with previous efforts, NYSERDA is collaborating with regional and national entities to leverage funds for pertinent research projects.

The 13-year budget is $39.0 million.

5.10.2 Recent Program Accomplishments

The recent program accomplishments for the six month period ending 12/31/06 are presented in Table 5-27.

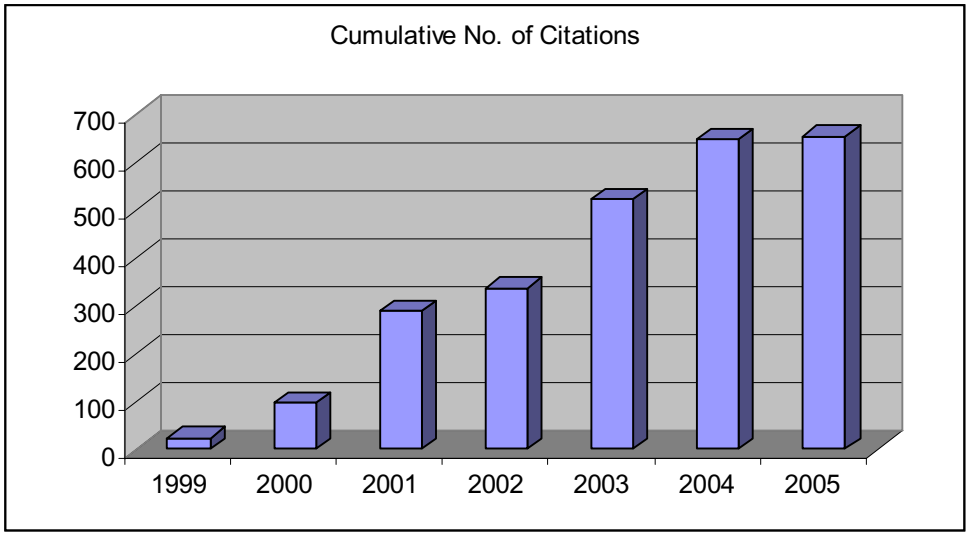
Table 5-27. Environmental Monitoring, Evaluation, and Protection Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Develop detailed multi-year EMEP research plan with input from policymakers, scientists, and stakeholders	Complete EMEP research plan in year 1	One planning meeting was held with the EMEP advisors, and two other major program advisory meetings were held in the fall. NYSERDA has signed a contract with the New York Academy of Sciences to help develop a 5 year technical research plan.
Develop, contract, and manage research projects aimed at priority energy-related environmental research areas	Issue 1 solicitation for outreach and science-policy analysis in year 1 Issue 1 solicitation addressing priority research needs Contract 8 projects	Three contractors were selected for the EMEP Outreach and Technical Assistance PON.
Disseminate information:		
Sponsor workshops, conferences, and seminars	2	NYSERDA held a one-day conference with environmental organizations to exchange information and ideas concerning environmental issues and initiatives in New York State.
Provide web-based EMEP data and information	40,000 customer "visits," inquiries, and downloads from EMEP's web page	During these six months, hits on EMEP web sites totaled nearly 115,000 and downloads totaled more than 11,000.
Publish NYSERDA research reports	5	4 research reports and 1 executive summary were published on: urban heat island, source apportionment, health effects of ambient air pollutants and asthma, and clinical health studies on air ultrafine particles, and ambient air ultrafine particles in Rochester
Publish peer-reviewed journal articles	15	8 articles were published in the area of Air Quality & Health in technical journals.
Provide briefings to decision makers	2	NYSERDA sponsored a meeting with policymakers concerning the effect of wind generation installations on wildlife.

Long-Term Program Accomplishments

Under SBC I and II, $21 million in NYSERDA funds were used to support 46 EMEP research projects and an additional $22 million in funding was leveraged. More than 125 peer-reviewed papers were published on EMEP findings and, as shown in Figure 5-5, EMEP research was cited 655 times in peer-reviewed journals. More than 80 organizations were involved in EMEP research projects, and EMEP fostered collaboration with scientists in 13 different countries to address New York environmental issues. Several advanced pollution measuring devices were developed and commercialized. A web page was launched in 2005, which received an average of 19,000 visits per month over the past year (up from 540 in its first month), and is routinely one of the top three NYSERDA web pages. Most importantly, EMEP research was cited as providing the scientific basis for several important environmental policies in air quality and health advisories.

Figure 5-5. Citations of Journal Articles from EMEP Projects



Accomplishments of the EMEP Program's progress since its inception have been documented as part of a peer review value/cost assessment conducted in 2006. Highlights include:

- Environmental monitoring data from hundreds of field sites throughout New York have been collected to support program goals.
- Achievements in knowledge dissemination have been significant, with over 125 articles published in peer-reviewed journals.
- 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-sponsored research has affected energy-related policy at the New York State level, including:
    - the Acid Deposition Reduction Program,
    - the recent State mercury regulations for power plants,
    - and the New York State Department of Health fish consumption advisories for mercury, as well as at the Federal level, including:
    - the Clean Air Mercury Rule,
    - the U.S. EPA's assessment of the Clean Air Interstate Rule,
    - and the U.S. EPA's review of the SO_2 National Ambient Air Quality Standard.

5.10.3 Program Impact Evaluation

A value-cost analysis was conducted for EMEP in 2006. Guided by a logic model, the evaluation team assembled a variety of performance data for EMEP for the following seven outcomes:

1. Knowledge Creation
    - Significance of Knowledge Created
    - Quantity of Knowledge Created
2. Knowledge Dissemination
    A. Availability of Knowledge Products
    B. Target Audience
3. Commercialization Progress
    - Capital Attraction
    - Technical Achievement
    - Market Advancement
4. Realized and Potential Energy Benefits
5. Realized and Potential Economic Benefits
6. Realized and Potential Environmental and Health Benefits
7. Value versus Cost
    - Value vs. NYSERDA and Participant Cost
    - Value vs. NYSERDA Cost

For the EMEP Program, four outcomes were deemed relevant – knowledge creation, knowledge dissemination, realized and potential environmental and health benefits, and value versus cost. All the scores for the four relevant outcomes were above 3.5, out of a possible 4. The overall score across all outcomes was also quite high at 3.7. Knowledge creation included program planning, research project selection and development, and project funding and management. Knowledge dissemination encompassed relevance, acceptance, and use by the scientific community and by policymakers, which included peer-reviewed publications and citations and impact of EMEP research on promulgated regulations. It is clear that EMEP is making noteworthy progress toward achieving significant long-term environmental benefits. Finally, the external peer review panel concluded that the value of the EMEP program significantly exceeds NYSERDA's costs as well as the combined costs of NYSERDA and its research partners, and the reviewers felt that few research programs in the country can claim the variety and significance of accomplishments as EMEP.

5.11 Industrial Research, Development, and Demonstration

5.11.1 Program Description

The IRDD program supports feasibility studies and technology demonstrations and commercialization that (1) improve energy productivity and competitiveness of New York manufacturers (minimize cost per unit output), (2) encourage capital investment and employment growth in New York facilities, (3) introduce New York-manufactured goods into new markets, and (4) encourage adoption of process changes that minimize waste. Cost-shared demonstration projects reduce risk and encourage manufacturers to adopt innovative and underutilized product and process alternatives. IRDD is a new program that combines two Industry programs, Industrial Process and Productivity Improvement (IPPI) and Industrial Product Development, to better serve the industrial sector's needs. IRDD is a collaborative effort of Industrial and Environmental R&D and Energy Efficiency Services.

The five year program budget is $15 million.

5.11.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Industrial Research, Development and Demonstration Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-28.

Table 5-28. Industrial Research, Development and Demonstration Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Issue annual solicitations	*By fall 2006,contract for 6 to 10* demonstrations and feasibility studies of innovative and under-utilized technologies that save energy and improve productivity in the industrial sector	PON 998 was issued with two rounds of due dates (June 8 and October 5, 2006) with total funding of $4 million ($2M SBC + $2M Statutory funding). NYSERDA selected 6 projects to receive SBC funding in round 1 and 5 projects to receive SBC funding in round 2.
Program metrics	Document realized energy efficiency, environmental, and economic benefits	Projects are being contracted with requirements for documentation of performance metrics. Projects have not been completed; therefore, metrics cannot be ascertained at this time.

Program Highlights

During the third quarter of 2006, NYSERDA solicited proposals for IPPI (which was the precursor to the IRD&D Program). Eleven projects have been selected for funding.

Over the past ten years NYSERDA Industrial Process and Productivity Improvement Program has averaged $1.75 million in annual funding, and resulted in cumulative energy savings of almost $20 million, non-energy benefits in excess of $21 million, project-related incremental sales of almost $40 million, and approximately 85 new jobs. This program combined statutory R&D funds and EES federal funds.

5.11.3 Long-Term Program Accomplishments

This section highlights key program outputs and market progress. All values reported are cumulative since program inception. Table 5-29 presents the key outputs for IPPI and Industrial Product Development (IRDD predecessor) through December 31, 2006. In addition to the key outputs, several long-term success indicators will also be tracked including: energy, demand and fossil fuel savings, cost savings from productivity improvements, processes developed, and processes deployed.

Table 5-29. Industrial Research, Development and Demonstration Program – Key Program Outputs

Outputs	Goal through 2011	Value (Cumulative through December 2006)
Number of Solicitations	5 PONs, 14 due dates	1 PON, 2 due dates
Number of proposals reviewed/Recommended for SBC funding	300/40	40/11
Number SBC contract actions	40	11
Number of unique SBC projects	35	11
SBC Funds Encumbered	$10,000,000	$1,513,547
Co-funding by Project Participants	$20,000,000	$3,155,688

5.12 Municipal Water and Wastewater Efficiency

5.12.1 Program Description

Since 2000, the ongoing water and wastewater initiative has supported projects that accelerate the use of energy-efficient and innovative technologies by municipal water and wastewater systems in New York through demonstrations, technology transfer, and feasibility studies. Approximately three to four billion kWh are consumed by municipal water and wastewater treatment plants in New York every year. On average, the sector consumes 35% of a typical municipality's energy budget.

There are currently 16 SBC-funded water and wastewater projects, derived from eight solicitations developed jointly by NYSERDA's Energy Efficiency Services and R&D staffs. Five of the eight solicitations were PONs, which solicited proposals to demonstrate and evaluate innovative or underutilized energy-efficient water and wastewater technologies. A sixth was an RFP, which solicited proposals to demonstrate real-time monitoring of energy and environmental performance at wastewater treatment plants, attempting to attract the energy service sector into the municipal wastewater market. The seventh was another RFP, which solicited proposals to benchmark energy use and evaluate the potential for energy efficiency and energy production improvements in the sector. The eighth solicitation is a sector-based initiative, the Energy Smart Focus Program, where municipal water and wastewater is one of the five sectors selected to receive services. A separate technology transfer project is helping to increase the utilization of a specific energy-efficient filtration technology by providing technical assistance to up to 10 wastewater treatment plants. In addition, NYSERDA's long-standing Technical Assistance (TA) Program has served municipal water/wastewater customers since 1997, including 70 site-specific analyses. All activities to date have had strong technology transfer components, and municipal

water and wastewater treatment is also integrated with the Enhanced Commercial/Industrial Performance program.

Going forward, the Municipal Water and Wastewater Efficiency Program will focus on providing municipalities with information, resources and services to increase the standard of energy efficiency in the sector. To that means, the program will continue to provide cost-shared demonstration projects to reduce risk and encourage adoption of innovative or underutilized energy-efficient technologies and practices. Energy management training will be offered for treatment plant operators, municipal decision makers, consultants, and product vendors. Technical assistance will continue to be emphasized for municipalities seeking to upgrade or improve the energy efficiency of their equipment and operations. Energy efficiency incentives will continue to be offered to move the market to more efficient equipment. In support of these efforts, technology transfer and outreach will be provided to encourage adoption of innovative and energy-efficient technologies and practices. The program will continue to be a collaborative effort between NYSERDA's R&D and Energy Efficiency Services staff.

The Municipal Process Efficiency Program is funded out of the Commercial/Industrial sector budget. SBC funds are leveraged in this sector for Technical Assistance and from the Enhanced Commercial and Industrial Performance Program.

5.12.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Municipal Water and Wastewater Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-30.

Table 5-30. Municipal Water and Wastewater Efficiency Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Issue annual solicitation	Select and fund 5 or more projects, provide assistance to a minimum of 5 municipal wastewater and water treatment facilities.	PON 1040 was issued and 17 proposals were received requesting $3.9 million in NYSERDA funding. These proposals were recommended for SBC funding. These contracts are being negotiated.

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Technology transfer	Provide critical information on technologies and strategies that will optimize energy production and use at municipal wastewater and water treatment facilities. Provide information to 100 treatment facilities in New York.	NYSERDA sponsored an energy management training session for the target sector was co-developed by EPRI and the New York Water Environment Association (NYWEA). Approximately 70 individuals representing consultants, engineers and municipalities attended the two-day session. Additionally, the materials developed for the session will be offered through NYWEA in webcast format in the near future. Energy management presentations were given at four NYSEFC hosted Co-funding Committee conferences and as part of a webcast hosted by the Comptroller's Office. At a minimum, an additional 100 individuals participated in these presentations. The submetering and evaluation of 20 wastewater treatment plants has been completed. The final reports an summary of findings have been posted online. (In a related sector-based EES program, the Energy Smart Focus solicitation was developed to provide sectors with customized services and strategies in support of energy efficiency. Proposals supporting the Municipal Water and Wastewater Sector were reviewed by a Technical Evaluation Panel for technical merit.)
Technical Assistance	Develop six new projects while reviewing and approving six ongoing projects.	Two new Technical Assistance (TA) projects were approved to begin work totaling $12K in NYSERDA funds. Four TA projects, representing $76K in NYSERDA funds, were completed.

5.12.3 Long-Term Program Accomplishments

As of December 2006, $3.2 million has been committed under the targeted water and wastewater initiative. An additional $1.1 million has been awarded for municipal water/wastewater projects under the TA Program. Table 5-31 summarizes the funding status of the programs.

Table 5-31. Project and Funding Status

	Proposals Received	Number of Projects	Number of Sites Approved	Funds Awarded ($ million)	Co-funding ($ million)
RFP 769 Energy Efficiency Improvements at Water & Wastewater Treatment Plants	10	1	n/a	$0.13	$0.05
RFP 601 (Submetering)[1]	17	2	20	$1.1	$0.4
Demonstration Projects (569, 786, 857, 935 and 1040)	99	12	12	$1.86	$2.4
Technical Assistance [2]	75a	70	70	$1.1	$1.1
Technology Transfer	1	1	3	$0.1	$0.1

[1] Funded in part under the general Technical Assistance Program.
[2] Funded under the general Technical Assistance Program.
a Number of viable projects.

5.12.4 Program Impact Evaluation

Energy Savings

On average, these projects take five to seven years from conception to implementation. However, once implementation is complete, the projects should lead to nearly 42,919 MWh of electricity savings and 14,774 kW of peak demand reduction. Depending on the effectiveness of information dissemination from knowledge created, the potential exists for substantial MWh savings and demand reductions due to replication across the broader New York municipal water/wastewater market sector.

5.13 Next Generation and Emerging Technologies

5.13.1 Program Description

The Next Generation and Emerging Technologies program emphasizes discrete and integrated end-use technologies for buildings; daylighting applications; solar thermal applications; and emerging technologies for industry and buildings not covered elsewhere in NYSERDA's portfolio of **New York Energy $mart**[SM] programs. The bulk of funds will be administered through narrowly defined competitive solicitations. Potential focus areas include:

- Advanced Building Products Program which concentrates on residential one- to four-family units. The advanced building demonstration element addresses the whole building – striving to reach a 92 or greater HERS rating (qualifying ENERGY STAR homes start at a HERS rating of 84). The discrete building technologies element targets development and demonstration of distinct technologies, *e.g.*, energy systems (production and recovery), heating and cooling, air quality, etc.

- Emerging technologies to support development and demonstration of discrete technologies that improve electrical end-use efficiency.

- Daylighting applications to support demonstration and provide technical assistance to advance daylight applications in commercial buildings.

- Solar thermal applications to support demonstration and provide technical assistance to advance economical collection and utilization of solar thermal energy.

- Lighting incubator program activities that develop and commercialize advanced lighting technologies.

- Power quality, energy management, controls and sensors activities that promote development of technologies that enable customers to monitor and control energy usage and power quality.

The program emphasis is on funding developers and 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. For example, advanced building demonstrations will focus exclusively on residential homes of one to four units.

Past solicitations have addressed transportation, sensors, energy efficiency, superconductivity, power quality, energy management, and time sensitive pricing.

The thirteen-year program budget is $47.8 million.

5.13.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Next Generation and Emerging Technologies Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-32.

Additional program highlights include:

- Two solicitations are under development for the Advanced Building Program. They are PON 1096 High Performance Residential Development Challenge (funded at $1.5 million) and PON 1126 Next Generation Emerging Technologies for Residential Buildings (funded at $2.5 million).

Table 5-32. Next Generation and Emerging Technologies Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Advanced Building Program	2 solicitations, 5 product development projects, 1 demonstration test bed	Proposals in response to PON 1062 *Advanced Building Envelopes and Energy Systems* were received on October 18, 2006. Total funding available is $1 million. Two proposals were funded for a total of $120,000. One proposal was funded for RFP 1032 *Reference Design Guide* with total funding of $100,000.
Daylighting Applications	5-10 design assistance projects, 1 daylighting implementation in buildings	Nine proposals were received in response to PON 1079 *Daylight Technical Services, Training and Demonstrations.* Total available funding is $675,000. RFP 1068 "Establishment of a Lighting Incubator Center to support lighting start-up companies in New York" was released. Proposals are due by January 25, 2007. Total funding available is $2 million.
Solar Thermal Applications	1 solicitation, 2 demonstrations	Submissions for PON 1085 *Solar Thermal Demonstrations* are due by February 5, 2007. Total available funding is $500,000.
Emerging Technologies	1 solicitation, 5 product development projects	Three projects involving emerging hydrogen technologies were selected to be funded with SBC funds through PON 957 Hydrogen Technology Development and Demonstration. PON 1105 has total funding of $4,000,000 for two rounds of proposals. First round proposals are due by January 22, 2007. The second round proposals are due by June 7, 2007.

5.13.3 Long-Term Program Accomplishments

In early 2007, project managers were asked to provide information on completed projects. The remainder of this section provides the results of this effort.

Program Portfolio

Since its inception in September 1998, the program has funded projects totaling over $25 million. There are currently 123 projects funded under the program. Of these, 71 are complete and 52 are ongoing. Projects were categorized into the following project types:

1. Research/Support Studies: include studies that analyze market potential, technological feasibility, and other studies designed to inform policy makers and supply-side market actors.

2. Product Development: projects that are focused on a clearly defined product and benefit New York manufacturers.

3. Demonstration: projects that demonstrate the performance of products that are commercially available.

4. Conference/Membership: projects support activities related to conferences and association membership.

The number of projects in each category is shown in Figure 5-6. Categories with the most projects are Research & Support at 35%, followed by Demonstration at 31%. The distribution of funding by project categories is shown in Figure 5-7. The largest categories in terms of funding are Demonstration with 50% of the funding, followed by Product Development with 21% of the funding. The distribution of funding by sector is shown in Figure 5-8. The industrial/manufaturing sector has been awarded the most funding at 39%.

Figure 5-6. Projects Distributed by Project Type

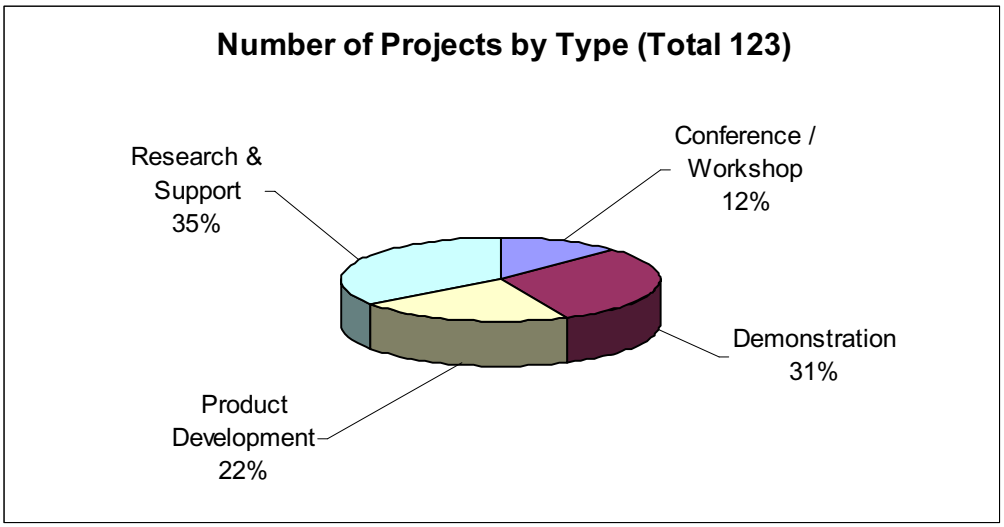


Figure 5-7. Distribution of Funding by Project Type

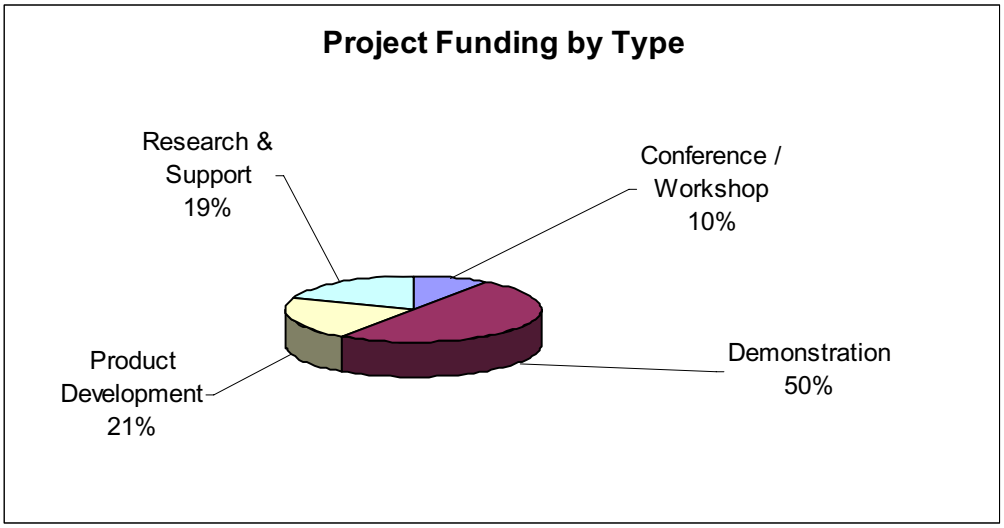


Figure 5-8. Encumbered Funding by Sector (through 2006)

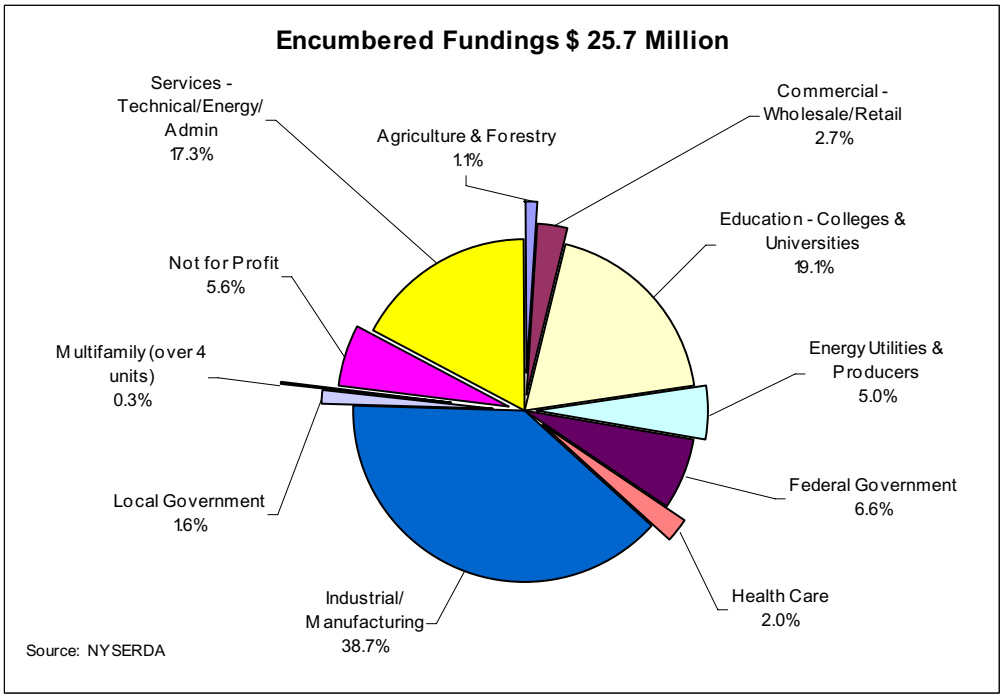


Table 5-33 presents results regarding the magnitude of knowledge creation, dissemination, and commercialization progress activities. For each project, project managers indicated whether a particular project resulted in 0, 1 to 5, 6 to 10, or 11 or more of specific outcomes such as published articles, websites reporting project information, conference presentations, etc. The number of projects with more than 1 instance of these outcomes is shown in Table 5-33 for the different response categories. Other program outcomes are shown in Table 5-34.

Table 5-33. Next Generation and Emerging Technologies Program – Number of Projects with Selected Outcomes (Through Year-End 2006)

Outcomes	Response Category		
	1 - 5	6 - 10	11 or more
Knowledge Creation and Disseminations			
Number of published articles	34	3	2
Number of websites where reports are available	28	0	0
Number of Conference Presentations	30	2	2
Number of field tests initiated	16	3	2
Number of lab tests initiated	14	1	1
Commercialization Progress			
Number of projects with UL listing, other Listings, patents, or patent applications	11	0	0

Table 5-34. Other Program Outcomes: Number of Projects with Attribute

Outcome	Result
Number of projects with recoupment provisions[1]	24
Number of new products developed	9
Number of projects with sales	4
Number of projects with job creation	7
Number of projects with new investments	17

1 Includes ongoing and completed projects

Nine new products were developed under the Next Generation Program and are in various stages of commercialization. These are shown in Table 5-35.

Table 5-35. Next Generation and Emerging Technologies Program: New Products Developed Since 1998.

Product Name	Development Objective
Ultra-Low Power Oil-fired Burner	Confirm fitness for full scale commercialization of the Ultra-Low Power system.
Voltage Sag Mitigation Device	Evaluate performance characteristics of an energy-efficient, voltage sag mitigation technology.
T 9000	Development and evaluation of a wall mounted, wireless thermostat control system for baseboard electric heaters and room air conditioners.
Power-Line-Carrier Controlled Fluorescent Lighting	To develop an ultra-efficient, electronic, sub-miniature dimming ballast (SMDB) for fluorescent lighting in the power range of 13W to 32W and a high power electronic dimming ballast (HPEDB) in the power range of 60W to 200W; both with 10-year reliabilities and on/off/dimming control functions through the use of power line carrier controls.
Online Lighting Education Training	To develop and conduct on-line educational seminars on energy efficient lighting systems for key lighting decision-makers in New York State.
Low electric power battery back up oil-fired heating system	Develop and laboratory test a self-powered, oil-fired, heating system for residential and small commercial buildings.
Hybrid Skylighting System	To design, evaluate and demonstrate a hybrid skylighting system combining a skylight with a photosensor to moderate electric light use.
HID Wallpack & Floodlight	To develop, manufacture and market high quality, affordable high intensity discharge (HID) wallpack and floodlight fixtures.
Revolutionary Power Cell	Design and develop a hybrid system including a high power density battery integrated with the contractor's high energy density power cell and demonstrate it in a small electric vehicle.

The primary technology investigated by each project was provided by the project managers. The technology categories are shown in Table 5-36. along with the number of projects in each category. The projects are further divided by project type, project status, and outcome attributes.

Table 5-36. Project Outcomes by Technology Type (Cumulative Through 2006)

															Economic Benefits[2]			
																		Resulted in new investment
Aggregation/ Metering/Demand Management	10	3	15	2	30	7	23	1	3	16	13	10			5		3	9
Emissions/Clean Vehicles/Truck stop Electrification	2	1	2		5	2	3	1	2	2	3	3					1	2
Energy Generation/ Storage/CHP	4	5	1		10	3	7		2						5			
HVAC/R	8	5	2		15	8	7	5	1	6	6	6			4			
Industrial Processes	4	1	4		9	2	7	3	5	5	3						1	2
Lighting and Lighting Controls	6	7	8	5	26	14	12	4	5	7	6	7	2	3	6	3	1	2
Power Quality/Power Management/ Inverter/Control Systems	2	5	4		11	7	4	2	3	2	2	1	3	3	4	1	1	2
Residential Building Systems	3				3	3												
Technology Transfer	4			8	12	5	7			1	1	1						
Transmission & Distribution			2		2	1	1											
Totals	43	27	38	15	123	52	71	16	21	39	34	28	5	6	24	4	7	17

[1] Includes ongoing and completed projects [2] These numbers represent each instance of a range of 1 – 11 cumulative events per project