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OFFICE OF
BUILDING TECHNOLOGY
STATE AND COMMUNITY PROGRAMS

Documentation for
FY2003 BTS GPRA Metrics

Building Technology, State and Community Programs
Energy Efficiency and Renewable Energy
U.S. Department of Energy

April 2002

Prepared for Building Technology,
State and Community Programs
by Pacific Northwest National Laboratory

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Executive Summary

Pacific Northwest National Laboratory (PNNL) estimated the fiscal year (FY) 2003 energy, environmental, and financial benefits (i.e., metrics) of the technologies and practices in the U.S. Department of Energy's (DOE's) Office of Building Technology, State and Community Programs (BTS). BTS is part of DOE's Office of Energy Efficiency and Renewable Energy (EE), which uses the estimates of benefits as part of its annual budget request.

This effort is referred to as GPRA Metrics because the Government Performance and Results Act (GPRA) of 1993 mandates such estimates of benefits, which are submitted to EE's Office of Planning, Budget, and Management as part of EE's budget request.

This report includes a series of sections that detail the approach and methodology used to estimate future energy, environmental, and financial benefits produced by technologies and practices supported by BTS in the FY 2003. An overview is describes the GPRA process and the models used to estimate savings. Forecasted benefits for all programs through 2030 are included in tables. The results of the forecasted energy savings, consumer cost savings, and carbon benefits for each of the 18 BTS programs are included in individual program summaries, and overall results of the FY 2003 GPRA efforts are summarized for all BTS programs. Technical appendixes include the FY 2003 GPRA data call and descriptions of the models used, baseline assumptions, and diffusion curve estimates.

Overview

Overview of the FY 2003 GPRA Metrics Process

Pacific Northwest National Laboratory (PNNL) estimated the FY 2003 energy, environmental, and financial benefits (i.e., metrics) of the technologies and practices in the U.S. Department of Energy's (DOE's) Office of Building Technology, State and Community Programs (BTS). BTS falls with DOE's Office of Energy Efficiency and Renewable Energy (EE), which uses the estimates of benefits as part of its annual budget request.

The metrics effort was initiated by EE in 1994 to develop quantitative measures of program benefits and costs. The Government Performance and Results Act (GPRA) of 1993 mandates such estimates of benefits, which are submitted to EE's Office of Planning, Budget, and Management (OPBM) as part of EE's budget request. The supporting analysis and data are used to set strategic goals and objectives within BTS and DOE, to communicate the benefits of EE programs to all interested parties, and to defend the budget before OPMB and Congress.

Estimating the Energy Savings of BTS Programs

Energy savings for the FY 2003 GPRA metrics were based on the FY 2003 budget request and estimated at a program level and then aggregated to the decision unit level. Benefits were estimated for 37 BTS programs or technologies and then rolled up into 17 program groups and then into 7 BTS decision units, as shown in Table 1. BTS's 7 decision units fall into one of two broad areas:

- Building Research and Standards, which develops, implements, and coordinates research and development (R&D) that improves the energy efficiency of building components and then uses system design and regulatory activities to integrate these components into building energy systems.[1]

- Building Technology Assistance, which is responsible for accelerating the adoption of energy efficiency and renewable building technologies through technical and financial assistance to states and local communities.[2]

Several different approaches are required to estimate the benefits of the wide array of BTS programs. This section briefly describes the analytical approaches used to estimate energy savings for BTS's FY 2003 budget request. Greater detail on each BTS program is provided later in this document in program-specific summaries.

The benefits of EE programs and technologies were assessed at an aggregated level as decision units (formerly known as planning units) to simplify cross-sector comparisons and to limit the number of elements being evaluated to a manageable number. Likewise, the benefits were assessed for a limited number of defined metrics:

[1] "BTS Building Research and Standards Mission Statement," FY 2003 Budget Request (internal BTS document).
[2] "BTS Office of Building Technology Assistance Mission Statement," FY 2003 Budget (internal BTS document).

Table 1. Decision Units and Programs Evaluated for the FY 2003 GPRA Metrics

Decision Units	BTS Programs or Technologies	BTS Programs Aggregated for GPRA FY 2003 Metrics
State Energy	• State Formula Grants	• State Formula Grants
Weatherization Assistance	• Weatherization Assistance Program	• Weatherization Assistance Program
Community Energy Program	• Rebuild America • Information Outreach • Training and Assistance for Codes	• Rebuild America • Information Outreach • Training and Assistance for Codes
Energy Star Program	• Energy Star: Clothes Washers • Energy Star: Refrigerators • Energy Star: Electric Water Heaters • Energy Star: Gas Water Heaters • Energy Star: Room Air Conditioner • Energy Star: Compact Fluorescent Lights • Energy Star: Dishwashers	• Energy Star
Residential Buildings Integration	• Residential Technology R&D • Residential Building Codes	• Residential Technology R&D • Residential Building Codes
Commercial Buildings Integration	• Commercial Technology R&D • Commercial Building Codes	• Commercial Technology R&D • Commercial Building Codes
Equipment, Materials, and Tools	• Lighting R&D: Two-Photon Phosphors • Lighting R&D: Solid State Lighting • Lighting R&D: Controls • Refrigeration & Thermal Distribution R&D: Residential HVAC Distribution System • Refrigeration & Thermal Distribution R&D: Advanced Electric Heat Pump Water Heater • Refrigeration & Thermal Distribution R&D: Refrigerant Meter • Refrigeration & Thermal Distribution R&D: Commercial Refrigeration • Emerging Technologies R&D: Heat Pump Water Heater • Emerging Technologies R&D: Roof Top Air Conditioning • Emerging Technologies R&D: Gas Condensing Water Heater • Emerging Tech R&D: Recessed Can Lights • Emerging Tech R&D: R-Lamps • Building Envelope R&D: Electrochromic Windows • Building Envelope R&D: Superwindows • Building Envelope R&D: Quick-Fill Walls • Building Envelope R&D: R30 Insulation/30 Year Life Roofs • Building Envelope R&D: Moisture/Wet Insulation • Design Strategies and Assistance • Lighting and Appliance Standards: Residential Gas Furnaces/Boilers • Lighting and Appliance Standards: EPAct Standards • Lighting and Appliance Standards: Distribution Transformers	• Lighting R&D • Refrigeration and Thermal Distribution R&D • Emerging Technologies R&D • Building Envelope R&D: Windows • Building Envelope R&D: Thermal Insulation and Building Materials • Design Strategies and Assistance • Lighting and Appliance Standards

- energy savings
- environmental benefits
- economic/financial metrics.

Environmental and economic benefits (energy cost savings) were keyed directly to energy savings. Therefore, the balance of this overview focuses on just the energy-savings' estimates.

For most BTS programs, estimates were broken out by building sector, building type, region, vintage, end use, fuel type, and type of equipment displaced and then aggregated to obtain the program or technology benefits. The program and decision unit structure used reflected the structure used in the FY 2003 budget request. The analysis considered program goals, technology characteristics (including performance and cost), the targeted market, and program milestones. The technologies and practices modeled were chosen as representing a specific program. Not all activities funded by BTS are modeled; activities were selected if they met some minimal threshold of funding and are likely to result in measurable energy savings.

The program characteristics were developed through extensive interaction with the BTS Office Directors and Program Managers. For FY 2003, program characterization summaries were based on information gathered during interviews conducted in August 2001. The program characterizations were then reviewed and revised during meetings with BTS Program Managers. The program characterizations presented in subsequent sections of this document represent the results of those interviews.

Analysis Changes for FY 2003 GPRA

Before EE released the FY 2003 GPRA data call, the National Research Council issued a report entitled *Energy Research at DOE: Was It Worth It?* The report assessed the outcomes of energy efficiency and fossil energy research from 1978 to 2000. One of the report's recommendations to consider for assessing research development and deployment programs was that "DOE should adopt an analytic framework similar to that used by this committee as a uniform methodology for assessing the benefits and costs of its R&D programs. DOE should also use this type of analytic framework of this sort in reporting to Congress under GPRA."

The National Research Council report assumed that the private sector would have developed the technology in the absence of DOE five years after DOE realized the benefits. As part of the GPRA data call, EE asked the sectors to consider what would have happened in the absence of the EE program and to identify benefits relating only to EE's effort.

This change was implemented within the BTS estimates by determining BTS programs that act as acceleration-to-market programs versus those that would not have been developed or implemented in the absence of government funding. Further detail as to how this was implemented at the program level is contained in the "Detailed Results" section of this document, and is referred to as the National Academy of Sciences or "NAS methodology."

Modeling Methods Used in Estimating Benefits

The BTS GPRA estimates of benefits were calculated using one of three methods:

- National Energy Modeling System (NEMS)
- Building Energy Savings Estimation Tool (BESET)
- Spreadsheets designed for a specific program.

NEMS can link the costs and benefit characteristics of a technology and its market penetration. However, NEMS has difficulty representing some BTS technologies, such as the whole-building programs because NEMS is designed to model specific technologies and not variable groups of technologies.

BESET was built specifically for estimating the benefits of BTS programs and therefore allows various types of programs to be characterized, including whole-building, envelope, and equipment programs. The major disadvantage of BESET is that the penetration rates (i.e., fraction of sales or fraction of installed base) are determined outside the model and therefore are not explicitly linked to the program's cost and benefit characteristics. In addition, BESET cannot model BTS equipment that competes against more than one baseline equipment type.

For programs that are not easily modeled in BESET or NEMS, spreadsheets were used. For example, because BTS's codes and standards programs have already developed its own set of spreadsheet tools for estimating impacts of the building codes programs, these tools were adapted for the GPRA estimation process. Each of the three methods used for deriving energy-saving estimates for the FY 2002 GPRA metrics is described in more detail in the following subsections.

NEMS

Many of BTS's technology programs were modeled using NEMS. The commercial and residential energy demand modules within NEMS were used to calculate the savings generated by the improved BTS technologies. Energy savings in equipment programs were calculated by comparing new equipment efficiencies with baseline efficiencies.[3]

The NEMS commercial and residential demand modules generate forecasts of energy demand (energy consumption) for those sectors. The commercial demand module generates fuel consumption forecasts for electricity, natural gas, and distillate fuel oil. These forecasts are based on energy prices and macroeconomic variables from the NEMS system, combined with external data sources. The residential model uses energy prices and macroeconomic indicators to generate energy consumption by fuel type and census division in the residential sector.

NEMS selects specific technologies to meet the energy services demands by choosing among a discrete set of technologies that are exogenously characterized by commercial availability,

[3] For the FY 2003 metrics, the NEMS model associated with the Energy Information Administration's *Annual Energy Outlook 2000* was used.

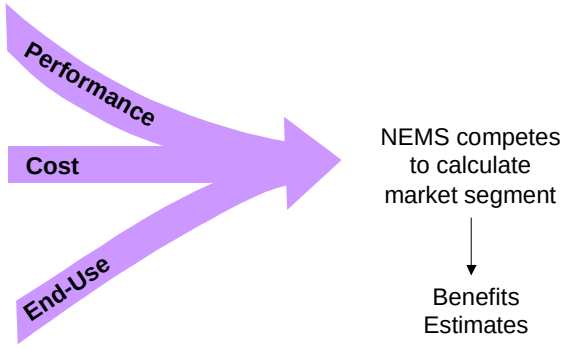

Figure 1. Developing the Market Segment (NEMS)

capital costs, operating and maintenance costs, efficiencies, and lifetime (see Figure 1). NEMS is coded to allow several possible assumptions to be used about consumer behavior to model this selection process. For the GPRA effort, the menu of equipment was changed to include relevant BTS program equipment, technological innovations, and standards.

The NEMS design can accommodate various technology choices. For the GPRA FY 2003 metrics, the NEMS data input was adjusted to reflect BTS technology choices. For BTS programs that target shell efficiency, specific shell-efficiency indices were read into the model.

BESET

BESET is a bottom-up accounting model that compares baseline energy use against the BTS technology. BESET also is used to centrally collect, store, and report all results produced by all the various estimation methods. Finally, BESET produces the input files needed for estimating employment impacts developed in a separate modeling environment.

BESET can estimate benefits for various programs: whole building, envelope, lighting, HVAC, cogeneration, and water heating. BESET also contains a "tax" algorithm that calculates the average energy savings per budget dollar for the BTS portfolio so the energy savings can be applied to an umbrella program. Beginning with the FY 2001 GPRA effort, BESET was primarily used to model BTS programs that target whole-building energy use. Although BESET can model equipment and envelope programs, NEMS estimates those programs.

To determine energy savings for specific BTS programs, BESET requires information in the following areas:

- **Program Performance Goals.** The goals of each program are assessed in terms of energy savings (e.g., percent load reductions and equipment efficiency improvements) and used as inputs to BESET.

- **Target Market.** Target markets are defined in terms of building sector (e.g. residential and commercial), building type (e.g. single family and commercial education), size (commercial only), income level (residential only), vintage (e.g., new or existing), and climate zone or region. Using the Rebuild America program as an example, Figure 2 illustrates the process used to define the program's targeted market segment within BESET.

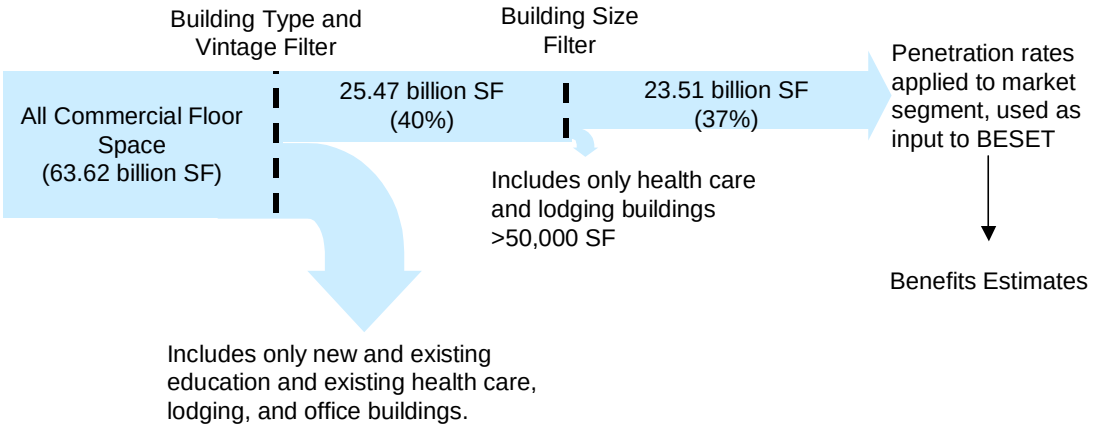

Figure 2. Developing the Market Segment (NEMS): Rebuild America Example

Once the target market has been identified, the penetration into that market is determined using technology diffusion curves (discussed later in this section). Within BESET, market penetration is defined as either the fraction of sales for equipment for new buildings or the fraction of installed base for existing buildings. The penetration model requires only the year of introduction into the market, an estimate of market penetration in 2020 (provided by BTS Program Managers), and the selection of the most appropriate diffusion curve category.

- **Private Investment (Cost).** Estimates of private investment for both the baseline and the BTS technology or practice are entered into BESET. Ideally, the investment costs would be considered when market penetration is developed; however, the current diffusion model used does not incorporate costs at this time. In addition to private investment, non-energy savings program benefits are also quantified when possible and entered into BESET.

The basic steps involved in calculating the energy savings for whole-building programs modeled in BESET are as follows:

1. Determine the size of the potential market.
2. Determine the number of units affected by the BTS program.
3. Determine the base space conditioning, water heating and other end-use loads if appropriate.
4. Determine the space conditioning and water heating end-use loads after the program is implemented.
5. Calculate the energy savings.

All estimates were aggregated through a BESET-NEMS interface. BESET contains a report generator that aggregates the program and technology level benefits into the decision units. The aggregated information is submitted to OPBM to include in the GPRA metrics effort for all EE sectors.

Spreadsheet Models

Whenever possible, programs were modeled within NEMS or BESET to help ensure consistency in baseline inputs and methodology. However, several BTS programs were modeled in spreadsheets because of their unique characteristics. The estimated savings generated by the spreadsheet models were entered by fuel type into "fixed" tables within BESET so that the environmental and energy cost-savings' benefits can be calculated using the same data set as the other programs. Spreadsheets were used to model the following programs:

- **State Formula Grants.** This program was modeled based on historical information that provides an estimated level of savings per program dollar. Because neither BESET nor NEMS are designed for this type of analysis, the program continued to be modeled in a separate spreadsheet.

- **Weatherization Assistance Program.** This program was modeled based on program studies that provide per-household savings' estimates. While these inputs may be able to be translated into load reductions and the program run through BESET, such an effort has not been undertaken. The primary barrier to incorporating this program into BESET is that fuel mix for houses in the target market is significantly different between the BESET baseline and historical Weatherization program data.

- **Information Outreach.** The estimates for the FY 2003 request and appropriation were adopted directly from a study commissioned by BTS (Messersmith and Azimi 2000).

- **Building Codes.** Building code activities are spread among three BTS decision units. However, because of the interrelationships between the three, savings were estimated for the building codes and standards as a whole. Savings estimates were then allocated among the three primary funding sources:

  – Training and Assistance for Codes (within the Community Energy Program decision unit)
  – Residential Building Energy Codes (within Residential Buildings Integration decision unit)
  – Commercial Building Energy Codes (within Commercial Buildings Integration decision unit).

  The long-term impact of DOE's assistance to code activities is based largely on data developed for internal use in building codes and standards. DOE provides a high level of support for states seeking to adopt new energy codes, either based on ASHRAE Standard 90.1 or the International Energy Conservation Code (IECC) (previously the Model Energy Code). Several states have self-developed codes that are not supported by building codes and standards and are not counted in the estimates of program impact.

- **Refrigeration and Thermal Distribution R&D.** The refrigeration savings' estimates were based on a report on end-use consumption produced by PNNL, program goals, and other various data sources (Belzer and Wrench 1997). Energy-savings estimates were developed in a spreadsheet model because commercial refrigeration is a service, not a specific piece of equipment, and therefore cannot be modeled in NEMS or BESET.

- **Lighting and Appliance Standards: EPAct Standards and Distribution Transformers.** For FY 2003, the energy savings from Energy Policy Act of 1992 (EPAct) standards were based on a spreadsheet developed by PNNL specifically to support an EPAct screening analysis conducted in late 1999 and early 2000. Because distribution transformers are part of the electricity distribution system, not the building system, transformers cannot be modeled in either NEMS or BESET. Saving estimates were based on a study by Geller and Nadel (1992).

Baseline Inputs

To the extent possible, the underlying assumptions about building stock forecasts, equipment efficiencies, market shares, and end-use loads were consistent across tools (i.e., NEMS, BESET, and spreadsheets). This consistency was accomplished by drawing most of the baseline characterization data from the Energy Information Administration (EIA), a statistical agency within DOE. For example, the same version of NEMS used in this document was used to produce EIA's *Annual Energy Outlook*.

For programs modeled in NEMS, consistency is ensured not only across these programs but also with EIA forecasts. BESET also has a baseline characterization, which is drawn from NEMS, EIA's *Annual Energy Outlook*, the "Residential Energy Consumption Survey," and the "Commercial Buildings Energy Consumption Survey." The consistency of the baseline assumptions of the spreadsheet tools is verified against EIA's data.

Budget Adjustment Process

The program characterizations that are key to the benefits' estimates were developed through close interaction with the BTS Program Managers. The characterizations require the Program Manager to make assumptions based on the requested level of funding and then describe what would be accomplished at that level. However, the budget request amount sometimes changes between the time the characterization is developed and the time the benefits estimates are required. Changes also occur between the final budget request (on which the final estimates are based) and the actual allocation (for which benefits estimates have also been developed to assist in planning).

For small changes in budget levels, a basic "budget adjustment" is made to the program estimates. It is assumed that to get to X savings, a total of Y budget must be spent, where Y is the cumulative budget. A change in the annual budget results in a change in the cumulative budget. Revised savings are calculated for each year as old savings in year z (new cumulative budget in year z/old cumulative budget in year z). This adjustment mechanism implicitly suggests that either the fraction of expected sales or the performance of the program has changed but does not explicitly tie the change to one factor or the other.

For larger changes, the program inputs are revisited with the BTS Program Managers to determine the impact of a reduced (or increased) budget. Options include changing the year of market introduction, changing the impact on sales (market penetration), modifying the performance objective, and adding or removing tasks or technologies within the program (e.g.,

increased funding in Energy Star may result in developing an Energy Star rating for an additional technology).

Technology Diffusion Curves

In 1998, a study was conducted by David Belzer, PNNL, to examine the historical market penetration (i.e., diffusion) for 10 energy-efficient products related to the building sector. Diffusion models were estimated for each product based on the specification proposed by Frank Bass in the late 1960s. The resulting models were incorporated into the GPRA metrics analysis for many of the programs and technologies not modeled within the NEMS framework. The model development and empirical analysis were designed to generate more credible predictions of the adoption process of important energy-efficiency technologies in the buildings sector.

The technologies were placed into four separate categories: lighting, HVAC and refrigeration (HVAC/R), envelope, and design. Two additional categories were added: 1) "Other Equipment" represents an average of lighting and HVAC/refrigeration technologies and 2) "Other Program" represents the envelope category. See Appendix C for a summary of this study.

Contents of this Document

The remainder of this report consists of 18 program descriptions, summarizing information about program's objective, long-term goals, and market and its savings in terms of primary energy savings, carbon equivalent reductions, and consumer cost savings.
Four appendixes provide more detailed information on topics covered in this document. Appendix A details the baseline scenario and inputs used for the FY 2003 metrics. Appendix B contains the GPRA Data Call for FY 2003. Appendix C provides more detailed information on the development of the technology diffusion curves. Appendix D provides detail on the GPRA methodology.

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Data Bucket Report for Appliances and Emerging Technology Program
Data Bucket Report for Building Envelope: Thermal Insulation and Building Materials Program
Data Bucket Report for Building Envelope: Windows Program
Data Bucket Report for Commercial Building Codes Program
Data Bucket Report for Commercial Building Integration R&D Program
Data Bucket Report for Energy Star Program
Data Bucket Report for Information Outreach Program
Data Bucket Report for Lighting and Appliance Standards Program
Data Bucket Report for Lighting R&D Program
Data Bucket Report for Rebuild America Program
Data Bucket Report for Residential Building Integration R&D Program
Data Bucket Report for Space Conditioning and Refrigeration: Refrigeration Program
Data Bucket Report for State Formula Grants Program
Data Bucket Report for Technology Roadmaps and New and Innovative R&D
Data Bucket Report for Weatherization Assistance Program
Data Bucket Report for Residential Building Codes Program

List of Terms

BESET	Building Energy Savings Estimation Tool
BTS	Office of Building Technology, State and Community Programs
COP	coefficient of performance
DOE	U.S. Department of Energy
EE	DOE's Office of Energy Efficiency and Renewable Energy
EER	energy efficiency ratio
EIA	Energy Information Administration
EPAct	Energy Policy Act of 1992
EREC	Energy Efficiency and Renewable Energy Clearinghouse
GPRA	Government Performance and Results Act of 1993
IEEC	International Energy Conservation Code
NEMS	National Energy Modeling System
OPBM	Office of Planning, Budget, and Management
ORNL	Oak Ridge National Laboratory
PNNL	Pacific Northwest National Laboratory
R&D	research and development
SEER	seasonal energy efficiency ratio
SEP	State Energy Program

Summary of Results

Summary of Results:
BTS Primary Energy Savings Forecasts Based on FY 2003 BTS Budget Request

The results of the forecasted energy savings, consumer cost savings, and carbon benefits for each of the 17 BTS programs (for 2003, 2010, and 2020) are included in the program summaries in this document. The next section in this document contains tables with forecasted benefits up to the year 2030 for all programs and decision units. The following benefit estimates are included:

- Energy Savings Benefits Tables (TBtu/yr)
  - Total Primary Energy Savings
  - Primary Electricity savings
  - Primary Non-Electric Savings
  - Site Electricity Savings
  - Site Natural Gas Savings
  - Site Oil Savings

- Environmental Benefits Tables (million metric tons per year [MMT/yr])
  - Carbon Equivalent Emissions Reductions
  - SO_2 Emissions Reductions
  - NO_X Emissions Reductions
  - CO Emissions Reductions
  - PM Emissions Reductions
  - VOC Emissions Reductions

- Financial Benefits Tables (million $/yr)
  - Consumer Cost Savings
  - Non-Energy Cost Savings.

Energy Savings Analysis by Decision Unit

Decision unit benefits are reported annually. The energy savings' estimates for 2010 represent energy saved in 2010 only. These are not cumulative benefits estimates. However, the energy savings in 2010 are a function of all program activities from FY 2003 on, so the number of affected buildings is a cumulative value. For example, the energy saved in 2010 from the compact fluorescent lights programs is the energy saved in 2010 only from all buildings that have had such lights installed any time between FY 2003 and FY 2010.

Table 1 summarizes the primary energy savings, the carbon equivalent reductions, and the consumer cost savings for the seven BTS decision units. Total primary energy savings for all BTS programs are estimated to reach 0.9 quadrillion Btu (QBtu) by year 2010 and 2.8 QBtu by year 2020. Figure 1 charts annual energy savings for all programs for all years from FY 2003 to 2020. Roughly half of the savings are generated in the residential sector and half in the commercial sector.

Table 1. Summary of Benefits: Analyses of BTS Programs

Decision Unit	FY 2003 Budget Request (million $)	2003	2005	2010	2020
Primary Energy Savings (TBtu/yr)					
State Energy Program	39	3.9	11.5	27.7	47.7
Weatherization Assistance Program	277	8.4	33.4	65.7	122.5
Community Energy Program	20	44.1	122.4	201.5	353.0
Energy Star Program	6	15.2	41.1	169.0	568.1
Residential Buildings Integration	13	0.2	0.9	12.2	74.0
Commercial Buildings Integration	5	1.0	4.0	41.5	238.8
Building Equipment and Materials	30	12.4	59.3	367.5	1359.3
Totals		85.2	264.6	885.1	2763.3
Carbon Equivalent Emission Reductions (MMT/yr)					
State Energy Program	39	0.1	0.2	0.5	0.9
Weatherization Assistance Program	277	0.1	0.4	1.1	2.0
Community Energy Program	20	0.8	2.2	3.9	6.6
Energy Star Program	6	0.3	0.7	3.4	10.9
Residential Buildings Integration	13	0.0	0.0	0.2	1.2
Commercial Buildings Integration	5	0.0	0.1	0.8	4.4
Building Equipment and Materials	30	0.2	1.1	7.1	24.9
Totals		1.5	4.7	17.0	51.0
Consumer Cost Savings (million $/yr)					
State Energy Program	39	24.0	70.0	177.0	345.0
Weatherization Assistance Program	277	59.0	175.0	469.0	917.0
Community Energy Program	20	281.0	756.0	1344.0	2723.0
Energy Star Program	6	107.0	288.0	1375.0	5373.0
Residential Buildings Integration	13	1.0	6.0	89.0	575.0
Commercial Buildings Integration	5	6.0	25.0	275.0	1820.0
Building Equipment and Materials	30	84.0	395.0	2612.0	10792.0
Totals		563.0	1716.0	6342.0	22545.0

Figure 2 compares the BTS program primary energy savings projections with EIA's *Annual Energy Outlook* building energy consumption forecasts. The FY 2003 estimates include only savings for programs that are included in the FY 2003 BTS funding request. Some activities funded in previous years may contribute to total BTS future energy savings but are *not* in the FY 2003 request. For example, a program that supports a rulemaking that is completed in FY 2002 would not be included in the FY 2003 request; however, this program would produce energy savings in future years.

Figure 2 shows savings for FY 2003 programs as well as for programs that have been retired since FY 2000 but have future energy savings. The BTS program savings projections are charted relative to the building energy consumption forecasts generated by the *Annual Energy Outlook 2001*. Figure 2 shows that if the forecasted savings generated by BTS programs are subtracted from forecasted total building energy use, total primary building energy use remains relatively flat through 2020.

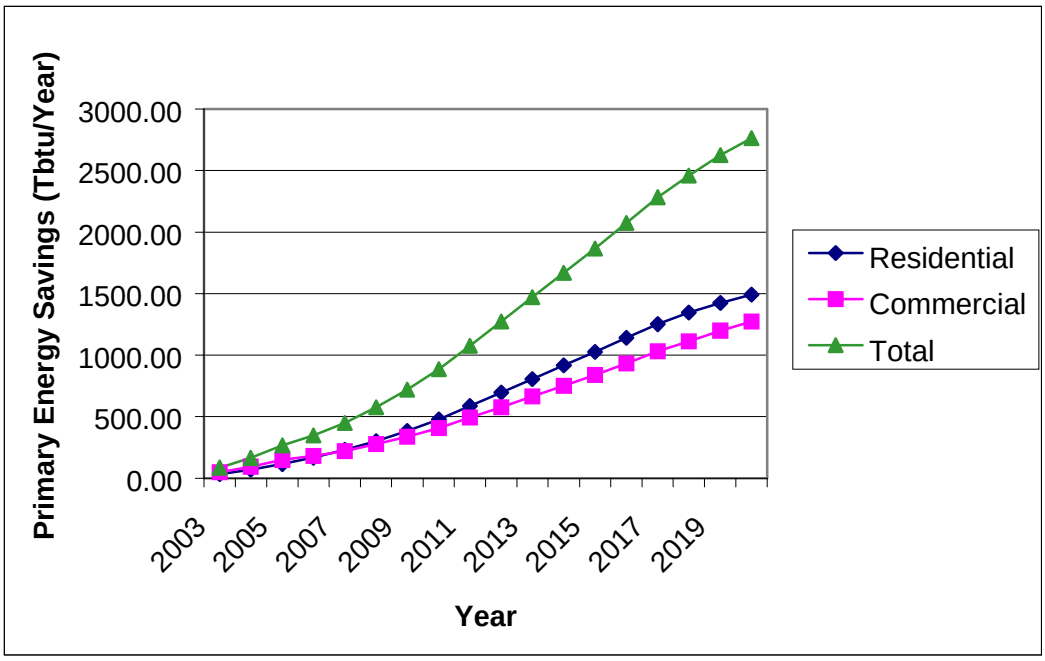

Figure 1. BTS Program Primary Energy Savings by Sector Through FY 2020

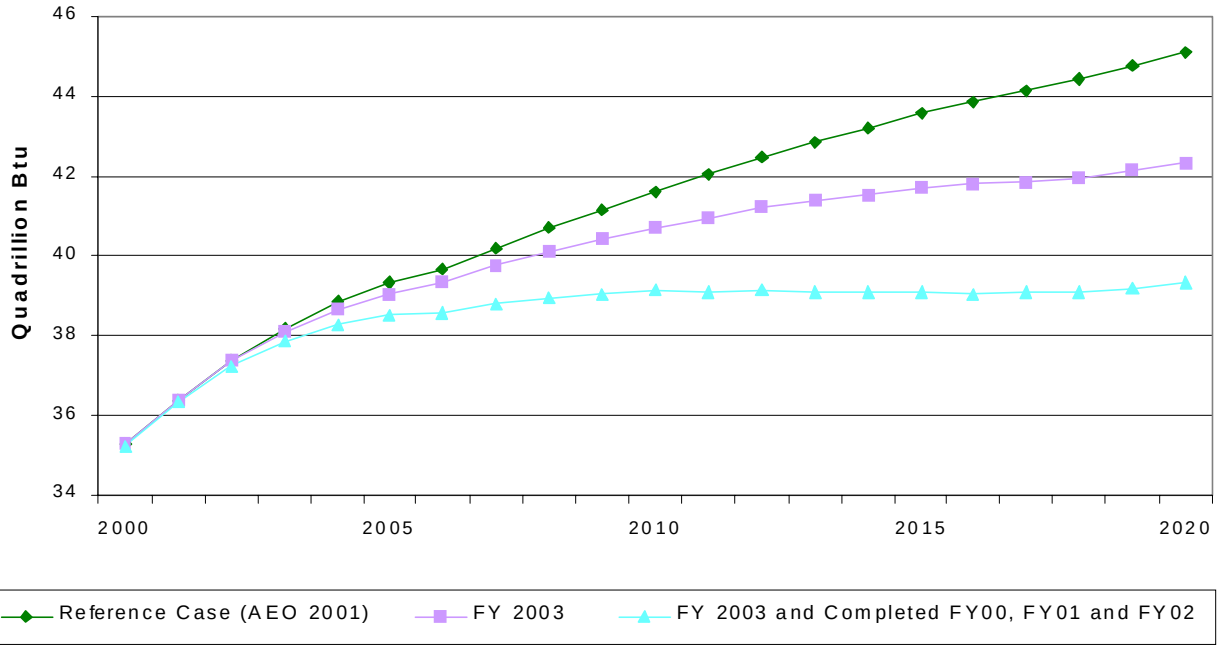

Figure 2. Building Energy Consumption with and without BTS Savings

Of all BTS energy savings (in year 2020), programs included in the Building Equipment and Materials decision unit generate 50% of the total savings (see Figure 3). This decision unit targets efficiency improvements for specific heating, cooling, and lighting equipment as well as shell (e.g., windows, roofs, and insulation) efficiency improvements, including standards that impact specific equipment. Building Equipment and Materials makes up about 8% of the overall BTS program FY 2003 budget.

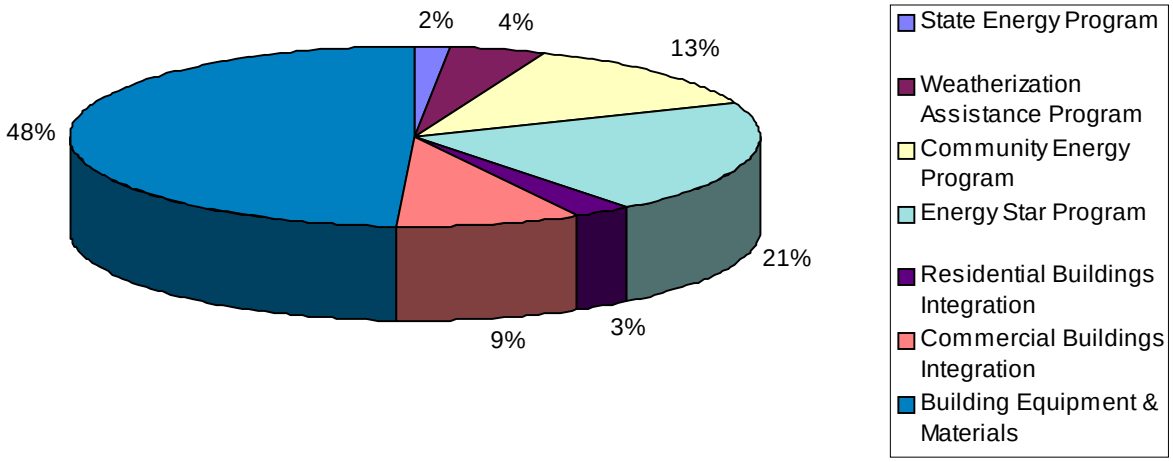

Figure 3. Primary Energy Savings by Decision Unit (for 2020)

Energy Star makes up about 20% of the total savings while accounting for just under 2% of the total budget request. Programs that support the Community Energy Program make up an additional 13% of the overall BTS savings (in year 2020). Community Energy Programs include a combination of programs that target whole-building energy use primarily by providing outreach, education, training and tools, and partnership assistance. Community Energy Programs make up 5% of the overall BTS FY 2003 budget.

In terms of energy savings per budget dollar, the building codes programs and Energy Star have relatively high ratios of savings to budget dollar. The building codes programs benefit from having high penetration rates because these standards become regulatory mandates when adopted by states. Energy Star focuses on market transformation through labeling and requires relatively few dollars to implement compared with programs that provide R&D or technical assistance. Programs such as Weatherization Assistance and State Energy programs tend to have relatively low ratios of savings to budget dollar because these programs provide grants and assistance directly to states and households. Figure 4 charts the FY 2003 budget dollars and the energy savings in 2020 of each decision unit.

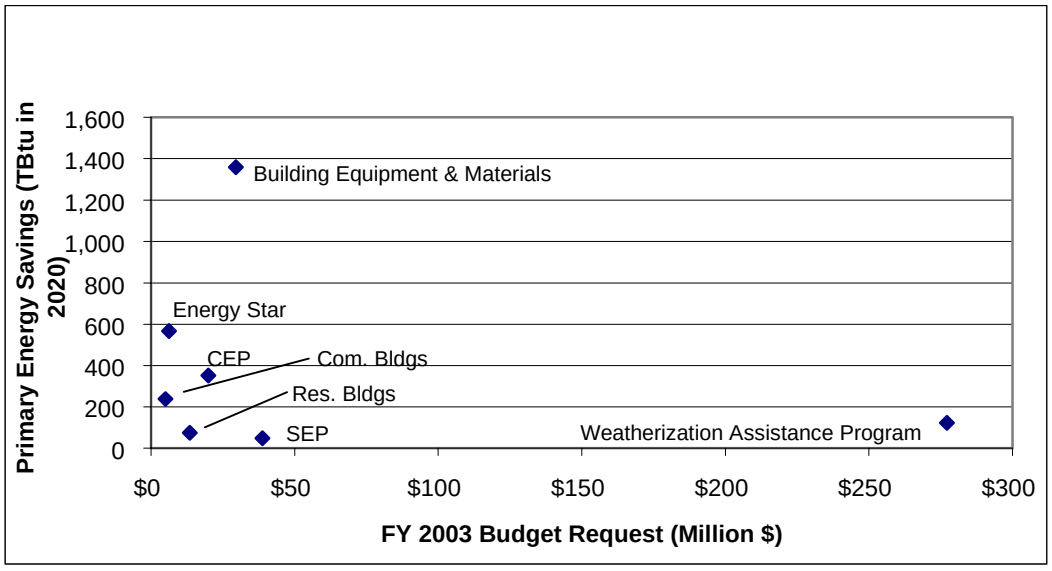

Figure 4. Budget and Energy Savings' Scatter Plot for BTS Decision Units

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