New York Energy $mart[SM]
Program Cost-Effectiveness Assessment
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ABSTRACT

This report summarizes the benefit/cost (B/C) model development and analysis activities conducted by the Heschong Mahone Group, Inc. in 2004 to assess the cost-effectiveness of selected **New York Energy $mart[SM]** public benefits programs. B/C ratios were calculated under a number of scenarios for 18 individual **New York Energy $mart[SM]** Program initiatives. Results are presented at the program, sector (*i.e.*, business/institutional, residential, and low-income), and portfolio levels. Although the B/C ratios for some programs are below 1.0, when all 18 programs are viewed as a portfolio, the B/C ratio is greater than 1.0 regardless of the scenario used. It is also expected that over time, B/C ratios might improve due to better-quality data, new data, and measuring of some market effects that heretofore were not quantified. A reported B/C ratio that is low today might become larger in the next update of this analysis as more is learned about a program's market effects. Also included in this report is a discussion of the inputs to the B/C model and a discussion of on-going issues related to data collection.

For this report, B/C ratios were calculated only for programs that claim kilowatthour (kWh) or kilowatt (kW) savings. Programs administered under NYSERDA's Research & Development (R&D) Program were not included in the analysis. A cost-effectiveness assessment of the activities in the R&D Program is currently underway and the framework and action plan for this assessment is presented in Appendix C of this report. Preliminary results will be included in the annual ***New York Energy $mart[SM]*** *Program Evaluation and Status Report* to be released in May 2005.

The programs within the **New York Energy $mart[SM]** Program portfolio are diverse, have multiple objectives, and are designed to work interactively with one another to achieve the Program's broad public policy goals. As a result, it is inappropriate and can be misleading to compare B/C ratios across programs. However, combined with the evaluation results presented in the May 2004 ***New York Energy $mart[SM]*** *Program Evaluation and Status Report*, the B/C analysis may be used to provide improved understanding of how the **New York Energy $mart[SM]** Program portfolio is performing.

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SECTION 1: INTRODUCTION

This report provides the benefit-cost (B/C) analysis conducted in 2004 for the **New York Energy $mart**[SM] public benefits program. The analysis was performed by the Heschong Mahone Group, Inc. in conjunction with Ridge & Associates and Energy and Environmental Economics, Inc. This analysis builds on the work of GDS Associates, which conducted a B/C analysis of the 11 largest **New York Energy $mart**[SM] programs covering the period 1998 through the second quarter of 2002.[1]

Starting in 2003, a comprehensive effort was begun to more fully evaluate all of the **New York Energy $mart**[SM] programs to verify the reported savings and to estimate energy savings attributable to market transformation efforts. In 2003, NYSERDA hired Nexant Inc. to conduct the measurement and verification activity. Summit Blue Consulting was hired to measure market effects and to assess the degree to which NYSERDA might claim responsibility for the energy savings. Summit Blue also estimated non-energy benefits for selected programs. The current B/C analysis includes macroeconomic benefits estimated by Neenan Associates[2] as well as the impact of the **New York Energy $mart**[SM] Program on the energy market price for electricity and the associated statewide reduction in customer bills. In addition, the current B/C analysis:

- Differentiates energy and capacity costs for the downstate and upstate regions as a more precise estimate of savings than using statewide averages.
- Uses avoided costs that are based on wholesale electricity bid prices rather than production costs.
- Uses updated energy efficiency measure load profiles[3] developed by Optimal Energy Inc. to differentiate savings by time of day.[4]

Evaluating public benefits programs and assessing their cost-effectiveness is not a trivial matter because of the difficulty in measuring the full range of benefits realized by participants and non-participants and also because many program benefits will not be realized until well into the future. For example, market development or transformation programs are intended to have impacts well beyond their lives or incentive offerings. Changes in customer and market actor behaviors relative to the energy efficiency services provided might take several years, can extend many years into the future, and might permanently transform a market. The real value of public support for these activities and their resulting long-term impacts should be compared to what would have likely occurred absent the program. It is difficult to estimate the "base case" and equally difficult to forecast longer-term market effects and customer behaviors. As a result, the B/C analysis conducted to date represents a static analysis at a point in time, including only known and quantifiable program benefits and costs. Total costs are known or are able to be estimated more easily, while prospective benefits are not. Market transformation programs that front-load costs in anticipation of realizing future benefits will not fare as well under the B/C analysis as programs that deliver immediate savings (*e.g.*, resource procurement programs).

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[1] GDS Associates, 2003, ***New York Energy $mart***[SM] *Program Cost-Effectiveness Assessment.*

[2] Neenan Associates, 2004, *Macroeconomic Impact Analysis of the* ***New York Energy $mart***[SM] ***Program****: An Analysis of Short-term and Longer-term Impact*.

[3] These profiles are used to allocate the energy savings to the six costing periods (summer off-peak, summer on-peak, summer shoulder, winter off-peak, winter on-peak, winter shoulder) so that the avoided cost for the same six costing periods can be applied.

[4] Optimal Energy Inc., 2003, *Energy Efficiency and Renewable Energy Resource Development Potential in New York State*.

Benefit/cost ratios were calculated at the program level, sector level, and the portfolio level. A total of 18 programs were included: nine business and institutional programs, six residential programs, and three low-income programs. The nine business and institutional programs represent more than 90% of the funds budgeted within the business and institutional sector. The six residential programs represent approximately 91% of the funds budgeted within the residential sector. The three low-income programs represent approximately 87% of the funds budgeted within the low-income sector. The programs and their associated budget and spending through December 31, 2003 are shown in Table 1 for the business/institutional programs, in Table 2 for the residential programs, and in Table 3 for the low-income programs.

Table 1. Business/Institutional Programs

Programs	8-year Budget *($ millions)*	% of Program Area Budget	Funds Spent Through Year-End 2003 *($ millions)*	% of Program Area Spending
C/I Performance Program	$126.6	34.8%	$59.3	40.5%
New Construction Program	$79.4	21.8%	$22.9	15.6%
Technical Assistance Program	$37.0	10.2%	$11.9	8.1%
Peak Load Reduction Program	$42.7	11.7%	$20.1	13.7%
Small Commercial Lighting Program	$10.6	2.9%	$4.4	3.0%
Premium Efficiency Motors	$4.5	1.2%	$2.4	1.6%
New York Energy $mart^{SM} Loan Fund (include $8.1 million for residential loans)	$18.6	5.1%	$7.3	5.0%
Smart Equipment Choices	$9.7	2.7%	$7.3	5.0%
*Other Business and Institutional Programs**	*$34.4*	*9.5%*	*$10.9*	*7.4%*
Total: Business and Institutional Program Area	**$363.5**	**100%**	**$146.5**	**100%**

* These are programs for which B/C ratios were not calculated because they were (a) support programs, (b) had benefits that were difficult to quantify, or (c) were pilot programs. However, the costs of these programs were added to the sector-level in the "with additional costs" scenario to more accurately estimate portfolio and sector-level B/C ratios.

Note: Funds spent for the C/I Peformance Program includes $19.5 million that has not yet been invoiced due to the M&V period that could last up to two years.

Table 2. Residential Programs

Programs	8-year Budget *($ millions)*	% of Program Area Budget	Funds Spent Through Year-End 2003 *($ millions)*	% of Program Area Spending
ENERGY STAR® Products	$32.7	23.0%	$18.8	18.7%
Bulk Purchase			$5.8	5.8%
Keep Cool	$19.9	14.0%	$18.4	18.3%
ENERGY STAR® Labeled Homes	$29.2	20.6%	$10.5	10.4%
Home Performance with ENERGY STAR®			$8.1	8.0%
Residential Comprehensive Energy Management	$12.7	8.9%	$4.3	4.3%
*Program Marketing**	$30.7	*21.6%*	*$24.4*	*24.2%*
*Other Residential Program Funding**	*$16.8*	*11.8%*	*$10.5*	*10.4%*
Total: Residential Program Area (Does not include funding for the residential portion of the Loan Fund included in Table 1)	**$142.0**	**100%**	**$100.8**	**100%**

* These are programs for which B/C ratios were not calculated because they were (a) support programs, (b) had benefits that were difficult to quantify, or (c) were pilot programs. However, the costs of these programs were added to the sector-level in the "with additional costs" scenario to more accurately estimate portfolio and sector-level B/C ratios.

Table 3. Low-Income Programs

Programs	8-year Budget *($ millions)*	% of Program Area Budget	Funds Spent Through Year-End 2003 *($ millions)*	% of Program Area Spending
Low-Income Assisted Multifamily Progam	$76.2	63.7%	$1.6	7.4%
Low-Income Direct Installation	$9.9	8.3%	$9.9	45.8%
Assisted Home Performance with ENERGY STAR®	$18.1	15.1%	$5.5	25.5%
*Other Low-Income Program Funding**	*$15.4*	*12.9%*	*$4.6*	*21.3%*
Total: Low-Income Program Area	**119.6**	**100%**	**$21.6**	**100%**

* These are programs for which B/C ratios were not calculated because they were (a) support programs, (b) had benefits that were difficult to quantify, or (c) were pilot programs. However, the costs of these programs were added to the sector-level in the "with additional costs" scenario to more accurately estimate portfolio and sector-level B/C ratios.

Note: Funds spent for the Low-Income Assisted Multifmamily Program do not include $8.2 million spent for projects that have not yet been completed and are planned to be completed.

The evaluation efforts of Nexant Inc. (Measurement & Verification contractor) and Summit Blue Consulting (Market Characterization, Assessment, and Causality contractor) during the 2003/2004 and 2004/2005 evaluation years are depicted in Table 4. Not all programs received the same level of evaluation in the first year due to time and resource limitations. A solid circle indicates a full analysis, a half-filled circle indicates a partial analysis, and an empty circle indicates a minimum level of effort. In most cases, programs that did not receive a full analysis in the first year will receive a full analysis in the second year. In addition, the results of the first-year activities will be updated for some programs. This updating is represented by a solid square.

Table 4. Evaluation Activity in 2003/2004 and 2004/2005

	Evaluation Focus	2003/2004 Evaluation Activity		2004/2005 Evaluation Activity	
		M&V Nexant	MCAC Summit Blue	M&V Nexant	MCAC Summit Blue
1	C/I Performance Program	●	◐	■	●
2	New Construction Program	●	●	■	■
3	Curtailable Load Programs	◐	●	●	■
4	Peak Load Reduction Program: Permanent Measures	●	●	■	■
5	Technical Assistance/Flex Tech	◐	◐	●	●
6	**New York Energy $mart^{SM}** Loan Fund	◐	○	●	○
7	Smart Equipment Choices Program	◐	○	●	●
8	Small Commercial Lighting	◐	○	●	●
9	Premium Efficiency Motors	◐	◐	●	●
10	ENERGY STAR® Products	●	●	■	■
11	ENERGY STAR® Bulk Purchase	●	○	○	○
12	ENERGY STAR® Labeled Homes	●	●	●	■
13	Home Performance w/ENERGY STAR®	●	●	●	■
14	Keep Cool	●	●	○	■
15	Residential Comprehensive Energy Management	◐	○	●	●
16	Low-Income Assisted Multifamily Progam	◐	●	●	■
17	Low-Income Direct Installation	◐	○	○	○
18	Assisted Home Performance w/ENERGY STAR®	◐	◐	●	■

●=Full Analysis, ◐=Partial Analysis, ○=Limited Analysis, ■=Updating of Year-One Analysis

For Nexant, full analysis denotes on-site verification of energy savings; partial analysis denotes review of program records and savings methodologies. For Summit Blue, full analysis denotes significant primary research on all three elements (market characterization, assessment, and causality); partial analysis denotes some primary research addressing one or more of the elements; limited analysis denotes secondary research to determine reasonable placeholder values until the program can be more fully addressed. For Nexant, updates denote in-depth review of savings methodologies. For Summit Blue, updates denote enhancing the full analysis.

The methodologies used to develop avoided energy costs, energy market price benefits, and macroeconomic benefits are presented in Appendix A of this report. Additional information on all of the 2003/2004 evaluation activities are presented in the May 2004 ***New York Energy $mart$^{SM}*** *Program Evaluation and Status Report*. The cost-effectiveness of NYSERDA's R&D Program is being assessed through a value-cost (V/C) analysis, which is not included here. A brief description of the V/C analysis is presented in Appendix C of this report.

The current analysis expands upon previous B/C work by including benefits associated with market effects spillover and excluding energy savings that cannot be readily attributable to NYSERDA's programs (*i.e.*, free-rider effects). Two different tests were used to calculate B/C ratios:

1. Total Market Effects Test (TMET) compares quantifiable life-cycle electric energy, fuel, and other benefits from program participants and spillover effects against both NYSERDA and customer costs incurred in achieving those benefits.
2. Program-Efficiency Test (PET) compares the same quantifiable life-cycle benefits against only NYSERDA's costs.

A TMET ratio greater than 1.0 means that the monetary benefits derived from the program exceed the costs incurred by both NYSERDA and customers. A PET ratio greater than 1.0 means that the monetary benefits exceed only the costs incurred by NYSERDA.

Four scenarios were constructed for each of the two tests with each successive scenario adding additional benefits that can be quantified and attributable to the **New York Energy $mart**[SM] Program. In Scenario #1, only the avoided costs associated with energy, capacity, natural gas, oil, propane, and water savings arising from participant actions and from market spillover are used as benefits. In Scenario #2, the energy market price benefits from lowering the requirements for energy given available supplies are added. In Scenario #3, non-energy benefits are added where available. In Scenario #4, macroeconomic benefits are added, but only at the portfolio level. The benefits and costs included in each scenario for each test are depicted in Table 5.

Environmental benefits such as reductions in emissions of sulfur dioxide, nitrogen oxides, and carbon dioxide were not included as a benefit primarily because the monetary value of these reductions are too uncertain at this time. Furthermore, with respect to sulfur dioxide and nitrogen oxides, since there are statewide regulatory emission caps as well as emission trading markets, emission credits may likely be sold in the marketplace, allowing generators to reduce operating costs (*e.g.*, through less stringent pollution controls) or expand generation (*e.g.*, to meet economic growth) without exceeding their caps. The net effect will be statewide emissions meeting the caps for sulfur dioxide and nitrogen oxides.

It is also expected that over time, as this Cost Effectiveness Analysis is continued and updated, B/C ratios might change to reflect better-quality data, additional or new data, or measurement of market effects that heretofore have not been quantified. A reported B/C ratio could change in the next round of this analysis as more is learned about a program's market effects. For example, the existence of multiple programs within a sector is anticipated to lead to customers hearing multiple messages in multiple ways, reinforcing the energy efficiency message, and increasing the impact of the programs. Also, synergy between the residential sector and the business/institutional sector is likely to occur. For example, commercial building owners and inhabitants are likely to carry over their learning on the importance of energy efficiency to their home energy use. Similarly, homeowners who learn about energy efficiency through residential programs are likely to apply their learning to their business settings. In addition, programs are continually reviewed and revised by NYSERDA in response to customer feedback and evaluation findings; therefore, final judgment of a program's cost-effectiveness, especially in its early stages, should be avoided particularly for market transformation programs.

Table 5. Benefits and Costs Included in Each Test and Scenario

	Total Market Effects Test (TMET)				Program Efficiency Test (PET)			
	Scenario				Scenario			
	#1	#2	#3	#4	#1	#2	#3	#4
BENEFITS								
Avoided wholesale costs for kWh and kW and other avoided costs (*e.g.*, water, natural gas, oil)	√	√	√	√	√	√	√	√
Energy market price effects (reduction in wholesale price of electricity due to reduced requirements)		√	√	√		√	√	√
Non-energy benefits (*e.g.*, health , safety)			√	√			√	√
Macroeconomic impacts				√				√
COSTS								
Incentives, implementation costs, administration and evaluation costs	√	√	√	√	√	√	√	√
Customer contributions to the incremental costs	√	√	√	√	No	No	No	No

SECTION 2: SUMMARY OF RESULTS

2.1 BUSINESS/INSTITUTIONAL PROGRAMS

Both the TMET and PET ratios for the Business/Institutional programs are shown in Table 6. For those programs for which net factor (free-rider) and market effects factor (spillover) were not assessed in Year 1, the programs were assigned factors based on secondary data from similar programs implemented elsewhere in the U.S. The ratios for Scenario #3 are denoted as TBD (to be determined) for those programs for which non-energy benefits have not yet been assessed. For those programs with non-energy benefits, a range of ratios is provided; the lower bound represents the inclusion of only 10% of the non-energy benefits and the upper bound represents inclusion of 100% of the non-energy benefits. The programs included in the B/C analysis were deployment programs that promote the installation of energy efficiency measures. However, because the Peak Load Reduction Program (PLRP) and Enabling Technologies Program (ETP) are designed to enable participation in the New York Independent System Operator (NYISO) load curtailment programs, a separate B/C analysis was conducted for these programs and is described in Section 5. Below is a discussion of some program-specific issues to be considered as this analysis is updated.

Table 6. Business/Institutional Sector Total Market Effects Test (TMET) and Program Efficiency Test (PET) Ratios

	TMET			PET		
Program	**Scenario #1**	**Scenario #2**	**Scenario #3***	**Scenario #1**	**Scenario #2**	**Scenario #3***
Business/Institional Sector	**2.2**	**2.5**	**2.6 – 4.2**	**5.5**	**6.3**	**6.7 - 10.6**
C/I Performance Program[P]	1.6	1.9	TBD	3.9	4.6	TBD
New Construction Program[F]	1.8	2.2	3.7 – 17.0	3.5	4.1	6.9 - 32.2
Curtailable Load Programs[(F)]	1.7	1.7	TBD	2.1	2.1	TBD
Peak Load Reduction Program: Permanent Measures[(F)]	7.1	8.1	TBD	10.4	11.9	TBD
Technical Assistance[P]	3.4	3.8	TBD	27.0	30.0	TBD
New York Energy $mart[SM] Loan Fund[N] (Includes residential sector)	1.1	1.3	TBD	2.4	2.7	TBD
Smart Equipment Choices[S]	3.2	3.8	TBD	5.3	6.3	TBD
Small Commercial Lighting[S]	0.5	0.6	TBD	0.6	0.7	TBD
Premium Efficiency Motors[P]	1.9	2.2	TBD	2.3	2.7	TBD

TBD: To be determined.

[P]: Received partial MCAC evaluation in Year 1. Free-rider and spillover estimates based on limited survey work and secondary data.

[F]: Received full MCAC evaluation in Year 1.

[(F)]: Received full MCAC evaluation in Year 1 with some aspects identified to be better addressed in Year 2.

[S]: Free-rider and spillover estimates based on secondary data only.

[N]: No MCAC evaluation in Year 1.

* The lower bound of the ratio is based on using 10% of the non-energy benefits; the upper bound is based on using 100% of the non-energy benefits.

C/I Performance Program

The effect of the interaction between HVAC and lighting measures was not addressed in the energy savings estimates. The expected additional electric savings are believed to be in the 5 to 15 percent range. Before these savings are included, the M&V contractor needs to establish the following:

- The mix of HVAC systems and building types that make up the population of facilities that received lighting retrofits under the C/I Performance Program.
- The percentage of C/I Performance Program lighting retrofits that occurred in conditioned space.
- Analyzing the indirect effect either through a DOE2 simulation, or monitoring of a sample of buildings, or both.

Nexant will estimate savings from such interaction effects in the year-two evaluation.

Stimulating demand and supply for energy efficiency services and building the ESCO infrastructure are important objectives of the program. The B/C analysis does not explicitly take into account the economic benefits arising from the development of an ESCO infrastructure. Also, the potential economic benefit from trading of emission credits created through the program has not been assessed. Year-two evaluation will include spillover effects as well as non-energy benefits such as reductions in operation and maintenance (O&M) costs.

New Construction Program

Currently, this program does not estimate or claim natural gas savings from measure implementation. These savings could have a significant effect on the B/C ratios and will be addressed as this body of work is developed further.

Peak Load Reduction Program (PLRP)

Year-two evaluation will address market spillover effects and non-energy benefits. The B/C analysis for the curtailable load components of this program are presented in Section 5.

Technical Assistance Program

Currently, the realization rates as well as free-rider and market effects for Technical Assistance (TA) have all been set to 1.0 pending the results of additional analyses by both Nexant and Summit Blue in the second-year evaluation. New estimates of these parameters will be used to estimate the B/C ratios for the 2005 **New York Energy $mart^{SM}** Program evaluation. Also, it is known that some participants in the TA Program who install recommended measures do so with the assistance of other NYSERDA incentive programs, *e.g.*, C/I Performance Program. It would be inappropriate for both the C/I Performance Program and the TA Program to claim the same energy savings. Nexant will conduct an analysis of possible double-counting of benefits and propose an adjustment factor. Both Nexant and Summit Blue will be extending their analyses of the program's impacts including estimates of spillover and non-energy benefits.

New York Energy $mart^{SM} Loan Fund Program

The Loan Fund Program database tracks total project cost and does not separate out the labor cost of the projects. To estimate co-funding, 50% of the total project cost was allocated to labor and deducted from total project cost to arrive at the measure cost. This deduction to customer spending was made based on the assumption that labor costs would have occurred regardless of the efficiency level of the equipment. Furthermore, for pre-qualified measures, the incremental cost was assumed to be 20% of the measure cost and co-funding was estimated to be this incremental cost less the interest payment reduction provided through the program. For custom

measures, 100% of the measure cost was used. Additional work on energy savings estimates and customer co-funding are planned as part of the year-two evaluation.

Smart Equipment Choices

This program received limited analysis by Summit Blue in 2003/2004. In the year-two evaluation, assessments of spillover effects and non-energy benefits will be made.

Small Commercial Lighting Program (SCLP)

SCLP goals include:

- Increasing electrical contractor, lighting supplier, and retailer knowledge of effective, energy-efficient lighting.
- Increasing availability of customer promotional materials on effective energy-efficient lighting.
- Influencing lighting decisions for about 15 million square feet of commercial building space.

The program has made initial progress toward each of these goals. Increases have occurred in electrical contractors' consideration of key factors, such as energy costs, reduced glare, and color rendering in lighting design. By the end of 2003, the program had influenced lighting decisions for more than 770,000 square feet of building space and had reported savings of about 4 GWh of electricity. Of the $4.4 million expended by NYSERDA through December 31, 2003, nearly 96 percent has been spent on infrastructure development such as increasing electrical contractor, lighting supplier, and retailer knowledge of effective energy-efficient lighting and increasing the availability of promotional materials on energy-efficient lighting. Investments in such infrastructure are essential if longer-term energy savings are to be achieved.

SCLP received limited emphasis by Summit Blue in 2003/2004. In the year-two evaluation, assessments of spillover effects and non-energy benefits will be made. The method for calculating incremental costs and co-funding will also be reviewed and modified if necessary.

Premium Efficiency Motors

This program received limited analysis by Summit Blue in 2003/2004. In the year-two evaluation, assessments of spillover effects and non-energy benefits will be made.

2.2 RESIDENTIAL PROGRAMS

Both the TMET and PET ratios for the residential programs are shown in Table 7. Below is a discussion of some outstanding issues and recommendations for selected programs.

ENERGY STAR® Products Program

Energy savings were available for

- Refrigerators
- Dishwashers
- Clotheswashers
- Room air conditioners
- Compact fluorescent Lights
- Light Fixtures

Water savings from dishwashers and clothes washers were monetized and included in the benefits calculation. For clotheswashers and dishwashers, the electricity savings from water heating were included. However, natural gas savings from water heating were not included in the current analysis, but are expected to be evaluated in the 2005 M&V update.

Table 7. Residential Sector Total Market Effects Test (TMET) and Program Efficiency Test (PET) Ratios

	TMET			PET		
Program	**Scenario #1**	**Scenario #2**	**Scenario #3***	**Scenario #1**	**Scenario #2**	**Scenario #3***
Residential Sector	**1.5**	**1.7**	**2.5 – 9.2**	**3.7**	**4.0**	**5.9– 22.9**
ENERGY STAR® Products[F]	1.8	2.0	3.2 - 13.3	8.2	9.2	14.7 - 65.6
ENERGY STAR® Bulk Purchase[S]	3.0	3.4	TBD	5.9	6.7	TBD
ENERGY STAR® Labeled Homes[(F)]	1.1	1.1	1.2 – 2.3	1.4	1.5	1.6 – 3.1
Home Performance w/ENERGY STAR®[(F)]	1.4	1.4	1.6 – 3.6	3.3	3.3	3.8 – 8.6
Keep Cool[F]	1.0	1.1	1.8 – 8.0	1.0	1.2	1.9 – 8.5
Residential Comprehensive Energy Management[S]	0.3	0.3	TBD	0.4	0.5	0.5

TBD: To be determined.

[F]: Received full MCAC evaluation in Year 1.

[(F)]: Received full MCAC evaluation in Year 1 with some aspects identified to be better addressed in Year 2.

[S]: Free-rider and spillover estimates based on secondary data only.

* The lower bound of the ratio is based on using 10% of the non-energy benefits; the upper bound is based on using 100% of the non-energy benefits.

ENERGY STAR® Labeled Homes.

This program provides incentives to one- to four-family homebuilders and Home Energy Rating System (HERS) raters. The program encourages the adoption of energy-efficient design features and installation of energy-efficient equipment in new construction and substantial renovation projects. The program has made progress in transforming the market for ENERY STAR® homes. Before the program, homeowners did not have access to builders who provided the option to build ENERY STAR® homes. Energy efficiency improvements supported by the program include building shell measures; electric measures, such as refrigerators and lighting fixtures; heating and cooling measures, such as boilers and central air conditioning; and renewable energy technologies, such as photovoltaics. This program and Home Performance with ENERGY STAR® both promote the "house-as-a-system" approach.

Home Performance with ENERGY STAR®

The Home Performance with ENERGY STAR® program seeks to create a “one-stop shopping” experience for consumers seeking to make energy efficiency improvements to their homes. This is accomplished by requiring the contractor that provides the home energy assessments to also develop the scope of work and install the energy efficiency measures. By taking this approach, this program strengthens the energy-efficient building infrastructure by making the contractors more aware and knowledgeable about energy-efficient building practices. The program has made

progress in transforming the market for home performance contractors. Thus, the investment in infrastructure is expected to provide increasing benefits as the market is further transformed.

Keep Cool Program

This program encourages the replacement of old, working air conditioners with ENERGY STAR® room air conditioners and through-the-wall (TTW) units. Turned-in units are demanufactured and recycled. Summit Blue provided an estimate of room air conditioner sales attributed to the Keep Cool Program and a separate estimate of room air conditioner sales attributed to the ENERGY STAR® Products Program. Because of the wide scope of the marketing conducted by the Keep Cool Program, 90% of the room air conditioners attributed to the ENERGY STAR® Products Program were allocated to the Keep Cool Program, resulting in total program-attributed sales of approximately 361,000 units of which approximately 141,000 units were given incentives through the program.[5]

The Keep Cool program was coupled with a multi-media marketing campaign encouraging consumers to follow three specific energy tips during the summer months: (1) encouragement to buy ENERGY STAR® products, (2) shift appliance use to non-peak periods, and (3) use timers or programmable thermostats on air conditioners. GDS Associates estimated that in the summer of 2002, 94 MW were reduced at the time of system peak due to load shifting resulting from the campaign. An additional 37 MW was attributed to the campaign for the summer of 2003. These load shifting benefits were not included in the current B/C analysis and the associated marketing costs were also excluded from the Keep Cool Program costs and assigned to the sector level. Also, because the benefits associated with demanufacturing and recycling were not monetized, the associated costs were also removed from the Keep Cool Program and assigned to the sector level.

Residential Comprehensive Energy Management (CEM) Program

The CEM Program funds feasibility studies and installation of meters and direct load control devices, provides education to the residential community, and helps minimize regulatory barriers. With advanced meters, consumer behavior can be altered to reduce energy use and costs. The CEM program is designed as the foundation for the future of residential energy use management in New York. Given the design of the CEM Program, a relatively low B/C ratio is expected; however an increase in the B/C ratio is anticipated as the benefits begin to materialize over time. The results of the year-two evaluation could impact the B/C ratios, especially if substantial non-energy benefits and market effects are verified.

2.3 LOW INCOME PROGRAMS

Both the TMET and PET ratios for the Low-Income programs are shown in Table 8. Below is a discussion of some outstanding issues and recommendations for selected programs.

Low-Income Direct Installation

Common area and outdoor lighting in low-income buildings have the dual effect of reducing the energy cost for the building and maintaining health and safety standards. Over $400,000 was invested in both multifamily buildings and small homes for safety and security purposes. The majority of this was installed in building common areas. In many low-income and older

[5] Attribution of room air conditioner sales between the ENERGY STAR® Products and Keep Cool programs differs from the attribution found in the **New York Energy $mart℠** Program Evaluation and Status Report (May 2004) based on updated information.

buildings exit signs were in disrepair, emergency lighting was nonexistent and many lights were broken due to vandalism. As a part of the Direct Installation Program, light levels were improved, emergency lighting was installed, and vandal-proof fixtures were installed where necessary. While Summit Blue did not estimate non-energy benefits for this program, the contractor believes these benefits to be substantial. As a result, the B/C ratios for this program are believed to be conservative.

Table 8. Low-Income Sector Total Market Effects Test (TMET) and Program Efficiency Test (PET) Ratios

	TMET			PET		
Program	Scenario #1	Scenario #2	Scenario #3*	Scenario #1	Scenario #2	Scenario #3*
Low-Income Sector	**0.9**	**1.0**	**1.1 – 2.3**	**1.1**	**1.2**	**1.3– 2.8**
Low-Income Assisted Multifamily Progam(F)	1.1	1.1	1.8 – 7.4	2.1	2.2	3.4 – 14.5
Low-Income Direct InstallationS	0.9	1.1	TBD	1.1	1.2	TBD
Assisted Home Performance w/ ENERGY STAR®(F)	1.0	1.0	1.2 – 2.7	1.1	1.1	1.2 – 2.8

TBD: To be determined.

(F): Received full MCAC evaluation in Year 1 with some aspects identified to be better addressed in Year 2.

S: Free-rider and spillover estimates based on secondary data only.

* The lower bound of the ratio is based on using 10% of the non-energy benefits; the upper bound is based on using 100% of the non-energy benefits.

Low-Income Assisted Multifamily Program

The long-term goals of the program are (1) to permanently change the financial criteria used by building owners for investing in energy efficiency, and (2) to make low-income housing more affordable. The program is working with financial institutions and building owners to demonstrate how energy efficiency can be used to support greater debt. The program also provides funding for energy efficiency measures to building owners. As of December 31, 2003, construction had been completed for 32 properties, representing over 2,600 units, and approximately $1.3 million in incentive payments. Because the paid incentives accounted for only 5% of total encumbered incentives ($27.2 million), only 5% of the invoiced implementation costs were applied to the program in the B/C analysis.

2.4 SECTOR- AND PORTOLIO-LEVEL RATIOS

Program administration and evaluation costs were added at the sector-level and portfolio-level for a more complete assessment of the cost-effectiveness analysis. The sector-level ratios are shown in Table 9 with two sets of calculations for each test: first, only the programs for which B/C ratios are calculated are included; second, all programs are included, whether or not they report energy savings. In general, adding the additional programs did not significantly affect the TMET ratios. The reason for the slight effect on the TMET is that the additional program costs were small relative to the large co-funding amounts. The PETs were impacted more by the additional programs because co-funding is not included in the analysis. The Business/Institutional sector TMET ratios ranged from 2.2 to 4.2. The Residential sector TMET ratios ranged from 1.5 to 9.6. The Low-Income sector TMET ratios ranged from 0.9 to 2.3. The portfolio-level B/C ratios are

shown in Table 10. The portfolio-level TMET ratios ranged from a low of 1.8 to 6.2 depending on the scenario.

Table 9. Sector-Level B/C Ratios

		TMET		PET	
		Without Additional Sector Costs	**With Additional Sector Costs**	**Without Additional Sector Costs**	**With Additional Sector Costs**
Scenario #1	Business/ Institutional	2.2	2.1	5.5	5.1
	Residential	1.5	1.2	3.7	2.3
	Low-Income	0.9	0.7	1.0	0.8
Scenario #2	Business/ Institutional	2.5	2.4	6.3	5.8
	Residential	1.7	1.4	4.0	2.6
	Low-Income	1.0	0.8	1.2	0.9
Scenario #3*	Business/ Institutional	2.6 - 4.2	2.5 - 4.0	6.7 - 10.6	6.2 - 9.9
	Residential	2.5 - 9.6	2.0 - 7.8	5.9 - 22.9	3.8 - 14.6
	Low-Income	1.1 - 2.3	0.9 - 1.9	1.3 - 2.8	1.0 - 2.2

* The lower bound of the ratio is based on using 10% of the non-energy benefits; the upper bound is based on using 100% of the non-energy benefits.

Table 10. Portfolio-Level B/C Ratios

	TMET		PET	
	Without Additional Sector Costs	**With Additional Sector Costs**	**Without Additional Sector Costs**	**With Additional Sector Costs**
Scenario #1	1.9	1.8	4.6	3.7
Scenario #2	2.2	2.0	5.2	4.2
Scenario #3	2.5 - 5.6*	2.3 - 5.1*	6.0 - 13.5*	4.9 - 10.9*
Scenario #4‡	3.1 - 6.2*	2.8 - 5.6*	7.3 - 14.7*	5.9 – 11.9*

* The lower bound of the ratio is based on using 10% of the non-energy benefits; the upper bound is based on using 100% of the non-energy benefits.

‡ Includes macroeconomic benefits.

2.5 RECOMMENDATIONS AND CONCLUSIONS

The data used in the current analysis represent the best available information to date. The following are recommendations to be implemented in the second year evaluation.

- The absence of building type data prevented the mapping of project savings associated with a given end use (*e.g.*, HVAC) into the load shapes provided by Optimal Energy for each end use and building type. It is recommend that facility-based Standard Industrial Classification (SIC) or the North American Industry Classification (NAIC) code be identified for each participating customer in the future.

- Estimating program spillover through the use of participant and non-participant surveys requires that respondents attribute installations of efficiency measures outside the program to awareness of the program and its message. It is very likely, however, that survey respondents may be unaware that NYSERDA's market transformation programs have brought about broad market changes such as stocking practices and more knowledgeable retail sales staff. Therefore, the market effects of many of NYSERDA's programs are likely to be underestimated. The best available estimates were used in the first-year report to capture the full market effects of the programs. Efforts to capture market share data for key measures in key programs should be increased so that more accurate market effect multipliers can be calculated.
- Efforts to quantify the non-energy benefits (*e.g.*, increased/improved energy affordability, comfort, safety, reliability and quality of living) associated with developing energy efficiency markets, serving low-income and small business energy consumers, and advancements in energy-related technologies will need to be continued and refined.
- Nexant has reviewed and adjusted nearly all of the savings estimates for the pre-qualified measures in NYSERDA's Deemed Savings Database. However, the incremental costs associated with each measure need to be reviewed and updated as necessary. Updates of incremental costs will be done as part of the year-two evaluation. The Deemed Savings Database will ensure that the correct savings and incremental costs are being used by program staff for pre-qualified measures.

Because the **New York Energy $mart**[SM] Program is a public benefits program, diverse objectives and benefits are sought. These additional benefits, in most cases, cannot be easily quantified. Therefore, individual B/C ratios alone should not be used as evidence to support or curtail program efforts – NYSERDA uses other broader decision criteria for this purpose, with B/C ratios being just one. In addition, B/C ratios should not be compared across programs for the following reasons:

- Different programs target different markets in which the technologies, customer characteristics, and magnitude of market barriers all may vary. Thus, a program with a lower B/C ratio may be addressing more significant market barriers than a program with a higher B/C ratio.
- Some programs place a much greater emphasis on certain objectives that are difficult, if not impossible to monetize. For example, low-income programs emphasize equity and the C/I Performance Program was designed specifically to strengthen the ESCO infrastructure. The extent to which such benefits cannot be monetized will understate the B/C ratios.
- There are other programs that have up-front costs, such as the Small Commercial Lighting Program, that supports training of lighting contractors, with most of the benefits expected to materialize in the future. For these programs, while there are relatively small energy and capacity impacts through 2003, more substantial impacts are expected in the future with B/C ratios increasing over time.
- During the first year, the level of evaluation effort varied across the programs. For example, market effects and non-energy benefits were estimated for only a subset of programs. As a result, some programs claimed these additional benefits while other programs that did not receive similar attention could not claim these benefits.

It is expected that the B/C analysis presented in this report will continue to be updated, refined, and expanded annually, as a component of the more comprehensive evaluation of the **New York**

Energy $mart[SM] Program. The current inputs to the model are described in Section 3. Section 4 provides levelized costs at the portfolio level.

SECTION 3: MODEL INPUTS

This section describes the inputs to the B/C model. The tables associated with the various subsections are presented together at the end of this section for ease of reference.

3.1 PROGRAM INCENTIVES, IMPLEMENTATION COSTS, AND CO-FUNDING

Program costs include incentives and implementation costs incurred by NYSERDA. For the TMET, customer costs are also included. In general, for pre-qualified measures, the incremental cost (*i.e.,* the cost difference between a high-efficiency model compared to a standard model) minus the NYSERDA incentive was used to compute customer co-funding. Full equipment cost was used to compute co-funding for custom measures and measures for which full savings (*i.e.,* the difference in energy savings between the existing equipment and the high-efficiency equipment) were used. Program costs and customer co-funding are shown in Table 16.

3.2 ADMINISTRATION AND EVALUATION COSTS

Administration and evaluation costs were estimated to be 9% of program spending. NYSERDA's current administration overhead is 7% and evaluation is budgeted at 2% of total program funding. These costs were applied to the sector-level and portfolio-level costs for the B/C analysis.

3.3 NET ANNUAL ENERGY SAVINGS AND PRESENT VALUE OF THE SAVINGS

The net energy, demand, and fuel savings are shown in Table 17. These are the annual savings from measures installed through year-end 2003, after adjustments were made for realization rate, free-ridership, and spillover. The present value of the life-cycle benefits for energy and non-energy benefits are also shown in Table 17.

3.4 NON-ENERGY EFFECTS

A significant body of work has developed to recognize and measure non-energy effects. Non-energy effects include a variety of impacts – positive and negative – that result from the program. The first year evaluation focused on non-energy benefits (NEBs). These benefits can be viewed from various perspectives:

> **Utility/Agency NEBs**: Net benefits accruing to the utilities or program-sponsoring agency, including fewer billing-related calls and other follow-ups, lower bad debt from unpaid bills, lower T&D losses, and other benefits, which result in lower revenue requirements for the agency, and are appropriately valued at the agency's marginal cost and discount rates.
>
> **Societal NEBs**: Net benefits beyond those accruing to the utilities/agencies or directly to participants, including economic multipliers or job creation benefits, reduced environmental impacts from emissions, and other benefits valued at societal costs and discount rates.[6]

[6] Macroeconomic benefits were estimated in a study conducted for NYSERDA (Neenan Associates, 2004, *Macroeconomic Impact Analysis of the* ***New York Energy $mart^{SM} Program****: An analysis of short-term and longer-term impact*). Emissions benefits are not being valued at this time. Other NEBs may be estimated at a later phase of the B/C project.

Participant NEBs: Positive and negative impacts that are realized and recognized by program participants. For residential programs, these benefits include increased comfort, ease of selling a home, personal satisfaction, and environmental benefits and other benefits for participants. For business/institutional programs, these benefits include increased productivity, equipment longevity, and noise and safety. These effects are measured using valuation methods appropriate to the owner.

Summit Blue's subcontractor, Skumatz Economic Research Associates (SERA), concentrated on estimating NEBs for the third category – participant NEBs. SERA noted that while many of these participant benefits are hard to measure (*e.g.* "comfort"), it is important to estimate dollar values for these benefits in order to allow comparison with direct energy benefits and to provide more comprehensive information for cost-effectiveness assessments of programs. Several steps were used to derive the dollar estimate of participant NEBs for each program.

1. Based on the literature and past research, a list of categories of NEBs was assembled that are relevant to the programs.
2. For each of the NEB categories, respondents were asked whether the energy-efficient equipment or design features led to a positive or negative effect or no effect compared to standard equipment or design features. The same was asked for the overall or total of all the individual NEB categories.
3. For those NEB categories with an effect (either positive or negative), respondents were asked how valuable – or costly – the effect was, ranked on a 1 to 5 scale where 1 = slightly valuable to 5 = very valuable. They were asked the same question for the overall or total of all the individual NEB categories.
4. Respondents were then asked whether the overall total NEBs were more valuable or less valuable than (or the same value as) the energy savings from the measures installed. As a follow-up question, the respondents were asked how much the NEBs were more valuable or less valuable (or more costly or less costly) than the energy savings.

These expressed "relative" values (*e.g.*, much more valuable, somewhat less valuable, etc.) were translated into numeric multipliers using information from the surveys, from past research, and relevant literature. The numeric multiplier was multiplied by the energy savings to obtain an estimate for each individual NEB category, and for the overall net NEBs.[7] The sum of the individual benefit categories exceeded the value assigned to "total/overall" benefits, which is common. The values for the individual categories were then scaled down proportionally to make sure they added to the total/overall benefit provided by the respondent. Shown in Table 19 are the per-unit NEBs that were monetized for each program.

The following is a list of the non-energy benefits included in the analysis:

- equipment maintenance costs
- appliance/equipment performance
- appliance/equipment lifetimes
- improved occupant productivity
- tenant/personal satisfaction

[7] For more information on these steps and multipliers, see Skumatz, Lisa A., 2001, "Non-energy Benefits (NEBs) – The New Standard in Comprehensive Estimation and Modeling of NEBs for Commercial and Residential Programs," *Proceedings of the 2001 International Energy Program Evaluation Conference*, Salt Lake City, UT.

- comfort
- building aesthetics/appearance
- noise levels
- building/equipment safety
- lighting/quality of light
- ease of selling/leasing home or building
- ability to stay in home/avoided moves
- doing good for the environment/environmental effects
- number of sick days lost from work
- number of calls to utility on bill issues
- operating cost

The B/C ratios in Scenarios 3 and 4 (which are the two scenarios that include the non-energy benefits) are expressed as a range, which results from using 10% and 100% of the non-energy benefits in two separate calculations.

Non-energy benefits will be addressed in the coming year for the following programs:

- C/I Performance Program
- Premium Efficiency Motors
- Small Commercial Lighting
- Smart Equipment Choices
- Technical Assistance
- Peak Load Program

3.5 REALIZATION RATES, NET FACTOR, AND MARKET EFFECTS FACTOR

Nexant was provided with gross energy and demand savings for each of the **New York Energy $mart**[SM] programs. Nexant adjusted these reported savings based on file reviews, verification of calculation methods, and on-site visits where appropriate or necessary to determine that the measures were installed and operating as expected. For each program, Nexant estimated a realization rate that adjusted the NYSERDA-reported annual energy savings through year-end 2003 for installed measures. For example, a realization of 100% indicates no difference between NYSERDA-reported and M&V verified savings. The verified gross annual energy savings were then adjusted by a Net-To-Gross (NTG) multiplier, estimated by Summit Blue, to yield net savings. The NTG multiplier has two components: (1) a net factor, and (2) a market effects factor.

Net Factor - The net factor is the percentage of gross savings that are attributable to the program. One minus this factor is the percentage of savings attributable to the free-rider effect, *i.e.,* the effect that would have occurred regardless of any intervention or incentives provided by the program. Savings attributable to free-riders are subtracted from the gross savings.

Market Effects Factor - The market effects factor captures program effects that go beyond the measures installed through the program. Many programs are designed to influence the broader market by increasing awareness of strategies to increase energy efficiency. The market effects

factor captures the energy and demand savings that participants and non-participants achieve as a result of actions taken beyond program participation. These effects are referred to as spillover. Net factors and market effects factors were not calculated for some programs. For these programs, a net factor and a market-effects factor was assigned based on similar programs that have been implemented elsewhere in the U.S. The various factors estimated by Nexant and Summit Blue for the 2003/2004 evaluation are presented in Table 20. At the portfolio level, the reported gross energy savings were equal to the verified gross savings. The net energy savings at the portfolio level were about 8% lower than the verified gross savings.

3.6 AVOIDED COSTS

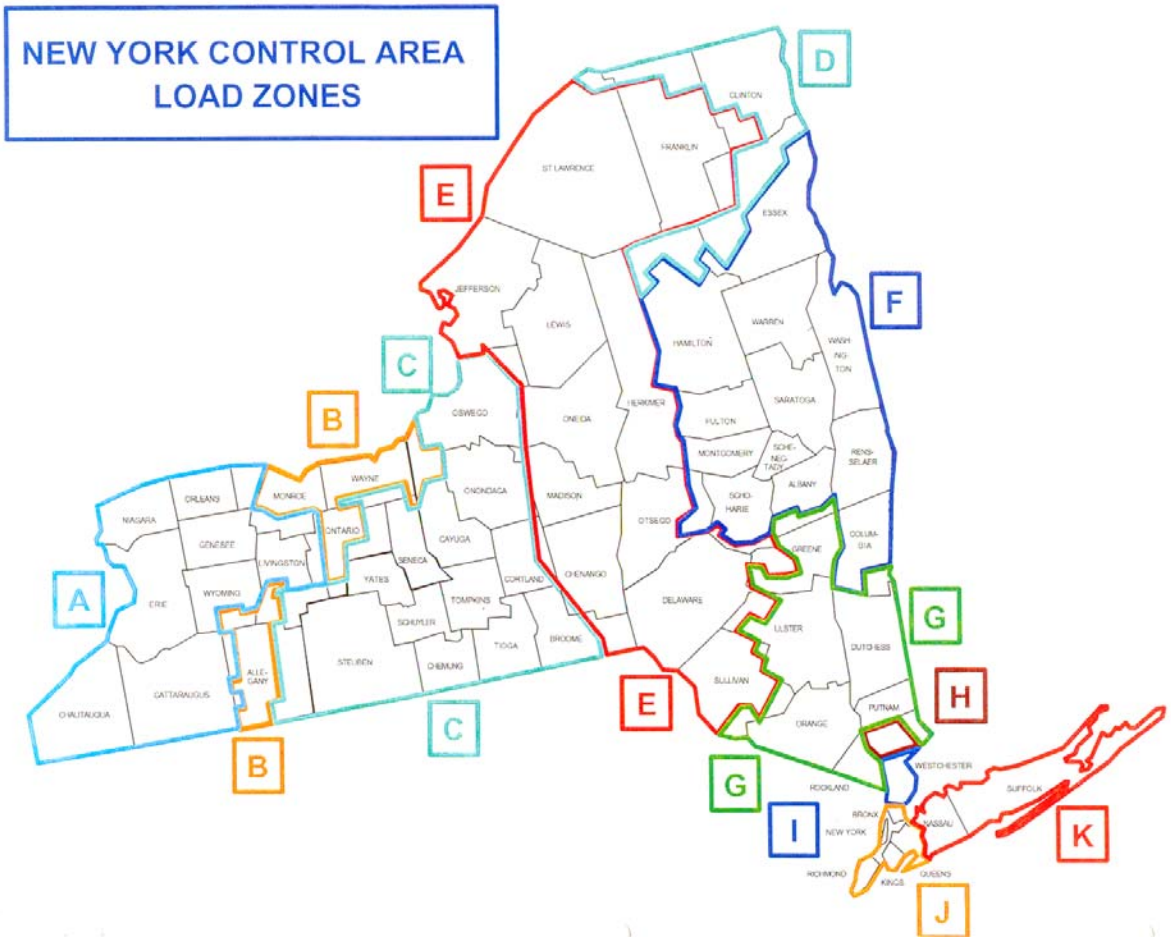
3.6.1 Avoided Electricity and Demand Costs

Prices for electricity and demand were estimated for six seasonal time periods. The seasonal time periods are defined as follows:

1. **Summer On-Peak (for energy and capacity)**: June, July, August: weekdays noon to 6 pm
2. **Summer Off-Peak**: June, July, August: midnight to 8 am weekdays, all weekend hours; May, Sept, Oct - all hours
3. **Summer Shoulder**: June, July, August: weekdays 8 am to noon and 6 pm to midnight
4. **Winter On-Peak**: December, January, February: weekdays noon to 8 pm
5. **Winter Off-Peak**: December, January, February: midnight to 8 am, all weekend hours; March, April, November: all hours
6. **Winter Shoulder**: December, January, February: weekdays 8 am to noon and 8 pm to midnight

Avoided energy costs were calculated for upstate and downstate regions. Summer and winter on-peak demand reductions were also allocated to upstate and downstate regions. presents the New York control area load zones. Upstate was defined as Load Zones A through G while downstate was defined as Load Zones H through J. When available, the program participant zip codes were matched with the zones to determine upstate and downstate participation rates. When participant zip codes were not available, savings occurring in the Consolidated Edison service area were assigned to the downstate region with all other savings assigned to the upstate region.

Figure 1. New York Control Area Load Zones



3.8 NOMINAL DISCOUNT RATE

A nominal discount rate of 5.2% was used to discount future benefits. The nominal discount rate is based on a real discount rate of 3% and an inflation rate of 2.1% and is calculated as follows: (1.021 x 1.3) – 1=.05163.

3.9 LOAD SHAPE DATA

Annual energy savings for each program were allocated to the same six costing periods for which avoided energy and capacity costs were forecasted. The allocation was based on load shape information obtained from Optimal Energy, Inc.[8] For the commercial sector, Optimal Energy provided allocation factors for nine building types and 12 end-use measures. The nine building types were:

[8] Optimal Energy, Inc. *Energy Efficiency and Renewable Energy Resource Development Potential in New York State*, 2003.

- Education
- Grocery
- Health
- Lodging
- Office
- Restaurant
- Retail
- Warehouse
- Other

The 12 end-use categories were:

- Space Cooling
- Economizer
- Exterior Lighting
- Interior Lighting
- Office Equipment
- Refrigeration
- Space Heating
- Vending Miser
- Ventilation
- Variable Frequency Drive
- Water Heating
- Miscellaneous

NYSERDA's program tracking databases were examined to determine the category of end-uses and building types. Although information was available to map the installed measures to the end-uses, building type was not available in some cases. To overcome this obstacle, it was assumed that the proportion of commercial building types participating in the NYSERDA programs reflect the proportion of statewide electricity sales to the nine building types. The distribution of statewide electricity sales by building type in 2003 was as follows:

- Office 36%
- Retail 10%
- Grocery 9%
- Warehouse 5%
- Education 8%
- Health 9%
- Lodging 3%
- Restaurant 8%

- Other 13%

Equation 1 shows the allocation factor calculation for a given time period:

$$E_k = \sum \beta_{k,i,j} \times M_h \times S_t \quad (1)$$

where

$E_k =$	Share of energy use in period *k*.
$\beta_{k,i,j} =$	Share of annual energy use in period *k* for end use *i* in building *j*.
$M_h =$	Share of savings for measure *h*.
$S_t =$	Share of annual New York Commercial Statewide Electricity Sales (MWh) for building type *t*.

Next, an example is presented of how energy allocation factors are calculated for a single end use, cooling, across all nine building types. Table 11 presents the load shape for space cooling for each of the nine building types. In order to estimate the space cooling load profile for each building type, the cooling load shape factors for each building type were multiplied by the proportion of electricity sales represented by the building type. The results of this calculation are shown in Table 12. The bottom row of the table shows the weighted allocation factor for each time period for space cooling. These six factors sum to 100% and account for all cooling energy used in a typical year.

Table 11. Cooling Load Shape for Nine Building Types

	Energy Allocation Time Periods					
	1 Summer Off-Peak	**2 Summer On-Peak**	**3 Summer Shoulder**	**4 Winter Off-Peak**	**5 Winter On-Peak**	**6 Winter Shoulder**
Education-Cooling	40.6%	27.8%	28.9%	2.7%	0.0%	0.0%
Grocery-Cooling	56.4%	16.5%	22.3%	4.8%	0.0%	0.0%
Health-Cooling	51.9%	14.6%	20.2%	10.8%	1.0%	1.5%
Lodging-Cooling	50.1%	22.7%	26.5%	0.7%	0.0%	0.0%
Office-Cooling	38.4%	25.8%	24.0%	8.9%	1.4%	1.5%
Other-Cooling	47.1%	22.3%	26.1%	3.8%	0.3%	0.4%
Restaurant-Cooling	53.9%	19.4%	24.2%	2.5%	0.0%	0.0%
Retail-Cooling	41.7%	26.4%	31.9%	0.1%	0.0%	0.0%
Warehouse-Cooling	43.9%	25.4%	30.7%	0.0%	0.0%	0.0%

Table 12. Energy Allocation Factors for Space Cooling Weighted by Building Type

		Energy Allocation Time Periods					
Building Type	**Percent of Statewide Electricity Sales**	**1 Summer Off-Peak**	**2 Summer On-Peak**	**3 Summer Shoulder**	**4 Winter Off-Peak**	**5 Winter On-Peak**	**6 Winter Shoulder**
Education	*8%*	3%	2%	2%	0%	0%	0%
Grocery	*9%*	5%	1%	2%	0%	0%	0%
Health	*9%*	5%	1%	2%	1%	0%	0%
Lodging	*3%*	2%	1%	1%	0%	0%	0%
Office	*36%*	14%	9%	9%	3%	1%	1%
Other	*13%*	6%	3%	3%	0%	0%	0%
Restaurant	*8%*	4%	2%	2%	0%	0%	0%
Retail	*10%*	4%	3%	3%	0%	0%	0%
Warehouse	*5%*	2%	1%	2%	0%	0%	0%
Weighted Factors*		**46%**	**22%**	**25%**	**5%**	**1%**	**1%**

* These factors were adjusted to eliminate rounding errors.

To illustrate how the weighted factors were applied to develop program-level energy allocation factors, an example is provided using the C/I Performance Program. Shown in Table 13 are the allocation factors (after adjustment for building type) for the measure categories in the C/I Performance Program. The distribution of program energy savings by measure category is shown in Table 14. Each factor in Table 13 was multiplied by the respective proportions shown in Table 14 in order to weight the factors by distribution of savings by measure category. The resulting weighted factors are shown in Table 15. The last row of this table presents the program-level allocation factors.

Table 13. Energy Allocation Factors for Measure Categories in the C/I Performance Program

	Energy Allocation Time Periods					
Measure Categoy	**1 Summer Off-Peak**	**2 Summer On-Peak**	**3 Summer Shoulder**	**4 Winter Off-Peak**	**5 Winter On-Peak**	**6 Winter Shoulder**
C/I Motors and VSDs	79%	0%	21%	0%	0%	0%
C/I Cooling	46%	22%	25%	5%	1%	1%
C/I Lighting	36%	9%	10%	31%	7%	6%
C/I Other	36%	6%	8%	36%	8%	6%

Table 14. Electricity Savings by Measure in the C/I Performance Program

Measure Category	Annual kWh Savings	% of Annual Savings
C/I Motors and VSDs	206,800,306	30%
C/I Cooling	120,745,558	17%
C/I Lighting	352,419,161	50%
C/I Other	20,467,504	3%
	700,432,529	100%

Table 15. Weighted Energy Allocation Factors for the C/I Performance Program

	Energy Allocation Time Periods					
Measure Category	**1 Summer Off-Peak**	**2 Summer On-Peak**	**3 Summer Shoulder**	**4 Winter Off-Peak**	**5 Winter On-Peak**	**6 Winter Shoulder**
C/I Motors and VSDs	23.2%	0.0%	6.2%	0.1%	0.0%	0.0%
C/I Cooling	8.0%	3.8%	4.3%	0.9%	0.1%	0.1%
C/I Lighting	18.3%	4.3%	5.2%	15.8%	3.7%	3.0%
C/I Other	1.1%	0.2%	0.2%	1.0%	0.2%	0.2%
Weighted Allocation Factors	**50.6%**	**8.3%**	**15.9%**	**17.9%**	**4.0%**	**3.3%**

For industrial end-uses, one industrial load shape was calculated by averaging the load shapes across all industries. In the residential sector, the following 14 load shapes were used:

- Clothes drying
- Cooking
- Dishwashing
- Domestic hot water
- Clothes washer
- Freezers
- Heat pumps
- Lighting
- Miscellaneous
- Pools/spas
- Refrigerators
- Space cooling
- Space heating
- Television

The load shapes for each program are presented in Table 21. For example, for the C/I Performance Program, 50.6% of the cumulative annual kWh savings was allocated to the summer off-peak period, 8.3% was allocated to the summer on-peak period, *etc*.

3.10 PROGRAM MEASURE LIFE

Measure lives were obtained from a recently completed energy efficiency potential study conducted for NYSERDA by Optimal Energy, Inc.[9] For each program, the average measure life was determined by weighting the measure life of individual measures by the relative savings associated with that measure. This weighted average, shown in Table 22 for each program, is the *program* measure life. For example, in the C/I Performance Program, the program measure life was calculated to be 17.6 years based on the percentage of savings from four measure categories: (1) Motors and VSD's (20-year measure life), Cooling (24-year measure life), Lighting (14-year measure life), and other (18-year measure life). The list of measures and the associated energy savings are presented in Appendix C for each program.

3.11 ENERGY MARKET PRICE EFFECTS

Electricity bill savings from reduction in the market clearing price of electricity due to the Program was estimated to range from $11.7 million in 2003 to $39.1 million (2004$) in 2023. A levelized value of $11 per MWh was added to the stream of benefits for each program in the scenario #2 calculations. The methodology used to calculate the wholesale price effect is presented in Appendix A.

3.12 MACROECONOMIC IMPACT DATA

Neenan Associates conducted a study to estimate the macroeconomic impact of the **New York Energy $mart**[SM] Program.[10] Compared to the base case, the additional income to the State resulting from the Program is shown in Table 23. Benefits used for the B/C analysis are the net impacts shown in Table 23. Because the macroeconomic benefits are derived mainly from the energy savings, the benefits were extrapolated to 2037 in accordance with anticipated energy savings.

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[9] *Ibid*.

[10] Neenan Associates, 2004, *Macroeconomic Impact Analysis of the **New York Energy $mart**[SM] **Program**: An analysis of short-term and longer-term impact.*

Table 16. Program and Participant Spending

		NYSERDA Incentives ($ Million)	NYSERDA Implementation ($ Million)	Participant Co-funding ($ Million)
Business/Institutional Program Area				
1	C/I Performance Program	$55.4	$3.9	$118.7**
2	New Construction Program	$12.6	$10.3	$12.6
3	Curtailable Load Programs	$15.2	$0.2	$8.8
4	Peak Load Reduction Program: Permanent Measures	$4.6	$0.08	$2.0
5	Technical Assistance	$11.5	$0.4	$82.0**
6	**New York Energy $mart℠** Loan Fund	$5.6	$1.7	$ 7.7**
7	Smart Equipment Choices Program	$6.1	$1.3	$6.1
8	Small Commercial Lighting	$0.2	$4.2	$0.3
9	Premium Efficiency Motors	$0.4	$2.0	$0.7
	Subtotal	**$111.6**	**$24.1**	**$7.1**
Residential Program Area				
10	ENERGY STAR® Products*	$11.0	$7.8	$78.4
11	ENERGY STAR® Bulk Purchase	$5.4	$0.4	$6.5
12	ENERGY STAR® Labeled Homes	$4.2	$6.3	$1.7
13	Home Performance w/ENERGY STAR®	$2.0	$6.1	$7.6**
14	Keep Cool*	$9.6	$8.8	$3.5
15	Comprehensive Energy Management	$2.4	$1.9	$2.4
	Subtotal	**$34.6**	**$31.3**	**$5.9**
Low Income Program Area				
16	Low-Income Assisted Multifamily Progam	$1.4	$0.3	$2.1**
17	Low-Income Direct Installation	$8.5	$1.4	$1.6
18	Assisted Home Performance w/ENERGY STAR®†**	$4.9	$1.8	$0.4
	Subtotal	**$14.8**	**$3.5**	**$2.0**
	All	**$161.0**	**$58.9**	**$15.0**

* Program spending shown here differs from spending found in the **New York Energy $mart℠** Program Evaluation and Status Report (May 2004) based on updated information.

** For these programs, only full project cost (including measure and labor costs) were readily available. Labor cost associated with the installation of the measures was conservatively assumed to be 50% of total project cost and these costs were removed from the full project cost since they would be incurred regardless of whether the equipment installed were efficient or standard.

† The results from the Assisted Home Performace w/ENERGY STAR® Program and the Home Performance w/ENERGY STAR® Program were combined in the **New York Energy $mart℠** Program Evaluation and Status Report (May 2004).

Table 17. Net Annual Energy Savings

	Program	% of Energy Savings Downstate	Electricity (1000's of MWh per Year)	On-Peak Demand (MW)	Natural Gas, Oil, Propane (1000's MMBtu per Year)
1	C/I Performance Program	37%	283	42	-
2	New Construction Program	28%	95	20	-
3	Curtailable Load Programs	48%	N/A	N/A	N/A
4	Peak Load Reduction Program: Permanent Measures	77%	44	15	
5	Technical Assistance/Flex Tech	32%	361	96	2,496
6	**New York Energy $mart[SM]** Loan Fund	4%	19	2	57
7	Smart Equipment Choices Program	14%	49	23	-
8	Small Commercial Lighting	23%	4	1	-
9	Premium Efficiency Motors	13%	6	1	-
10	ENERGY STAR® Products*	22%	138	10.6	-
11	ENERGY STAR® Bulk Purchase	71%	28	6	23
12	ENERGY STAR® Labeled Homes	2%	1	0.3	85
13	Home Performance w/ENERGY STAR®*	2%	2	1	159
14	Keep Cool*	76%	17	25	-
15	Residential Comprehensive Energy Management	100%	2	1	-
16	Low-Income Assisted Multifamily Progam	56%	2	0.1	22
17	Low-Income Direct Installation	93%	11	2	-
18	Assisted Home Performance w/ENERGY STAR®†	1.5%	0.8	0.2	47
	Total		1,078	251.8	2,876

† The results from the Assisted Home Performace w/ENERGY STAR® Program and the Home Performance w/ENERGY STAR® Program were combined in the **New York Energy $mart[SM]** Program Evaluation and Status Report (May 2004).

* Energy savings shown here differs from savings found in the **New York Energy $mart[SM]** Program Evaluation and Status Report (May 2004) based on updated information.

Table 18. Present Value of Energy and Non-Energy Benefits (2003 $)

		Electricity ($ Million)	On-Peak Demand ($ Million)	Natural Gas ($ Million)	Oil and Propane ($ Million)	Water ($ Million)	Non-Energy Benefits ($ Million)
1	C/I Performance Program	$229.5	$2.5	-	-	-	TBD
2	New Construction Program	$79.0	$1.1	-	-	-	$644.4
3	Curtailable Load Programs	-	$72.7	-	-	-	TBD
4	Peak Load Reduction Program: Permanent Measures	$47.1	$1.3	-	-	-	TBD
5	Technical Assistance	$206.0	$8.5	$105.4	-	-	TBD
6	**New York Energy $mart^{SM}** Loan Fund	$13.5	$0.07	$3.5	$0.11	-	TBD
7	Smart Equipment Choices	$38.3	$0.7	-	-	-	TBD
8	Small Commercial Lighting	$2.4	$.04	-	-	-	TBD
9	Premium Efficiency Motors	$5.5	$.05	-	-	-	TBD
10	ENERGY STAR® Products	$86.0	$0.41	-	-	$68.6	$1,048.5
11	ENERGY STAR® Bulk Purchase	$25.3	$0.6	$2.9	-	$5.7	TBD
12	ENERGY STAR® Labeled Homes	$1.2	$0.01	$6.9	$0.93	-	$10.1
13	Home Performance w/ENERGY STAR®	$1.7	$0.02	$21.7	$2.9	-	$42.6
14	Keep Cool	$17.7	$2.1	-	-	-	$164.1
15	Residential Comprehensive Energy Management	$1.8	$0.09	-	-	-	TBD
16	Low-Income Assisted Multifamily Progam	$1.1	$0.007	$1.3	$0.9	-	$20.1
17	Low-Income Direct Installation	$10.2	$0.2	-	-	-	-
18	Assisted Home Performance w/ ENERGY STAR®	$0.70	$0.007	$5.6	$0.70		11.8

Table 19. Monetized Non-Energy Benefits

Program	Annual Monetary Value of Non-Energy Benefits	Unit
ENERGY STAR® Labeled Homes	$711	Per home
Home Performance w/ENERGY STAR®	$920	Per home
Commercial New Construction	$40,100	Per building
ENERGY STAR® Products	$66	Per home
Low-Income Assisted Multifamily Program	$70,300	Per building
Keep Cool	$60	Per home

Table 20. Adjustment Rates for Realization, Free-riders, and Spillover

		Realization Rate, Energy	Realization Rate, Capacity	Net Factor	Market Effects Factor	Net-to-Gross Ratio
1	C/I Performance Program	1.02	0.68	0.75	1.07	0.80
2	New Construction Program	1.00	1.42	0.64	2.06	1.32
3	Curtailable Load Programs	n/a	0.97	0.76	1.25	1.00
4	Peak Load Reduction Program: Permanent Measures	1.00	1.00	0.75	1.37	1.03
5	Technical Assistance Program	1.00	1.00	1.00	1.00	1.00
6	**New York Energy $mart℠** Loan Fund	1.00	0.80	1.00	1.00	1.00
7	Smart Equipment Choices	1.00	1.00	0.90	1.00	0.90
8	Small Commercial Lighting	1.00	1.00	0.95	1.00	0.95
9	Premium Efficiency Motors	1.00	1.00	0.81	1.10	0.89
10	ENERGY STAR® Products	1.13	0.93	0.80	1.10	0.88
11	ENERGY STAR® Bulk Purchase	0.67	0.62	0.90	1.05	0.95
12	ENERGY STAR® Labeled Homes	0.47	0.27	0.77	1.51	1.16
13	Home Performance w/ENERGY STAR®	1.00	0.68	0.83	1.44	1.20
14	Keep Cool*	1.05	0.99	0.82	2.57	0.94
15	Comprehensive Energy Management	1.00	1.00	1.00	1.00	1.00
16	Low-Income Assisted Multifamily Progam	1.00	1.00	0.73	1.15	0.84
17	Low-Income Direct Installation	1.00	0.35	1.00	1.00	1.00
18	Assisted Home Performance w/ENERGY STAR®†	1.00	0.68	1.00	1.00	1.00

* The results shown here differs from results found in the **New York Energy $mart℠** Program Evaluation and Status Report (May 2004) based on updated information.

† The results from the Assisted Home Performace w/ENERGY STAR® Program and the Home Performance w/ENERGY STAR® Program were combined in the **New York Energy $mart℠** Program Evaluation and Status Report (May 2004).

Table 21. Program Load Shapes

		1	2	3	4	5	6
		Summer, Off-Peak 3,376 Hours 39%	**Summer, On-Peak** 390 Hours 4%	**Summer, Shoulder** 650 Hours 7%	**Winter, Off-Peak** 3,288 Hours 38%	**Winter, On-Peak** 528 Hours 6%	**Winter, Shoulder** 528 Hours 6%
1	C/I Performance Program	50.6%	8.3%	15.9%	17.9%	4.0%	3.3%
2	New Construction Program	37.3%	8.9%	12.8%	28.2%	6.3%	6.2%
3	Curtailable Load Programs	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
4	Peak Load Reduction Program: Permanent Measures	46.4%	21.9%	24.9%	5.5%	0.6%	0.7%
5	Technical Assistance/Flex Tech	40.7%	11.1%	13.9%	24.7%	5.2%	4.4%
6	**New York Energy $mart^{SM}** Loan Fund	38.5%	10.3%	12.6%	27.6%	5.8%	5.1%
7	Smart Equipment Choices Program	58.1%	12.8%	22.7%	4.9%	0.7%	0.7%
8	Small Commercial Lighting	36.3%	8.6%	10.4%	31.4%	7.3%	6.0%
9	Premium Efficiency Motors	41.1%	16.6%	18.4%	17.4%	3.7%	2.8%
10	ENERGY STAR® Products	34.4%	3.6%	9.7%	37.0%	7.0%	8.3%
11	ENERGY STAR® Bulk Purchase	36.2%	5.2%	9.9%	35.0%	6.5%	7.2%
12	ENERGY STAR® Labeled Homes	39.9%	13.9%	14.1%	22.7%	4.3%	5.0%
13	Home Performance w/ENERGY STAR®	32.2%	7.9%	9.5%	35.7%	6.7%	7.8%
14	Keep Cool Program	48.6%	29.7%	21.0%	0.8%	0.0%	0.0%
15	Residential Comprehensive Energy Management	44.8%	22.7%	18.0%	10.4%	1.8%	2.2%
16	Low-Income Assisted Multifamily Progam	31.6%	3.9%	9.2%	39.5%	7.3%	8.5%
17	Low-Income Direct Installation	36.8%	3.7%	8.5%	37.7%	6.4%	6.9%
18	Assisted Home Performance w/ENERGY STAR®	32.2%	7.9%	9.5%	35.7%	6.7%	7.8%

Table 22. Program Measure Life

	Program	Program Measure Life (Years)
1	C/I Performance Program	17.6
2	New Construction Program	18.8
3	Curtailable Load Programs	10.0
4	Peak Load Reduction Program: Permanent Measures	19.5
5	Technical Assistance/Flex Tech	16.4
6	**New York Energy $mart[SM]** Loan Fund	16.8
7	Smart Equipment Choices Program	17.8
8	Small Commercial Lighting	14.0
9	Premium Efficiency Motors	20.0
10	ENERGY STAR® Products	13.9
11	ENERGY STAR® Bulk Purchase	18.7
12	ENERGY STAR® Labeled Homes	27.8
13	Home Performance w/ENERGY STAR®	20.6
14	Keep Cool	19.0
15	Comprehensive Energy Management	14.3
16	Low-Income Assisted Multifamily Progam	14.7
17	Low-Income Direct Installation	17.6
18	Assisted Home Performance w/ENERGY STAR®	20.6

Table 23. Macroeconomic Impacts of the New York Energy $mart[SM] Program: Average Value Added Per Year

	Program Implementation Years *1999-2006* (2004$)	Years Following Implementation *2007-2016* (2004$)
Program Case	$516 Million	$284 Million
Base Case (w/o Program)	$295 Million	$275 Million
Net Impact	$221 Million	$9 Million

SECTION 4: LEVELIZED COSTS

Various levelized costs are shown in Table 24. Each type of levelized cost is described below:

- **New York Energy $mart^{SM} $/MWh:** Program cost is amortized over the life of the program and divided by the annual electric energy savings.
- **Societal $/MWh:** Program and participant costs are amortized over the life of the program and divided by the annual electric energy savings.
- **Allocated New York Energy $mart^{SM} $/MWh:** Program costs are allocated to each category of energy savings (*i.e.*, electric energy, electric capacity, natural gas, etc.) based on the proportion of benefits contributed by each category. The portion of costs allocated to electric energy is amortized and divided by the annual electric energy savings. Thus, if electric energy savings constitute only a small portion of the program benefits, only a small portion of the cost is used in the calculation.

Table 24. Levelized Costs

Scenario	New York Energy $mart^{SM} $/MWh	Societal $/MWh	Allocated New York Energy $mart^{SM} $/MWh
Scenario #1 Without Additional Sector Costs	$22.47	$53.43	$15.88
Scenario #1 With Additional Sector Costs	$27.70	$54.04	$19.59

SECTION 5: LOAD CURTAILMENT PROGRAM B/C METHODOLOGY

A combined B/C analysis was conducted for the Peak Load Reduction Program (PLRP) and the Enabling Technologies Program (ETP). Both programs provide funding for measures that enable customers to curtail load. This analysis does not include the permanent measures funded through PLRP which are included in the main B/C model.

5.1 MW ENABLED, REGISTERED, AND DELIVERED

To date, 668 MW have been enabled through **New York Energy $mart[SM]** of which 360 MW (54 percent) are associated with the PLRP and 308 MW (46 percent) are associated with the ETP. As of December 31, 2003, 288 MW (43 percent) of the 668 MW were registered with the NYISO. Table 25 presents the registered MW and those MW delivered upon request.

Table 25. MW Registered and Delivered by PLRP and ETP Participants, by Year

	2001	2002	2003
MW Registered by NYSERDA Participants	174	311	288
Average Hourly MW Curtailment Performance During Emergency Events	102.5	175.6	124.2
Percent of Registered MW Delivered	58.9%	56.9%	43.1%

For forecasting future performance, the delivery rates in 2001 and 2002 were averaged to 57.3 percent. The delivery rate of 43.1% that occurred in 2003 was not included in the average because that curtailment was conducted to facilitate the re-starting of the electricity system in New York after the Northeast blackout and thus did not represent a typical load curtailment year. Given the 288 MW registered in 2003, 57.3 % of this amount yields 165 MW of average load curtailment. It is reasonable to expect that as the **New York Energy $mart[SM]** participants gain experience with their equipment, more of them will register with the NYISO and that the delivery rate will rise for those that are registered. These additional gains are not represented in the current analysis.

5.2 PROGRAM LIFE

The persistence of program impacts is more a function of behavioral rather than technological factors. That is, the technologies will last approximately 15 to 20 years but the length of time that customers are willing, on average, to continue to register and deliver load is expected to be much shorter. While over the last several years some **New York Energy $mart[SM]** participants have left the NYISO programs and others have joined, this analysis assumes a steady state of 668 enabled MW. To address uncertainty surrounding the persistence of this resource, three scenarios of 5, 10, and 15 years were developed. For sake of simplicity, the costs and benefits during the years 2001, 2002, and 2003 are treated as occurring in the first year. Thus, costs and benefits in 2004 are treated as the second-year cost and benefits, etc.

5.3 NUMBER OF HOURS OF OPERATION

For each of these three scenarios, it is assumed that 22.5 hours of interruptions occur each year. Increasing the number of hours of interruption will increase both the reliability benefits and NYISO incentive costs in a 3 to 1 ratio.

5.4 PROGRAM COSTS AND BENEFITS

Program costs (PLRP and ETP) and participant costs are shown in Table 26. The program costs total $15.4 million for the time period 2001 through 2003. For the purpose of the current analysis, this time period is considered to be the first year. The co-funding represents the participants' portion of the costs associated with purchasing and installing measures to enable load curtailment.

Table 26. Program Costs and Participant Co-Funding for the Peak Load Reduction and Enabling Technologies Programs Through Year-End 2003

Program	New York Energy $mart[SM] Spending ($ Million)	Participant Co-Funding ($ Million)	NYISO Payments ($ Million)
Peak Load Reduction Program: Curtailable Load	$13.8	$5.8	-
Enbabling Technologies	$1.6	$3.0	-
Total	$15.4	$8.8	$4.4

In addition to costs associated with measure installation, the NYISO incentive of $500 per MWh was included as a cost. This cost was included since the delivered load curtailment during emergency events is dependent on these payments. The NYISO payments from 2001 through 2003 for **New York Energy $mart[SM]** participants were calculated as the $500 times the average hourly load reductions delivered to the NYISO by **New York Energy $mart[SM]** participants**.** The inputs for these calculations are presented in Table 27. The total NYISO incentives paid to participants in the PLRP and ETP was $4.4 million for the three years covered by this analysis.

Table 27. Input to Calculate NYISO Incentives Paid to Participants in the PLRP and ETP, by Year

	2001	2002	2003
Average hourly energy curtailment/performance during emergency events (MW) that summer	102.5	175.6	124.2
Total hours of interruption	23	22	20
Total MWh	2,357.5	3,863.2	2,484.0
Total NYISO incentive paid	$ 1,178,750	$ 1,931,600	$ 1,242,000

The collateral, hedge, and reliability benefits provided by PLRP and ETP participants from 2001 through 2003 are shown in Table 28. Collateral benefits[11] of $3.4 million and hedge benefits[12] of $1.1 million were counted for 2001 and are not expected to occur in the future. These benefits were produced by unintended price effects that have been essentially reduced to zero by a restructuring of the NYISO programs. Reliability benefits[13] of $16.8 million have been realized through December 31, 2003.

Table 28. Benefits Realized by PLRP and ETP Participants, by Year (Million 2003$)

	Realized in 2001	Realized in 2002	Realized in 2003	Realized through 2003	Forecasted Annual Benefits in 2004 and Beyond (2003$)
Collateral Benefits	$3.4	$0.0	$0.0	**$3.4**	$0.0
Hedging Benefits	$1.0	$0.0	$0.0	**$1.0**	$0.0
Reliability Benefits	$5.2	$1.3	$10.3	**$16.8**	$6.6

In addition to these realized benefits, the B/C analysis included future reliability benefits expected to be realized from the investment in the installed measures. According to Neenan Associates, the ratio of reliability benefits to NYISO incentives is to 3 to 1. As a simplifying assumption, this ratio was used to forecast reliability benefits. An additional reliability benefit was included to account for a major outage, such as the blackout that occurred in 2003. The probability of this event was estimated to be one in ten years. Applying a probability of 0.10 to the expected annual benefit of $10.3 million produced an additional annual benefit of $1.03 million for a total of $6.6 million in 2003 dollars.[14]

5.5 TMET AND PET RESULTS

The TMET and PET results of the three program-life cases (5, 10, and 15 years) are shown in Table 29. These ratios are based on the assumption that the delivery rate of 57% remains constant and that the 288 MW of registered load is at a steady-state. The B/C ratios exceed 1 regardless of the program life assumption.

[11] Collateral benefits result from the change in the real-time location-based marginal price (LBMP) due to customer load curtailment.

[12] Hedge benefits result from lower costs for bilateral contracts or financial hedge instruments due to reduced price volatility.

[13] Reliability benefits result from avoidance of costs associated with loss of load such as loss of business.

[14] The reliability benefit was calculated as follows: 165 MW of performance times 22.5 hours = 3,712 MWh; 3,712 MWh times the NYISO incentive of $500 per MWh = $1.86 million. The 1 to 3 ratio of NYISO incentive to benefits yields a reliability benefit of $5.6. Added to this amount is the $1.03 million representing the 1 in 10 probability of a blackout, resulting in a total benefit of $6.6 million per year.

Table 29. PLRP & ETP TMET and PET Benefit/Cost Results

Program Life	Total Market Effects Test	Program Efficiency Test
5 Years	1.29	1.72
10 Years	1.69	2.12
15 Years	1.88	2.28

APPENDIX A: METHODOLOGIES FOR DEVELOPING AVOIDED ENERGY AND CAPACITY COSTS, ENERGY MARKET PRICE EFFECT, AND MACROECONOMIC IMPACT

A.1 AVOIDED ENERGY AND CAPACITY COST

The steps and assumptions used in estimating the avoided energy and capacity costs, due to participation in the **New York Energy $mart**[SM] programs, are described below.

A.1.1 Avoided Energy Cost

This is the avoided energy cost savings that occur for **New York Energy $mart**[SM] Program participants as a result reduction in energy use attributable to the program.

The starting point for estimating avoided energy cost was to calculate separate weighted averages of hourly New York Independent System Operator (NYISO) market clearing prices for energy for Upstate and Downstate areas during each of six time periods: Summer Peak, Summer Off-Peak, Summer Shoulder, Winter Peak, Winter Off-peak, and Winter Shoulder. The six time periods are defined as follows:

Summer Peak: June - August, noon to 6 pm (week days).

Summer Off-Peak: June – August, midnight to 8 am (week days), all week-end hours; May, September, and October, all hours.

Summer Shoulder: June – August (week days) 8 am to noon and 6 pm to midnight.

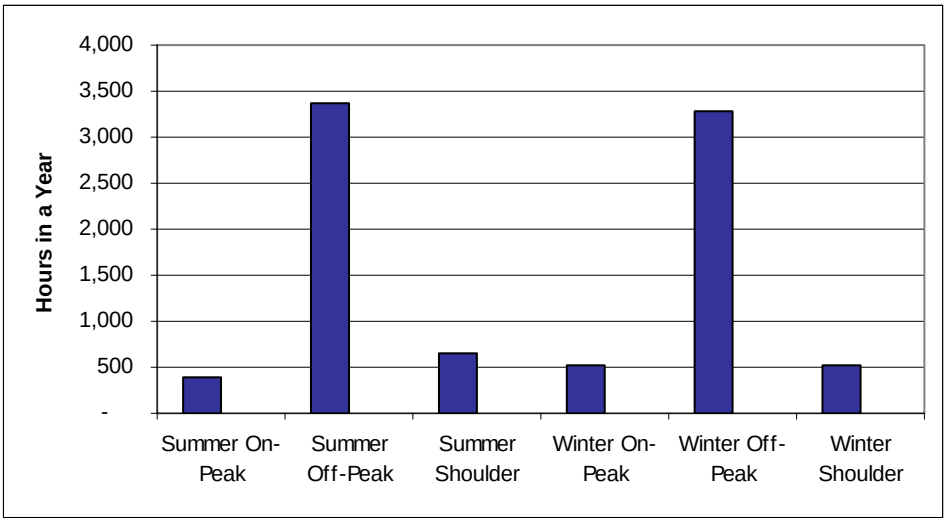
Winter Peak: December – February (week days) noon to 8 pm.

Winter Off-Peak: December – February, midnight to 8 am, all week-end hours; and March, April, and November, all hours.

Winter Shoulder: December – February (week days), 8 am to noon and 8 pm to midnight.

Figure A-2 presents the allocation of the 8,760 hours in a year to the six time periods.

Figure A-2. Hours in Each Time Period



The weighted average prices are based on hourly NYISO day-ahead market data for January 2000 through July 2004, which represents the first four full-calendar years of NYISO operation plus seven months of data from the current year. Annual weighted average prices were adjusted for inflation to reflect constant 2004 dollars.

The cost of ancillary services was estimated from NYISO data and added to the estimated energy price for each location and time period. Ancillary services include a range of additional costs associated with services procured by the NYISO that are necessary to support the transmission of energy and capacity from the generation level to the end-use level while maintaining reliable operation of the transmission system.

A forecast of future energy prices for each time period (including ancillary services) was developed, based on the annual real rate of energy price increase predicted using the Multi-Area Production Simulation (MAPS)[1] modeling software, which simulates the operation of the electricity system in New York. A 2004 MAPS base case was developed along with a MAPS sensitivity case which removed the energy and demand reduction benefits of the **New York Energy $mart**[SM] Program. The forecast of real energy price increases for 2004 through 2008 is based on MAPS output from the sensitivity case representing the years in which currently-known planned new capacity is assumed to come on-line. In subsequent years, energy prices are assumed to increase at the rate of general inflation. The reason for assuming no real energy price increases after 2008 is that no new capacity is assumed in the MAPS cases after that time. The model outputs, therefore, reflect diminished reserve margins and the model increases wholesale prices above those that would be expected had new capacity been built to meet the forecasted system load growth (as is expected but not forecasted for this analysis). MAPS runs and calculation of annual energy price escalation rates were conducted by NYSERDA staff. The HMG Team forecasted the future energy prices by applying escalation rates to the weighted average hourly NYISO energy price data by location and time period, also developed by NYSERDA staff.

The end-use kWh savings for each program (as reported in the May 2004 ***New York Energy $mart***[SM] *Program Evaluation and Status Report)* were increased by 11.5% to account for transmission and distribution system losses, and thereby reflect kWh savings at the generation level. The generation-level kWh savings were allocated to the Upstate or Downstate regions, using zip code data, and were subsequently distributed across the six time periods based on the hourly load shapes of the energy efficiency measures implemented by each program.

Generation-level kWh savings for each program, distributed by location and time period, were multiplied by the corresponding weighted average avoided energy price in cents per kWh to get a total dollar value of avoided energy costs for each year over the expected life of the measures implemented by each individual program. The present value of the stream of annual avoided energy costs, in total dollars over the expected life of the measures, was then calculated.

A.1.2 Avoided Capacity Cost

This is the avoided capacity cost savings for **New York Energy $mart**[SM] Program participants associated with the kW of capacity avoided due to the **New York Energy $mart**[SM] Program. Avoided capacity cost is based on NYISO capacity auction data (excluding Long Island) from

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[1] The MAPS model, proprietary software developed by General Electric, simulates the operation of New York's electricity system on an hour-by-hour basis. The objective of the model is to meet the hourly electric load with the available user-defined generation units, while minimizing bid costs, subject to generation and transmission constraints, operating reserve, and other requirements.

November 2002 through July 2004. Values were calculated in $/kW per month for Upstate and Downstate and for both summer and winter.

The forecast of future avoided capacity costs was developed using the same annual escalation rates that were applied to avoided energy. The kW reductions for each program were distributed to Upstate and Downstate regions of the State and across time periods, multiplied by corresponding $/kW costs, and net-present-valued over the life of the measures, by a methodology that parallels the methodology applied to avoided energy costs.

A.2 ENERGY MARKET PRICE EFFECT

The following is a description of the methodology used to estimate the energy market price effect due to the implementation of the **New York Energy $mart**[SM] Program. This methodology estimates the savings that result from lower wholesale electricity commodity prices for all kWh generated. This benefit is derived from lower average market clearing price for electricity that occurs because the price bids from the most expensive generating units are not needed when the system requirements are lowered by the amount of kWh saved by **New York Energy $mart**[SM] Program. In other words, when the most expensive units are backed out because of lower requirements, the market clearing price for all kWh generated is lowered. This is a benefit for all electricity customers regardless of whether they participate in the **New York Energy $mart**[SM] Program.

The estimated reduction in average wholesale electricity commodity price is based on analysis using the model of New York's electricity system over the period 2006 (full implementation of programs) to 2008 (the year after which no currently-known planned new capacity is assumed to come on-line). The analysis compares the average annual wholesale electricity commodity prices of electricity (in cents per kWh) in the 2004 MAPS base case (which includes the impacts of the **New York Energy $mart**[SM] Program) to the prices predicted in a sensitivity case in which the total energy requirement is increased by the amount of additional kWh that would need to be generated in each year if the **New York Energy $mart**[SM] Program did not exist. The difference in average annual wholesale electricity commodity prices between the two scenarios (in cents per kWh) represents the amount by which the average price of electricity would be higher in the absence of the **New York Energy $mart**[SM] Program. This methodology is based on a total revenue analysis of the difference in total system costs between the MAPS base case and the MAPS sensitivity case without the **New York Energy $mart**[SM] Program described above. To avoid double-counting, this methodology explicitly excludes the avoided energy costs due to fewer kWh generated that result from the specific savings attributable to **New York Energy $mart**[SM] Program measures.

The electricity price output of MAPS (reported in both cents per kWh and in total dollars) reflects production costs only (fuel costs, fixed and variable operation and maintenance (O&M) costs, and emission allowance costs). To convert MAPS production costs to the required estimates of NYISO wholesale electricity commodity prices (market clearing prices), MAPS production costs were increased by a factor of 1.33. This factor was estimated by NYSERDA staff to account for ancillary services, congestion costs due to transmission outages, electricity price spikes due to short-term fuel price spikes and/or extreme weather, and other factors that contribute to actual market bidding behavior. This factor was estimated by comparing backcasted MAPS output prices for 2002 and 2003 (*i.e.,* "after-the-fact" model runs based on actual load data and fuel prices) to historical NYISO electricity commodity prices in the same years.

The present value of the *energy market price effect* was estimated, using the annual wholesale electricity commodity price differential calculated above (in cents per kWh) multiplied by the

total kWh expected to be generated in New York each year (from the MAPS base case) over the expected life of the measures implemented by the **New York Energy $mart**[SM] Program.

A.3 MACROECONOMIC IMPACT STUDY

Economic evaluation of the **New York Energy $mart**[SM] Program to date has focused on tracking program costs and the direct benefits to program participants. Expenditures made by NYSERDA and participants within the **New York Energy $mart**[SM] Program have substantial macroeconomic impacts that go beyond these direct benefits. Purchases of goods and services through the Program set off a ripple effect of spending and re-spending that influences many sectors of the New York economy and the level and distribution of employment and income in the State. The macroeconomic impact analysis of the **New York Energy $mart**[SM] Program undertaken for this report was designed to quantify the net impacts of the programs by comparing the impacts of program expenditures and energy savings to the impacts that would have resulted had the programs not been implemented and the money not paid by ratepayers into the System Benefits Charge fund. This type of analysis required the use of an input/output model to characterize the myriad of interdependencies in the New York economy and how the expenditures of each of these groups within the State's economy differ between these two cases. The net macroeconomic impacts are expressed in terms of annual employment, income, and gross state product.

The first step of the analysis was to estimate the impact of the **New York Energy $mart**[SM] Program funds on the New York economy had they been retained by the customers of the participating utilities. This case provides a baseline, or frame of reference, with which to compare the impacts of the **New York Energy $mart**[SM] Program. The second step was to estimate the impact on the New York economy of SBC funds allocated to the complete portfolio of **New York Energy $mart**[SM] Program expenditures on goods and services. In each of these two cases, expenditure decisions are made by different entities, for different reasons, resulting in purchases of widely different combinations of goods and services from different sectors of the economy. By comparing the impacts of these two cases, the analysis provides a comprehensive assessment of the net macroeconomic impacts of the **New York Energy $mart**[SM] Program.

Results of the analysis, summarized in Table A-1, indicate that the **New York Energy $mart**[SM] Program provides a substantial net macroeconomic benefit to New York in the form of increased employment and labor income. The jobs and labor income created during the Program implementation years (1999-2006) are primarily due to Program expenditures. The jobs and labor income created in the years following Program implementation are entirely driven by the continuing stream of energy bill savings that results from the energy efficiency and demand reduction measures installed under the Program.

During the Program implementation years (1999-2006), it is estimated that the Program will create and sustain an average net gain of about 5,500 jobs per year. Over this period, annual labor income will be about $221 million (2004 $) more than it would be if the Program did not exist. In the years following Program implementation (2007-2016), after Program expenditures have been completed, the Program will create and sustain an average net gain of about 4,200 jobs per year. Over this period, annual labor income is estimated to be about $9 million (2004 $) more than it would be if the Program did not exist. Benefits used for the B/C analysis is the value-added per year as shown in Table A-1. Since the forecast period ends in 2016, these benefits were extrapolated to 2037 to capture the benefits of those programs with the longest measure life.

Table A-1. Macroeconomic Impacts of New York Energy $mart[SM] Program

	Average Jobs per Year		Average Value-Added per Year (2004 $)	
	Program Implementation Years *1999-2006*	**Years Following Implementation** *2007-2016*	**Program Implementation Years** *1999-2006*	**Years Following Implementation** *2007-2016*
Program Case	8,016	4,442	$516 Million	$284 Million
Base Case (w/o Program)	2,524	241	$295 Million	$275 Million
Net Impact	5,492	4,201	$221 Million	$9 Million

APPENDIX B. PROGRAM MEASURE LIVES

Business/Institutional Programs

C/I Performance Program

Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
C/I Motors and VSDs	206,800,306	30%	20	5.9
C/I Cooling	120,745,558	17%	24	4.1
C/I Lighting	352,419,161	50%	14	7.0
C/I Other	20,467,504	3%	18	0.5
Total	700,432,529	100%		17.6

New Construction

Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
C/I Motors and VSDs	33,087,835	11%	20	2.2
C/I Cooling	24,928,369	8%	15	1.2
Chillers	58,916,145	20%	24	4.7
C/I Heating	9,059,407	3%	15	0.5
Other C/I HVAC	2,999,804	1%	15	0.1
C/I geothermal heat pumps	50,996,663	17%	15	2.5
C/I Lighting	40,707,337	14%	14	1.9
C/I Building Shell	31,707,925	11%	30	3.2
C/I Building Controls	47,576,887	16%	15	2.4
Total	299,980,373	100%		18.8

Small Commercial Lighting

Measure	kWH	% of Savings	Measure Life	Weighted Measure Life
Lighting	3,961,611	100%	14	14.0

Technical Assistance				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
Building Envelope	12,005	1%	30	0.4
Controls	117,653	13%	15	1.9
DHW	13,207	1%	20	0.3
Generation	216,959	23%	15	3.5
HVAC	284,781	30%	19	5.8
Industrial Process	23,902	3%	20	0.5
Lights	220,305	24%	14	3.3
Other	45,287	5%	15	0.7
Total	934,099	100%		16.4

Peak Load Reduction Program: Permanent Measures				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
HVAC	42,703,500	100%	19.5	19.5

Premium Efficiency Motors				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
Motors	7,122,076	100%	20	20.0

Smart Equipment Choices				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
Commercial Refridgerator	3,500	0%	15	0.0
Compact Fluorescent Bulbs	107,622	1%	4	0.0
Fluorescent Fixtures	72,187	1%	20	0.1
Fluorescent Fixtures - Daylight Controlled	1,416	0%	10	0.0
Fluorescent Fixtures - Occupancy Controlled	8,254	0%	10	0.0
Heat Pump	4,896	0%	15	0.0
HID	81,600	1%	10	0.1
HID - Daylight Controlled	540	0%	15	0.0
HID - High Pressure Sodium	21,935	0%	15	0.0
HID - Metal Halide	137,658	1%	10	0.1
HID - Occupancy Controlled	220	0%	15	0.0
HVAC	42,504	0%	20	0.1
LED	28,780	0%	25	0.1
LED – Exit	28,815	0%	25	0.1
Lighting in vending machine - Occupancy Controlled	34,515	0%	10	0.0
Lighting Timer	390	0%	7	0.0
Motors	596,061	5%	20	1.1
Occupancy sensors	61,880	1%	10	0.1
Pre-Cooler	5,958,114	53%	20	10.7
Variable Speed Drives	3,963,400	35%	15	5.3
Washers	21,099	0%	12	0.0
Windows	196	0%	20	0.0
Total	11,175,581	100%		17.8

Loan Fund Program				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
Alternative Power	29,325	0%	15	0.0
Building Envelope	62,694	0%	30	0.1
CHP	1,620,280	9%	15	1.3
Chiller	559,025	3%	24	0.7
Compressor	2,355,600	13%	20	2.5
Custom	6,805,998	36%	15	5.4
Duct Sealing	10,923	0%	15	0.0
EMS	1,546,001	8%	15	1.2
Economizers	16,410	0%	19	0.0
ENERGY STAR® Products	60,156	0%	15	0.0
HVAC	692,375	4%	19	0.7
Heat Pump	477,342	3%	15	0.4
Heat Recovery System	78,338	0%	15	0.1
Insulation	1,623,705	9%	25	2.2
Lighting	2,277,792	12%	14	1.7
Motorized Roof Vents	10,713	0%	20	0.0
Motors	99,820	1%	20	0.1
Occupancy Controls	36,582	0%	10	0.0
Refrigerated Display Cases	259,494	1%	15	0.2
Transformer	5,745	0%	30	0.0
Vending Machines	1,280	0%	7	0.0
Washer	137,011	1%	12	0.1
Water Heater	2,282	0%	10	0.0
Weatherstripping	4,862	0%	10	0.0
Total	18,773,752	100%		16.8

Residential and Low-Income Programs

ENERGY STAR® Bulk Purchase				
Measure	Counts	% of Savings	Measure Life	Weighted Measure Life
Refirgerator	21,994	25%	19	4.8
Dishwasher	2,855	3%	15	0.5
Residential Clothes Washer	385	0%	15	0.1
Commercial Clothes Washer	2,889	3%	7	0.2
Room Air Conditioner	6,883	8%	15	1.2
Lighting Fixture	52,577	60%	20	12.0
Total	87,583	100%		18.7

ENERGY STAR® Labeled Homes				
Measure	BTUs	% of BTUs	Measure Life	Weighted Program Life
ENERGY STAR® Refrigerator	227,976,000	0.18%	19	0.034
ENERGY STAR® Dishwasher	820,680,000	0.65%	15	0.098
ENERGY STAR® Clothes Washer	110,271,000	0.09%	15	0.013
Central Air Conditioner	6,633,382,000	5.26%	15	0.789
ENERGY STAR® Lighting	7,897,627,500	6.26%	12	0.752
Envelope	109,188,567,000	86.59%	30	25.978
Appliance	1,214,433,000	0.96%	14	0.130
Total	126,092,936,500			27.794

Keep Cool				
Measure	kWh	% of Savings	Measure Life	Weighted Measure Life
Room Air Conditioner	25,173,284	100%	15	15.0

Home Performance with ENERGY STAR®
(Includes Assisted Home Performance with ENERGY STAR®)

Measure	BTUs	% of BTUs	Measure Life	Weighted Program Life
Air and Duct Sealing – Heating	369,369,000	0.23%	15	0.0338
Insulation – Heating	39,677,324,787	24.18%	20	4.8353
Building Shell – Other	18,900,000	0.01%	30	0.0035
Windows – Heating	44,301,572,944	26.99%	25	6.7485
Clothes Washer	26,922,000	0.02%	15	0.0025
Dishwasher	3,192,000	0.00%	15	0.0003
Fluorescent Fixtures	171,549,000	0.10%	20	0.0209
CFL Bulbs	8,254,585,500	5.03%	4	0.2012
Refrigerator	1,796,991,000	1.09%	19	0.2080
Boiler	1,792,346,547	1.09%	20	0.2184
Water Heater	31,298,636,692	19.07%	20	3.8142
Furnace	31,093,512,405	18.95%	20	3.7892
Heat Pump	132,531,000	0.08%	15	0.0121
Heating System – Other	336,609,000	0.21%	20	0.0410
Other	31,752,000	0.02%	19	0.0037
Central Air Conditioners	1,393,560,000	0.85%	15	0.1274
Shell Measures - Cooling Savings, Homes with Central AC	1,652,371,875	1.01%	30	0.3020
Shell Measures - Cooling Savings, Homes with Room AC	1,304,667,000	0.79%	30	0.2385
ECM Fans	459,459,000	0.28%	15	0.0420
Total	164,115,851,750	100%		20.6

Residential Comprehensive Energy Management

Measure*	kWh	% of Savings	Measure Life	Weighted Measure Life
HVAC	1,163,156	75%	15	11.3
Lighting	387,719	25%	12	3.0
Total	1,550,874	100%		14.3

* This program supports meters and load control equipment. It was assumed that the equipment controlled the above measure types.

Assisted Multi-Family Program (AMP)

Measure	BTUs	% of BTUs	Measure Life	Weighted Program Life
Envelope/Shell	495,751,108	1.08%	30	0.3
Lighting	11,299,050,000	24.54%	12	2.9
Appliances	4,044,988,500	8.78%	16.3	1.4
Heating Systems	28,939,160,892	62.84%	15	9.4
Cooling Systems	15,750,000	0.03%	15	0.0
Motors	1,256,524,500	2.73%	20	0.5
Total	46,051,225,000	100.00%		14.7

Low-Income Direct Installation Program

Measure	kWh Savings	% of Savings	Measure Life	Weighted Measure Life
Refrigerators	3,076,994	27%	19	5.1
CFLs	1,555,414	14%	4	0.5
Light Fixtures	2,817,775	25%	20	4.9
Outdoor Lighting	4,042,135	35%	20	7.0
Total	11,492,318	100%		17.6

APPENDIX C. VALUE COST ANALYSIS FOR RESEARCH & DEVELOPMENT PROGRAMS

C.1 INTRODUCTION

R&D programs and their societal impacts are difficult to evaluate by their nature. The outcomes are subject to multiple and uncontrollable influences that are difficult to foresee. In addition, the cycle for product development is 5 to 15 or 20 years, and many of the energy and economic impacts of R&D projects may not be fully realized and measured for many years. Given the multiple and compounding effects that happen along the way, it is also very difficult to be exact about costs and attribution of impacts to any one particular effort. There is also an added difficulty when evaluating an entire portfolio of R&D projects, as objectives and outcomes vary by project. GDS and HMG have begun the development of a cost-effectiveness model for the R&D program area that takes into account these difficulties. This work will supplement the traditional benefit-cost analysis that was conducted for NYSERDA's deployment programs.

The model in development was named the Value-Cost (V/C) analysis to set it apart from the Benefit/Cost (B/C) analysis. The V/C model is based on the premise that while most of the immediate and intermediate outputs and outcomes of R&D cannot be monetized, they can be monitored over time to assess whether programs are on track to achieve their ultimate energy and economic impacts. A second premise of the model is that long-term impacts of R&D projects can eventually be monetized, thus allowing a more traditional B/C analysis for some projects.

C.2 R&D PROGRAM ASSESSMENT FRAMEWORK

C.2.1 Six Stages of R&D Activities

Working with the NYSERDA R&D program staff, six activity types (or stages of project development) were identified. These stages are shown in Figure B-1, the R&D Program logic model. The stages are

(1) information for policy makers and R&D community

(2) product development stage 1 – study and prove concepts

(3) product development stage 2 – develop new or improved products

(4) product development stage 3 – product testing

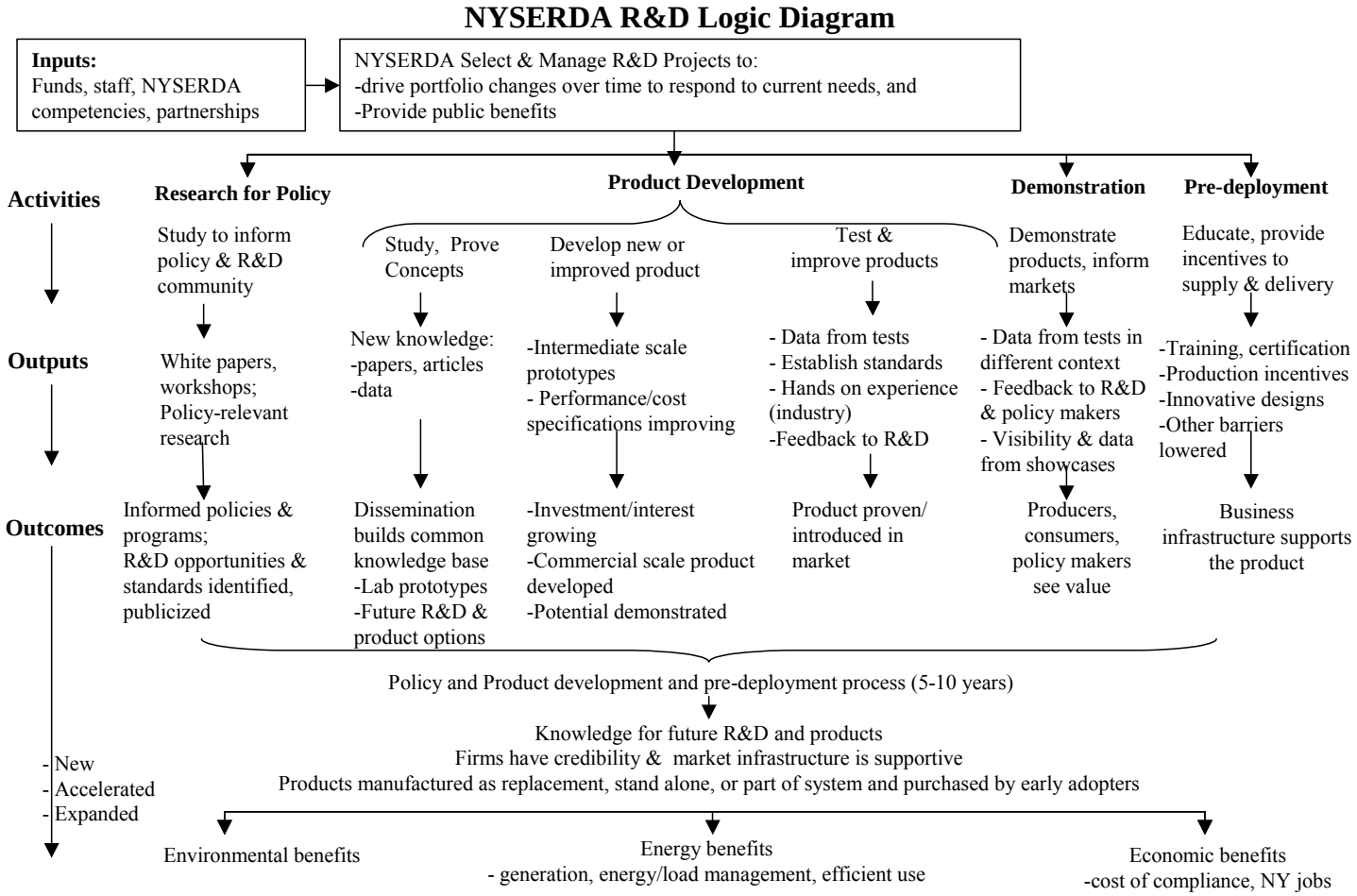
(5) demonstration

(6) pre-deployment

Identifying these distinct stages was important because progress and success within each stage will be different and separate measurement indicators will be needed to assess such progress. The logic model shows indicators of progress through each stage (read down the columns). Some of these indicators are quantifiable (number of papers and patents, amount of additional investment) and others are qualitative (changes in behavior, changes in procedures).

The current framework also recognizes that progress can be measured across the stages within a specific technology area, such as lighting, HVAC, or power generation. Additional indicators that measure this progress may also be needed.

Figure C-1. NYSERDA R&D Logic



External Influences:
Cost, Performance of existing technologies; Industry willingness to take risks; Uncertainty of R&D; Energy prices; Government policies

C.3 THE AGGREGATION OF PERFORMANCE INDICATOR DATA

One goal of the R&D Value/Cost assessment is to combine, in a meaningful way, the various progress measures for the several project types, in a way that provides a portfolio level assessment. Discussions with the GDS Team and a review of the literature revealed a number of approaches developed specifically for the evaluation of the impact of R&D programs including *Evaluating R&D Impacts: Methods and Practice*, edited by Bozeman and Melkers (1993)[15], *Evaluating Public Sector Research and Development*, Link (1996)[16], and *A Toolkit for Evaluating Public R&D Investment: Models, Methods, and Findings from ATP's First Decade,* Ruegg and Feller (2003).[17] The approach described in Ruegg and Feller (2003) seems the most promising at this time because it offers a relatively simple approach, called the Composite Performance Rating System (CPRS), which can be used to construct performance measures using multiple indicators.

The CPRS approach was applied to the Advanced Technology Program (ATP), located in the U.S. Department of Commerce's National Institute of Standards and Technology. The purpose of the APT effort was to consolidate the extensive amount of project performance information and produce a single symbolic performance rating which can be quickly grasped and used for comparisons and whose distribution across projects can be used to depict portfolio performance. In addition to collecting and compiling information on specific measurement indicators, brief case studies were conducted on 50 individual R&D projects to provide economic, contextual and quality information on each project. Projects were scored in terms of 0 to 4 stars, depending on the strength of its overall progress toward the key goals, thus providing a distribution of scores across the portfolio of completed projects. This approach is consistent with the GDS/HMG Team's R&D Value/Cost framework and progress tracking recommendations discussed in more detail below. While the CPRS approach should be considered a rough and approximate rating metric, it can be used both to discriminate among projects in terms of their level of success and to serve as a management tool for identifying the relative progress of completed projects in progressing toward program goals.

Results from the ATP/CPRS effort also show that over time, the performance of individual projects change and that performance measures will need to be updated. Also, as developed technologies enter the market and are deployed into the marketplace, commercial market impact data can be collected, allowing the use of more traditional benefit-cost analysis.

C.3.1 General Formulation of the Composite Performance Ratings System

The CPRS is constructed as the sum of the weighted indicator measures for a set of mission-driven goals, adjusted to a 0–4 point scale. In its general form, CPRS is formulated as follows:

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[15] Bozeman, Barry and Julia Melkers, 1993, *Evaluating R&D Impacts: Methods and Practice*, Norwell, MA: Kluwer Academic Publishers.

[16] Link, Albert N., 1996, *Evaluating Public Sector Research and Development*, Westport, CT: Praeger Publishers.

[17] Ruegg, Rosalie and Irwin Feller, 2003, *A Toolkit for Evaluating Public R&D Investment: Models, Methods, and Findings from ATP's First Decade*. Prepared for the Economic Assessment Office, Advanced Technology Program, National Institute of Standards and Technology, Gaithersburg, MD.

$$CPRS = \sum_{j=1}^{K} \sum_{i=1}^{N} (I_i \gamma_{I_i})_j A$$

where

i = the i[th] of N indicators of progress towards the j[th] of K mission-derived goals,

γ_{I_i} = the weighting factor applied to I_i indicator of progress,

N = the number of progress indicators for a given mission-derived goal, counting from i = 1 to N

K = the number of mission-derived goals for which there are progress indicators, counting from j = 1 to K

A = an adjustment factor for converting the total raw score to a 0–4 point scale.

This initial algorithm and the assignment of weights will be refined over time.

C.3.2. Selecting Indicator Variables and Assigning Weights

Specifying the indicator variables for NYSERDA's R&D programs will be guided by a logic model. The data collection will reflect NYSERDA's specific goals as well as short, intermediate, and longer-term outcomes associated with R&D. Once the performance indicators are collected, they will be assigned weights depending on how much an indicator is appropriate for the type of R&D activity and combined to calculate scores signaling progress in each activity area. These could be combined around the three goal areas noted in Ruegg and Feller (2003) as: (1) knowledge creation, (2) knowledge diffusion and (3) commercialization progress. Assessing progress of projects toward accomplishing each of three major goals of NYSERDA's R&D portfolio (Economic benefits, Energy benefits and Environmental benefits – the 3 E's) will also be appropriate in cases where the development cycle of a particular project or technology is short, or in cases where the project has been going on for a sufficiently long time. The weighting factors used to develop the composite rating will be determined in close collaboration with the R&D staff. In general, there will be a menu of indicators, taken from NYSERDA's R&D logic model and supplemented as necessary to recognize project specific activities. Where indicators apply to a particular stage, they will be weighted heavily and where specific indicators do not apply, they will be weighted with a "0".

Basic statistics, such as the number of projects, expenditures by technology type, leveraged funds, and the stage of development will be calculated to describe the entire R&D portfolio. However, this initial approach to constructing CPRS scores for NYSERDA's R&D portfolio will be exploratory and, initially, will be applied to a small sample of successful R&D projects, covering each of the six R&D stages (project types). As more is learned about available data and how best to routinely collect data in a cost-effective manner, the number of projects that are included in the V/C analysis will increase, making the projects examined more representative of the population of the NYSERDA R&D portfolio. In addition, once a system is in place, the data collection will be conducted in mostly real time, as opposed to retrospectively.

C.4 CURRENT ACTIVITIES

Six projects have been identified for in-depth data collection, one from each R&D stage/project type. The six projects are shown in Table C-1 along with project type, technology area, and

project name. A few of the listed projects span multiple R&D stages but at this time, the projects will be assessed mainly for a particular stage (however, where appropriate, progress across stages for these projects will also be noted). The objective of this initial data collection effort will be to test and validate the appropriateness of key indicators and to demonstrate that meaningful measurements can be made at a reasonable expenditure of time and cost. Once these indicators have been identified and measured for the six projects and lessons about the scoring system have been learned, a more comprehensive set of projects will be assessed using a possibly revised set of indicators and approach.

Following the initial within-stage indicators investigation, a particular group of NYSERDA R&D projects that all focus on a single technology area will be assessed across the multiple R&D stages. One potential technology area that could be selected is lighting (14 individual NYSERDA R&D efforts are currently being implemented within this technology area and are working within and across specific R&D stages). Another technology area is distributed generation. Assessing NYSERDA R&D activities within specific technology areas will be quite helpful in showing progress and determining energy, environmental and economic benefits (since the magnitude of these benefits could vary significantly by technology due to timing, cost and market conditions). This assessment will also be useful in demonstrating the synergistic effects of NYSERDA's involvement within a particular technology area across various R&D stages. Results from these ongoing analyses (the six individual project assessments and the technology area assessment) will be presented in the May 2005 ***New York Energy $mart***^{SM} *Program Evaluation and Status Report.*

Table C-1. Projects Selected for Initial Investigation and Data Collection

R&D Stage	Technology Area	Project Name
Information for Policy and R&D Community	HVAC	21st Century HVAC Research Consortium
Product Development Stage 1 – study and prove concepts	Demand Resposne	Aggregating Distributed Generators (also in R&D Demonstration stage)
Product Development Stage 2 – develop new or improved products	Environmental	EMEP – Development of Continuous Ambient Paticulate Monitor
Product Development Stage 3 – product testing	Transportation	Evaluation of Truck Stop Electrification for NYS (also in Product Development Stages 1 and 2, Demonstration, and Pre-Deployment)
Demonstration	Industrial	Turnkey Pump and Compressed Air Program
Pre-deployment	Power generation	Green Power Marketing Program

ADDITIONAL SOURCES

Ausubel, Jesse H. and H. Dale Langford, 1997, *Technological Trajectories and the Human Environment*, New York: National Academy Press.

Boardman, Anthony E., David H. Greenberg, Aidan R. Vining, and David L. Weimer, 1996, *Cost-Benefit Analysis: Concepts and Practice,* Upper Saddle River, N.J.: Prentice Hall.

California Public Utilities Commission, 2001, *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*.

Edwards, Ward and J. Robert Newman, 1982, *Multiattribute Evaluation*, Thousand Oaks, CA: Sage Publications.

Edwards, Ward, Marcia Guttentag and Kurt Snapper, 1975, "A Decision Theoretic Approach to Evaluation Research," In Elmer L Struening and Marcia Guttentag (Eds.), *Handbook of Evaluation Research,* Beverly Hills, CA: Sage Publications, Inc.

Lee, Russell, Gretchen Jordan, Paul Leiby, Brandon Owens, James Wolf, 2003, "Estimating the Benefits of Government-Sponsored Energy R&D," *Research Evaluation*, Vol. 12 No. 3, pp. 189-195.

Mahajan, Vijay, and Robert A. Peterson, 1985, *Models for Innovation Diffusion*, Newbury Park, CA: SAGE Publications.

Mahajan, Vijay, Eitan Muller, and Rajendra K. Srivastava, 1990, "Determination of Adopter Categories by Using Innovation Diffusion Models," *Journal of Marketing Research*, Vol. XXVII, pp. 37-50.

Mahajan, Vijay, Eitan Muller, and Yoram Wind, 2000, *New-Product Diffusion Models*, Boston: Kluwer Academic Press.

RER, 1999, "Suggestions for Incorporating Multiperiod Market Transformation Effects and Energy Center Informational Impacts in the Public Purpose Tests for Some 2000 Programs," Prepared by Regional Economic Research for the Southern California Edison Company.

Ridge, Richard, 2000, "Evaluation of Southern California Edison's Emerging Technology Program," Submitted to the Southern California Edison.

Ridge, Richard, 2003, "Evaluation of the 2002 California Emerging Technologies Program," Submitted to the Southern California Edison.

Rogers, Everett M., 1995, *Diffusion of innovations,* New York: The Free Press.

Rogers, Everett M. and F. Floyd Shoemaker, 1971, *Communication of innovations: A cross-cultural approach,* New York: Free Press.

Ruegg, Rosalie and Irwin Feller, 2003, *A Toolkit for Evaluating Public R&D Investment: Models, Methods, and Findings from ATP's First Decade*. Prepared for the Economic Assessment Office, Advanced Technology Program, National Institute of Standards and Technology, Gaithersburg, MD.

Saaty, T.L., 1980, *The Analytic Hierarchy Process,* New York: McGraw-Hill.

Sebold, Frederick D., Alan Fields, Lisa Skumatz, Shel Feldman, Miriam Goldberg, Ken Keating, and Jane Peters, 2001, *A Framework for Planning and Assessing Publicly Funded Energy Efficiency (Study ID PG&E-SW040)*, Prepared for Pacific Gas & Electric.

Soft, Steven, 2002, *Power System Economics: Designing Market for Electricity,* Piscataway, N.J.: IEEE Press/Wiley-Interscience, John-Wiley & Sons, Inc.

Sultan, Fareena, John U. Farley, and Donald R. Lehmann, 1990, "A meta-analysis of applications of diffusion models," *Journal of Marketing Research*, Vol. XXVII, pp. 70-77.