

## **APPENDIX**

### **FINAL REPORT ON THE INITIAL THREE-YEAR SBC PROGRAM JANUARY 2002**

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## APPENDIX C

# NEW YORK ENERGY \$MART<sup>SM</sup> COST EFFECTIVENESS ASSESSMENT METHODOLOGY

## INTRODUCTION

Through NYSERDA's administration of the **New York Energy \$mart<sup>SM</sup>** program, nearly 229 individual measures are being promoted as part of a portfolio of 35 carefully designed energy efficiency, renewable energy resource, and research and development initiatives. In accordance with a January 2001 order issued by the NYS Public Service Commission, \$139 million in annual funding for these initiatives is being provided through a Statewide systems benefit charge.<sup>1</sup> This report discusses methodology and presents current results from a benefit-cost analysis being conducted by GDS Associates, Inc., to assess cost-effectiveness of the **New York Energy \$mart<sup>SM</sup>** public benefits program.<sup>2</sup> Benefit-cost ratios have been calculated and are shown for all quantifiable measures being promoted through NYSERDA's portfolio of energy efficiency and research and development programs. Benefit-cost ratios have also been calculated and are presented, where completed, at the program and sector level (*i.e.*, residential, commercial, and industrial) and portfolio-wide. This analysis is intended to help NYSERDA to ensure that cost-effective measures are promoted through its public benefits program and to help to guide improvement of existing programs and development of future program efforts.

## METHODOLOGY

The benefit-cost (B/C) ratios presented in Section 6 of this report were developed through a multi-stepped process including: (1) identifying and compiling all **New York Energy \$mart<sup>SM</sup>** Program initiatives, and all measures being delivered within each initiative; (2) collecting and documenting key measure and program-specific data (*e.g.*, measure lives, annual energy and capacity savings, summer/winter/on/off-peak savings allocations, incremental measure costs, other program costs, in-program and with-program penetrations rates, etc.); (3) developing flexible cost-effectiveness screening models able to calculate measure-specific B/C ratios as well as ratios at the program, sector, and portfolio levels; (4) estimating Statewide avoided energy and capacity costs for use in the model<sup>3</sup>; and (5) utilizing models to calculate

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<sup>1</sup> State of New York Public Service Commission. January 26, 2001. *Order Continuing and Expanding the System Benefits Charge for Public Benefit Programs*. CASE 94-E-0952 - In the Matter of Competitive Opportunities Regarding Electric Service.

<sup>2</sup> The full analysis and report: **New York Energy \$mart<sup>SM</sup>** Program Cost-Effectiveness Assessment provided by GDS Associates, Inc. will be completed during Summer 2002.

<sup>3</sup> The avoided cost forecast was prepared solely for use in the B/C model to quantify the benefits of savings resulting from the installation of energy efficiency and related measures/services promoted through NYSERDA's **New York Energy \$mart<sup>SM</sup>** program. The avoided cost projections included in the model and the inputs to those

B/C ratios for analysis. The model results are then analyzed and draft and final reports are being developed that summarize the results. Activities performed within each step are discussed in more detail below.

### Step 1 - Program Initiatives and Measure Compilation

As highlighted within this report, the **New York Energy \$mart<sup>SM</sup>** program comprises 35 different program initiatives within the major areas of Energy Services Industry, Market Transformation, Technical Assistance, Low-Income, and Research and Development (including renewable energy program support). Appendix A to the Report presents summary information on each program. A list of these programs is presented in Table 1 below.

**Table 1: New York Energy \$mart<sup>SM</sup> Program Initiatives**

| <b>Program Category/Name</b>  | <b>Customer Sector</b> |
|---|------------------------|
| <i>Energy Services Industry Programs</i>                                      |                        |
| Commercial/Industrial Performance (formerly Standard Performance Contracting) | C/I Sector             |
| Institutional Energy Performance Contracting Assistance Program               | C/I Sector             |
| <i>Market Transformation Programs</i>   |                        |
| New Construction Program  | C/I Sector             |
| Smart Equipment Choices Program   | C/I Sector             |
| Premium Efficiency Motors Program   | C/I Sector             |
| Small Commercial Lighting Program   | C/I Sector             |
| Commercial HVAC Program   | C/I Sector             |
| <b>New York Energy \$mart<sup>SM</sup> Loan Fund</b>                          | C/I Sector             |
| Loan Fund Multifamily Building Demonstration                                  | C/I Sector             |
| Innovative Opportunities: Commercial and Industrial                           | C/I Sector             |
| Residential Appliances & Lighting and ENERGY STAR Public Awareness            | Residential Sector     |
| Keep Cool (Air Conditioner Bounty) Program                                    | Residential Sector     |
| Residential New Construction: ENERGY STAR Homes                               | Residential Sector     |
| Home Performance with ENERGY STAR   | Residential Sector     |
| Innovative Opportunities: Residential   | Residential Sector     |

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projections should not be used for any other purpose.

**Table 1: New York Energy \$mart<sup>SM</sup> Program Initiatives**

| <b>Program Category/Name</b>   | <b>Customer Sector</b> |
|--|------------------------|
| <b><i>Technical Assistance Programs</i></b>  |                        |
| Technical Assistance (Energy Feasibility Studies, Energy Operations Management, and Rate Analysis and Aggregation) | C/I Sector             |
| Energy Audit Pilot   | C/I Sector             |
| FlexTech   | C/I Sector             |
| Cooling Recommissioning Program  | C/I Sector             |
| Residential Comprehensive Energy management Services   | Residential Sector     |
| <b><i>Low-Income Energy Affordability Programs</i></b>   |                        |
| Low-Income Direct Installation   | Residential Sector     |
| Low-Income Aggregation   | Residential Sector     |
| Technical Assistance for Publicly-Assisted Housing   | Residential Sector     |
| Affordable Assisted Housing  | Residential Sector     |
| Low-Income Public Awareness  | Residential Sector     |
| <b><i>Research and Development Programs</i></b>  |                        |
| New York State Wind Power Plant Demonstration  | Non Sector-Specific    |
| Wind Prospecting Program   | Non Sector-Specific    |
| Residential Photovoltaics  | Residential Sector     |
| Photovoltaics on Buildings   | C/I Sector             |
| High Value Photovoltaics and Wind  | Non Sector-Specific    |
| Willow Plantation Development  | Non Sector-Specific    |
| Environmental Monitoring, Evaluation and Protection  | Non Sector-Specific    |
| Energy Efficiency and Strategic R&D  | Non Sector-Specific    |
| Static Inverter Test Procedure Demonstration   | Non Sector-Specific    |
| New York State Environmental Disclosure  | Non Sector-Specific    |

As a first step in the benefit-cost analysis, each NYSERDA project summary was carefully reviewed along with other available program materials (*i.e.*, PON and RFP information, program marketing and application pieces, savings methodology review write-ups) to identify all specific measures, products and services being delivered or promoted within each program. In total, 229 potential individual measures, products and/or service items were identified. The nature of each of these items was then assessed to

determine their ability to be characterized as a quantifiable measure (*i.e.*, where a kWh, kW, measure life, incremental cost value could be directly applied). Through this process, the list of 229 items was reduced to a group of 70 quantifiable measures or measure bundles. Efforts were then undertaken to collect and document key data for each measure/bundle and, at the program level, each **New York Energy \$mart<sup>SM</sup>** initiative was reviewed to identify reasonable modeling approaches for calculating benefit-cost ratios (see Step 2 below).

## **Step 2 - Data Collection/Documentation (Measure and Program-Specific Modeling Assumptions)**

In this step, measure-and-program specific information was collected for each individual measure and **New York Energy \$mart<sup>SM</sup>** initiative identified in Step 1. Key measure-specific data items included:

- Annual energy savings estimates (and seasonal allocations of savings where applicable);
- Peak load reduction/capacity savings estimates (and seasonal allocations where available);
- Average measure lives;
- Incremental cost (combined capital, installation, and any estimated operations and management costs) of premium efficient measure vs. cost for standard efficient practice; and
- Other resource benefits (*i.e.*, water, fuel), where appropriate.

At the program level, in addition to these items, the costs for implementing each initiative was included (*i.e.*, marketing, administration, third party contractor payments, rebates), along with estimates for market penetration expected to occur within the programs themselves. Market effects, resulting from the programs beyond those occurring within the programs, were also estimated where necessary.<sup>4</sup>

A comprehensive listing of all measures analyzed, including measure-specific model input assumptions will be provided in the **New York Energy \$mart<sup>SM</sup>** Program Cost-Effectiveness Assessment Report. This report will also present a similar listing of input assumptions for each of the **New York Energy \$mart<sup>SM</sup>** program initiatives modeled. Documentation supporting all key assumptions will be included within comment fields in the actual measure and program spreadsheets. The following hierarchy was used when developing and documenting input assumptions:

- NYSERDA-specific data sources (savings methodology reviews, data tracking reports, program-specific information and estimates);
- Regional estimates from publicly available/documented sources (recent utility and agency filings)
- Other secondary sources (ACEEE reports, governmental studies, published papers, and presentations); and,

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<sup>4</sup> Attempts to estimate market effects were only undertaken in cases where program B/C ratios would otherwise fall below 1.0.

- Conservative expert opinion (GDS Associates, Inc. and NYSERDA Energy Analysis Group estimates) based on generally accepted engineering principles and/or extrapolations from other reliable sources.

### Step 3 - B/C Model Development

When developing benefit-cost models for this report, two separate approaches were utilized (one for calculating measure-specific B/C ratios and a second for determining ratios at the program level). Each of these approaches is described briefly below.

At the measure level, a simple spreadsheet model was developed for use in calculating B/C ratios. For each measure, functionality was designed into the spreadsheet to quantify benefits by multiplying the annual energy and capacity savings values over their identified measure life, times the cumulative net present value of a statewide estimate of avoided energy and capacity costs over the same measure life time period<sup>5</sup> (refer to Step 4 for information on how avoided costs were estimated). Any other benefits were quantified (in year 2001 dollars) and added to the energy dollars saved to make up the numerator in the B/C ratio. Costs (also in year 2001 dollars) were taken directly from the incremental cost data documented for each measure and were used in the denominator of the B/C ratio equation. A simple formula, as shown below, was then written to calculate a B/C ratio for each measure:

$$B / C \text{ Ratio} = \frac{(\text{CNPV}) \text{ Benefits}}{(\text{CNPV}) \text{ Costs}}$$

A slightly more complex model (also a spreadsheet tool) was developed, incorporating additional functionality to calculate B/C ratios at the program level.<sup>6</sup> Consistent with State requirements, the Total Resource Cost (TRC) test was used for calculating B/C's at the program level. Key input assumptions used in the TRC test are listed in Table 2 below. In general, the benefit categories included electric system benefits and other measurable benefits

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<sup>5</sup> When calculating cumulative net present values (CNPV) a real discount rate of 4% was used (based on earlier NYSERDA screening model assumptions). An inflation rate of 2.6% was also used. In the model, CNPVs for avoided energy and capacity costs were calculated from measure lives ranging from 1 year to 30 years. At the measure level, the appropriate CNPV was applied to each unique measure to ensure that the value of savings from that measure was accurately captured over the entire life of that measure (*i.e.*, for an HVAC measure with a 15-year measure life the 15-year CNPV energy and capacity value was used). Similarly at the program-level CNPVs corresponding to the weighted average (by kWh contribution) measure life of all measures delivered within that particular program was used to determine the value of savings from that program.

<sup>6</sup> As a starting point in development of the total resource cost (TRC) benefit/cost screening model for this report, two publically available models were reviewed (Fitchburg Gas and Electric Light Company's TRC screening tool and the NStar model) and enhanced and updated to reflect NYSERDA-specific assumptions relating to program costs and benefits, discount rates, avoided electric and gas costs, etc. Both of these models were filed and approved as part of FG&E and NStar's individual utility Energy Efficiency Plans earlier in 2001.

(for example, participant resource benefits, participant non-resource benefits and benefits due to measurable market effects - where necessary and quantifiable). Where applicable, the benefit-cost analyses include assumptions about monetized savings beyond electric energy and capacity savings (such as savings in operation and maintenance costs). The resulting benefit-cost ratios do not include a full range of participant non-resource benefits because such benefits could not be identified and quantified. If additional benefits could be identified, program benefit-cost ratios would be higher.<sup>7</sup> Costs used in the TRC test for all programs studied in this report include all program administration costs and program participant costs.

**Table 2: Components of Total Resource Cost (TRC) Test**

| Benefit/Cost Test Components:  | Total Resource Test (TRT) |
|--|---------------------------|
| <b>BENEFITS</b>  |                           |
| Avoided Electric Energy and Capacity Costs – From Direct Program Participation | ✓                         |
| Avoided Electric Energy and Capacity Costs – From any Estimated Market Effects | ✓                         |
| Other Avoided Costs (Water, Fuel)  | ✓                         |
| Other Non Resource Benefits (where quantifiable)                               | ✓                         |
| <b>COSTS</b>   |                           |
| Program Participant Costs (In program)   | ✓                         |
| Participant Costs due to market effects  | ✓                         |

✓ Signifies that the input assumption was used in the total resource test (TRT).

The following is a brief explanation of how specific items in the TRC model are calculated.

**New York Energy \$mart<sup>SM</sup> Program Savings**

Program Savings Data Annual Energy Savings. Incremental savings from installations in a particular year are calculated by multiplying the total units attributable to the program by the estimated kWh savings per unit. The kWh savings values are based on previous program data as verified through savings methodology reviews where performed, and are savings estimates from similar programs. Cumulative annual program savings are calculated by summing the annual incremental savings each year. However, as measure lives expire, the cumulative program savings decline to reflect that replacement of expired

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<sup>7</sup> The B/C models developed for these analysis’ recognize avoided cost benefits associated with capacity savings from the load reduction elements of the **New York Energy \$mart<sup>SM</sup>** Program initiatives. However, a recent study sponsored by PACE and NAESCO identified the potential for significant additional market effects from load reduction measures (JBS Energy Inc. *Mid-Atlantic States Cost Curve Analysis*. December 5, 2000). The benefit-cost calculations presented in this report do not consider these potential benefits.

measures.<sup>8</sup> Results are presented in kWh.

Peak Demand Savings. Incremental kW reduction from installations in a particular year (winter values) are calculated by multiplying the total incremental savings attributable to the program by the estimated kW winter peak demand factor for each program. Cumulative kW reduction (Winter) is calculated by multiplying the cumulative annual program savings by the estimated kW winter peak demand factor for each program. Similarly, incremental kW reductions from installation in a particular year (Summer) are calculated by multiplying the total savings attributable to the program by the estimated kW summer peak demand factor for each program. Cumulative kW reduction (Summer) is calculated by multiplying the cumulative annual program savings by the estimated kW summer peak demand factor for each program. Results are presented in kW.

Water [or Fuel] Savings. Where applicable, incremental savings values for water [or fuel] are calculated by multiplying the total units attributable to the program by the estimated water [or fuel] savings per unit. Any cumulative annual program savings for water [or fuel] are calculated by summing the annual incremental savings each year. However, as measure lives expire, the cumulative program savings decline to reflect that replacement of expired measures are assumed to be the standard efficiency levels at the time of replacement.

#### **New York Energy \$mart<sup>SM</sup> Program Benefits**

Avoided Electric Supply Costs. These costs were calculated by multiplying the cumulative annual program savings (kWh), by the appropriate avoided electric supply cost value (cents/kWh) using the avoided electric energy and capacity cost forecast discussed in Step 4 below.

Participant Resource Benefits. These benefits account for reduced consumption of oil, water, sewage disposal, and other resources as a result of the implementation of energy efficiency programs and calculated as the product of (a) reduced consumption of oil, water, sewage disposal and other resources, and (b) avoided costs factors for each of these resources. Avoided water [or fuel] costs, where applicable, are calculated by multiplying the cumulative annual water [or fuel] savings by an estimated water [or fuel] cost projection. Price projections for water and fuel are included in the avoided cost numbers derived and discussed in Step 4 below.

Participant Non-Resource Benefits. These benefits are quantified, where applicable, to capture any reduced costs for operation and maintenance associated with efficient equipment or practices; the value of

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<sup>8</sup> Although actual savings will likely degrade over the life of each measure installed, given the “incremental” nature of this analysis, such degradation is expected to be less than would occur with the standard efficiency equipment that otherwise would have been installed, potentially yielding greater incremental savings from each energy-efficient measure over its useful life. As a conservative estimate in this analysis, therefore, no incremental savings degradation was assumed.

longer equipment replacement cycles and/or productivity improvements associated with efficient equipment; reduced environmental and safety costs (*i.e.*, those for changes in a waste stream or disposal); and/or reduced disconnections for inability to pay.

### **New York Energy \$mart<sup>SM</sup> Program Costs**

**NYSERDA Costs.** Direct NYSERDA costs are the sum of all design, administration, marketing, evaluation, customer and contractor rebates, and other costs directly associated with each program. Program administrative costs include: payments to vendors for energy efficient equipment and services; payments to contractors to plan for and install energy efficient equipment; rebates or incentives paid to program participants or vendors for energy efficient equipment and services; costs to check for proper functioning of and maintenance of installed equipment; costs to market energy efficient equipment and services to customers and to seek participation in energy efficiency programs; and NYSERDA costs to develop, plan, deliver, administer, monitor, and evaluate energy efficiency programs.

**Participant Costs.** Participant costs are calculated by multiplying the full incremental measure and installation costs, minus any rebates provided in the program, times the number of measures installed as a result of the program. These costs represent all expenses incurred by program participants in energy efficiency programs including: net cost of the energy efficient equipment (*e.g.*, incremental participant costs); cost to plan for and install the energy efficient equipment; and cost of the energy efficiency services (*i.e.*, inspections for proper equipment functioning). Participant costs may also include in-kind contributions and other documented leveraged funding resulting directly from program implementation efforts.

### **Step 4 - Avoided Cost Estimation**

GDS Associates, Inc., in close cooperation with key NYSERDA staff, developed avoided electric energy and capacity forecasts and natural gas, fuel oil, and water price escalation projections explicitly for the purpose of quantifying the benefits of savings resulting from installing energy efficiency and renewable resource-related measures and services promoted through NYSERDA's **New York Energy \$mart<sup>SM</sup>** program. The following is a brief explanation of the sources and methodologies used to derive key elements of the avoided cost forecast.

### **Avoided Capacity Cost<sup>9</sup>**

Avoided capacity prices were found to vary depending on the capacity need/reserve situation existing in the State over the projected study period. NYSERDA's latest Statewide electricity demand forecast was

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<sup>9</sup> Electricity demand and natural gas price forecasts were provided by NYSERDA to GDS Associates, Inc. as input data into the avoided cost model that was constructed. These data spreadsheets have not been included here, but may serve as appendices to the final report on cost-effectiveness.

used for the period 2001 through 2021, and extrapolated at an average annual growth rate of 0.64% for the period 2022 through 2035. Results, when applied to NYSERDA's forecast (including an 18% minimum reserve requirement) indicated capacity needs for the period 2001 through 2003 and then no additional capacity requirements through 2035.

An Avoided Cost Forecast for the period 2000 and 2001 was constructed using New York Independent System Operator (NYISO) Summer 2000 and 2001 Strip Auction values of \$52.50 per kW-6 month (\$105/kW-year) as a proxy for the market price/avoided cost of electric generation capacity. For the period 2002 through 2004, avoided capacity values were derived based on a value of three times the levelized embedded capital charges for a new gas turbine. Estimated capacity values for the remainder of the study period (2005 through 2035) were based on the NYISO \$52.50/kW-6 month value escalated from 2001 dollars to the proper year at 2.6% per year. Seasonal price variations (summer/winter) were not modeled.

### **Avoided Energy Costs**

Avoided electric energy cost values for the period 2000 through 2006 were estimated for all seasons, summer, winter and swing periods, based on prices included in NYSERDA's forecast. Values for years following 2006 were derived using NYSERDA's 2.6% annual escalation factor multiplied by NYSERDA's natural gas growth rate projections. On-and off-peak allocations were calculated using the seasonal and time period allocation factors provided by NYSERDA.

### **Avoided Water and Fuel Costs**

For water, an average per-gallon cost (2001 dollars) was estimated for a typical New York customer based on discussion with staff at the New York Department of Public Service Water Department.<sup>10</sup> This value was then escalated at 0.5% per year. For fuel oil, the Department of Energy's Energy Information Administration (DOE EIA) World Oil Price forecast (January 2001) was used as the basis for model input. Gas price projections were taken directly from NYSERDA's forecast.

## **Step 5 - B/C Cost Calculation, Data Analysis and Report Development**

As a final step, the two benefit-cost calculation models (discussed above in Step 3) were used to derive ratios at both the measure and program levels. Results were prioritized and rank ordered from highest to lowest ratio, and will be summarized in the formal **New York Energy Smart<sup>SM</sup>** Program Cost-Effectiveness Assessment Report. The results section of this report will provide:

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<sup>10</sup> \$3.75/thousand gallons – Using average annual residential customer public water and sewer cost of \$300 and 80,000 gallons/yr average usage.

- (1) A portfolio-wide B/C ratio for the **New York Energy \$mart<sup>SM</sup>** program and will include residential, commercial/industrial, and renewable/other non sector-specific breakouts;
- (2) B/C ratios for each of the 35 **New York Energy \$mart<sup>SM</sup>** program initiatives, by the same residential, commercial/industrial, and renewable/other non sector-specific groupings; and,
- (3) A prioritized ranking of measure level B/C ratios, by end-use category.