

DEPARTMENT OF ENERGY
FY 2001 CONGRESSIONAL BUDGET REQUEST
ENERGY EFFICIENCY AND RENEWABLE ENERGY
ENERGY CONSERVATION

(Tabular Dollars in Thousands, Narrative in Whole Dollars)

BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR

PROGRAM MISSION

Mission

In partnership with industry and government, the Office of Building Technology, State and Community Programs (BTS) develops, promotes, and integrates energy technologies and practices to make buildings more efficient and affordable and communities more livable. Accomplishing this mission through a variety of innovative programs that leverage non-Federal resources and expertise will save tens of billions of dollars, create new jobs, and lower the emission of air pollutants, including greenhouse gas emissions.

BTS programs support the Department's strategic goals of improving the efficiency of energy systems, promoting energy use in ways that respect health and the environment, and expanding future energy choices.

Situation

Homes and commercial buildings consume more than 34 quadrillion Btu annually, or 36 percent of the Nation's energy, as well as two-thirds of all electricity generated. The growth of the Nation's population and a high performance economy is leading to more, larger and better equipped homes, resulting in increasing energy consumption in this sector. The energy, primarily fossil energy based electricity, that is consumed in buildings represents a major source of acid rain, smog, and greenhouse gas emissions.

The introduction of new technology to increase energy efficiency can have significant economic and environmental benefits. Specifically, Federal investments in five major areas: building design software, electronic fluorescent lamp ballasts, low emissivity windows, advanced oil burners, and efficient refrigerator compressors throughout

Competitive R&D

A smarter way to building energy efficiency

As part of its new way of doing business, BTS has awarded \$8.3 million in grants to fund promising building efficiency R&D projects. The 19 grant recipients are contributing an additional \$3.3 million in industry cost share. These competitive grants help implement BTS' road-mapping activities and support development of innovative technologies. One new, small-business partner proposes to develop an energy-efficient and durable solid-state ceramic lamp, a flat panel light source which can save energy in a wide variety of applications. Another partner proposes to develop a new dehumidification system that uses electrically-charged polymeric desiccant gels. Another small business partner proposes to develop a system that places heating and cooling air ducts inside a wall-to-ceiling cornice, saving energy while maintaining the aesthetic appeal. From electricity-producing fuel cells, to operationally-dynamic window and wall systems, to heat pump water heaters, these projects have the potential to improve the efficiency of buildings, creating cleaner, more livable communities.

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the 1970s and 1980s have resulted in present value savings in the U.S. economy totaling nearly \$33 billion through 1997, while simultaneously eliminating more than 60 million metric tons of cumulative carbon emissions.

Energy Use in the Building Sector

In 1997, Americans spent roughly \$238 billion to heat, cool, light and run equipment and appliances in the Nation's buildings. Projections indicate that more than 16 million new households and 19 billion square feet of commercial buildings will be constructed in the United States by 2010. Even if the energy intensity of buildings remains constant, as more buildings are constructed, energy consumption and associated economic and environmental costs will continue to escalate.

Environmental Impact of the Building Energy Use

The energy, primarily fossil energy based electricity, that is consumed in buildings results in 47 percent of U.S. sulfur dioxide emissions, 23 percent of nitrogen oxide emissions and 35 percent of carbon dioxide emissions. Emissions of carbon attributable to the provision of energy services in U.S. buildings alone are roughly equal to the total carbon emissions of Japan and the United Kingdom combined. Studies report that 1 in 5 schools suffer inadequate indoor air quality, affecting student performances. The American Lung Association reports that the cost of lung disease, particularly in young people is \$5 billion annually due to pollution.

Economic Contribution of the Building Sector

The building sector exerts a large influence on the economy, contributing to economic competitiveness. In 1997, the building industry contributed \$690 billion, or nearly 9 percent, to the Gross Domestic Product (GDP). New construction represented \$420 billion of this amount and building renovations and modifications contributed another \$270 billion.

Fragmentation of the Building Sector

One of the primary challenges to achieving efficiency in the building sector is its fragmented structure. To start with, the building construction industry encompasses literally thousands of different businesses and millions of individual decision makers. Developers, designers, builders, utilities, engineers, and occupants pursue objectives which often are at cross-purposes. Also, unlike the transportation sector that is dominated by a few major firms responsible for final assembly and product delivery, the building sector has thousands of builders who assemble individual components into complete structures. One result of all this diversity is that product integration is less than optimal and buildings are typically designed and constructed as complex amalgamations of individual technologies, each of which carries out its intended function largely independent of (or even in spite of) others, rather than as a tightly integrated system of interrelated components. Inefficiencies and lost energy opportunities are frequent consequences of this situation.

Unfortunately, the number of decision makers that must be influenced and the effort required to pursue a change in the current predicament are substantial. The buildings sector is a risk-averse industry that has been slow to adopt new technologies, including those that are more efficient

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than conventional ones. Therefore, BTS emphasizes activities that encourage the deployment of new energy efficiency technologies through education, training, and related efforts across the buildings community.

Low Rate of Private Investment in Building Energy R&D

R&D expenditures for the buildings sector as a whole are on an order of magnitude less than the national average. The industry is dominated by small firms that can ill afford research programs, and competition effectively prevents coordinated or integrated research. Given the economic costs and environmental impact of energy consumption in the buildings sector, and the projected growth of the sector, maintaining and growing a vital research program for efficient buildings is critical to the success of the Department's overall strategic goal of increasing the efficiency and productivity of energy use.

STRATEGIC GOAL AND APPROACH

In FY 2001, the maturing BTS organization is striving to provide for a more integrated, customer-driven R&D portfolio through its peer review and road mapping efforts, and is securing an increasing diversity of performers through competitive solicitations. Statutory responsibilities for development and implementation of building codes and standards are being successfully carried out in collaboration with states, industry and other stakeholders. Deployment of the technologies, codes and standards, tools and techniques that emerge from research and standards efforts is being accelerated through state and community based partnerships that leverage non-Federal resources and tailor activities to the needs of the local communities. The crosscutting residential, commercial and equipment teams operate to ensure coordination of BTS research, codes and standards, and deployment efforts to serve building retrofit and new construction markets in an effective, balanced, and integrated manner. Beginning in FY 1999 and implemented in FY 2000, BTS reorganized into two offices and three cross-cutting teams to assure coordination and effective delivery of its programs. By combining R&D with standards, BTS could apply research lessons to appliance standards and anticipate research needs. Combining all program delivery efforts in the second office provided a more orderly process to carry technology from development to market acceptance. The three BTS cross-cutting teams have allowed program staff to work together for greater effectiveness. In FY 2001, BTS will continue to refine its organization to achieve even greater administrative excellence.

Research, development, and deployment of building technologies by BTS fills three needs. First, BTS can provide the critical mass necessary to accelerate progress in an area in which the private sector does limited research. Second, in many cases, important research would not occur at all in the absence of BTS efforts, due to the fragmented nature of the buildings marketplace. Third, BTS leadership provides industry with an objective analysis on new technologies and techniques, reducing barriers to new technology adoption.

The focus of BTS research, development and deployment is on buildings in both the residential and commercial sectors. Residential construction includes single-family, multi-family, and "industrialized" (manufactured) housing. Commercial construction includes buildings used for commercial business such as offices, restaurants, hospitals, schools and warehouses. R&D in the buildings sector ranges from

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improvements to the building envelope (i.e., walls, windows, foundations) to improving the equipment used for heating and cooling, as well as lighting, and other building equipment and appliances, to methods of integrating all of these through “whole building” design techniques. BTS recognizes that high performing buildings require the best components that are integrated in the original design and continually optimized.

A significant element of the Department’s R&D program is making homes more energy efficient, environmentally benign, and more affordable for all Americans. Increased affordability is achieved by developing technologies and techniques which can either reduce the amount of energy used or improve the efficiency of its use in buildings at little or no net consumer cost. Such techniques are demonstrated, for example, by the *Building America* program, which strives to increase a home’s energy performance 50 percent over the 1996 Model Energy Code at little or no additional cost. The *Building America* program employs strategies such as improved design techniques that greatly reduce thermal leakage through the building envelope, or improved insulation and windows whose costs are offset by resulting reductions in the size of required space conditioning equipment. Other R&D efforts are focused on low-cost technology developments that offer sizable enough returns to justify their use within one or two years of implementation. One example is applying research from DOE’s thermal duct-sealing technology in the low-income Weatherization Program. This technology reduces leakage of thermal conditioning air by up to 30 percent and yet only costs a few hundred dollars to apply.

In consultation with industry and other stakeholder organizations, BTS is developing technology road maps to define the future portfolio and to develop strategic alliances with industry. Road maps are being developed for lighting; windows; heating, ventilation, and air conditioning (HVAC) with the Air Conditioning and Refrigeration Institute; commercial buildings including combined cooling, heating, and power; and building envelope. The road maps will continue to impact FY 2001 program efforts as they evolve. Furthermore, BTS has initiated a peer review process to ensure that its R&D projects have scientific and technical merit, high importance to DOE’s energy efficiency mission, and a reasonable probability of success.

The BTS R&D portfolio is performed by the private sector, the DOE National Laboratories, states, and universities. Cost-sharing with the private sector varies greatly among research programs, but typically averages between 50 to 75 cents of private contribution for each dollar of public expenditure. State research funds are being supported by recent utility restructuring funds and BTS has built partnerships to increase effective investment of state and Federal funds. The diversity of performers continues to expand through competitive solicitations, the topics of which are driven by the road-mapping activities. The percent of fully competitive research in the BTS R&D portfolio has increased from 26 percent in FY 1998 to 37 percent in FY 1999. BTS expects even further increases in competitive R&D in FY 2001.

In the current context of the building marketplace, even if technical capacity to reduce energy intensity is achieved, market barriers such as declining real energy prices or conservatism on the part of building designers or builders may still impede market penetration of energy efficient technologies. BTS collaborates with buildings industries, state and local organizations and the National Laboratories in efforts to promote the use of efficiency technologies and practices, in part through the greater involvement of the buildings community in research, development and

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deployment activities. The BTS road-mapping process allows industry to focus on overcoming market barriers that inhibit investment in energy-efficient technologies and practices.

Technical assistance to state and local governments, communities and consumers, as well as new building codes, new appliance standards, and the adoption of cost-effective energy technologies and materials developed from research, development and deployment (RD&D) programs will provide near-term savings in FY 2001. New codes and standards will help accelerate the transfer of the most cost-effective, life-cycle technologies and building practices and help eliminate those that are inefficient.

Goals and Strategies

The BTS Strategic Plan has established challenging, but attainable, goals for building energy savings. The FY 2001 Budget Request for R&D, outreach, and market transformation activities, implemented in collaboration with the private sector, State and local governments, academia, and research laboratories is consistent with that Plan's priorities.

BTS' long-term goals, as identified in the 1998 Strategic Plan, are to displace 2 quads per year by 2010, saving \$15 billion, equal to all the energy used annually in the State of Washington. By 2020, the BTS goal is to save 5 quads per year, saving \$36 billion, equal to all the energy used annually in the States of New York and Colorado combined. BTS is helping DOE to meet its goal of improving the efficiency of energy systems and making more productive use of energy resources by significantly increasing energy efficiency in the building sector. By reducing the energy consumption of buildings, BTS' programs save Americans money and enhance overall economic performance while protecting the environment.

BTS' goal will be reached by achieving the following specific program goals:

- Improving the energy efficiency of the Nation's new homes 50 percent by 2010 compared to typical homes built in 1996.
- Improving the energy efficiency of the Nation's new commercial buildings 30 percent by 2010 compared to 1996.
- Improving the energy efficiency of the Nation's existing commercial and residential buildings 20 percent by 2010 compared to 1996.

PROGRAM BENEFITS

Office of Building Technology, State and Community Programs

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Metric (Annual Savings Achieved in Year)	2001	2010	2020
Total Primary Energy Displaced (Quads)	0.08	1.31	2.71
Total Energy Cost Savings (Billion Dollars)	\$0.5	\$10.3	\$21.7
Total Carbon Reduction (Million Metric Tons)	1.5	23.0	47.4

As shown above, BTS' FY 2001 programs will displace 75 trillion Btu, equivalent to the typical amount of energy consumed by 216,000 Americans annually. By 2010, more than 1.3 quads will be displaced, equivalent to the typical amount of energy consumed by nearly 3.8 million Americans annually. By 2020, BTS' programs will displace 2.7 quads, equivalent to the typical amount of energy consumed by more than 7.6 million Americans annually. Addressing building energy issues also provides non-energy benefits such as comfortable and healthy indoor environments, improved worker productivity in energy-efficient buildings, and reduced on-site construction waste. Furthermore, BTS' programs provide communities with tools, information, and resources that they can use to enhance their quality of life, ensure their economic competitiveness, and build a stronger sense of community, contributing to the Administration's Liveable Communities initiative.

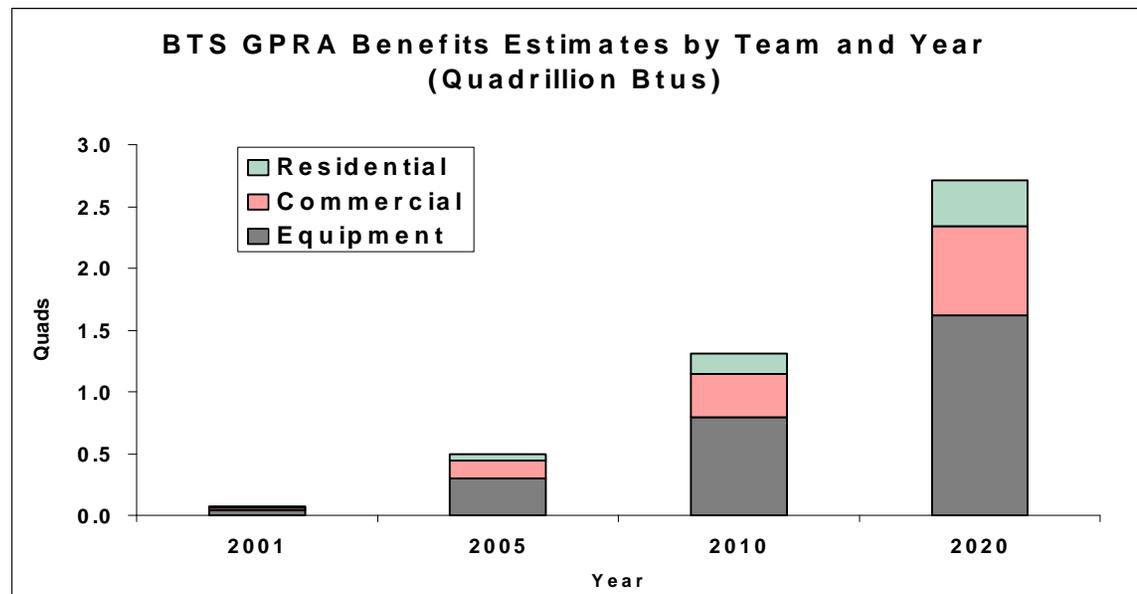
BTS established goals in the 1998 Strategic Plan consisting of 2 quads annual energy savings in 2010 and 5 quads annual energy savings in 2020. On a year to year basis, in its continuing progress towards achieving these targets, BTS completes some activities and initiates new ones, such as the competitive research and development solicitations. As a consequence of this process, the portion of the savings goals remaining to be achieved through each subsequent year's budget drop as the fixed target years of 2010 and 2020 are approached. For example, development of the Fluorescent Ballast Standard was successfully completed in FY 2000. As a result, the nearly quarter of a quad of energy savings in 2020 attributed to this standard no longer appear as projected savings in the FY 2001 Budget Request. Similarly, a number of other programs have been completed since 1998 and their corresponding savings are no longer included in the current budget benefits estimates. Thus, the portions of the original 2 and 5 quad energy savings goals remaining to be achieved in the current budget are 1.3 quads in 2010 and 2.7 quads in 2020.

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PERFORMANCE MEASURES

For the FY 2001 budget request, BTS has established performance measures for residential buildings, commercial buildings, and building equipment to help measure the achievement against the BTS energy savings goal. These overarching market-oriented measures are an initial departure from the approach taken in past BTS budget requests, which were centered on a program-by-program, component-by-component approach. This change in approach mirrors the BTS organization initiated in FY 2000, which is designed to integrate research and development and codes and standards efforts with outreach, and state and community-based deployment efforts through crosscutting, market-oriented teams. The residential and commercial buildings performance measures include programs covering building design and operation, building energy codes, and information and education. The equipment performance measure includes all programs covering building equipment and building material research, as well as appliance standards. We anticipate further modification of our program measures as our organization matures and as our understanding of the potential outcomes of an integrated approach to achieving BTS goals increases.

The projected energy savings are based on a detailed analysis of the likely impacts of program outcomes as required by the Government Performance and Results Act (GPRA). These savings represent the estimated reductions in energy use from what would otherwise have occurred in the absence of these programs. The overall goal for 2010 is 2 quadrillion Btu (Quad) (5 Quads in 2020) of avoided energy consumption in the buildings sector, and represents a 45% reduction (70% in 2020) in growth from Energy Information Administration reference case projections for the buildings sector (1997 baseline). For comparison purposes, 1 Quad is about the amount of energy required to power 5 million households for a year at 1998's rate of energy usage. These goals are very aggressive and involve substantial technical and market risk. Successful achievement of these goals will be difficult, and will require more rapid market adoption of technologies and techniques than has occurred in the buildings sector in the past. The results presented assume full funding of this budget request, as well as full funding of these program activities over their lifetime, as well as successful realization of all programs in the portfolio.



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Residential Buildings Performance Measure

As currently constructed, the Residential Team primarily focuses upon improving the energy efficiency of new residential buildings by developing and promoting energy-efficient design and construction techniques (e.g. Building America), eliminating the least efficient construction practices through energy-efficient building codes development and promotion, and aggressive outreach and information efforts to educate and inform builders, government officials, and home buyers. To be successful, this approach will need to catalyze broader adoption (i.e. beyond direct partners) of efficient building codes, as well as accelerated market diffusion of the advanced building concepts emerging from the residential research program. The low income Weatherization Assistance Program is the largest effort in addressing energy efficiency in existing homes. The residential buildings performance measure encompasses residential research and development focusing on integrating design and equipment; residential building codes; low income weatherization assistance; and contributions to the Partnership for Advancing Technology in Housing (PATH).

Commercial Buildings Performance Measure

The mainstays of the Commercial Team's efforts are development and promotion of commercial energy-efficient building codes for new construction and the promotion of efficient retrofit of existing commercial properties and institutional buildings (e.g. *Rebuild America*, Energy Smart Schools). The effort initiated in FY 2000 to more strongly focus on new commercial construction is continued in FY 2001. To be successful, this approach will need to catalyze broader adoption (i.e. beyond direct partners) of efficient building codes, as well as accelerated market diffusion of the advanced building concepts emerging from commercial buildings research and development. The commercial buildings performance measure encompasses research and development targeted towards design, operation, and maintenance of energy-efficient commercial buildings; commercial building codes; State energy grants; and all community energy programs.

Equipment Performance Measure

The Equipment Team focuses on improving specific building equipment, appliances, and materials through research and development, elimination of the least efficient equipment and appliances through development and adoption of national standards, and the promotion of the most efficient (i.e. beyond performance levels prescribed in codes and standards) equipment and appliances (e.g. Energy Star Program with EPA). These programs are crosscutting, addressing commercial and residential buildings, and existing and new construction. We have taken care to assure that the benefits estimated are additive to the estimated benefits of the residential and commercial efforts. Again, to be successful, this approach will need to catalyze market adoption beyond direct partners and accelerate market penetration of the more efficient (e.g. Energy Star) equipment and appliances. The equipment performance measure includes all research on building materials (e.g., roofs, walls, windows) and equipment, lighting, appliances, and the development and implementation of appliance and equipment standards.

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External Factors Influencing Performance Measures

A number of factors can impact achievement of BTS' goals, as measured by the performance measures. Chief among these is the assumption of continued support of these program activities beyond the upcoming fiscal year. Other factors include the general economy, consumer choice, regional disparities, and overall structural change in the buildings market.

The construction industry is susceptible to economic slowdowns. This would impact both new construction as well as retrofits to existing buildings. The energy savings goal assumes a robust construction market to generate the demand for new, energy-efficient housing and commercial space, as well as demand for remodeling and commercial retrofits to replace aging and relatively inefficient equipment. The labor pool of trained construction and installation workers is showing strain from the construction boom.

Other factors also affect energy use in buildings. Characteristics of new construction that would tend to increase energy consumption in residential buildings would be larger homes, more construction in less temperate climates, and an increase in telecommuting which would result in more home offices. While commercial energy use may tend to fall with telecommuting, factors such as increased electrification (more computers, printers, and fax machines), as well as shifts in the relative mix of commercial buildings (e.g., hospitals and retail versus office buildings) can contribute to a rise in energy use and intensity. In addition, aging and prosperity of the American population will have an effect. Indeed, even the distinction between residential and commercial buildings may blur in the future as homes and workplaces merge and the number of assisted living centers (which combine residences with clinics, food service, and entertainment facilities) rise.

SIGNIFICANT ACCOMPLISHMENTS (In FY 1999, unless otherwise stated)

Metric (Savings Achieved)	Cumulative Benefits 1980 through 1999
Total Primary Energy Displaced (Quads)	12.56
Total Energy Cost Savings (Billion Dollars)	\$90.64
Total Carbon Reduction (Million Metric Tons)	201.29

BTS Office of Building Research and Standards

Technology Road Maps and Competitive R&D

- As of Spring 2000, four strategic technology road maps will be complete—lighting; windows; commercial buildings, which now incorporates combined building cooling, heating, and power; and heating, ventilating, and air conditioning (HVAC) and refrigeration. These road maps

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help the private and public sectors reach consensus on future R&D direction and improve collaboration, leading to market transformation activities that will help accelerate the adoption of new technologies and approaches in the marketplace.

Residential Buildings Integration

- Completed 100 homes that are over 50 percent more efficient in heating and cooling than typical homes through the *Building America* program, bringing the total number of homes completed to 700.

Commercial Buildings Integration

- Supported completion of the next generation voluntary commercial energy code, American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineers Society of North America Standard 90.1 - 1999.

Equipment, Materials, and Tools

- Established minimum energy efficiency standards for major energy consuming equipment and appliances.
- Completed and released the final version of DOE-2, the most widely used building energy simulation program for designing and retrofitting residential and commercial building.
- Completed the successful jointly-funded materials compatibility and lubricants research program that paved the way for the new generation of chlorine-free refrigerants.
- Fabricated and demonstrated full-sized electrochromic windows.
- Developed prototype methane reformers and incorporated into the proton exchange membrane fuel cell reformers.

BTS Office of Building Technology Assistance

Weatherization Assistance Program

- Weatherized 67,330 homes, bringing the total number of homes weatherized to 4.7 million.

State Energy Program

- Implemented comprehensive grants management system (WinSAGA) to improve data collection and explicitly document results.

Community Energy Program

- Recruited 85 additional *Rebuild America* partners, meeting the original goal of 250 *Rebuild* communities. New partners will begin action plans that will result in more than 400 million square feet of floor space renovated, reducing annual energy costs by more than \$143 million and reducing annual carbon emissions by 0.345 million metric tons.

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Energy Star Program

- Recruited an additional 1,500 stores to market ENERGY STAR appliances nationwide.

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BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR

PROGRAM FUNDING PROFILE

Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Base	FY 2001 Request	Program Change Request vs. Base	
					Dollar	Percent
Building Research and Standards						
Technology Roadmaps and Competitive R&D . . .	\$6,262	\$6,885	\$6,885	\$11,000	\$4,115	59.8%
Residential Buildings Integration	\$9,429	\$11,948	\$11,948	\$13,480	\$1,532	12.8%
Commercial Buildings Integration	\$2,519	\$4,244	\$4,244	\$6,460	\$2,216	52.2%
Equipment, Materials and Tools	\$42,121	\$52,331	\$52,331	\$69,160	\$16,829	32.2%
Subtotal, Building Research and Standards	\$60,331	\$75,408	\$75,408	\$100,100	\$24,692	32.7%
Building Technology Assistance						
Weatherization Assistance Program	\$133,000	\$135,000	\$135,000	\$154,000	\$19,000	14.1%
State Energy Program	\$33,000	\$33,500	\$33,500	\$37,000	\$3,500	10.4%
Community Energy Program	\$18,589	\$18,235	\$18,235	\$27,500	\$9,265	50.8%
Energy Star Program	\$2,674	\$2,724	\$2,724	\$6,500	\$3,776	138.6%
Subtotal, Building Technology Assistance	\$187,263	\$189,459	\$189,459	\$225,000	\$35,541	18.8%
Cooperative Programs with States	\$0	\$2,000	\$2,000	\$0	\$-2,000	-100.0%
Energy Efficiency Science Initiative	\$0	\$3,900	\$3,900	\$0	\$-3,900	-100.0%

PROGRAM FUNDING PROFILE - BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR (Cont'd)

Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Base	FY 2001 Request	Program Change Request vs. Base	
					Dollar	Percent
Management and Planning	\$13,541	\$13,231	\$13,231	\$14,659	\$1,428	10.8%
TOTAL	<u>\$261,135</u>	<u>\$283,998</u>	<u>\$283,998</u>	<u>\$339,759</u>	<u>\$55,761</u>	<u>19.6%</u>
Summary						
Operating Expenses	<u>\$261,135</u>	<u>\$283,998</u>	<u>\$283,998</u>	<u>\$339,759</u>	<u>\$55,761</u>	<u>19.6%</u>
Total Program	<u>\$261,135^a</u>	<u>\$283,998</u>	<u>\$283,998</u>	<u>\$339,759</u>	<u>\$55,761</u>	<u>19.6%</u>
Staffing (FTEs)						
HQ FTEs	<u>73</u>	<u>81</u>	<u>81</u>	<u>81</u>		
Total FTEs	<u>73</u>	<u>81</u>	<u>81</u>	<u>81</u>		

Authorizations:

- P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
- P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
- P.L. 95-91, "Department of Energy Organization Act" (1977)
- P.L. 95-618, "Energy Tax Act of 1978"
- P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
- P.L. 95-620, "Powerplant and Industrial Fuel Use Act of 1978"
- P.L. 96-294, "Energy Security Act" (1980)
- P.L. 100-12, "National Appliance Energy Conservation Act of 1987"
- P.L. 100-615, "Federal Energy Management Improvement Act of 1988"
- P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"
- P.L.102-486, "Energy Policy Act of 1992"

^{a/} Reflects adjustment for approved reprogrammings 99-R-4 of \$-3,212.0 thousand for the Small Business Innovative Research (SBIR) program and \$-194.0 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities, and \$400.0 thousand for approved reprogramming 99-R-21 to support state grant implementation, and \$-57.4 thousand associated with the Administration and Travel rescission, P.L. 105-61.

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SUMMARY OF CHANGES

	FY 2001 Request
FY 2000 Enacted	\$ 283,998
- Non-Discretionary	0
FY 2001 Base	\$ 283,998
 <u>Building Research and Standards:</u>	
- Technology Road Maps and Competitive R&D - The change reduces funding for road maps (-\$762), solicits 5 - 7 additional competitive R&D proposals from industry to expand the R&D portfolio and increase the share of competitive R&D (\$3,877), and supports the development of international R&D partnerships and the adoption of DOE-developed technology in international markets (\$1,000).	4,115
- Residential Buildings Integration - Provides for an increase in the number of <i>Building America</i> partners and accelerates the transfer of <i>Building America</i> results to the President's Partnership for Advancing Technology in Housing (PATH) (\$1,117), also provides for an increase in the development of residential code guidelines (\$165), and adapts whole building design tools and develops residential building codes for use in 5 countries (\$250).	1,532
- Commercial Buildings Integration - The increase expands cost-shared R&D projects and demonstrations of innovative techniques and strategies for energy-efficient buildings (\$1,810), ends research conducted on low-energy buildings, slightly increases the development of commercial code guidelines (\$156), and adapts whole building tools and develops commercial building codes for use in 5 countries (\$250).	2,216

SUMMARY OF CHANGES - BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR (Cont'd)

- Equipment, Materials, and Tools - The increase accelerates research for Cogeneration/Fuel Cells by \$1,950 to begin fabrication of a prototype natural gas reformer for low-temperature fuel cells; increases Analysis Tools and Design Strategies by \$3,302 to release three new versions of whole-building software tools; and in Lighting and Appliance Standards accelerates the rulemaking process for commercial HVAC and water heaters and distribution transformers and initiates efforts to harmonize energy-efficient standards, test methods, and rating procedures to facilitate international trade (\$4,765); in Space Conditioning and Refrigeration issues a competitive solicitation to accelerate the research on natural gas heat pump/chillers and advanced desiccants that will improve indoor air quality (\$5,278), ends furnace and boiler combustion research (-\$500), and slightly reduces refrigeration research (-\$15); increases competitive Lighting R&D projects by \$360, and Appliances and Emerging Technologies by \$1,085; ends Urban Heat Island research (-\$200) and increases Building Envelope by \$804. 16,829

Building Technology Assistance:

- Weatherization Assistance Program - The increase weatherizes over 7,460 additional homes of low-income families. 19,000
- State Energy Program - The increase supports State energy program priorities. 3,500
- Community Energy Program - The increase accelerates the deployment of energy efficiency and renewable energy technologies in communities by establishing and supporting 50 new *Rebuild America* partnerships (\$1,498), developing national design guidelines and outreach to State and local organizations through PATH and Energy Smart Schools (\$4,500), fund 10 to 12 innovative, cost-shared community partnership grants (\$3,512), and increase outreach activities to communities and States and local governments (\$970). Volume Purchasing, Affordable Housing, and Highly Reflective programs will be complete in FY 2000 (-\$1,222), State Building Energy Codes (\$7). 9,265
- Energy Star Program - The increase accelerates the rate of appliances and products validation, expands the Energy Star product portfolio, recruits 5 utility partner, and provides technical assistance to expand the Energy Star and labeling program to 6-10 countries. 3,776

Cooperative Programs with States:

- Cooperative Programs With States - No funding for this FY 2000 initiative was requested in FY 2001. -2,000

Energy Efficiency Science Initiative:

SUMMARY OF CHANGES - BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR (Cont'd)

- Energy Efficiency Science Initiative - No funding for this FY 2000 initiative was requested in FY 2001.	-3,900
<u>Management and Planning:</u>	
- Evaluation and Planning - Increases support for state and local grant programs (\$258) and decreases the quantity and/or scope of topical analyses conducted (-\$40).	218
- Program Direction - The increase will provide for 8 additional FTEs and cost of living adjustment for BTS' FTEs.	<u>1,210</u>
FY 2001 Congressional Budget Request.	<u><u>\$ 339,759</u></u>

BUILDING TECHNOLOGIES
BUILDING TECHNOLOGY, STATE, AND COMMUNITY SECTOR
(dollars in thousands)

BUILDING RESEARCH AND STANDARDS

I. Mission Supporting Goals and Objectives:

I.A. Program Strategy

The mission of the BTS Building Research and Standards program is to significantly enhance the energy efficiency and environmental quality of the Nation's commercial and residential buildings by improving the energy efficiency of building components through R&D and effectively integrating those components into the building energy systems through systems design and regulatory activities. Given the importance of current energy consumption and projected growth in the buildings sector, maintaining and growing a vital research program for efficient buildings is critical to the success of the Department's overall strategic goal of increasing the efficiency of energy use.

The FY 2001 Building Research and Standards program is expected to displace more than 17 trillion Btu, saving consumers \$120 million. By FY 2010, the energy displaced as a result of these programs will increase to more than 0.7 quads, saving consumers nearly \$5.4 billion. By FY 2020, energy savings will increase to almost 1.7 quads and \$13.5 billion. The Building Research and Standards Office will provide nearly a quarter of the expected energy savings from BTS' overall program, accounting for 23 percent of the energy savings for FY 2001 and rising to 62 percent in FY 2020.

The Building Research and Standards program will achieve these goals through two strategies:

- Accelerate the introduction of highly efficient building technologies and practices through research and development; and
- Increase the minimum energy efficiency of buildings and equipment through appliance standards, building codes, and guidelines.

4 Times Square
DOE-2 finds the savings

The design of 4 Times Square, the epitome of an energy efficient office building, was made possible in part due to BTS-developed software. Architects of this new 48-story building, at the corner of Broadway and 42nd Street in New York City, used DOE-2 to design a skyscraper with highly efficient building technologies. 4 Times Square incorporates energy-efficient and CFC-free chillers, on-site building power generation through fuel cells and photovoltaic cells, exceptional daylighting, and superior indoor air quality. The building's energy efficiency measures typify the technologies researched, developed, and promoted through BTS support.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

R&D Portfolio

The current portfolio of investments is driven by both energy use and market characteristics of the buildings sector. Homes and buildings often last 50 years or longer—considerably longer than most power plants. Thus, the impacts of buildings design, construction, and equipment decisions affect energy use far into the future. Fully 30 percent of commercial floor space and 40 percent of all housing currently in use were built prior to 1960. Consequently, the R&D portfolio must address new buildings, as well as retrofit and renovation of existing buildings. The potential savings impacts to the Nation's projected energy use in buildings are great. The Department projects that from 10 to 30 percent savings are cost-effective in existing buildings and from 30 to 70 percent in new construction. Reduced environmental impacts of energy production and use can also be realized.

Whole Buildings Approach

The FY 2001 Building Research and Standards program will emphasize a “whole buildings” approach that addresses the dynamic interrelated systems nature of buildings and user requirements. The whole buildings approach views a building as an integrated system of interacting components. Research is conducted on individual building components and their interaction in thermal, ventilation, and lighting systems. In addition, research is conducted on the whole building to develop energy-saving approaches that improve the integration of systems and enhance the overall building performance throughout the building's life. The outcome of BTS' whole buildings approach is highly efficient buildings with improved air quality, and increased occupant comfort and productivity.

Stronger Partnerships and Increased Collaboration

BTS will continue to strengthen its partnerships with private industry and other government entities by collaborating on energy R&D and leveraging Federal investment in buildings energy efficiency. Cost sharing with the private sector varies greatly among research programs, but typically averages between 50 to 75 cents of private contribution for each dollar of public expenditure. BTS' improved collaboration began with the industry-driven technology road maps, which helped to set priorities and identify opportunities, and has led to their implementation through competitive R&D awards. These awards increase collaboration and cost-sharing and open business opportunities to innovative firms. By using industry-led, public/private collaborations to demonstrate and commercialize new energy technologies, R&D programs appropriately target R&D investment, leading to improved market penetration and providing the greatest benefits to consumers. BTS will also focus its R&D on areas that have been historically underfunded by industry, have high potential benefits for society, and where modest Government investments can complement and leverage work in the private sector. Expanded partnerships with States and communities directly and with other EERE sectors and regional offices will result in even greater success.

Peer Review

BTS has adopted peer review as a fundamental element of its management approach. Within the BTS Office of Building Research and Standards, peer review is helping to ensure that the R&D projects have scientific and technical merit, high importance to DOE's energy efficiency mission, and a reasonable probability of success. The comprehensive peer review of all BTS' R&D projects, conducted by DOE's

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

Office of Science during FY 1998 -1999, rated 94 percent of these projects as either strong or good. As a result of peer review, project managers receive objective, expert feedback and recommendations, allowing them to take appropriate actions to improve or conclude R&D activities.

Technology Road Maps and Competitive R&D

In FY 2001, BTS will complete the road maps for residential buildings, appliances, and building envelope technologies and update the completed R&D road maps developed in collaboration with industry partners, academia, States, and other public and private stakeholders. Competitive solicitations will be used to initiate R&D activities that are identified in the road maps. The projects resulting from the Technology Road Maps and Competitive R&D planning unit are estimated to displace 90 trillion Btu in FY 2010, increasing to 160 trillion Btu in FY 2020, saving almost \$700 million and \$1.3 billion, respectively.

The road-mapping process creates a shared vision among diverse groups within each sector and provides a framework for cooperative technology development efforts. The road-mapping process identifies high-priority, high-return research areas and better aligns limited Government and industry resources to optimize energy efficiency and reduce greenhouse gases and other pollutants. The road maps have helped the private and public sectors reach consensus on future R&D direction and improved collaboration, which will lead to market transformation activities that will help accelerate the adoption of new technologies and approaches in the marketplace. By 2001 four road maps will be complete—lighting; windows; commercial buildings, which now incorporates combined cooling, heating, and power; and heating, ventilating, and air conditioning (HVAC) and refrigeration.

To continue the momentum developed during the road-mapping process, BTS will solicit competitive proposals to jump start promising new research in sectors with completed road maps. BTS will also continue to solicit proposals for innovative, high-potential, high-risk R&D in areas outside of road-mapped technologies. This will result in a research portfolio that is prioritized, has a high probability for success, and is most beneficial to BTS stakeholders and the taxpayer. This process will benefit all phases of BTS' RD&D and technology transfer efforts, encouraging increased partnerships and cost sharing.

Residential Buildings Integration

In partnership with industry, States, and communities, the Residential Buildings Integration program will achieve its strategic goals through R&D, demonstrations, and regulatory strategies to improve energy efficiency in new and existing homes. The FY 2001 Residential Buildings Integration program will displace 20 trillion Btu and \$148 million in FY 2010. The Residential Buildings Integration program will transfer the major systems innovations to nearly 30,000 of the 1 million new homes built in 2004 and into 373,000 of the 1 million new homes built in 2010.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

By 2010, new homes will on average consume 50 percent less energy than typical homes built in 1996, and existing homes will consume 20 percent less energy than in 1996.

A significant element of BTS' R&D program is making homes more energy efficient and environmentally sound at little or no additional cost. Increased energy efficiency is achieved through *Building America*, BTS' partnership with industry to jointly fund, develop, demonstrate, and deploy housing that integrates energy-efficient technologies and practices. *Building America* employs strategies such as improved design techniques that greatly reduce thermal leakage through the building envelope, or improved insulation and windows whose costs are offset by resulting reductions in the size of required space conditioning equipment. These new homes save consumers money, are more environmentally benign, and provide more comfortable living space. The number of partners in the *Building America* consortia will increase by 25 in FY 2001 to 225, accelerating the development, testing, and adoption of advanced residential energy systems by additional communities. These partners have demonstrated their commitment by contributing a minimum of 50 percent in cost sharing. R&D on advanced energy-saving homes and super-efficient building designs add a prudent balance to the R&D portfolio and will contribute to the longer term energy and environmental goals.

BTS helps advance energy efficient, environmentally sound, design and construction of residential buildings through its regulatory activities conducted in partnerships with Federal agencies, State and local governments, the building industry, building financial institutions, utilities, public interest groups, and building owners and users. By supporting improvements to the next generation of residential model building energy codes, developing code compliance tools for residential construction, and promulgating updated Federal residential building energy codes, the Residential Buildings Integration program helps to transfer energy-efficient building techniques and practices into residential buildings.

Commercial Buildings Integration

The Commercial Buildings Integration program, in partnership with the design and construction community, building product companies, developers, building owners and operators, States, and communities, will achieve its strategic goals through R&D, demonstrations, and regulatory strategies to improve the energy performance of commercial buildings. FY 2001 activities will displace 8 trillion Btu and save \$60 million in 2005. By 2010, energy consumption in new commercial buildings will be reduced by 30 percent compared to FY 1996. In FY 2010, more than 40 trillion Btu will be displaced, saving nearly \$320 million.

In FY 2001, BTS will work to realize the energy-saving opportunities in new construction and the major renovation of existing commercial buildings that were identified in the commercial building road map. This R&D also follows the recommendations from the *Energy Resources R&D Portfolio Analysis*, which identified efficiency improvements in commercial buildings as a significant gap in R&D and specifically identified advanced controls as a priority R&D opportunity. Reducing energy use in commercial buildings increases the profits and productivity of businesses, makes those buildings more comfortable, improves the environment, and increases asset value. BTS will also

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

expand its partnerships and activities that focus on opportunities to adopt a whole buildings approach early in the design phase of new commercial buildings. To align efforts closer with the industry vision and the R&D opportunities identified in the *Portfolio Analysis*, BTS will increase its industry partnerships in design, construction, operation and maintenance, indoor environment, and control and diagnostics of heating, ventilation, air conditioning, lighting, and other building systems. As a result of the ongoing commercial buildings road-mapping process, partnerships are increasing with utilities and State R&D organizations. These partnerships will continue to contribute, on average, \$2 for each \$1 of Federal investment in Commercial Buildings Integration.

One of the mechanisms the Commercial Buildings Integration program uses to transfer the most energy-efficient building techniques and practices into commercial buildings is through its regulatory activities. The program assists building industry model codes organizations and other concerned stakeholders in upgrading the model building codes to include technically feasible and cost-effective measures; promulgates upgraded Federal commercial building energy codes; and provides assistance to States in updating and implementing their commercial building energy codes by developing simplified approaches to code use and enforcement.

Equipment, Materials, and Tools

In collaboration with industry and other stakeholders, the Equipment, Materials, and Tools program will achieve its strategic goals through a balanced program of R&D and accelerated regulatory activities that will promote the widespread adoption of energy-efficient products and technologies in both residential and commercial buildings. FY 2001 activities will displace 7 trillion Btu and save \$46 million. In FY 2010, more than 0.5 quad will be displaced, saving \$4.2 billion. In 2020, more than 1.2 quads will be displaced, saving more than \$10 billion, equivalent to eliminating nearly all the energy currently used for residential lighting in the country.

BTS' strategy is to collaborate with industry to conduct R&D on building components, such as innovative lighting, advanced space conditioning and refrigeration, fuel cells, and new designs for appliances, that will increase the energy efficiency of buildings and improve building performance. BTS' Equipment, Materials, and Tools R&D portfolio addresses several gaps identified by the *Energy Resources R&D Portfolio Analysis* including advanced lighting technologies, thermal conversion, and in collaboration with other EERE sectors, combined cooling heat and power systems for buildings. One example of BTS' successful collaboration is the joint effort to develop and manufacture high-efficiency gas-fired absorption heating and cooling equipment with the potential of at least a 50 percent increase in efficiency over existing technology and at a competitive cost. The consortium, consisting of gas utilities, a small business manufacturer of absorption systems, and BTS, expects to introduce a new chiller for light commercial application in 2001.

R&D will also be conducted on building envelope technologies, such as advanced windows, coatings, and insulation. More efficient building envelope technologies lower building heating, cooling, and lighting requirements and permit smaller, less expensive equipment to be used. The Equipment, Materials, and Tools program also focuses on developing, improving, and deploying analytical tools to effectively integrate all

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

elements affecting building energy use and assist building designers, owners, and operators to develop the best design solutions for new buildings and retrofit strategies for existing buildings.

BTS will maintain the accelerated schedule of the lighting and appliance energy efficiency standards program to realize even greater energy savings, consumer energy cost savings, and reduced air emissions. Setting efficiency standards leads to substantial increases in the average energy performance of buildings and equipment. Furthermore, manufacturers support the development of Federal standards as they lessen manufacturers' burden of complying with a myriad of differing state standards. BTS involves stakeholders and relevant Federal agencies early in the standards-setting process. Improved analysis will enable early determination of consensus standards in some cases and accelerate the pace of the process in other cases. The Equipment, Materials, and Tools program also prescribes test procedures that measure the energy efficiency and energy use and provide an estimate of annual operation cost of each appliance. This effort is a complement to voluntary programs such as Energy Star that encourage consumers and businesses to purchase energy-efficient appliances and equipment.

BTS' greatest appliance and equipment successes to date—high-efficiency refrigerators, electronic ballasts for fluorescent lights, and improved supermarket refrigeration—have achieved swift market penetration and extraordinary savings through a three-prong strategy of R&D, appliance standards, and promotion. In FY 2001, BTS-developed efficient technologies and products, combined with the accelerated promulgation of appliance standards, will provide nearly one quarter of the energy and carbon emissions displaced by all of BTS' programs.

I.B. Program Benefits

At the proposed funding levels, the entire Building Research and Standards Program is estimated to yield the following benefits:

Metric - Building Research and Standards	2001	2010	2020
Total Primary Energy Displaced (Quads)	0.02	0.68	1.67
Total Energy Cost Savings (\$Billion)	0.1	5.4	13.5
Total Carbon Reduction (MMTons)	0.4	12.1	29.5

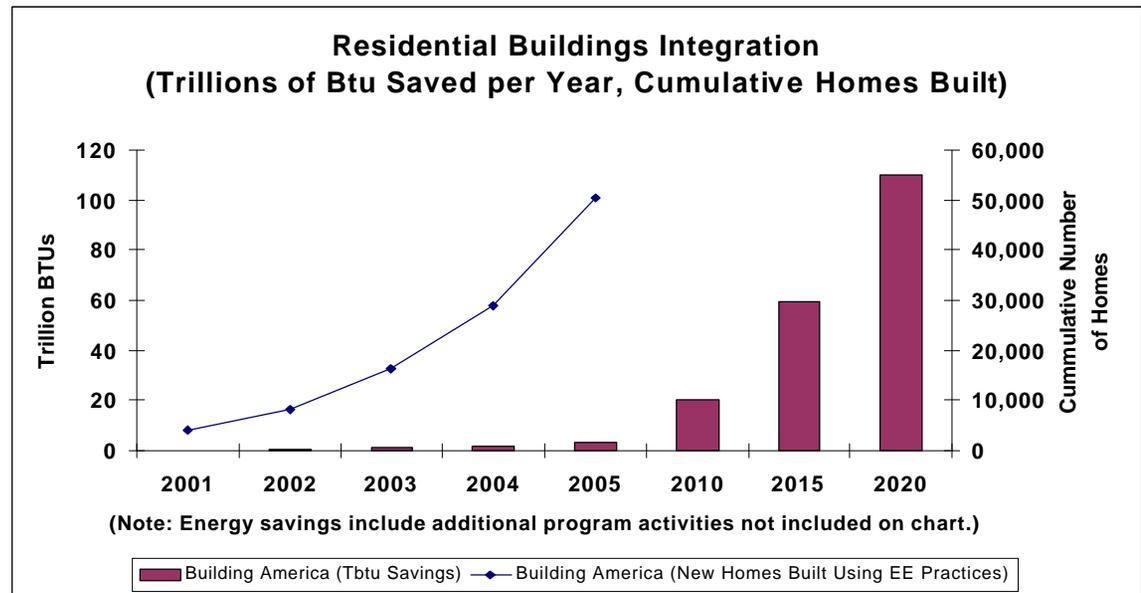
The benefits in FY 2020 correspond to approximately the amount of energy used in 8.5 million households.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

I.C. Performance Measurements

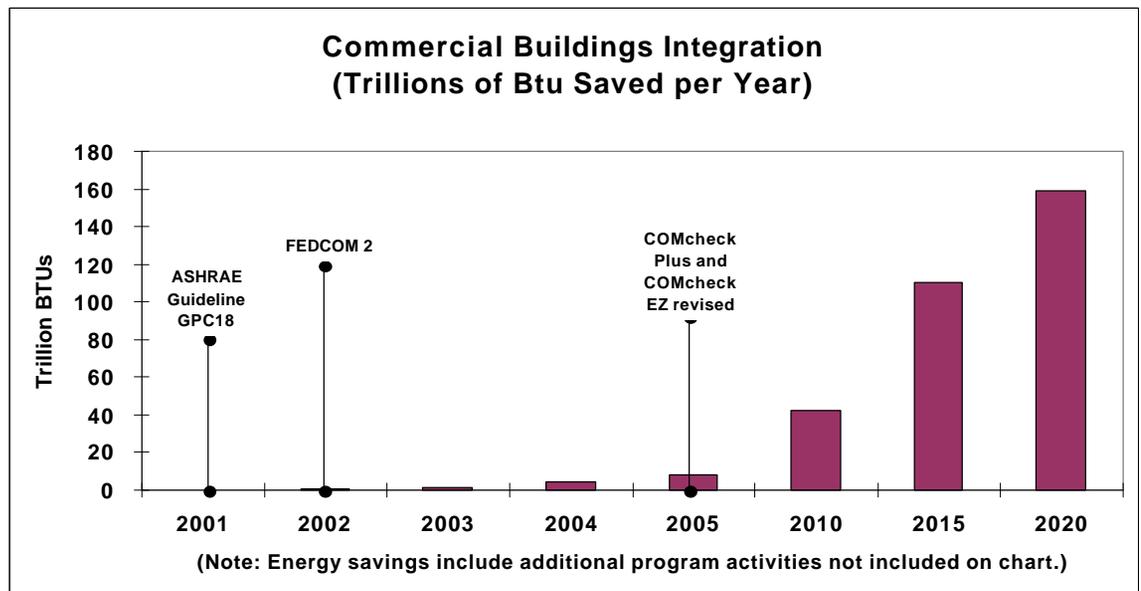
Residential Buildings Performance Measures

The performance measures for Residential Buildings Integration track the number of new homes being built with *Building America* techniques and include all energy savings for Residential Buildings Integration. These techniques currently reduce the energy required for space conditioning by 50 percent, at no additional cost of construction. The goal by FY 2010 is to reduce total energy usage by 50 percent at no or little increase to first cost. (Estimated benefits are included in the BTS overarching Residential performance measure.)



Commercial Buildings Performance Measures

The performance measures for Commercial Building Integration includes activities related to code design and implementation, as well as appliance standards development. Also included are efforts to bring a systems engineering approach to the design, construction, operation, and maintenance of commercial buildings. (Estimated benefits are included in the BTS overarching Commercial performance measure.)



I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

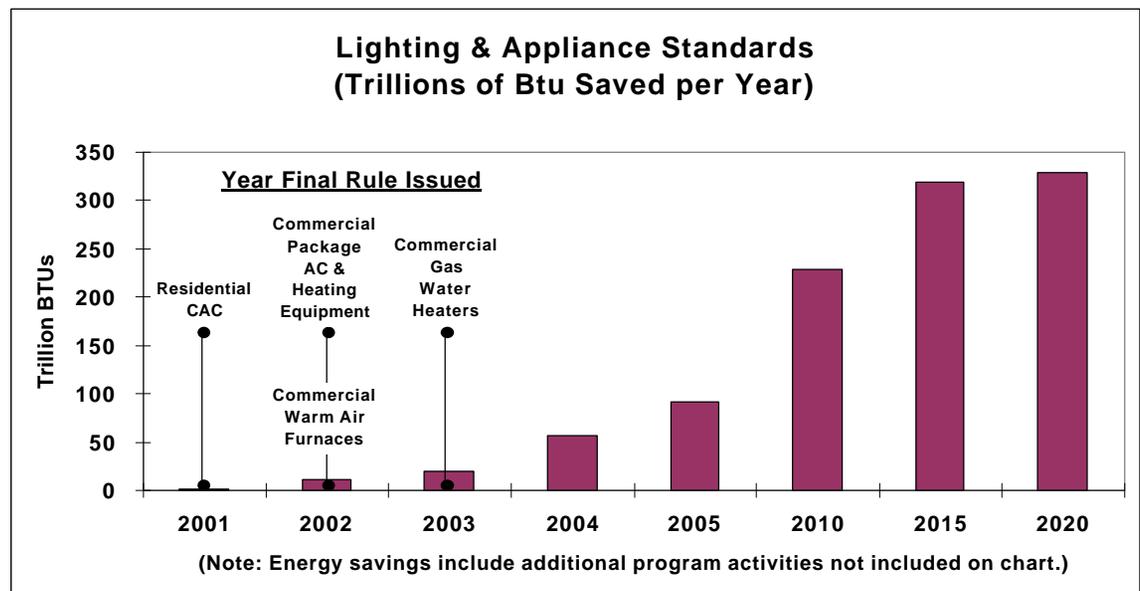
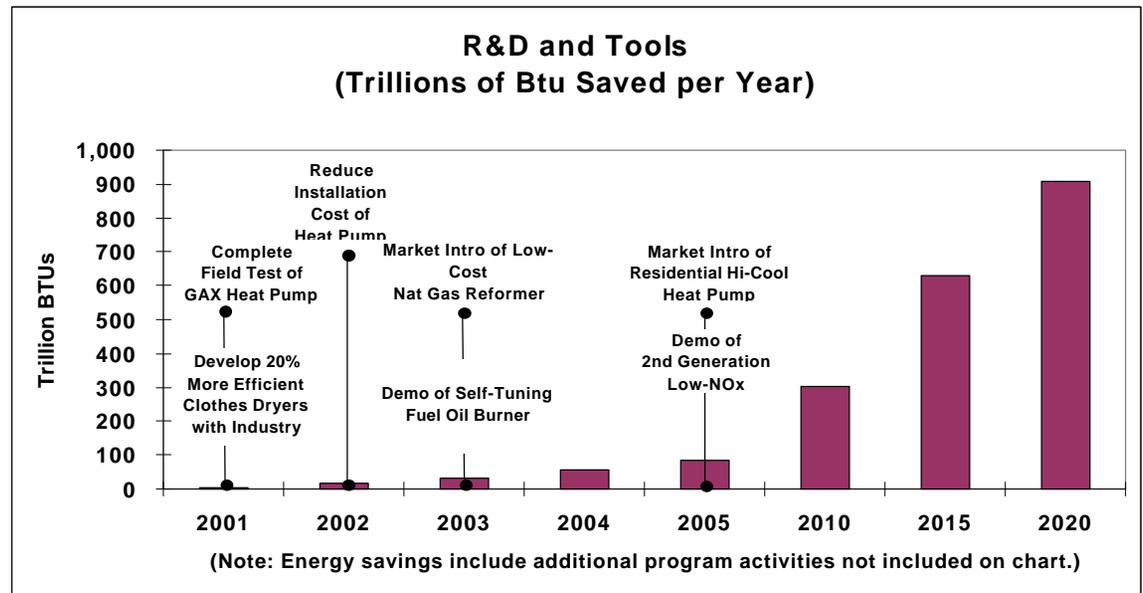
Equipment, Materials, and Tools Performance Measures

Equipment, Materials, and Tools encompasses both R&D as well as lighting and appliance standards. Research includes a wide range of programs targeted towards several end-uses. These include windows, building equipment such as heat pumps, appliances, and software tools used to evaluate design and operation of buildings.

Lighting and appliance standards includes light sources, controls, residential and commercial appliances, and major energy consuming equipment such as air conditioners and furnaces. The selected future milestones depicted are representative of these activities; however, energy savings attributable to the full range of program activities are captured. (Estimated benefits are included in the BTS overarching Equipment performance measure.)

External Factors Influencing Performance Measures

Future energy savings assume research success and the market adoption of technologies being pursued by BTS. Research success can be stymied by unforeseen technical problems. Market success hinges on a number of factors including the price of energy and the willingness of the private sector to commercialize resulting technologies. Future success in appliance standards depends upon active participation of stakeholders.



I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

I.D. Significant Accomplishments

Metric (Savings Achieved)	Cumulative Benefits FY 1980 - 1999
Total Primary Energy Displaced (Quads)	11.21
Total Energy Cost Savings (Billion Dollars)	\$81.09
Total Carbon Reduction (Million Metric Tons)	180.70

FY 1999 Accomplishments

Technology Road Maps and Competitive R&D:

- Began developing technology road maps for lighting, windows, commercial buildings, and building envelope technologies in collaboration with industry and the research community.
- Announced and awarded the first 19 competitive R&D awards as part of a broad-based solicitation to support industry-driven road maps and other innovative building R&D.

Residential Buildings Integration:

- Expanded *Building America* to include 100 industry members and began construction of 5 additional community-scale projects, totaling 1,000 houses.
- Issued and awarded a competitive solicitation that addresses industrialized housing.
- Began cooperative work with manufactured housing industry on incorporating component efficiency improvements into a systems integrated approach.
- Completed home energy rating system for seven pilot States that will help overcome barriers to energy efficiency financing.
- Supported improvements to the 1998 International Energy Conservation Code (IECC) pertaining to the next generation voluntary residential energy code.
- Drafted determination on whether the 1998 IECC would improve energy efficiency of residential buildings.
- Developed improvements to the Federal residential standards rulemaking based on those proposed and incorporated into the 1998 IECC and ASHRAE Standard 90.2-1993.

Commercial Buildings Integration:

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

- Issued a competitive solicitation to increase research on whole building concepts that improve energy and other performance characteristics.
- Completed and published findings from the lighting/controls system integration study.
- Established database of project performance data on commercial building retrofits.
- Supported completion of the next generation voluntary commercial energy code, American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineers Society of North America (ASHRAE/IESNA) Standard 90.1 - 1999.
- Completed development of code compliance manuals and builders guides.
- Established partnerships with commercial construction companies to incorporate whole buildings design in three major projects.

Equipment, Materials, and Tools:

- Tested and demonstrated prototype sulfur and sulfur-like lamps with advanced power supplies which, for the first time, provide high frequency power to the lamp in a fully solid state, integrated package. The small-sized lamp is highly-efficient and low cost.
- Demonstrated significantly increased performance attributes of sulfur and sulfur-like sources in novel configurations that offer the potential to decrease source cost while maintaining very high efficiencies.
- Completed extensive research into methodologies to reduce the cost of screw-based compact fluorescent lamps in collaboration with a major lamp manufacturer.
- Developed smallest and least expensive compact fluorescent light bulbs.
- Completed the lighting controls project in a large Federal office building and reported results to General Services Administration.
- Fabricated and laboratory tested an engineering prototype methane reformers to incorporate into the proton exchange membrane (PEM) fuel cell.
- Fabricated a gas-fired, laboratory bread board, light commercial Hi-Cool heat pump using advanced branched generator absorber heat exchange (GAX) absorption technology.
- Began testing a prototype desiccant-based outside air preconditioner and completed desiccant systems field testing in Wendy's restaurants.
- Began laboratory testing several preproduction prototypes of a 3-ton residential GAX heat pump and a commercial prototype double-condenser coupled chiller.
- Completed the successful jointly-funded materials compatibility and lubricants research program that paved the way for the new generation of chlorine-free refrigerants.
- Demonstrated energy-efficient supermarket refrigeration and heat recovery systems in two new or remodeled supermarkets.
- Refined design of a "drop-in" heat pump water heater with industry and initiated 3 field site tests.
- Issued and awarded a competitive solicitation for building envelope technologies.
- Fabricated and demonstrated full-sized electrochromic windows.
- Demonstrated full-sized, high-performance, spectrally selective windows using enhanced ion-beam deposition.
- Completed and released the final version of DOE-2.2, which is easier to use and simulates building envelope and HVAC technologies.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

- Released alpha version of EnergyPlus, a major new energy simulation package developed with DOD that will replace DOE-2 as the most widely used energy analysis and simulation tool.
- Completed development of test procedures for duct distribution systems with ASHRAE and issued First Public Review.
- Issued Proposed Rules concerning test procedures for electric distribution transformers and dishwashers.
- Issued test procedures for large electric motors.
- Revised Advanced Notice of Proposed Rulemaking (ANOPR) concerning clothes washer standards.
- Published ANOPR for energy conservation standards for residential central air conditioners/heat pumps.

FY 2000 Planned Accomplishments

Technology Road Maps and Competitive R&D:

- Complete the development of technology road maps for lighting, windows, and commercial buildings.
- In collaboration with industry and the research community, begin the development of the road maps for residential buildings and appliances.
- In collaboration with industry, the research community, and DOE's Offices of Industrial Technologies (OIT) and Power Technologies (OPT), begin the development of the road map for buildings cooling, heating, and power.
- Develop, announce, and award the second competitive R&D solicitation to support industry-driven road maps and other innovative building R&D.

Residential Buildings Integration:

- Expand *Building America* partners from 100 to 200.
- With *Building America* partners, complete more than 2,000 highly energy-efficient, environmentally sound, and cost-effective houses. Disseminate results to builders of 15,000 other houses.
- Incorporate systems integration research recommendations from *Building America* into the President's Partnership For Advancing Technology in Housing (PATH).
- Complete development of the Residential Ventilation Standard with ASHRAE.
- Conduct evaluation to determine if upgraded model residential code (2000 IECC) will save energy.
- Issue Final Rule regarding standards for energy-efficient construction in Federal residential buildings.
- Issue NOPR updating the Final Rule for energy-efficient construction in Federal residential buildings.

Commercial Buildings Integration:

- Issue a competitive solicitation in response to the industry-derived commercial buildings road map and begin first cost-shared R&D to implement the commercial buildings road map.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

- Document the worker productivity gains from improved indoor environments in commercial buildings through on-site measurement and analysis of data.
- Scientifically validate techniques and technologies for indoor environment assessment.
- Prepare determination of building energy savings that could result from States adopting the upgraded model commercial energy code (Standard 90.1-1999).
- Issue the Final Rule on the Federal Commercial Building Energy Code, 10 CFR 434, which is based on proposed Standard 90.1-1999.

Equipment, Materials, and Tools:

- Issue competitive solicitations in response to industry-derived lighting, windows, and HVAC road maps.
- Complete a comprehensive technical and market analysis to quantify the energy conservation potential offered by hybrid lighting (lighting from centralized light sources and daylighting systems).
- Complete a collaborative study with industry to quantify vision improvements and energy conservation potential of advanced, outdoor illumination systems.
- Fabricate and conduct laboratory test of a rotary heat exchanger for a residential 3-ton natural gas absorption chiller.
- Demonstrate superinsulating materials with an R-50 insulating value per inch in building and appliance applications.
- Complete design of low-cost "drop in" heat pump water heater and coordinate national field studies with more than 50 units.
- Complete beta testing and release EnergyPlus Version 1.0 for general use.
- Work with private sector software developers to facilitate third party development of user-friendly interfaces for EnergyPlus.
- Issue Proposed and Final Rules concerning standards for fluorescent lamp ballasts and water heaters, and ANOPR and Proposed Rules concerning standards for residential central air conditioners.
- Issue Proposed Rules concerning test procedures for residential central air conditioners/heat pumps and Final Rules concerning test procedures for distribution transformers and dish washers.
- Issue Proposed and Final Rules incorporating legislated standards and test procedures for commercial furnaces.
- Issue Final Rule adopting certain ASHRAE 90.1-covered product types (commercial HVAC and water heaters).
- Issue NOPR for test procedures and incorporating legislated standards for commercial water heaters, air conditioners, and boilers.

FY 2001 Planned Accomplishments

Technology Road Maps and Competitive R&D:

- Complete the development of road maps for appliances and building envelope technologies in collaboration with industry and the research community.
- Complete the residential buildings road map in collaboration with PATH.
- Announce and award the third competitive R&D solicitation to support industry-driven road maps.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

Residential Buildings Integration:

- Transfer systems innovations derived from *Building America* to more than 4,100 private sector homes and Federal residences.
- Expand *Building America* partners from 200 to 225.
- With *Building America* partners, complete 3,000 energy-efficient, environmentally sound, high performance homes.
- Revise the voluntary residential building energy code.
- Complete evaluation of the differences between the 1998 and 2000 IECC and publish the formal determination.
- Develop new residential building energy code compliance tools for private sector and Federal residential construction.
- Issue updated Final Rule for energy-efficient construction in Federal residential buildings.
- Provide technical assistance to develop residential building energy codes in 5 countries.

Commercial Buildings Integration:

- Continue implementation of industry-identified R&D.
- Issue second competitive solicitation to implement whole-building activities based on the commercial buildings road map.
- Complete updating COMcheck code compliance tools for the upgraded commercial building model energy code, Standard 90.1 and upgraded Federal code, 10 CFR 434.
- Propose improvement to model commercial code in the areas of lighting controls, transformers, and fenestration.
- Provide technical assistance to develop commercial building energy codes in 5 countries.

Equipment, Materials, and Tools:

- Complete progress reviews of FY 1999 and FY 2000 competitively-awarded R&D projects in lighting research. Evaluate opportunities for continued success and refine energy conservation estimates associated with each technology.
- Test a breadboard prototype low-power sulfur lamp system using the lamp designs and power supply technologies developed in the prior two years.
- Fabricate and test innovative fixture designs that efficiently integrate and control ambient lighting requirements with task specific needs.
- Fabricate and test full-size, prototype commercial electrochromic windows.
- Double condenser-coupled absorption chiller ready for commercial production by industry.
- Begin fabrication of two different concepts of a prototype natural gas reformer for a proton exchange membrane (PEM) fuel cell.
- Develop high-efficiency dryers that are at least 20 percent more efficient than conventional products.
- Demonstrate biomass fuel-based stoves with twice the efficiency and ten times lower emissions than traditional biomass stoves.
- Develop air and vapor barrier alternatives to existing products that eliminate liquid and vapor traps.
- Plan and begin developing second release of EnergyPlus Version 1.1 with users and third party software vendors.
- Test and prepare for release the new simulation capabilities for EnergyPlus Version 1.1 and SPARK Version 1.1.

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

- Adapt user-friendly U.S. whole building energy design software to local building markets in 5 countries and train 250 architects, engineers, and builders in the use of tools.
- Issue Final Rule for standards for residential central air conditioners and clothes washers.
- Publish ANOPR for certain ASHRAE 90.1-covered product types (commercial HVAC and water heaters) and distribution transformers.
- Provide technical support and analysis tools for the development of 6 key energy efficiency appliance standards in 10 countries.
- Issue Final Rule for test procedures and incorporating legislated standards for commercial water heaters, air conditioners, and boilers.
- Issue Final Rule for test procedures for residential central air conditioners.

FY 2002 - FY 2005 Planned Accomplishments

Technology Road Maps and Competitive R&D:

- Transfer maintenance of completed road maps to the specific program areas: windows; commercial buildings, including buildings cooling, heating and power; HVAC and refrigeration; building envelope; residential buildings; and appliances. (FY 2002)

Residential Buildings Integration:

- Continue R&D efforts with industry. Focus on ending less promising R&D, completing high-potential R&D, and initiating new cost-shared R&D. (FY 2002 - 2005)
- Provide the necessary retrofit technologies to allow achievement of the national 30 percent goal to improve energy efficiency in 15 million existing homes. (FY 2003)
- Publish NOPR for the Federal Residential Building Energy Code Rule (10 CFR 435). (FY 2004)
- Publish a determination in the *Federal Register* regarding the energy savings of upgraded residential model code, 2003 IECC. (FY 2004)
- Transfer major systems innovations to a total of nearly 30,000 homes. (FY 2004)
- Complete updating of support materials to implement upgraded model residential code, 2003 IECC. (FY 2004 - 2005)

Commercial Buildings Integration:

- Continue R&D efforts with industry. Focus on ending less promising R&D, completing high-potential R&D, and initiating new cost-shared R&D. (FY 2002 - 2005)
- Complete the initial projects identified in the FY 1999 commercial building road map. (FY 2004)
- Publish Federal Commercial Building Energy Code Final Rule. (FY 2004)
- Publish a determination in the *Federal Register* regarding the energy savings of upgraded commercial model code, Standard 90.1. (FY 2004)
- Complete updating of support materials to implement upgraded model commercial code, Standard 90.1. (FY 2004 - 2005)

I. Mission Supporting Goals and Objectives: BUILDING RESEARCH AND STANDARDS (Cont'd)

Equipment, Materials, and Tools:

- Continue R&D efforts with industry. Focus on ending less promising R&D, completing high-potential R&D, and initiating new cost-shared R&D. (FY 2002 - 2005)
- Conduct test procedure and standards rulemakings for priority products. (FY 2002)
- Begin designing critical components for a laboratory 50-kW PEM fuel cell. (FY 2002)
- Complete development, test, and release Version 1.1 of EnergyPlus for general use. (FY 2002)
- Commercialization of high efficiency clothes dryer by industry. (FY 2003)
- Begin fabricating a 50-kW PEM fuel cell for building applications. (FY 2003)
- Begin demonstration of Hi-Cool GAX heat pumps for residential applications. (FY 2004)
- Develop, test, and release Version 1.2 of EnergyPlus. Planned new features include electrical system simulation to facilitate evaluation of buildings with integrated photovoltaic and fuel cell systems. (FY 2004)
- Begin testing Hi-Cool absorption heat pumps. (FY 2004)

II. A. Funding Table: BUILDING RESEARCH AND STANDARDS

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Technology Road Maps and Competitive R&D	\$ 6,262	\$ 6,885	\$ 11,000	\$ 4,115	59.8%
Residential Buildings Integration					
Research and Development	5,570	10,463	12,580	2,117	20.2%
Energy Efficiency in Industrialized Housing	1,279	1,000	^{a/}	-1,000	-100.0%
Residential Energy Efficiency Program	590	0	0	0	0.0%
Home Energy Rating Systems	1,510	0	0	0	0.0%
Residential Building Energy Codes	480	485	900	415	85.6%
Total, Residential Buildings Integration	9,429	11,948	13,480	1,532	12.8%
Commercial Buildings Integration					
Research and Development	1,931	3,650	5,460	1,810	49.6%
Commercial Building Energy Codes	588	594	1,000	406	68.4%
Total, Commercial Buildings Integration	2,519	4,244	6,460	2,216	52.2%
Equipment, Materials, and Tools					
Lighting Research and Development	5,394	6,000	6,360	360	6.0%
Space Conditioning and Refrigeration R&D	11,490	15,000	19,763	4,763	31.8%
Cogeneration/Fuels Cells	1,750	3,550	5,500	1,950	54.9%
Appliances and Emerging Technologies	1,500	1,500	2,585	1,085	72.3%
Building Envelope Research and Development	11,499	11,723	12,327	604	5.2%
Analysis Tools and Design Strategies	4,013	4,058	7,360	3,302	81.4%
Lighting and Appliance Standards.	6,475	10,500	15,265	4,765	45.4%
Total, Equipment, Materials, and Tools.	42,121	52,331	69,160	16,829	32.2%
Total, Building Research and Standards.	\$ 60,331	\$ 75,408	\$ 100,100	\$ 24,692	32.7%

^{a/} Activities formerly identified as “energy efficiency in industrialized housing” will now be conducted and funded within the Building America initiative in order to use the proposed request in a leveraged and more cost-effective manner.

II. B. Laboratory and Facility Funding Table: BUILDING RESEARCH AND STANDARDS

	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Argonne National Lab (East)	\$ 200	\$ 200	\$ 200	\$ 0	0.0%
Brookhaven National Lab	600	600	600	0	0.0%
Lawrence Berkeley National Lab	8,500	8,500	8,500	0	0.0%
National Renewable Energy Lab	5,881	8,600	8,600	0	0.0%
Oak Ridge National Lab	12,300	12,500	12,500	0	0.0%
Pacific Northwest National Lab	3,682	4,000	4,000	0	0.0%
All Others	29,168	41,008	65,700	24,692	60.2%
Total, Building Research and Standards	<u>\$ 60,331</u>	<u>\$ 75,408</u>	<u>\$ 100,100</u>	<u>\$ 24,692</u>	<u>32.7%</u>

III. Performance Summary: (New BA in thousands of dollars)

Building Research
and Standards

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Technology Road Maps and Competitive R&D.	\$ 6,262	\$ 6,885	\$ 11,000

Program Activity	FY 1999	FY 2000	FY 2001
Technology Road Maps and Competitive R&D	<p>TRANSFER FROM: Building Equipment and Materials</p> <p>TECHNOLOGY ROAD MAPS AND COMPETITIVE R&D: This effort represented a new approach to conducting research for the building sector based on the BTS strategic plan. The overall goal was to make BTS programs more responsive to industry needs and to greatly increase the level of competition in executing the program. Began four technology road maps for lighting, windows, commercial buildings, and building envelope technologies in collaboration with industry and the research community. Participants included industry leaders, academia, National Laboratories, States, and other road map contributors. The goal was to identify R&D necessary to develop and deliver new energy-efficient technologies to the marketplace and to develop metrics in concert with industry partners during the road-mapping process. Research and development actions that were identified as appropriate for DOE will be undertaken through competitive procurement that will have significant cost sharing with</p>	<p>TECHNOLOGY ROAD MAPS AND COMPETITIVE R&D: In collaboration with industry partners, academia, States, and National Laboratories, BTS will complete the strategic road maps for lighting, windows, and commercial buildings; continue developing the building envelope technologies road map; and begin developing long-term strategic road maps for residential buildings, appliances, and buildings cooling, heating, and power in collaboration with OIT. BTS will solicit additional proposals from industry, academia, States, and National Laboratories for R&D related to the completed road maps and for new and innovative technologies and other research topics not covered by the road maps. Selection criteria include technical relevance to the vision, potential energy savings, industry participation, cost realism and sharing, and prior performance of the researcher. (FETC, NREL, ORNL, PNNL, TBD) (Road Maps \$1,762, Competitive R&D \$5,123) (\$6,885)</p>	<p>TECHNOLOGY ROAD MAPS AND COMPETITIVE R&D: In collaboration with industry partners, academia, States, and National Laboratories, complete the strategic road maps for residential buildings, appliances, and building envelope technologies. Solicit 14 to 21 additional proposals from these stakeholders for R&D related to completed road maps and for new and innovative technologies and other research topics not covered by the road maps. The funding for road-mapped activities will be used to bridge the gap between ongoing R&D activities and newly identified high-priority areas. Selection criteria include relevance to the vision, technical feasibility, potential energy savings, and a minimum 20 percent cost share.</p> <p>Facilitate development of international R&D partnerships to adapt and implement key areas of the road maps leading to adoption of DOE-developed technology in international markets. (Road Maps \$1,000, Competitive R&D \$9,000,</p>
Technology Road Maps and Competitive R&D (Cont'd)			

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	\$6,262	\$6,885	\$11,000

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Residential Buildings Integration			
Research and Development	\$ 5,570	\$ 10,463	\$ 12,580
Energy Efficiency in Industrialized Housing	1,279	1,000	^{b/}
Residential Energy Efficiency Program	590	0	0
Home Energy Rating Systems	1,510	0	0
Residential Building Energy Codes	480	485	900
Total, Residential Buildings Integration	\$ 9,429	\$ 11,948	\$ 13,480

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration	RESEARCH AND DEVELOPMENT:	RESEARCH AND DEVELOPMENT:	RESEARCH AND DEVELOPMENT:

INTRODUCTION: The R&D program focuses on advanced, integrated technologies; design techniques; and practices to optimize whole-building energy performance and develop the next generation of zero- and net-energy homes. The R&D program (*Building America*) increases the capability of the *Building America* consortia to demonstrate, test, and integrate the innovative technologies and practices into new and existing housing to improve energy efficiency and performance. Examples include natural and hybrid cooling, duct behavior, application of advanced technologies such as fuel cells, solar and cogeneration, and whole building design including passive solar strategies. By the end of FY 2001 there will be 12 *Building America* communities with more than 5,800 energy efficient, high performance homes. In FY 2000, these homes will be 40 percent more energy efficient than the current building code and in FY 2001 they will be 60 percent more efficient. *Building America* will provide research recommendations to the public/private Partnership for Advancing Technology in Housing (PATH) through BTS' Community Energy Program.

^{b/} Activities formerly identified as "energy efficiency in industrialized housing" will now be conducted and funded within the Building America initiative in order to use the proposed request in a leveraged and more cost-effective manner.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	<p>TRANSFER FROM: Building Systems Design</p> <p><i>Building America:</i> Expanded <i>Building America</i> to include 100 industry members. Completed the development of 825 highly energy-efficient, environmentally friendly, and cost-effective houses. Shared information with the overall building industry so that innovations used by <i>Building America's</i> builders can be transferred to all lead builders within 7 to 10 years. Provided systems integration research recommendations from <i>Building America</i> to PATH. Continued the learning process from test and prototype production houses, expanded upon existing developments.</p>	<p><i>Building America:</i> Expand the number of <i>Building America</i> partners from 100 to 200 and increase industry participation. The <i>Building America</i> consortia will develop more than 2,000 highly energy-efficient, environmentally sound, and cost-effective houses. Disseminate innovations and results to housing through builders of 15,000 other houses and PATH, a comprehensive Presidential initiative that brings Government (DOE, HUD, Commerce, DOD, EPA, FEMA, HHS, Labor, USDA, VA) and industry together to accelerate the widespread use of advanced, energy-efficient technologies to radically improve the affordability, durability, and environmental quality of homes.</p>	<p><i>Building America:</i> Increase industry participation by signing up 25 new partners, including lead builders, equipment manufacturers, material suppliers, contractors, mortgage lenders, and utilities, bringing the total number of partners to 225. The <i>Building America</i> consortia will develop more than 3,000 highly energy-efficient, environmentally sound, and cost-effective houses In addition to a 50 percent cost share, the new partners will contribute significant efficiency improvements to the new housing stock by broadening the participation of production builders, their suppliers and contractors, and local planning officials. The FY 2001 <i>Building America</i> program has targeted an overall 60 percent improvement in energy efficiency over the current building code.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	Started five new, first-generation communities of 200 homes each.	Begin developing a subdivision or community using tested, advanced design strategies with one <i>Building America</i> consortium member.	Add 7 additional communities with high performance building systems to serve as models of resource-efficient residential neighborhoods, bringing the total number of communities to 12. The 7 communities will add 3,000 new homes, bringing the total to 5,800.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	<p>Continued critical next generation strategic planning and systems integration research as construction begins on several second generation test homes to validate advancements and incorporate them into renovations and new homes. R&D advancements included improved thermal distribution using validation, demonstration, and training to define quantitatively the benefits of efficient distribution systems. Validated the design and analysis tools used for these buildings. In an effort to push performance levels higher, expanded the <i>Building America</i> program to the next generation of systems integration research—e.g., “zero net-energy home”—and incorporated emerging technologies and design techniques</p>	<p>Conduct field tests and apply results to modify and improve building systems using a systems engineering approach. Using data from completed and monitored buildings, test re-engineered, advanced design strategies to verify their improved performance and appropriateness. Work with industry to develop lightweight thermal storage systems such as phase change materials, small-scale auxiliary heating and cooling systems, and reliable control systems. Expand current testing of integrated appliances and building systems in cold, mixed, and hot/dry climates to include low-energy designs in hot/humid climates. In addition, develop, validate, and adapt advanced technologies permitting “modular” retrofit of existing houses. Modular retrofit will shorten the time buildings must be vacant for rehabilitation, lower costs, and result in better, more consistent performance. New activities to develop and demonstrate retrofit technologies include working with the private sector and other agencies through PATH’s existing buildings programs.</p>	<p>Apply strategies in these communities that in addition to saving energy, reduce construction waste, conserve water, and use best land practices. Use a systems engineering approach to evaluate cost and performance tradeoffs associated with advanced equipment and systems to meet building heating, cooling, ventilation, hot water, and lighting loads. Expand use of high performance envelope designs, gas-fired cooling systems, renewable energy technologies, distributed power generation systems, and Energy Star appliances. Monitor and report on performance of the initial, community-scale <i>Building America</i> projects to determine the impact of occupant behavior on overall building energy use. Through continued systems engineering research and demonstration, expand the technology base for retrofit technologies in response to the needs of PATH, DOE’s Weatherization Assistance Program, and DOE’s <i>Building America</i> factory-constructed infill and brownfield projects.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>Improved and simplified advanced concepts used in the passive solar design houses constructed and monitored in FY 1997 and 1998. Replicated the lessons learned in additional subdivision/planned unit developments, providing the opportunity to test passive cooling concepts and more effective means to integrate the auxiliary heating and cooling systems and other renewable energy technologies with the passive solar ones.</p>	<p>Continue development and testing of more effective natural and hybrid cooling technologies. Work is also directed towards integrating auxiliary heating and cooling systems which incorporate renewable energy technologies and other advanced technologies with potential application to residential buildings. Improve affordable housing design to ensure that the homes incorporate a whole buildings approach to energy efficiency.</p>	<p>Apply promising natural and hybrid cooling strategies in one or two advanced, very low energy buildings. Develop and demonstrate residential ventilation strategies and designs that meet the new ASHRAE Residential Ventilation Standard 62.2 expected to be issued in FY 2000. Working with <i>Building America</i> industry teams, continue to develop cost-effective strategies for downsizing space conditioning equipment for very low or zero energy/net energy buildings without compromising comfort or energy performance on peak heating and cooling periods.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	<p>Issued and awarded a competitive solicitation that addressed the demand for industrialized housing by focusing on the process of producing energy-efficient industrialized housing, such as panelized, modular, and HUD Code manufactured units. Used a prototype manufacturing facility computer simulation to demonstrate adaptability of production facilities and assisted in the continuing effort to improve the energy efficiency of the construction processes in two manufactured housing plants. Completed cooperative research with the American Lung Association for the construction, monitoring, and evaluation of Health Houses.</p> <p>Completed the Residential Energy Efficiency Program by training builders and building-related stakeholders in the latest <i>Building America</i> technologies and building practices. The trainees used a comprehensive design and renovation approach based on <i>Building America</i> techniques and technologies research to obtain, on average, energy-efficiency gains of 20 percent energy in existing housing.</p>	<p>As part of <i>Building America</i>, begin cooperative work with the manufactured housing industry on incorporating component efficiency improvements into a systems integrated approach.</p> <p>Residential Energy Efficiency Program complete.</p>	<p>Continue work with factory-constructed housing industry on developing an integrated approach to building design and component efficiency that was initiated by the FY 1999 competitive solicitation.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	<p>Completed the fifth and final year of financial support for the seven pilot states under the Home Energy Rating Systems program. Provided support to other competitively-selected states to overcome barriers to energy efficiency financing through Home Energy Ratings and related activities. (The Integrated Building and Construction Solutions of Pittsburgh (IBACOS), Building Science Consortium, Consortium For Advanced Residential Buildings (CARB), the Hickory Consortium, NREL, National Association of Homebuilders' Research Center (NAHBRC), LBNL, ORNL, Industrialized Housing Partnership, LBNL, Tuskegee Institute, Energy Efficient Building Association (EEBA), Southface Energy Institute, Alaska, Arkansas, California, Colorado, Mississippi, Virginia, Vermont, Kentucky, Michigan, Wisconsin, Nebraska, Delaware, Idaho, Washington) (Special Project State Grants included \$250 from Home Energy Rating Systems.) (<i>Building America</i> \$5,570, Industrialized Housing \$1,279, Residential Energy Efficiency Program \$590, Home</p>	<p>A new implementation mechanism for the <i>Building America</i> program is participation in the Special Project State Grants. Grants are provided to States on a competitive basis. IBACOS, CARB, the Hickory Consortium, NREL, National Association of Homebuilders' Research Center (NAHBRC), LBNL, Bectel/Battelle/MRI, others TBD) (Special Project State Grants include \$300 from <i>Building America</i>) (<i>Building America</i> \$10,463, Industrialized Housing \$1,000) (\$11,463)</p>	<p>Participate in the Special Project State Grants that are provided to states on a competitive basis. (IBACOS, Building Science Consortium, CARB, Florida Solar Energy Center, NREL, NAHBRC, LBNL, ORNL, others TBD). (Special Project State Grants include \$300 from <i>Building America</i>.) (\$12,580)</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	TRANSFER FROM: Codes and Standards	RESIDENTIAL BUILDING ENERGY CODES:	RESIDENTIAL BUILDING ENERGY CODES:
	RESIDENTIAL BUILDING ENERGY CODES (Formerly Analysis):	RESIDENTIAL BUILDING ENERGY CODES:	RESIDENTIAL BUILDING ENERGY CODES:
	INTRODUCTION: The activity develops and promulgates Federal residential codes and participates in developing and disseminating voluntary (model) residential codes in partnership with the building industry consensus and model code organizations, States, code officials, design professionals, builders, building product manufacturers, public interest groups, and utilities. Codes are essential to transferring energy-efficient technologies and practices in residential buildings. Technical and financial assistance, training, and outreach activities for residential building codes are included in the Community Energy Program under Building Technology Assistance programs.	Support upgrading voluntary residential building energy codes to help deploy the best technologies and practices, increase efficiency, and reduce carbon emissions. Begin developing an improved residential compliance tool. Conduct an evaluation to determine if the upgraded voluntary residential code, 2000 IECC, will save energy and quantify the savings. This Determination will be used by States in evaluating whether to update their residential codes to meet the new voluntary codes.	Promote specific revisions to the residential building codes that will support the deployment of five new EE technologies, such as fuel cells and microturbine generator sets, that are completing research and development. Complete development of new code compliance tools, MEC <i>check</i> and FED <i>check</i> , for private sector and Federal residential construction. Complete evaluation of differences between the 1998 and 2000 International Energy Conservation Code (IECC) and issue a Determination.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Residential Buildings Integration (Cont'd)	<p>Developed improvements to the Federal residential code based on those proposed and incorporated them into the 1998 IECC and other residential codes. Analyzed passive and active solar space cooling and heating technologies for inclusion in the next-generation Federal residential code. (PNNL, NREL) (\$480)</p>	<p>As part of the Federal code process, promulgate final Energy Code for Federal residential buildings. Propose upgraded Federal residential building standards rulemaking that includes improvements based on the 2000 IECC, other residential codes, and the use of solar space cooling and heating technologies. (PNNL, NREL) (\$485)</p>	<p>Issue updated final Energy Code for Federal residential building standards based on improvements to the 2000 IECC, and develop cost-effective guidelines for advanced building construction practices and energy-efficient technologies based on whole building systems approach and <i>Building America</i> successes. (PNNL, NREL) (\$650)</p> <p>International Clean Energy Initiative - As part of the PCAST initiative, help develop residential building energy codes in 5 countries based on local construction practices and resources and provide technical support to establish residential building design competitions. (TBD) (PCAST International \$250)</p>
	\$9,429	\$11,948	\$13,480

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Commercial Buildings Integration			
Research and Development	\$ 1,931	\$ 3,650	\$ 5,460
Commercial Building Energy Codes	<u>588</u>	<u>594</u>	<u>1,000</u>
Total, Commercial Buildings Integration	\$ 2,519	\$ 4,244	\$ 6,460

Activity	FY 1999	FY 2000	FY 2001
Commercial Buildings Integration	<p>RESEARCH AND DEVELOPMENT (Formerly Building Performance):</p> <p>INTRODUCTION: The R&D program works with the design and construction community, controls and equipment companies, developers, and building owners and operators to demonstrate, test, and integrate innovative technologies and practices into new and existing commercial buildings to improve energy efficiency and performance. The R&D program focuses on advancing integrated technologies and practices to optimize whole building energy performance and significantly lower energy use.</p> <p>TRANSFER FROM: Building Systems Design</p> <p>Developed and advertised a competitive solicitation to implement whole-building activities based on the commercial buildings road map.</p>	<p>RESEARCH AND DEVELOPMENT:</p> <p>Issue and award a competitive solicitation to implement whole-building activities based on the commercial buildings road map.</p>	<p>RESEARCH AND DEVELOPMENT:</p> <p>Issue and award a second competitive solicitation to implement whole-building activities based on the commercial buildings road map.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Commercial Buildings Integration (Cont'd)	<p>With industry teams of manufacturers, designers, and builders, worked to improve and accelerate research and adoption of building processes and technical innovations that increase efficiency and affordability. Continued building commissioning and performance monitoring of school buildings with Southern California Edison. Building commissioning is a process during the design and construction of a new building that assures that the building operates as specified. With industry, began implementing actions defined in the national strategy for incorporating building commissioning as a vital component of the industry construction process. Completed commissioning equipment/system performance technical specifications. This energy benchmarking tool will be distributed widely for use by architects and engineers. In partnership with industry, promoted the widespread use of the early problem detection tool, the Whole Building Diagnostician, developed with Honeywell and University of Colorado (UC).</p>	<p>Accelerate R&D on advanced technologies in collaboration with the design and construction community, controls and equipment companies, developers, and building owners and operators by funding cost-shared R&D projects identified in the commercial buildings road map. If supported by the industry-developed road map, continue work on several projects, such as the building commissioning study of GSA's Adaptable Workplace Lab; the transfer of the Whole Building Diagnostician, a performance monitoring tool, to the private sector for commercialization; research on techniques for diagnosing problems in building systems; and the analysis of advanced system design and control strategies for high-performance buildings.</p>	<p>Conduct cost-shared R&D on advanced technologies identified in the commercial buildings road map in collaboration with the design and construction community, controls and equipment companies, developers, and building owners and operators. New areas may include energy management practices, whole building design concepts, low-cost sensor technology, and information management systems. In coordination with the <i>Rebuild America</i> program and its most progressive community partnerships, expands research on innovative techniques and strategies for energy-efficient building renovations. Work with 5 to 10 <i>Rebuild America</i> community partnerships to test the viability of new energy-efficient commercial equipment and systems in practical applications. Research and demonstrate energy efficiency techniques and strategies, including whole-building design techniques, Internet-based building controls combined with real time utility pricing strategies, innovative lighting design and technologies, new information management techniques for the design and construction</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>Supported National Science Foundation grants to university “centers of excellence” by completing the “Intelligent Workplace” office laboratory at Carnegie Mellon University that allows performance testing of commercial building operating systems integration. Established a project performance database, which documents commercial building retrofits, including energy use, financing, and measurement and verification methods. Conducted monitoring and analysis activities at the high-performance Visitor Center building at Zion National Park in Utah. Completed and published findings from the lighting/controls systems integration study on the 450 Golden Gate building in San Francisco.</p>	<p>Support National Science Foundation grants to university “centers of excellence”, such as the Center for the Built Environment in Berkeley, California that tests and assesses advances and innovations in materials, components, and assemblies for thermal, visual, acoustic, and air quality performance. In addition to projects stemming from the road map, identify two major commercial real estate developments with private sector partners to test and evaluate BTS-developed technologies.</p>	<p>Support National Science Foundation grants to university “centers of excellence”, such as the Center for the Built Environment in Berkeley, California that tests and assesses advances and innovations in materials, components, and assemblies for thermal, visual, acoustic, and air quality performance. These partners have historically cost shared, providing in FY 1999 more than 6 times the BTS funding of \$230,000. Publish findings from the testing and evaluation of BTS-developed technologies by two major commercial real estate developments.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Commercial Buildings Integration (Cont'd)	<p>Conducted research to offset the increase in energy use that will result from the expected increase in the recommended ventilation rate for commercial buildings in the industry consensus standards. Explored natural ventilation solutions for commercial buildings. Continued interagency work on productivity effects from improved indoor environments to include widespread dissemination of findings. Fundamental studies with National Institute of Occupational Safety and Health (NIOSH) reported on a second hypothesis for ventilation rates, developed in cooperation with industry and academia. (LBNL, PNNL, Honeywell Technology Center, National Science Foundation, UC) (\$1,931)</p> <p>TRANSFER FROM: Codes and Standards</p> <p>COMMERCIAL BUILDING ENERGY CODES (Formerly Voluntary and Federal Energy Codes):</p>	<p>Document the worker productivity gains from improved indoor environments in commercial buildings through on-site measurement and analysis of data. Scientifically validate techniques and technologies for indoor environment assessment in collaboration with industry, NIOSH, and other Federal agencies. (PNNL, NREL, Massachusetts Institute of Technology, LBNL, Purdue University, Portland Energy Conservation, Inc. (PECI), NIST) (\$3,650)</p> <p>COMMERCIAL BUILDING ENERGY CODES:</p>	<p>Conduct research to offset the increase in energy use that will result from the expected increase in the recommended ventilation rate for commercial buildings in the industry consensus standards. Explore natural ventilation solutions for commercial buildings. Continue interagency work on productivity effects from improved indoor environments to include widespread dissemination of findings. (PNNL, NREL, UC, Carnegie Mellon University, LBNL, NIST) (\$5,460)</p> <p>COMMERCIAL BUILDING ENERGY CODES:</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
<p>INTRODUCTION: The activity develops and promulgates Federal commercial building codes and participates in developing and disseminating voluntary (model) commercial codes in partnership with the building industry consensus and model code organizations, States, code officials, design professionals, builders, building product manufacturers, public interest groups, and utilities. Codes are essential to transferring energy-efficient technologies and practices in commercial buildings and help to reduce carbon emissions. Technical and financial assistance, training, and outreach activities for commercial building codes are included in the Community Energy Program under Building Technology Assistance programs.</p>			

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

<u>Activity</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Commercial Buildings Integration (Cont'd)	<p>Promulgated final Energy Code for Federal Commercial Buildings. Completed preparation and distributed technical assistance materials in support of 1999 Federal code. Implemented training programs to teach Federal employees and their contractors the provisions of the 1998 Federal code. Issued proposed rules amending the Federal commercial code to further support Federal energy efficiency goals.</p> <p>Supported the voluntary energy code process, including analysis, proposed revisions, and responses to public comments on the proposed upgrading of ASHRAE/IESNA Standard 90.1-1989. Conducted a comparative analyses of the relative energy efficiency of State commercial building codes compared to the proposed ASHRAE/IESNA Standard. Developed and proposed improvements to the simplified compliance path for commercial buildings in the IECC.</p>	<p>Promulgate the final Energy Code for Federal Commercial Buildings (10 CFR 434, based on Standard 90.1-1999).</p> <p>Determine if the 1999 voluntary commercial energy code proposed by ASHRAE/IESNA saves energy compared with the current version. This Determination will be used by States in updating their commercial codes to meet the new voluntary codes. Develop and propose a simplified compliance approach similar to the IECC for inclusion in ASHRAE/IESNA Standard 90.1 to assist States in implementing the standard as a code.</p>	<p>No Federal commercial building energy code activities.</p> <p>Develop supporting materials and propose lighting controls, transformer, and fenestration (windows and doors) amendments to the model commercial energy code, Standard 90.1-1999. Develop and propose upgrades to ASHRAE/IESNA Guideline 18, Energy Guideline for Buildings Except Low-Rise Residential Buildings, to assist those wanting to go beyond Standard 90.1-1999. Propose the International Energy Code Council adopt Standard 90.1-1999 by reference in the 2003 IECC and upgrade their simplified compliance path.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Commercial Buildings Integration (Cont'd)	Completed the initial version of <i>COMcheck-PLUS</i> to facilitate compliance with the Multistate Commercial Code and the 1998 IECC. Upgraded <i>COMcheck-EZ</i> to reflect changes in the IECC. (EPA Act Section 101) (PNNL, NREL) (\$588)	Initiate revisions to <i>COMcheck-EZ</i> and <i>COMcheck-PLUS</i> to include compliance with ASHRAE/IESNA Standard 90.1-1999. Revise core materials, train-the-trainer program, and training to reflect the new requirements of ASHRAE/IESNA Standard 90.1. (EPA Act Section 101) (PNNL) (\$594)	Complete revisions to <i>COMcheck-EZ</i> , and <i>COMcheck-PLUS</i> , including compliance checking for the upgraded Federal commercial code, 10 CFR 434. (EPA Act Section 101) (see also Special Project State Grants and Community Energy Program) (PNNL) (\$750) International Clean Energy Initiative - As part of the PCAST initiative, help develop commercial building energy codes in 5 countries based on local construction practices and resources and provide technical support to establish commercial building design competitions. (TBD) (PCAST International \$250)
	\$2,519	\$4,244	\$6,460

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Equipment, Materials, and Tools			
Lighting Research and Development	\$ 5,394	\$ 6,000	\$ 6,360
Space Conditioning and Refrigeration R&D			
Residential Absorption Heat Pumps	5,779	6,265 ^{c/}	7,910 ^{c/}
Desiccants and Chillers	2,425	3,990 ^{c/}	7,623 ^{c/}
Furnaces and Boiler/Combustion Research	489	500 ^{c/}	0
Refrigeration	<u>2,797</u>	<u>4,245^{c/}</u>	<u>4,230^{c/}</u>
Total, Space Conditioning and Refrigeration R&D	11,490	15,000	19,763 ^{d/}
Cogeneration/Fuel Cells	1,750	3,550	5,500
Appliances and Emerging Technologies R&D	1,500	1,500	2,585
Building Envelope Research and Development		11,723	12,327
Competitive Solicitation	1,667		
Thermal Insulation and Building Materials	3,035		
Urban Heat Island Research	687		
Electrochromic Research	4,203		
Superwindow Technologies	343		
Advanced Glazing	<u>1,564</u>		
Total, Building Envelope Research and Development	11,499	11,723 ^{d/}	12,327 ^{e/}
Analysis Tools and Design Strategies	4,013	4,058	7,360
Lighting and Appliance Standards	<u>6,475</u>	<u>10,500</u>	<u>15,265</u>
Total, Equipment, Materials, and Tools	\$ 42,121	\$ 52,331	\$ 69,160

^{c/} Proposed funding represents planning estimates.

^{d/} This includes an open, competitive solicitation at a minimum of \$2.0 million consistent with our roadmapping strategy and peer review.

^{e/} Consolidation of buildings R&D envelope components into a focused, integrated research activity.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools	LIGHTING R&D:	LIGHTING R&D:	LIGHTING R&D:
<p>INTRODUCTION: In close partnership with manufacturers, R&D firms, universities, National Laboratories, utilities and other professional organizations, develop highly-efficient, advanced lighting technologies that will achieve the goal of 50% lighting energy reduction by 2010. Consistent with the BTS Strategic Plan, new lighting R&D activities are being initiated through competitive, cost-shared mechanisms. Consistent with R&D priorities established independently by the lighting technology road map, the Lighting R&D program supports R&D in three broad areas: new light sources, integrated controls and distribution, and lighting impacts. Research on new light sources seeks technology breakthroughs for conventional types of lamps (incandescent, fluorescent, and gas discharge) to improve efficiency 20 to 50% and develops revolutionary new lighting technologies which can potentially double efficiency. Research on controls and distribution focuses on achieving energy efficiency by delivering light in the right quantity and quality to meet occupant needs in the networked buildings of the future. Lighting impacts projects explore the complex interrelationship between human vision and efficient light utilization.</p>			

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>TRANSFER FROM: Building Equipment and Materials</p> <p>Initiated several new, cost-shared research activities through competitive solicitation as identified below. Under light sources research, completed a cost-shared effort with a major lamp manufacturer to develop a low-cost compact fluorescent lamp (CFL). This project identified the cost and performance trade-offs of various ballast circuits and internal lamp component technologies and concluded that a low-cost, high quality CFL with an integrated ballast was not achievable. Initiated a competitively-awarded project to develop technology for a permanent, luminaire-integrated ballast for CFLs to avoid severe cost constraints. Continued to develop the sulfur lamp, focusing on technologies critical to achieving a low-power lamp with wide application: new lamp designs and highly efficient solid-state power sources. Initiated a study of solid-state light sources (which are developing very rapidly for information displays and</p>	<p>Issue a competitive solicitation to fund new cost-shared R&D activities identified in the lighting road map. Under the light sources research element, continue research on a luminaire-integrated ballast for CFLs, cost-shared with a major lamp manufacturer, so that a laboratory breadboard prototype can be constructed and tested. Continue to develop the sulfur lamp, focusing on technologies critical to achieving a low-power lamp with wide application: new lamp designs and highly efficient solid-state power sources. Continue to evaluate the promise of solid-state light sources for building lighting through industry interaction and continue a competitively-awarded project to develop basic technology for a new type of solid-state light source with a small business firm by evaluating advanced light-emitting materials. Initiate exploratory studies of approaches for increasing the efficiency of solid-state light-emitting materials. Completed a</p>	<p>Further align R&D priorities with the lighting technology road map and accelerate the development of energy-efficient lighting technology with lighting industry partners, small business firms, National Laboratories and universities, using the competitive solicitation approach begun in FY99. In the new light sources area, continue research on two paths: seeking technology breakthroughs for conventional types of lamps (incandescent, fluorescent, and gas discharge) to improve efficiency 20 to 50% and developing revolutionary lighting technologies which can potentially double efficiency. Continue research on a luminaire-integrated ballast for CFLs, cost-shared with a major lamp manufacturer, by testing a fully integrated laboratory test unit and evaluating marketing strategies. Continue to develop the low-power sulfur lamp by testing a breadboard prototype lamp system using the lamp designs and power supply</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Under the lighting impacts research element, evaluated initial experimental results of mesopic lighting together with industry. Mesopic lighting modifies the spectrum of high-intensity outdoor lamps to produce a better quality light that improves vision, thereby allowing lamps to be operated with less energy. Began planning industry-recommended field tests for mesopic street lighting with technical assistance and cofunding from the four largest manufacturers of lighting in the U.S. (GE, Fusion Lighting, LBNL, LANL, Meadow River, ADL, ORNL, Translight, Lighting Research Center) (\$5,394)</p>	<p>Under the lighting impacts research element, begin industry-recommended field tests of the impact of mesopic street lighting on vision with technical assistance and cofunding from four large manufacturers of lighting. To increase effort on lighting impacts as suggested in the lighting road map, initiate the first field test of the scotopic lighting concept in an office building. (GE, Fusion Lighting, LBNL, Meadow River, ADL, Translight, Lighting Research Center, Abratech, ADL, TBD) (\$6,000)</p>	<p>In the lighting impacts area, achieve two major milestones by completing two preliminary field tests of the most promising concepts for saving energy through improved vision, with a potential energy savings of 30% in office and/or highway lighting systems. Based upon the success of these demonstrations, initiate more comprehensive tests to fully characterize the energy conservation potential, economic risk, and technical uncertainties, guided by detailed technology transfer plans prepared with industry partners. (GE, Fusion Lighting, LANL, LBNL, Meadow River, ADL, Translight, Lighting Research Center, Abratech, TBD) (\$6,360)</p>
	SPACE CONDITIONING AND REFRIGERATION R&D:	SPACE CONDITIONING AND REFRIGERATION R&D:	SPACE CONDITIONING AND REFRIGERATION R&D:

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
<p>INTRODUCTION: The program works in collaboration with HVAC and refrigeration manufacturers and the natural gas industry to develop and facilitate commercialization of advanced heating, cooling, and refrigeration technologies and equipment using benign refrigerants and natural gas absorption systems that can reduce energy use by as much as 50 percent. This program has the potential to substantially reduce the electric load peaking problem experienced by electric utilities during summer cooling and reduce emissions of CO₂ and environmental pollutants by more than 60 percent. It will also increase the international competitiveness of U.S. industry through globally marketable technology and products. Several thermally-activated absorption heat pumps are being developed, including an improved heat pump design using generator absorber heat exchange (GAX) technology for the residential and light commercial markets where heating dominates and two design concepts for “Hi-Cool” absorption heat pumps for markets where cooling dominates. Research for the large commercial market focuses on double condenser-coupled (DCC) absorption chillers that enhance the internal recovery of heat, thereby increasing the thermal efficiency, and on desiccant cooling technologies that efficiently and cost-effectively remove moisture from the air and improve air quality.</p>			

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Designed, built, and completed laboratory testing of heat exchangers in collaboration with a major HVAC manufacturer. Built multiple prototype GAX heat pumps in collaboration with a small business manufacturer and initiated field testing and evaluation at a gas industry site. With the industry-led consortium, built critical components for the scale-up design of the Absorption Sealed Module (ASM) that will house the GAX technology and completed manufacturing cost analysis to verify first cost and marketability of a commercial product. Completed fabrication of the ASM for a prototype small commercial Hi-Cool branched-GAX heat pump. Completed laboratory testing of high-temperature heat exchanger for the residential Solid/Vapor Hi-Cool heat pump.</p>	<p>Develop and issue solicitations for projects that were identified and prioritized in the FY 1999 HVAC and Refrigeration Road Map. Field test multiple GAX heat pumps for potential commercialization in FY 2001. Complete testing of a laboratory high-temperature heat exchanger prototype and begin prototype development for the 3-ton Solid/Vapor Hi-Cool heat pump that could be introduced to the market in 2005. Complete field test of the commercial prototype and facilitate the commercialization of a 450-ton DCC chiller using the DOE-patented lithium bromide/water refrigerant with York International. Fabricate and begin testing a rotary heat exchanger for a residential 3-ton natural gas absorption chiller.</p>	<p>Complete multiple unit field test of GAX heat pump. Begin fabricating several pre-production prototype units for introduction into the market place. Fabricate several engineering prototype units of a 3-ton Solid/Vapor heat pump for field test and evaluation. Complete work on a pre-production 450 ton DCC cycle chiller and begin technology transfer to the market place. Continue laboratory test and evaluation of a novel rotary heat exchange chemical heat pump.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	Completed laboratory support to CRADA partner DuPont and a heat pump manufacturer in testing of an innovative heat pump with improved performance at high outdoor temperatures, which is lower in cost and easier to install than conventional technology. Published an ASHRAE method of test procedure for public review as part of the development of the proposed ASHRAE Standard 152 for thermal distribution efficiency.	Conduct research on low-cost heat pump water heaters as a replacement for conventional electric water heaters and initiate durability testing of a market optimized design. Continue developing the proposed ASHRAE Standard 152 for thermal distribution efficiency by field validation testing improved designs.	Complete laboratory durability testing of a market-optimized design heat pump water heaters and complete field testing of a high-velocity forced air system and a hydronic heat pump distribution system.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Began testing of a prototype desiccant based pre-conditioner into a modular HVAC system. Completed field testing of desiccant systems in comparative testing with standard HVAC cooling equipment and laboratory test advanced components. For the chiller, began field testing of a modified high efficiency pre-production commercial size chiller. Continued to develop two desiccant concepts in competitively-selected projects with cost-sharing industry partners. Monitored comparative field tests of a desiccant air-conditioner concept at large restaurants and schools and completed a report on costs, energy savings, and indoor air quality benefits in the field installations. Completed a field pilot test of the desiccant pre-conditioner for treating ventilation air and completed development and initiated a field test of a unit with integrated desiccants and conventional air-conditioning. Completed the second round of testing of manufacturer prototype solid desiccant wheels. Expanded liquid desiccant efforts by initiating</p>	<p>Work with manufacturers of HVAC systems, major gas industry partners, and the Gas Research Institute (GRI) to accelerate the commercialization of improved desiccant technology allowing commercial and residential air conditioners to increase ventilation and improve indoor air quality while reducing energy consumption. Test performance enhancement of advanced, liquid desiccants system prototype that will significantly improve air quality. Field test a desiccant air preconditioner integrated into a modular preproduction commercial-size chiller in collaboration with industry. Construct a prototype mobile desiccant unit to conduct sophisticated analyses of air quality in various high occupancy buildings. Incorporate thermally-activated technologies into the building cooling, heating, and power initiative.</p>	<p>Continue working with the gas industry to commercialize desiccant technology for improved ventilation and indoor air quality. Continue work with Georgia Tech Research Institute in testing and evaluating desiccant systems impact on indoor air quality in schools and high occupancy buildings. Complete testing desiccant systems in side-by-side comparison with standard HVAC systems in high occupancy restaurants and evaluate the impact of desiccants on comfort, indoor air quality, and humidity control in buildings. Continue research, development, and testing of liquid desiccant units to establish the impact on scrubbing indoor air and removing contaminants introduced by bad air brought into the building.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	Completed development of a simplified design of the fan atomized burner (FAB), improving design for lower cost, lower power, application and field testing, and demonstrations for potential industry partners. Demonstrated reduced fouling capability of the FAB in accelerated testing of boilers. Demonstrated the use of Computational Fluid Dynamics (CFD) in the design of a new oil burner in collaboration with manufacturer. Provided technology transfer to industry by supporting a 1999 Oil Heat Technology Conference.	Complete two demonstration projects for oil burners: the first demonstrates the reduced fouling capability of the FAB in accelerated testing of boilers, while the second, in collaboration with a manufacturer, demonstrates the use of CFD in the design of a new oil burner. Provide technology transfer to industry by supporting a 2000 Oil Heat Technology Conference.	No Furnace and Boiler Combustion Research activities.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Initiated cooperative agreement with industry to support the <i>HVAC&R Research for the 21st Century</i> plan. Focused research on high priority areas, including the integration of equipment and the distribution systems. Conducted an independent peer review of the program and assessed technical and market opportunities in the HVAC, refrigeration, and water heating sectors. Completed the successful 7-year, industry-led, jointly funded program of materials compatibility and lubricants research that paved the way for a new generation of chlorine-free refrigerants. For refrigeration systems, initiated CRADA with soft drink vending machine manufacturer. Demonstrated supermarket refrigeration/HVAC energy savings in field tests of new systems with industry partners. (Phillips Engineering, Robur, Lennox, Energy Concepts, Rocky Research, ORNL, York International, Semco/Trane, ICC Technologies, American Institute of Learning (AIL), NREL, BNL, National Institute of Standards and</p>	<p>Continue cost-shared, industry-driven refrigeration research in five high-priority areas including new refrigerants, improved equipment efficiency, integrating equipment and distribution systems improving quality of conditioned air, and alternative refrigeration cycles. Complete field tests and demonstrate a new, highly efficient supermarket refrigeration/HVAC systems with industry partners. (Phillips Engineering, Robur, Lennox, Energy Concepts, AMTI, Rocky Research, American Gas Cooling Center (AGCC), SoCal Gas, Mississippi State University, Air Quality Consortium, ORNL, York International, Semco/Trane, ICC Technologies, Kathabar, ASHRAE, Collier, American Institute of Learning (AIL), NREL, National Institute of Standards and Technology (NIST), LBNL, BNL, University of Maryland, Arthur D. Little, Foster Miller, ARTI, EPA Research, EPRI) (Heat Pumps ≈ \$6,265, Desiccants ≈ \$3,990, Furnaces and Boiler/Combustion Research ≈ \$500, Refrigeration ≈ \$4,245) (\$15,000)</p>	<p>Complete development of a supermarket system energy evaluation guide and work with manufacturers of commercial refrigeration equipment and supermarket operators to implement the guide as a tool for use in an Energy Star supermarket rating program. Continue support of the Air-Conditioning and Refrigeration Technology Institute (ARTI) Research for the 21st Century R&D projects.</p> <p>Conduct a competitive solicitation to perform research in four areas: 1) on an advanced cycle, hybrid gas-fired heat pump/chiller integrated with an advanced cycle desiccant unit that will provide maximum energy savings and improved indoor air quality by removing moisture and contaminants and improving use through dehumidification from high occupancy buildings; 2) on an advanced liquid desiccant system for high occupancy buildings, such as schools and hospitals, that will have the capability of scrubbing indoor air and removing contaminates that mitigate sick building syndrome,</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	COGENERATION/FUEL CELLS (Formerly Fuel Cells for Buildings):	COGENERATION/FUEL CELLS:	COGENERATION/FUEL CELLS:
	<p>INTRODUCTION: Fuel cells hold the promise of very high performance, very clean and cost-effective means for power generation. Work is being done with industry in cost-shared programs to develop and demonstrate fuel cell technologies that are cost-effective and unique to buildings and are not being addressed by other fuel cell programs. Fuel cells offer an excellent opportunity to cogenerate electric power and use waste heat energy to significantly reduce consumption of primary energy and emissions of carbon dioxide. Building fuel cells are unique compared to automotive fuel cells because they will operate at higher temperature and lower pressure. They will also have low noise and increased power density, and will last for 40,000 hours, compared to 3,000 for an automotive fuel cell. These characteristics offer certain benefits: higher temperatures provide thermal energy to be used for other purposes - heating water, generating steam for building operations, and reforming natural gas into hydrogen. Generating electricity at the site also minimizes electrical transmission and distribution losses. This R&D program will develop a first-generation, laboratory-prototype fuel processor for a low-temperature fuel cell system, which will be installed in a proton exchange membrane (PEM) fuel cell for testing in a building in FY 2002.</p>		

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	Fabricated and laboratory tested the selected methane reformer that extracts hydrogen from natural gas to power the fuel cell.	Continue development and laboratory testing of two different concepts of natural gas reformers. Continue test and evaluation of an Avista Laboratory air-cooled PEM fuel cell operating on bottled hydrogen at Argonne National Laboratory visitor center. Continue the four design competitions for a second-generation, 50kW fuel cell system for buildings that will operate at higher temperatures, lower pressure, and be cost-effective and suitable for cogeneration.	Conduct R&D to implement the building cooling, heating, and power (BCHP) road map, which is part of the commercial building road map. Complete the design competition for a 50kW fuel cell for buildings and initiate one or two of the design concepts for a PEM fuel cell system. Initiate the next phase of the reformer design and fabricate an engineering prototype for laboratory testing, incorporate it into a 50kW PEM fuel cell, and install in a building for test and evaluation.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>Initiated the design of a laboratory breadboard proton exchange membrane (PEM) fuel cell for building applications. Initiated research into high-temperature membrane materials and advanced CO-tolerant and high-temperature catalysts. With an industrial partner, continued working with low-cost bipolar plates derived from the SBIR program.</p>	<p>Accelerate research on membranes, a critical component in the fuel cell stack (membrane electrode assembly), that operate at temperatures in the range of 120 - 140 degrees Centigrade, which will produce water temperatures at a level needed for cogeneration. Continue R&D of bi-polar plate materials.</p>	<p>Continue research and development of a membrane that will operate at a temperature in the range of 120 to 140 degrees Centigrade. Incorporate the selected material into fuel cell stack (membrane electrode assembly) and begin testing. The PEM fuel cell, when fully developed, will have electrical generating efficiencies 30 percent better than current state-of-the-art methods. The fuel cell system will substantively reduce CO₂ emissions due to the more efficient use of natural gas, contribute to reductions in primary energy consumption, and diminish the need for new electric infrastructure and delivery services. The fuel cell will also play a major role in the BCHP program as a power generator/waste heat provider for building heating and cooling, providing efficiencies as high as 80 percent better than the state-of-the-art.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>No Activities. (International Fuel Cells, H₂Burner Technologies, Energy and Environmental Research Corporation (EERC), Avista Labs, Materials & Electrochemical Research, EIC Laboratories, ANL) (\$1,750)</p>	<p>In addition to on-going fuel cell R&D that is unique to buildings application, actively pursue adoption of technologies being developed in the transportation and other fuel cell programs. Continuously seek early applications of fuel cell in buildings such as 4 Times Square. (International Fuel Cells, H₂Burner Technologies, Foster Miller Associates (FMA), EERC, ADL, Allied Signal, Analytic Power, Plug Power, Avista Labs, Materials & Electrochemical Research (MER), EIC Laboratories, ANL, PNNL) (\$3,550)</p>	<p>Incorporate fuel cell design into the overall program of all natural gas BCHP design competition. Continue close cooperation with other fuel cells programs. (H₂Burner, EERC, ADL, Energy Research Corporation (ERC), Allied Signal, Analytic Power, Plug Power, Foster Miller Associates (FMA), ANL, PNNL) (\$5,500)</p>
	<p>APPLIANCES AND EMERGING TECHNOLOGIES R&D: Demonstrated a “drop-in” heat pump water heater for residential use with a major manufacturer, based on DOE R&D programs.</p>	<p>APPLIANCES AND EMERGING TECHNOLOGIES R&D: Conduct large-scale demonstration of innovative heat pump water heater with at least 25 utilities in every region of the country.</p>	<p>APPLIANCES AND EMERGING TECHNOLOGIES R&D: Conduct R&D on emerging technologies and develop and monitor the performance of the next generation of appliances. Continue demonstrations of heat pump water heaters.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Conducted demonstrations of promising designs for high-efficiency laundry systems, including detailed clothes dryer evaluation and monitoring. Developed a specification for compact fluorescent light bulbs and brought to market small, low-cost alternatives. (ORNL, PNNL, LBNL, Consortium for Energy Efficiency) (\$1,500)</p>	<p>Develop prototypes of high-efficiency laundry equipment that are very cost effective and just as easy to install as conventional technology. With a major manufacturer and gas utility partner, demonstrate a new gas cooling and water heating technology. (ORNL, PNNL) (\$1,500)</p>	<p>With industry, develop high-efficiency dryers that are at least 20% more efficient than conventional products. Conduct evaluation of integrated hot water heating and appliance systems to validate potential energy savings. With a major manufacturer and gas utility partner, continue demonstration of a new gas cooling and water heating technology. (ORNL, PNNL) (\$2,085)</p> <p>International Clean Energy Initiative - As part of the PCAST initiative, conduct R&D on low-cost, low-polluting, high-efficiency cookstoves, particularly those fueled by biomass and biomass derivatives. Develop cost-effective biomass fuel-based stoves with twice the efficiency and ten times lower emissions than traditional biomass stoves. Conduct field, production, and marketing tests. (TBD) (PCAST International \$500)</p>
	BUILDING ENVELOPE R&D:	BUILDING ENVELOPE R&D:	BUILDING ENVELOPE R&D:

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>INTRODUCTION: This program develops proven, energy-efficient materials and building envelope components with industry. Envelope research focuses on developing building envelope components, including advanced window technologies identified in the FY 1999 windows road map, thermal insulation, and building materials, that will lower the heating, cooling, and lighting loads of buildings, reduce construction waste, and improve the environment by developing environmentally benign products. FY 2001 Building Envelope R&D activities will save more than 550 TBtu in FY 2020.</p>		

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	Competitive Solicitation: Initiated two competitively-selected, cost-shared R&D projects: one to develop and demonstrate an integrated window/wall system and the other to develop improved manufacturing technology for high performance windows.	Competitive Solicitation: Develop and award a competitive solicitation for activities identified in the windows road map.	Competitive Solicitation: Award approximately 2 additional, second-phase competitive solicitations and/or award new competitively-selected projects to accelerate implementation of the windows and building envelope road map. This will expand the building envelope R&D portfolio increasing the probability of success, increase the percentage of competitive R&D in the envelope portfolio, and provide a minimum 20 percent cost share.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Thermal Insulation and Building Materials: FY 1999 projects included measuring and analyzing attic, duct, wall, window, roof, and foundation technologies energy savings; determining performance characteristics and development of advanced manufacturing processes for sustainable, environmentally safe, affordable, next-generation insulation alternatives, including superinsulations and non-HCFC foams; evaluating extremely low-cost indigenous insulating materials such as straw, expanded clays, sawdust, perlite, vermiculite, lava, fly ash, and other natural or waste materials; and developing and demonstrating advanced building insulation application technology concepts for retrofit and new construction. The Building Envelope Research Center measured and evaluated overall system thermal performance for walls and roofs under real-world conditions. Advanced self-drying roof systems with an effective R-value of 30 and service life of 30 years (R-30/30 roof) will become available in the commercial roofing industry.</p>	<p>Thermal Insulation and Building Materials: Complete development and demonstrate superinsulating materials that exhibit R-50 insulating value per inch, have a 20-year life, and are cost-effective in building and appliance applications. Continue cooperative research with industry on improving insulations using environmentally benign materials. Continue to develop an integrated window/wall system including integrated HVAC functions in a competitively-selected, cost-shared project with industry. Complete the development of the Whole Wall Rating System, which analytically measures the thermal performance of wall systems. Complete the development of metrics that define an energy-efficient roofing system. Deploy an Internet calculator to allow roofing professionals to design these systems.</p>	<p>Thermal Insulation and Building Materials: Continue cooperative research with industry on improving insulations using environmentally benign materials. Initiate development of two new advanced building insulation application technology concepts for retrofit and new construction. Assemble a transportable envelope durability testing machine to perform industry-supported testing and evaluation of envelope materials and structures to identify opportunities for improving energy efficiency and wind resistance. Continue to evaluate the performance of third-generation blowing agents with the Polyisocyanurate Manufacturers Association (PIMA). Complete characterization and development of models to predict the performance of third-generation blowing agents in closed-cell foams. Complete development of an advanced multidimensional heat, air, and mass transfer model to predict the moisture tolerance durability of envelope systems. Develop air barrier and vapor barrier alternatives to existing products that eliminate</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Window Technologies: Continued materials and systems analytic and testing capability to support industry development of high-performance SuperWindow and spectrally-selective window technologies. Completed industry designs for an automated production line for full-size windows. Fabricated nonautomated full-size prototype windows and skylights and complete interim field and durability testing. Provided technical assistance to industry for development of durable ion-beam deposition technology and evaluated new coatings optimized for this process.</p>	<p>Window Technologies: In partnership with industry, conduct R&D on advanced windows, including prototype commercial electrochromic windows for niche architectural applications markets, very high R-value "Super-Window" technology, and spectrally-selective "cool" windows for hot climates. Continue to develop advanced thin film technology to improve manufacturing processes for advanced windows in a competitively-selected, cost-shared project with industry.</p>	<p>Window Technologies: Coordinate advanced window research, e.g., complex fenestration systems, with International Energy Agency partners. Fabricate and test full size, prototype commercial electrochromic windows developed through a 50 percent cost share by industry and establish design criteria for a full-size production line. Support industry development of durable, spectrally-selective and low-E glazing for sunbelt and retrofit applications.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>Worked with the National Fenestration Rating Council (NFRC) and other technical associations to guide the research for the voluntary energy rating system for windows and glazing products that is being used for the new International Standards Organization (ISO) standards, which will aid U.S. firms' ability to compete in foreign markets. Completed a draft of the <i>Commercial Buildings Fenestration Handbook</i> and initial modules supporting computer design tools.</p>	<p>Complete the development of design, rating, and information tools needed to optimize the use of these window and glazing technologies. The ability to use simulation tools to measure performance will enable industry to include windows and glazings in its voluntary energy rating system. Initiate a program with the Polyisocyanurate Manufacturers Association (PIMA) to evaluate the performance of third-generation blowing agents.</p>	<p>Conduct industry-driven R&D, such as condensation resistance and International Standards Organization (ISO)-compatibility of commercial building glazing systems, and support development of simulation tools to measure performance, allowing the National Fenestration Rating Council (NFRC) voluntary ratings to be expanded to commercial building windows and glazings. Complete web-based design and rating tools program that provides energy and peak load impacts of windows on buildings and expands applications from the Commercial Glazing Handbook and the Residential Windows Handbook.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Urban Heat Island Research: With the National Laboratories, conducted analysis of urban air temperature, air quality, and satellite imagery data in additional U.S. cities. Developed tools for cities to use in quantifying community-wide cooling effects of light surfaces and vegetation. Implemented standardized and voluntary reflectivity measurement and product labeling in conjunction with the Energy Star program. Continued technical support to air quality management districts establishing air pollution credits for reflective surfaces and vegetation for urban development as an offset to ozone standards. Continued work with GSA on using highly reflective surfaces on Federal facilities. Collaborated with roofing industry representatives through the newly incorporated Cool Roof Rating Council to reach consensus on reflective roofing standards. (ORNL, LBNL, NREL, Aspen Research, Sage Electrochromics, National Fenestration Rating Council (NFRC), University of Massachusetts, Florida Solar Energy</p>	<p>Urban Heat Islands Research: Complete a roof coating study with the Roof Coating Manufacturers Association. Complete research on reflectivity of roofing and paving materials that will be used to develop standards for measuring and labeling reflectivity. (ORNL, LBNL, NREL, PNNL, Aspen Research, Sage Electrochromics, National Fenestration Rating Council, University of Massachusetts, University of Minnesota, Florida Solar Energy Center) (Competitive Solicitation \$2,200, Window Technologies \$6,229, Other Envelope Technologies \$3,094, Urban Heat Islands \$200) (\$11,723)</p>	<p>Urban Heat Islands Research: Program complete. (ORNL, LBNL, NREL, NFRC, University of Massachusetts, Florida Solar Energy Center) (Competitive Solicitation \$2,262, Window Technologies \$6,725, Other Envelope Technologies \$3,340, Urban Heat Islands \$0) (\$12,327)</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	<p>ANALYSIS TOOLS AND DESIGN STRATEGIES: (Formerly Design Strategies for Commercial and Residential Buildings):</p>	<p>ANALYSIS TOOLS AND DESIGN STRATEGIES:</p>	<p>ANALYSIS TOOLS AND DESIGN STRATEGIES:</p>
	<p>INTRODUCTION: Building designers, engineers, operators, and owners need accurate and reliable building analysis tools that show the cost and performance benefits of energy-efficient materials, systems, and equipment when making decisions for new construction and retrofits. The program researches the interrelationship of energy systems and buildings energy performance, develops a variety of building analysis tools to more accurately model energy use in new and existing buildings, and provides recommendations and strategies to cost-effectively lower energy use and improve building performance. The program focuses on whole building software tools for evaluating energy efficiency and renewable energy. DOE-2 is currently the most widely used building energy simulation program for designing and retrofitting residential and commercial buildings in the world. DOE-2 is available from more than 15 private sector companies that provide technical support; the final version was released in FY 1999. DOE-2 will be replaced by EnergyPlus, a new, modular, user configurable building simulation program that incorporates the best features and capabilities of DOE-2 and DOD's BLAST and allows analysis of new and innovative technologies. SPARK is an object-based simulation program that analyzes detailed interactions of building equipment, components, controls, and other innovative building systems. The Building Design Advisor is a program to support energy-related decisionmaking during the early design phase of commercial buildings. It acts as a common interface to other software programs, and is being developed with several utilities, the California Energy Commission, and the California Institute for Energy Efficiency. ENERGY-10 is a user-friendly energy simulation tool for residential and small commercial buildings that allows trade-offs among renewable and energy efficiency strategies.</p>		

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	TRANSFER FROM: Building Systems Design		
	With industry and research partners, developed computer design and analysis tools to evaluate options for selecting equipment and materials, test design concepts, study alternative design strategies, and minimize whole-building energy use. Released DOE-2.2, the last version of DOE-2, with new features for residential and commercial buildings.	With industry and research partners, develop computer design and analysis tools to evaluate options for equipment and material selections, test design concepts, study alternative design strategies, and minimize whole-building energy use.	With industry and research partners, develop computer design and analysis tools to evaluate options for selecting equipment and materials, test design concepts, study alternative design strategies, and minimize whole-building energy use.
	Developed software modules to simulate complex innovative building systems performance for use in EnergyPlus. Began beta testing EnergyPlus.	Complete much anticipated building integration software by beta testing and releasing EnergyPlus, Version 1.0. Based on the commercial buildings road map and industry partner feedback, begin developing Version 1.1 of EnergyPlus to include new modules that simulate performance of complex, innovative building systems and components.	Test and prepare for release new simulation capabilities for EnergyPlus Version 1.1. Continue working with and supporting third party developers of interfaces and simulation modules for EnergyPlus.
	Released Version 1.0 of SPARK.	Begin developing Version 2.0 of SPARK to allow evaluation of complex building envelopes.	Test and prepare for release new simulation capabilities within SPARK Version 1.1.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	Released Version 1.0 of the Building Design Advisor. Began developing links from the Building Design Advisor to DOE-2 and Radiance, a realistic lighting simulation program.	Complete development, test, and release Version 2.0 of the Building Design Advisor with links to DOE-2 and Radiance. Once EnergyPlus Version 1.0 is complete, transfer the link to DOE-2 in the Building Design Advisor to EnergyPlus.	Transfer development and commercialization responsibilities for the Building Design Advisor Version 2.0 to the private sector, completing DOE's role.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Completed, tested, and released Version 1.3 of ENERGY-10 software for making informed decisions among solar and other efficiency strategies. Began developing Version 2.0 of ENERGY-10.</p> <p>Released Version 2.0 of Industry Foundation Classes, a specification for sharing information among building-related software tools, and continue participation in the Industry Alliance for Interoperability to ensure that energy efficiency can be considered in building-related software.</p>	<p>Complete, test, and release Version 2.0 of the ENERGY-10 software that incorporates advanced concepts learned in buildings studies.</p> <p>Continue participation in the Industry Alliance for Interoperability to ensure that energy efficiency can be considered and incorporated in building-related software.</p>	<p>Working with industry partners, define needs for further work on ENERGY-10 Version 2.1 and begin development work.</p> <p>Continue working with the International Alliance for Interoperability through release 3.0 of their Industry Foundation Classes (IFCs). Implement the IFCs in the Building Design Advisor.</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Incorporated new technologies, simulation capabilities, and strategies and methodologies developed under <i>Building America</i> and other projects into residential design tools. Developed the next-generation designs of low-energy building concepts that will be demonstrated by the <i>Building America</i> consortia. Developed test procedures and measurement techniques related to thermal distribution, indoor air quality, and air leakage with ASHRAE and American Society of Testing and Materials (ASTM). Provided technical contributions to the ASHRAE Standard for residential ventilation. Incorporated ventilation and mitigation strategies from the indoor air quality research into all whole-building simulation tools. Completed test procedures for duct distribution systems. (LBNL, NREL, ORNL, Sustainable Buildings Industries Council, University of Illinois/U.S. Army Construction Engineering Research Laboratories, University of Oregon) (\$4,013)</p>	<p>Incorporate ventilation and air flow into all energy simulation software tools. Research the interrelationship of energy systems on commercial and residential buildings energy performance. Develop test procedures, measurement techniques, and standards related to thermal distribution, air quality, and air leakage with ASHRAE and ASTM. Assess advanced ventilation designs and strategies and report results that will contribute to achieving energy efficiency and improved indoor environmental quality through design excellence. (NREL, LBNL, ORNL, Athena Sustainable Materials Institute, ASHRAE, Passive Solar Industries Council, GARD Analytics, J. Neymark Associates, California State University, Fullerton/Chapman University, University of Illinois/U.S. Army Construction Engineering Research Laboratories) (\$4,058)</p>	<p>Continue performance measurement research with ASHRAE, ASTM, and others to advance the calculation basis of all energy analysis tools. Highlights include issuance of thermal distribution and ventilation standards by ASHRAE. (NREL, LBNL, University of Illinois, U.S. Army CERL, Oklahoma State University, University of Wisconsin, Passive Solar Industries Council) (\$6,360)</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
	LIGHTING AND APPLIANCE STANDARDS:	LIGHTING AND APPLIANCE STANDARDS:	LIGHTING AND APPLIANCE STANDARDS:
	INTRODUCTION: This program develops and promulgates test procedures and energy conservation standards for residential appliances and certain commercial equipment. These standards are central to meeting the energy efficiency goals and reducing carbon emissions.		

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>TRANSFER FROM: Codes and Standards</p> <p>Supported the consensus standards organization with regard to covered commercial products. Began rulemaking to revise standards, as required by the legislation, in response to changes in the consensus standards. With stakeholders, continued investigating alternative means of accomplishing the goals of the program without revising mandatory standards.</p> <p>Promulgated amended energy conservation standards designed to achieve the maximum improvement in energy efficiency that is technically feasible and economically justified. Implementing the new process for standards, published the Supplemental Advance Notice of Proposed Rulemaking (ANOPR) for</p>	<p>The Department's commitment to issuing three energy conservation standards (fluorescent lamp ballasts, water heater, and clothes washers)The Department's commitment to issuing three energy conservation standards (fluorescent lamp ballasts, water heater, and clothes washers) in one year reflects a highly accelerated schedule and a greatly increased level of effort. Devote resources to refine analytical tools and conduct more robust analyses to address complex issues raised by the Appliance Efficiency Standards Advisory Committee.</p> <p>Promulgate amended energy conservation standards designed to achieve the maximum improvement in energy efficiency that is technically feasible and economically justified. Issue NOPR and Final Rules concerning standards for fluorescent lamp ballasts and residential water heaters, and NOPR for clothes</p>	<p>Review analytical methodologies and software tools used for the residential products standards rulemaking and adapt/develop analytical methodologies and tools as required for the commercial equipment standards rulemaking. These tools, which are used in the analysis of such issues as manufacturers' impact, energy savings, and life-cycle cost, help address complex rulemaking issues raised by the Appliance Efficiency Standards Advisory Committee, a formal advisory group consisting of trade associations, utilities, states, and energy conservation advocates.</p> <p>Promulgate amended energy conservation standards designed to achieve the maximum improvement in energy efficiency that is technically feasible and economically justified. Issue Final Rule concerning standards for clothes washers and residential central air conditioners. Issue ANOPR for standards for certain ASHRAE</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	Issued Final Rule to incorporate legislated standards and test procedures for large electric motors. Published Notice of Proposed Rulemaking (NOPR) for test procedures for distribution transformers and dishwashers.	Conduct research to develop, maintain, simplify, and improve test procedures for appliances. Revise the test procedures to ensure innovative designs can be fairly tested and process manufacturer requests for test procedure waivers. Publish NOPR and Final Rule incorporating legislated standards and test procedures for commercial furnaces. Publish NOPR for test procedures and incorporating legislated standards for commercial water heaters, air conditioners, and boilers. Issue NOPR for test procedures for residential central air conditioner/heat pumps and commercial furnaces and Final Rule for test procedures for distribution transformers and dishwashers.	Conduct research to develop, maintain, simplify, and improve test procedures for appliances. Revise the test procedures to ensure innovative designs can be fairly tested and process manufacturer requests for test procedure waivers.

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Equipment, Materials and Tools (Cont'd)	<p>Worked with equipment manufacturers to ensure products are properly certified and that they meet the standards. Supported voluntary efficiency rating and labeling programs for commercial office equipment and luminaires. Worked with industry to develop mandatory labeling requirements for EPCAct-covered commercial products. (NIST, LBNL, PNNL, NREL) (\$6,475)</p>	<p>Work with equipment manufacturers to ensure products are properly certified and that they meet the standards. Work with the Federal Trade Commission (FTC) to support mandatory energy rating and labeling programs for residential appliances. Also work with the FTC to develop a labeling program for commercial equipment and support voluntary, industry-sponsored rating programs for commercial office equipment and luminaires. (NIST, LBNL, PNNL, NREL, ORNL, ADL) (\$10,500)</p>	<p>Continue to work with equipment manufacturers to insure products are properly certified and that they meet the standards. Continue to work with the Federal Trade Commission (FTC) to support mandatory energy rating and labeling programs for residential appliances. Develop a labeling program for commercial equipment and support voluntary, industry-sponsored rating programs for commercial office equipment and luminaires. (NIST, LBNL, PNNL, NREL) (\$13,765)</p> <p>International Clean Energy Initiative - As part of the PCAST initiative, initiate efforts to harmonize energy-efficiency standards, test methods and rating procedures to facilitate international trade and minimize burdens on manufacturers. Provide technical support and analysis tools for the development of 6 key energy efficiency appliance standards in 10 countries. Partner with these countries to establish national test facilities and test programs for appliances and equipment. (TBD) (PCAST International \$1,500)</p>

III. Performance Summary: BUILDING RESEARCH AND STANDARDS (Cont'd)

Activity	FY 1999	FY 2000	FY 2001
Technical/Prog. Management Support	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Efficiency programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p> <p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits and contributions directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request includes the funding requirements for Technical/Program Management Support as shown below.</p>		
	<p>Funding of \$681,000 from within the Equipment, Materials, and Tools Program described above was used to provide Technical/Program Management Support.</p>	<p>An estimated \$1,500,000 from within the Equipment, Materials, and Tools Program described above provides for the continuation of critical Technical/ Program Management Support.</p>	<p>A total off \$1,500,000 from within the Equipment, Materials, and Tools Program described above provides for the continuation of critical Technical/ Program Management Support.</p>
	\$42,121	\$52,331	\$69,160
Building Research and Standards, Total	\$60,331	\$75,408	\$100,100

BUILDING TECHNOLOGIES
BUILDING TECHNOLOGY, STATE, AND COMMUNITY SECTOR
(Dollars in Thousands)

BUILDING TECHNOLOGY ASSISTANCE

I. Mission Supporting Goals and Objectives

Program Strategy

The mission of BTS' Building Technology Assistance programs is to promote and accelerate the adoption of energy efficiency and renewable energy technologies by States, communities, institutions, companies, and private citizens, and thereby help the Nation realize a stronger economy, a cleaner environment, and a more secure energy future.

The FY 2001 BTS Building Technology Assistance programs are expected to displace 58 trillion Btu, saving consumers \$420 million and creating more attractive and affordable places to live and work. In FY 2010, the energy displaced will be 625 trillion Btu, saving consumers almost \$5 billion. In FY 2020, energy savings will increase to more than 1 quad, saving consumers more than \$8.2 billion -- equal to the entire current energy consumption of the State of Kansas. In FY 2001, the Building Technology Assistance programs will provide 77 percent of the energy savings for the BTS Sector. By 2020, when dramatic energy savings will have accrued from BTS' Building Research and Standards programs, the Building Technology Assistance programs will still contribute 38 percent of the Sector's total energy savings.

Partnerships with States and Communities

BTS works with private and public sector stakeholders to accelerate the adoption of energy efficiency technologies and practices into the marketplace. This is accomplished by establishing partnerships with States and communities and providing technical and financial assistance to them. After establishing such partnerships, BTS works with the States and communities to leverage local resources, tailoring programs to meet state and local circumstances and needs. This approach provides improved customer service and satisfaction, and helps speed the widespread adoption of energy-efficient technologies

EnergySmart Schools

Reinvesting heating and cooling dollars for our children's education

More teachers, books and computers for our Nation's schools. More comfortable classrooms and a better learning environment for our children. EnergySmart Schools, a DOE-directed national public/private partnership, is helping bring this about by dramatically cutting school's energy bills. More than 110,000 K-12 schools in the U.S. spend six billion dollars a year on energy. EnergySmart Schools is helping reduce schools' energy bills by 25 percent or more by making heating and cooling systems more energy efficient. Schools can then use the savings to hire more teachers and for other educational improvements. An EnergySmart School also helps children, parents, and teachers learn how saving energy saves dollars and makes sense.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

developed as a result of BTS-sponsored research. BTS further accelerates the introduction of the most energy-efficient building techniques and practices by providing training and assistance to States in adopting and implementing new building codes.

Livable Communities

Building Technology Assistance programs support the Administration's Livable Communities initiative by providing communities with tools, information, and resources to create more attractive and affordable places to live and work. Better homes and work places enhance the quality of life, ensure economic competitiveness, and build a stronger sense of community.

BTS' Building Technology Assistance programs are based upon several activities:

- Demonstrating the performance, cost, and reliability of new technologies, thus helping remove market barriers. These barriers include hesitancy to use new technologies, lowest first-cost procurement policies, and a lack of credibility about professed benefits of new technologies that prevent greater adoption of energy-efficient technologies.
- Educating decision makers by providing unbiased, accurate information on performance, reliability, purchasing, and financing for energy-efficient products and services.
- Disseminating success stories and applying R&D results and tools developed in the Building Research and Standards programs, such as advanced air duct sealing technologies, to products and practices.
- Training builders and State and local code officials to increase their awareness of new building codes that incorporate energy-efficient technologies and practices.
- Providing stakeholders and consumers with the building product information and tools needed to make the best decisions affecting energy use and comfort of their buildings and homes.
- Working with manufacturers, retailers, utilities, and associations and using their established infrastructure to reach consumers.
- Awarding targeted grants to States and communities to support wide-ranging activities that promote energy efficiency.

These activities improve the energy efficiency of buildings and foster transformation in the marketplace by stimulating demand for more economical, comfortable buildings that meet occupants' fresh air, temperature, and lighting needs.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Weatherization Assistance Program

The mission of the Weatherization Assistance Program is to provide cost-effective energy efficiency services to low-income constituencies who otherwise could not afford the investment and who stand to benefit greatly from the cost savings of newly developed energy efficiency technologies. The Weatherization Assistance Program focuses on households that spend a disproportionate amount of their income for energy, giving priority to households with elderly members, persons with disabilities, and children.

The Weatherization Assistance Program has long served as the core program for delivering energy conservation services to low-income Americans. By increasing the energy efficiency of low-income customers' homes, this program reduces their energy costs while improving their health and safety. One example of the way the Program increases energy efficiency is by applying improved building envelope techniques and thermal distribution procedures developed in BTS' R&D programs.

The FY 2001 goal of the Weatherization Assistance Program is to achieve annual average savings of 25 percent of home heating energy in just under 75,000 low-income family households. Based on the FY 2001 budget request, 6 trillion Btu will be displaced in FY 2001, saving \$44 million. This is a significant milestone in line with the goals of the Presidential Partnership for Advancing Technology in Housing (PATH) initiative; i.e., to save 30 percent of the total home energy in 15 million existing homes by 2010. In FY 2010, 63 trillion Btu will be displaced, saving \$442 million.

The Program also contributes to achieving national and social goals, including cleaner air through reduced emissions of criteria pollutants and CO₂; reduced consumption of imported fuels; reduced demand on other social programs such as fuel assistance, housing, and health care; and implementation of innovative energy conservation technologies, leading to a transfer of the technologies into the private marketplace. The program's effectiveness is enhanced by the flexibility of DOE Weatherization funding, which enables States and local agencies to leverage additional funding from low-income housing programs, utilities, and in the case of weatherization of rental properties, from property owners. A recently completed study of 17 State-level evaluations indicates that advanced energy audits and improved practices in weatherizing homes have produced 80 percent higher average energy savings today compared to 1989. As a result, the annual average value of energy savings to low-income households has increased from \$107 in 1989 to \$193 in 1996, an increase of more than 80 percent. The benefits to society, which include employment, health and safety, and other non-energy effects, are more than double the cost of the program.

In FY 2001, the Weatherization Assistance Program will build its capability to implement the "millennium strategy" that was developed by the Weatherization network in FY 1999. The strategy, called "Weatherization *Plus*," will add whole-house and advanced technologies to the program portfolio, complementing proposed regulatory and legislative changes that will further enhance the program's effectiveness in accomplishing its mission and realizing significant socioeconomic and environmental benefits. The program incorporates PATH strategies and

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

applies technologies that address global climate change, affording this sector of the population access to technologies that reduce carbon emissions.

State Energy Program

The mission of BTS' State Energy Program (SEP) is to provide a supportive framework with sufficient flexibility to enable States to address their energy priorities in concert with national priorities. The State Energy Program provides grants to States, allowing them to tailor energy efficiency programs to local needs and leverage non-Federal resources. SEP assists State Energy Offices to effectively implement and coordinate activities that address their unique energy priorities, opportunities, and barriers. The FY 2001 State Energy Program expects to displace nearly 6 trillion Btu and save \$38 million. In FY 2010, the energy displaced will increase to 51 trillion Btu and save more than \$374 million. In doing so, this program leverages DOE's efforts to address national energy priorities. SEP will continue to increase the ability of Federal, State, and local government to work with other public and private sector entities, including schools and hospitals, to achieve widespread adoption of available energy efficiency and renewable energy technologies that benefit all sectors of the economy.

Due to the unique capabilities and positioning of State Energy Offices, DOE partnerships with States accelerate the deployment of energy-efficient and renewable energy technologies. The State Formula Grants help maintain a strong State Energy Office delivery network that is essential to achieving national energy objectives. In addition to coordinating energy policies, the State Energy Offices also coordinate environmental and economic policies in response to the challenges of the 21st century, including utility restructuring and climate change. State Energy Offices have been able to leverage their Federal Formula Grant funding at the rate of \$4 in non-Federal funding for each Federal dollar and, for some activities, as much as \$13 to \$14 in non-Federal funding for each Federal dollar.

The Special Project State Grants provide States and Territories an opportunity to more fully utilize their unique capabilities in forming partnerships with local governments, industry, utilities, and private organizations to remove barriers to deploying selected EERE technologies. BTS and other end-use sector offices in EERE make competitive awards through the Special Project State Grants to implement the States' portions of the sector office programs from which the funds are provided. These Special Project State Grants maximize the benefits of State involvement. States continue to increase resources devoted to expanding market opportunities for energy efficiency and renewable energy technologies, and the State Energy Offices act as catalysts for public/private partnerships that encourage energy-efficient technology deployment.

Community Energy Program

The mission of the Community Energy Program is to provide technical assistance, demonstrations, training, and education to communities to accelerate the introduction of innovative and cost-effective energy technologies, strategies, and methods. The Program helps communities,

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

towns, and cities save energy, create jobs, promote economic growth, and protect the environment through improved energy efficiency and sustainable building design and operation making our communities more livable.

The FY 2001 Community Energy Program will displace 21 trillion Btu, saving communities \$137 million. In FY 2010, 293 trillion Btu are expected to be displaced, saving more than \$2.2 billion. The consolidated Community Energy Program provides integrated information, technical assistance, and financial assistance to communities to increase their use of innovative and cost-effective building technologies, strategies, and practices. The Program has four thrusts: *Rebuild America*, Information Outreach, Partnership for Advancing Technology in Housing (PATH), and Training Assistance for State Building Energy Codes.

BTS' Community Energy Program is helping to meet DOE's strategic goals by enabling local energy services to be delivered more efficiently, improving the local revenue base, and fostering community-wide energy sustainability. BTS' community partnerships are wide-ranging, with partners encompassing mayors and governors offices, community and economic development agencies, school boards, citizen conservation groups, building owners/operators/financiers, and energy specialists. BTS utilizes technical resources and Regional Offices to work with States, local partners, and industry and leverages \$10 for each Federal dollar invested. The Community Energy Program allows local citizens to become active participants in improving their communities. BTS continues to evaluate how best to deliver services to America's communities.

Rebuild America helps designated communities design and implement energy-saving programs that respond to their own circumstances and goals, providing access to a portfolio of technical assistance, with a core focus on existing commercial and institutional buildings. By the end of FY 1999, BTS had established more than 240 partnerships through *Rebuild America*. These *Rebuild America* community partnerships have committed to improving energy efficiency and reducing energy costs of more than 815 million square feet of building space, equal to more than 1,100,000 U.S. Capitol-sized buildings, thereby putting \$9.8 billion a year back into their communities. Partnerships are giving older buildings a new lease on life with the latest technology and retrofit practices, as well as helping business people, school districts, housing authorities, arts and cultural organizations, and public agencies save 20-30 percent on their energy bills. With the goal of increasing *Rebuild America* partnerships by 50 each year, this initiative will save communities 85 trillion Btu annually by 2010. This is equivalent to the amount of energy used by almost 37,000 average-sized (12,800-square-foot) commercial buildings.

Through *Rebuild America*, BTS assists community partnerships to develop and implement action plans tailored to each community's local needs and resources. *Rebuild America* partners receive technical assistance in using the most current BTS-developed design tools, such as DOE-2 and EnergyPlus, to evaluate retrofit options and help select the most effective retrofits. In addition, *Rebuild America* applies lessons learned from BTS' R&D programs. For example, *Rebuild America* partners use BTS-developed energy monitoring, verification, and diagnostic techniques to verify savings from their building retrofits.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Through *Rebuild America*, the Department supports the public/private EnergySmart Schools initiative by working with national organizations and *Rebuild America* partners to improve energy efficiency in schools. In FY 2001, BTS will award competitive grants that support community-wide energy projects and save energy, create jobs, promote growth, and protect the environment through improved energy efficiency and sustainable building design and operation. BTS will also provide case studies, construction guidelines, and lessons learned from *Building America* homes to communities through the *Rebuild America* program.

Information Outreach provides citizens and businesses in communities nationwide with informative and educational materials to help them improve the energy efficiency of their buildings. Outreach and educational campaigns promote energy-efficient and renewable energy technologies and practices that are essential to influencing consumer demand for new, high-efficiency homes and energy retrofits of existing homes. BTS provides technical assistance through national experts on buildings, energy, and finance and prepares outreach materials on new, cost-effective energy technologies and practices. In FY 2001, BTS will participate and contribute to outreach activities of the public/private Partnership for Advancing Technology in Housing, providing customized technical assistance to residential partners. The PATH initiative is a multi-agency effort linking key Federal agencies with leaders from the home building and related industries. One of the DOE roles is broad dissemination of advanced technologies to residential partners. By FY 2010, PATH will displace almost 80 trillion Btu, saving communities \$580 million.

Training and Assistance for State Building Energy Codes helps build the expertise to implement building energy codes at the community level. BTS provides training resources to home builders, commercial building developers and builders, and State and local code officials to increase their awareness of new commercial, Federal, and residential codes and to ensure that communities are using the latest technologies and practices in building designs and retrofits. The Community Energy Program makes available products that simplify code implementation and provides services tailored to meet the unique needs of States. BTS assists States and communities in implementing the American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineering Society of North America Standard 90.1-1989, updating and implementing the multistate commercial code, and updating the 1998 model residential code. By FY 2010, Training and Assistance for State Building Energy Codes will displace 96 trillion Btu, saving communities nearly \$850 million.

Energy Star Program

The Energy Star Program identifies and promotes highly efficient appliances, office equipment, and homes and buildings with a distinctive label and educates consumers about the benefits of energy-efficient products. The Energy Star Program also promotes BTS' research results, such as the development of high-efficiency windows. Energy Star products are typically 20 percent more efficient than the minimum mandated energy efficiency standards or guidelines. Although purchases of small appliances such as dishwashers, home electronics, microwave ovens, and home computers are growing, gains in energy efficiency promoted in part by the Energy Star Program will help keep the average national energy consumption increase for the 16 most energy-consuming small residential appliances to only 6 percent by 2010.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

BTS' strategy is to work with manufacturers, builders, and retailers to expand the joint EPA-DOE Energy Star program and increase collaboration with manufacturers and utilities. The voluntary program of identifying products and buildings with the highly visible Energy Star label educates the public on the energy use of equipment, appliances, and buildings and helps consumers choose more-efficient models that can save money and help protect the environment.

In FY 2001, BTS will recruit 500 retail stores, 160 window partners, and 5 utilities to promote Energy Star products and will work with builders to promote Energy Star appliances and windows in new homes. The Energy Star label will become more widely recognized by consumers and building owners and operators as the symbol for energy-efficient appliances, windows, commercial buildings, and homes. The Energy Star label will aggressively raise the public's awareness of equipment and appliance energy use, increasing the use of Energy Star equipment and appliances and resulting in savings of 25 trillion Btu and \$200 million in FY 2001. By 2004, 20 percent of all appliances sold will display the Energy Star label and 65 percent of all windows sold will qualify for the Energy Star label. In FY 2010, 220 trillion Btu will be displaced, saving consumers \$1.9 billion.

I.B. Program Benefits

At the proposed funding levels, the Building Technology Assistance programs are estimated to yield the following benefits:

<u>Metric - Building Technology Assistance</u>	<u>2001</u>	<u>2010</u>	<u>2020</u>
Primary Energy Displaced (Quads)	0.06	0.63	1.04
Energy Cost Savings (\$Billion)	0.4	4.9	8.3
Carbon Reduction (MMTons)	1.2	11.0	17.9

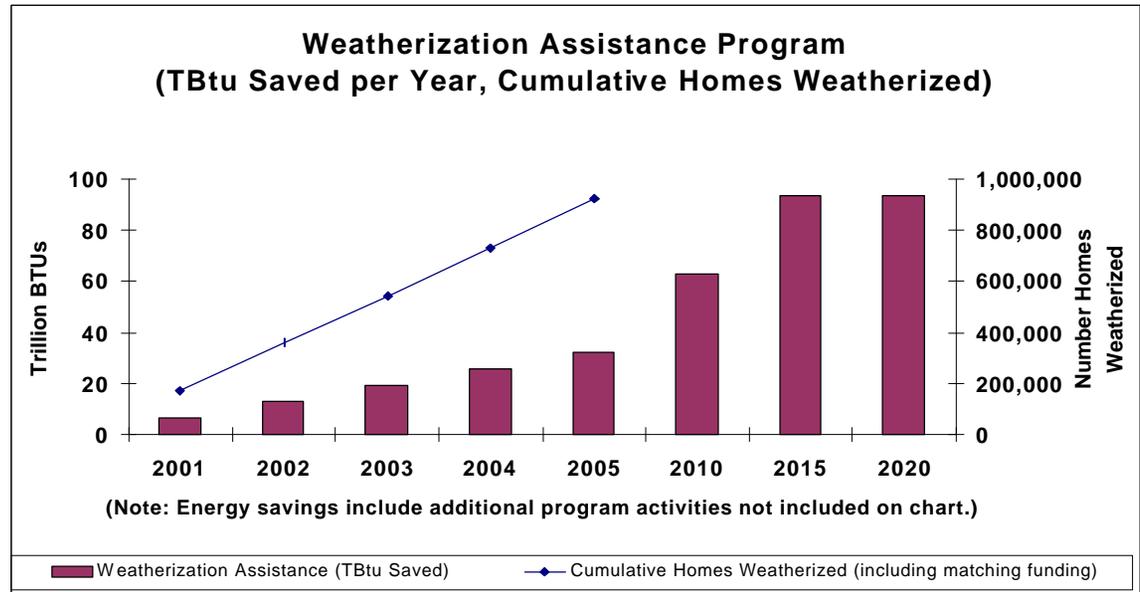
In FY 2010, the benefits of all Building Technology Assistance programs are equivalent to the energy use of 3.4 million households, or almost the entire current energy use of New Mexico. In FY 2020, the benefits are equivalent to the energy use of 5.7 million households, equal to the entire current energy use of Kansas for a year.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

I.C. Performance Measures

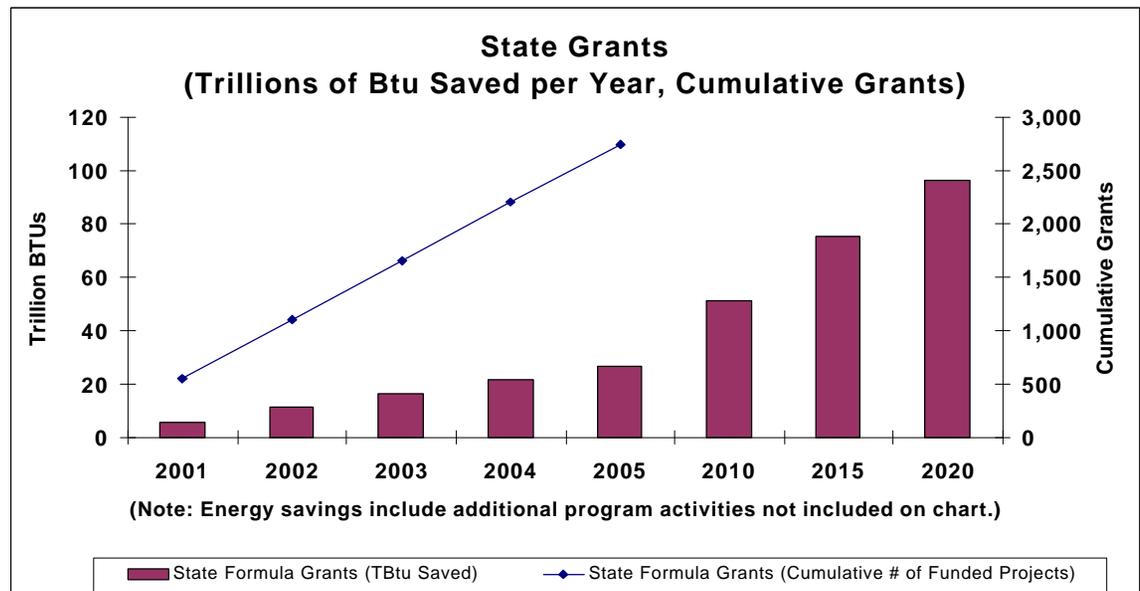
Weatherization Assistance Program Performance Measures

The Weatherization Assistance Program forecast of energy savings is based on level funding and a fixed number of homes weatherized each year. However, energy savings grow as the energy savings accrue each year for homes weatherized in previous years. (Estimated benefits are included in the BTS overarching Residential performance measure.)



State Energy Program Performance Measures

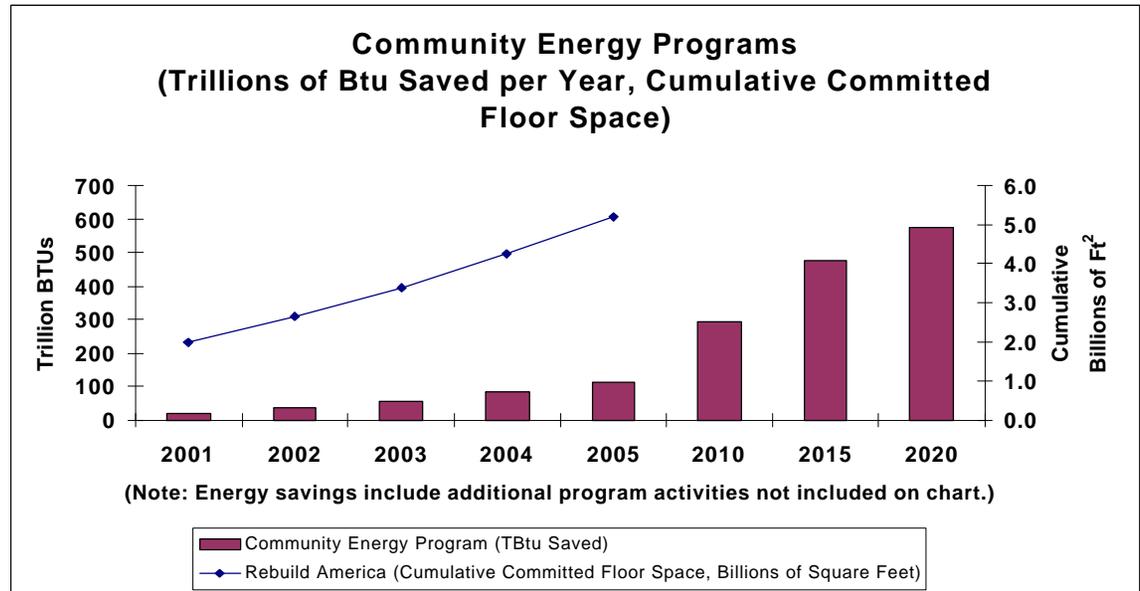
State Grants through the State Energy Program fund both buildings energy efficiency and renewable energy programs as well as other energy efficiency programs. The following energy savings projections are based on a past record of energy efficiency measures directed to buildings. The future forecast of energy savings is based on constant funding and a stable number of projects funded at the state level. (Estimated benefits are included in the BTS overarching Commercial performance measure.)



I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

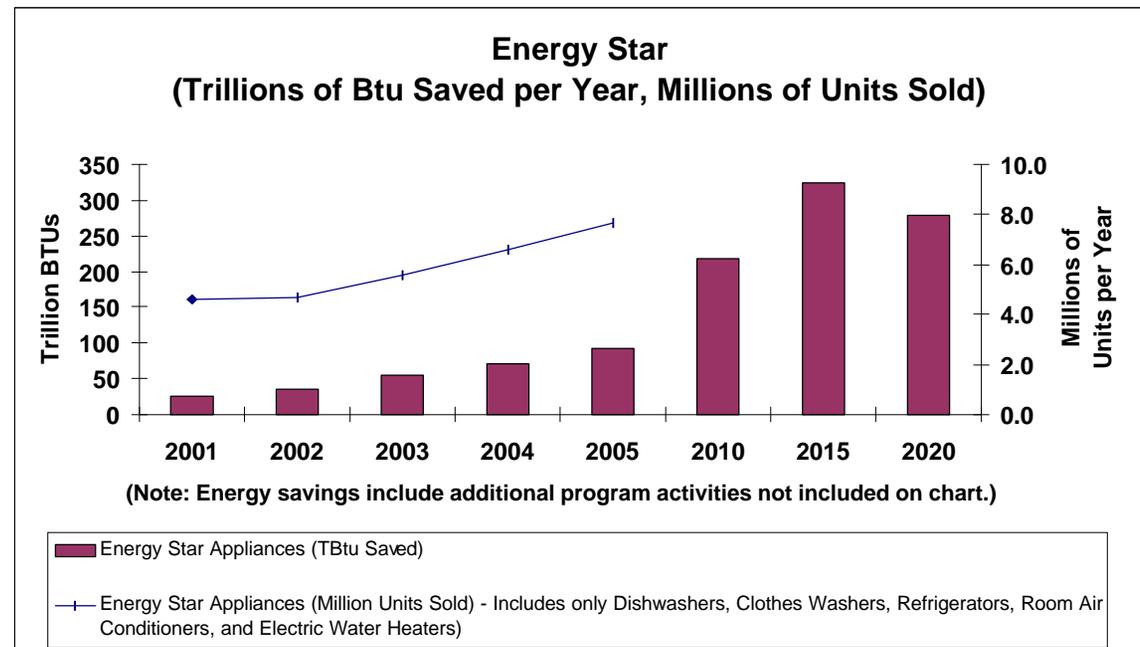
Community Energy Program Performance Measures

The performance measures for the Community Energy Program include the *Rebuild America* program, as well as other community-focused efforts such as EnergySmart Schools, Partnership for Advancing Technology in Housing (PATH), and training and assistance for building energy codes. *Rebuild America* partners commit to retrofitting commercial floor space as measured in square feet. As that space is retrofitted, energy savings accrue in trillions of Btu each year. (Estimated benefits are included in the BTS overarching Commercial performance measure.)



Energy Star Program Performance Measures

The Energy Star label now appears on a wide variety of products. DOE participates with EPA in a well coordinated effort to convince manufacturers to sell high-efficiency products under the Energy Star label. DOE also works directly with retailers to assure they both carry and promote these units. While DOE directly affects the number of participating manufacturers and retail stores, energy savings estimates are based on forecasted sales of Energy Star products. (Estimated benefits are included in the BTS overarching Equipment performance measure.)



I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

External Factors Influencing Performance Measures

Other than with the Weatherization Assistance Program, DOE only indirectly impacts the marketplace. That is, energy savings estimates are based on key partnering strategies with the private sector, other Federal agencies, State and local Governments, and non-governmental organizations. The ultimate success of these programs is highly dependent on all partners, including DOE, fulfilling their commitments. In addition, decision-makers, whether household or business, must ultimately be convinced to change behavior or make wise investments. In all cases, the marketplace plays a large role in determining the success or failure of these programs. Falling, or rising, energy prices, and a growing, or shrinking economy can overwhelm these efforts.

I.D. Significant Accomplishments

Metric (Savings Achieved)	Cumulative Benefits FY 1980 - 1999
Total Primary Energy Displaced (Quads)	1.35
Total Energy Cost Savings (Billion Dollars)	\$9.55
Total Carbon Reduction (Million Metric Tons)	20.59

FY 1999 Accomplishments

Weatherization Assistance Program:

- Provided State grants to weatherize 67,330 homes for low-income families, saving \$1.80 in energy costs for every dollar invested over the life of the measures.
- Completed development of the strategic plan, "Weatherization *Plus*: Opportunities for the New Millennium."

State Energy Program:

- Successfully implemented the Special Project State Grants portion of SEP, awarding at least 100 Special Project State Grants with approximately \$14 million in funding from all EERE end-use sector offices to support State and local EERE research, development, demonstration, and outreach efforts.
- Provided report to EERE sector offices on value added by State involvement in technology deployment via Special Project State Grants.
- Launched development of the SEP strategic plan to focus program strengths on opportunities for the 21st century.

Community Energy Program:

- Recruited 85 new *Rebuild America* partnerships, increasing the total number of *Rebuild America* communities to 240.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

- Provided technical assistance to communities and nonprofit organizations to purchase heat pump water heaters and high-efficiency gas appliances.
- In coordination with the public/private Partnership For Advancing Technology in Housing (PATH), began major outreach and technology transfer effort for *Building America* technologies and building practices.
- Co-funded 18 competitive, applied research projects in municipal buildings and processes, transportation, and sustainable urban energy systems.
- Targeted the award of 5 to 10 Special Project State Grants to community partnerships for school-related initiatives using funds from building and transportation sector program areas within the State Energy Program.
- Sponsored more than two dozen residential build/design training programs.
- Developed and disseminated software tools and materials for implementing new Federal residential and commercial energy codes.
- Assisted 5 States in updating their residential building energy codes to the 1995 Model Energy Code (MEC) and assisted 10 States in updating their residential building energy codes to the 1998 International Energy Conservation Code (IECC).
- Provided technical assistance and incentive funding to support the training of 7,000 designers, builders, and code officials so they can implement the newly adopted State energy codes and recently promulgated Federal energy codes.
- Assisted 10 States in the implementation of ASHRAE/IESNA Standard 90.1 - 1989R using DOE-developed tools and a commercial building incentive program to build above code.

Energy Star Program:

- Worked with the Federal Trade Commission to allow manufacturers to add the Energy Star logo to the “energy guide” label for covered products.
- Added water heaters and compact fluorescent lamps to the Energy Star portfolio.
- Recruited additional stores to label Energy Star appliances, bringing the total number of stores that label high-efficiency appliances and equipment to more than 4,000.

FY 2000 Planned Accomplishments

Weatherization Assistance Program:

- Provide State grants to weatherize 67,340 homes for low-income families, saving \$1.80 in energy costs for every dollar invested over the life of the measures.
- Increase program flexibility to leverage additional resources, through proposed legislative and regulatory changes.
- Lay groundwork for building technological capacity of the network to apply whole-house and advanced technologies.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

State Energy Program:

- Leverage SEP formula grants by at least 4:1.
- Continue to implement the Special Project State Grants portion of SEP, awarding approximately 100 Special Project State Grants with funding from all EERE end-user sector offices.
- Complete strategic plan to focus program strengths on opportunities for the 21st century.

Community Energy Program:

- Recruit 50 new *Rebuild America* partners, increasing the total number of communities to 290.
- Through *Rebuild America*, work with 20 school districts to support EnergySmart Schools objectives.
- Provide technical assistance to new partners in renovating more than 100 million square feet of floor space, reducing annual energy costs by \$28 million when all local actions are completed in 2003.
- Provide customized technical assistance to partners, such as outreach materials, workshops, and tools and training on advanced technologies, financing options, and the construction and retrofit process.
- Expand training programs to optimize energy savings in *Rebuild America* and *Building America* communities and ensure that the latest technologies and practices are incorporated into designs and retrofits.
- Transfer experience and tools from *Building America* to the network of *Rebuild America* community partnerships.
- Assist States and communities to update and implement the multistate commercial energy code and to update the 1998 model residential energy code (1998 IECC).
- Develop and disseminate tools for implementing the new Federal commercial energy code.
- Train 4,000 code officials, designers, and builders on 1998 IECC and 10 CFR 435.
- Issue and award competitive solicitation.

Energy Star Program:

- Work with builders to promote Energy Star appliances and windows in new homes.
- Extend the Energy Star label to buildings that meet the DOE/EPA performance level and the requirements of ASHRAE 90.1-1989.
- Extend the Energy Star program to include products currently promoted through DOE's Federal Energy Management Program.
- Recruit an additional 500 retail stores to label Energy Star appliances, bringing the total number of stores that label highly-efficient appliances and equipment to 4,500.
- Recruit 5 utility partners to promote Energy Star products, bringing the total number of utilities to 60, and recruit 40 window partners to promote Energy Star windows.
- Work with industry to develop criteria for commercial Energy Star window specifications.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

FY 2001 Planned Accomplishments

Weatherization Assistance Program:

- Provide State grants to weatherize 74,800 homes for low-income families, saving \$1.80 in energy costs for every dollar invested over the life of the measures.
- Extend network capability to implement whole-house and advanced technologies as part of “Weatherization *Plus*” strategy.

State Energy Program:

- Formalize State Energy Office involvement in meeting EPA Clean Air Act goals.
- Award at least 100 Special Project State Grants with end-use sector funding to support State and local EERE research, development, demonstration, and outreach efforts.
- Initiate SEP evaluation of the impact of State energy efficiency and renewable energy programs.
- Begin implementation of strategic plan to focus program strengths on opportunities for the 21st century.

Community Energy Program:

- Recruit 50 new *Rebuild America* partners, increasing the total number of *Rebuild America* communities to 340.
- Complete projects in 50 school districts that provide models for schools across the Nation in support of the EnergySmart Schools partnership.
- Provide technical assistance to new partners in renovating more than 100 million square feet of floor space, reducing annual energy costs by \$28 million when all local actions are completed in 2004.
- Expand energy projects that have 25% energy savings for new homes in 50 *Rebuild America* partnerships using knowledge and experience from the *Building America* program.
- Provide customized technical assistance to partners, such as outreach materials, workshops, and tools and training on advanced technologies, financing options, and the construction and retrofit process.
- Assist States and communities to update and implement the upgraded commercial code, Standard 90.1 - 1999 and the upgraded model residential energy code, 2000 IECC.
- Develop and disseminate tools for implementing the new Federal residential building energy code, 10 CFR 435.
- Train 4,000 code officials, designers, and builders to use the 2000 IECC, Standard 90.1-1999, and the upgraded Federal commercial building energy code, 10 CFR 434.

Energy Star Program:

- Phase in new qualifying levels for Energy Star refrigerators and room air conditioners.
- Promotion of Energy Star products by more than 5,000 retail stores.

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

- Promotion of Energy Star products by 65 utility partners.
- Promotion of Energy Star windows by at least 200 window partners.
- Work with two manufacturers to incorporate the Energy Star logo into the FTC label.
- Launch an Energy Star program for commercial windows.
- Provide technical assistance to expand non-regulatory market transformation programs, such as the Energy Star labeling program, to 6-10 countries.
- Develop and conduct energy savings performance contracts and other innovative financial mechanisms training programs in 6-10 countries.

FY 2002 - FY 2005 Planned Accomplishments

Weatherization Assistance Program:

- Provide State grants to weatherize approximately 304,000 homes for low-income families. (FY 2002 - 2005)
- Leverage sufficient funding to fully implement “Weatherization **Plus**” strategy in at least 25 States by 2005.

State Energy Program:

- Publish results of nationwide evaluation of State energy efficiency and renewable energy technologies. (FY 2002)
- Award at least 400 Special Project State Grants with end-use sector funding. (FY 2002 - 2005)
- Implement changes in program emphasis based on results of national evaluation. (FY 2003)

Community Energy Program:

- Recruit 50 new *Rebuild America* partners each year, increasing the total number of *Rebuild America* communities to 490 by the end of 2004. (FY 2002 - 2004)
- Develop and disseminate tools for implementing new voluntary commercial energy code (Standard 90.1 - 2002) and new Federal commercial energy code (10 CFR 434). (FY 2002)
- Initiate broad peer-to-peer training effort to replicate *Rebuild America* successes in 100 communities with minimal DOE involvement. (FY 2002)
- Retrofit 2 billion square feet of existing commercial space through *Rebuild America*. (FY 2003)
- Assist 165 school districts achieve a 25 percent increase in energy efficiency through the EnergySmart Schools initiative. (FY 2003)
- Assist States and communities to update and implement the upgraded model commercial energy code (Standard 90.1 - 2002) and the upgraded model residential energy code (2000 IECC). (FY 2003)
- Develop tools for implementing the updated residential energy code (2003 IECC). (FY 2003)
- Assist States and communities to update and implement the upgraded model commercial energy code (Standard 90.1 - 2002) and the upgraded model residential energy code (2003 IECC). (FY 2004)

I. Mission Supporting Goals and Objectives: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

- Disseminate tools and provide training for implementing upgraded residential energy code (2003 IECC). (FY 2004-2005)
- Assist States and communities to update and implement the upgraded model commercial energy code (Standard 90.1 - 2005). (FY 2005)

Energy Star Program:

- Each year, increase by 500 the number of retail stores promoting Energy Star products, reaching 5,500 retail stores in FY 2004. (FY 2002 - FY 2004)
- Each year, increase by 5 the number of utilities promoting Energy Star products, reaching 80 utilities in FY 2004. (FY 2002 - FY 2004)
- Each year, increase by 50 the number of window partners promoting Energy Star windows, reaching 350 window partners in FY 2004. (FY 2002 - FY 2004)
- Incorporation of the Energy Star logo into the FTC label by all major manufacturers. (FY 2003)

II. A. Funding Table: BUILDING TECHNOLOGY ASSISTANCE

<u>Program Activity</u>	<u>FY 1999 Enacted</u>	<u>FY 2000 Enacted</u>	<u>FY 2001 Request</u>	<u>\$ Change</u>	<u>% Change</u>
Weatherization Assistance Program	\$ 133,000	\$ 135,000	\$ 154,000	\$ 19,000	14.1%
State Energy Program	33,000	33,500	37,000	3,500	10.4%
Community Energy Program (Includes <i>Rebuild America</i> , Training and Assistance for State Building Energy Codes, Information Outreach, PATH, and the former Municipal Energy Management, Affordable Housing, Highly Reflective Surfaces, and Volume Purchases programs)	18,589	18,235	27,500	9,265	50.8%
Energy Star Program.	2,674	2,724	6,500	3,776	138.6%
Total, Building Technology Assistance	<u>\$ 187,263</u>	<u>\$ 189,459</u>	<u>\$ 225,000</u>	<u>\$ 35,541</u>	<u>18.8%</u>

II. B. Laboratory and Facility Funding Table: BUILDING TECHNOLOGY ASSISTANCE

<u></u>	<u>FY 1999 Enacted</u>	<u>FY 2000 Enacted</u>	<u>FY 2001 Request</u>	<u>\$ Change</u>	<u>% Change</u>
Argonne National Lab (East)	\$ 250	\$ 250	\$ 250	\$ 0	0.0%
Brookhaven National Lab	0	0	0	0	0.0%
Lawrence Berkeley National Lab	2,500	2,500	2,500	0	0.0%
National Renewable Energy Lab	4,000	3,500	3,500	0	0.0%
Oak Ridge National Lab	4,150	4,150	4,150	0	0.0%
Pacific Northwest National Lab	4,000	3,500	3,500	0	0.0%
All Others	172,363	175,559	211,100	35,541	20.2%
Total, Building Technology Assistance.	<u>\$ 187,263</u>	<u>\$ 189,459</u>	<u>\$ 225,000</u>	<u>\$ 35,541</u>	<u>18.8%</u>

Program Activity	FY 1999	FY 2000	FY 2001
Building Technology Assistance			
Weatherization Assistance Program	<p>WEATHERIZATION ASSISTANCE: Provided State grants to weatherize 67,330 low-income homes, less than 1 percent of eligible homes nationwide. The relative scarcity of funds means that only the very neediest could be served. The States performed weatherization measures through local organizations. Measures included installing insulation and ventilation fans, performing heating and cooling tune-ups and modifications, and when appropriate, replacing units for energy efficiency and safety. Latest performance data indicates that every dollar invested in the program yielded \$1.80 in energy savings and \$0.60 in economic and environmental benefits. (States) (\$130,700)</p>	<p>WEATHERIZATION ASSISTANCE: Provide State grants to weatherize homes of 67,340 low-income families, less than 1 percent of eligible homes. Proposed legislative and regulatory changes will increase flexibility to incorporate whole house and advanced technologies. (States) (\$132,700)</p>	<p>WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 74,803 low-income homes, less than 1 percent of the eligible homes. Emphasize investment in rebuilding State technical capacity to lay the foundation for implementation of the Weatherization <i>Plus</i> strategy jointly developed and endorsed by DOE and the network. Of critical importance, State and local agencies will be in a better position to strategically improve their programs' results by incorporating new technologies and a whole-house approach, thus connecting with broader community priorities. By expanding the scope of the Program to adopt Weatherization <i>Plus</i> activities, i.e, advanced technologies and whole-house techniques, local agencies will be able to address all energy uses in low-income homes, not just heating and cooling. Local agencies engaging in Weatherization <i>Plus</i> activities can achieve significantly greater energy savings, further</p>
Weatherization			

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Weatherization Assistance Program (Cont'd)	<p>TRAINING AND TECHNICAL ASSISTANCE: Continued training and technical assistance activities to improve techniques to identify and install the most cost-effective weatherization measures; analyze health/safety issues; and promoted the use of advanced residential technologies, including those from DOE's R&D efforts. (Atlanta Regional Office (RO), Boston RO, Chicago RO, Denver RO, Philadelphia RO, San Francisco RO, ORNL, NREL, Data Tree) (\$2,300)</p>	<p>TRAINING AND TECHNICAL ASSISTANCE: Provide technical assistance and training to promote the application of advanced technologies and collaborative strategies to further improve program effectiveness and document program performance. Incorporate technologies that address climate change and PATH strategies. (Atlanta Regional Office (RO), Boston RO, Chicago RO, Denver RO, Philadelphia RO, San Francisco RO, ORNL, NREL, Data Tree, National Association for State Community Services Programs) (\$2,300)</p>	<p>TRAINING AND TECHNICAL ASSISTANCE: Provide technical assistance and training to promote the application of advanced technologies and collaborative strategies to further improve program effectiveness and document program performance. Incorporate technologies that address climate change and PATH strategies. Increase the scope of the audits and the use of advanced energy efficiency technologies to promote the whole-house approach. (Atlanta Regional Office (RO), Boston RO, Chicago RO, Denver RO, Philadelphia RO, San Francisco RO, ORNL, NREL, Data Tree) (\$2,300)</p>
Technical/Prog. Management Support	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p> <p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request identifies the funding requirements for Technical/Program Management Support as shown below.</p>		

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Funding of \$500,000 from within the Weatherization Assistance Program described above was used to provide Technical/Program Management Support.		An estimated \$500,000 within the Weatherization Assistance Program described above provides for the continuation of critical Technical/Program Management Support.	A total of \$500,000 from within the Weatherization Assistance Program described above provides for the continuation of critical Technical/Program Management Support.
	\$133,000	\$135,000	\$154,000

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
State Energy Program	STATE ENERGY PROGRAM: Provided grants to 50 States, D.C., and 5 Territories for energy efficiency programs. Continued to promote broad-based program to support innovative approaches, such as incentive funding, revolving loan funds, and energy technology commercialization services.	STATE ENERGY PROGRAM: Provide grants to 50 States, D.C., and 5 Territories for energy efficiency programs. Continue to promote broad-based programs to support innovative approaches, such as incentive funding, revolving loan funds, and energy technology commercialization services. Focus technical assistance/training on developing State-level capabilities to use collaborative partnerships.	STATE ENERGY PROGRAM: Provide grants to 50 States, D.C., and 5 Territories for energy efficiency programs. Continue to promote broad-based programs to support innovative approaches, such as incentive funding, revolving loan funds, and energy technology commercialization services. Focus technical assistance/training on developing State-level capabilities to use collaborative partnerships.
State Energy Program (Cont'd)	Increased program emphasis on technology transfer and on partnering with States to explore leveraging strategies. Provided technical assistance/training, with the focus on developing State-level capabilities to use collaborative partnerships for EERE utilization. Involved States in providing better performance measures for State Energy Program activities. (States, ORNL, NREL, D&R International) (\$33,000)	Evaluate impact of State energy efficiency and renewable energy programs. (States, ORNL, NREL, Data Tree) (\$33,500)	Work with States, EPA and other appropriate parties to formalize the State Energy Office's ongoing involvement in meeting EPA Clean Air Act requirements. Initiate evaluation of the impact of State energy efficiency and renewable energy programs nationwide. Incorporate planning for 21st century recommendations into program guidance. (States, ORNL, NREL, Data Tree) (\$37,000)

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
State Energy Program (Cont'd)	<p>SPECIAL PROJECT STATE GRANTS: Awarded at least 100 Special Project State Grants to States on a competitive basis to help deploy end-use sector technologies in the following EERE programs:</p>	<p>SPECIAL PROJECT STATE GRANTS: Award at least 100 Special Project State Grants to states on a competitive basis to help deploy end-use sector technologies in the following EERE programs:</p>	<p>SPECIAL PROJECT STATE GRANTS: Award at least 100 Special Project State Grants to states on a competitive basis to help deploy end-use sector technologies in the following EERE programs:</p>
	<p>Office of Building, State and Community Programs: <i>Rebuild America</i> \$1,250, Training and Assistance for State Building Energy Codes \$4,200, Home Energy Rating Systems \$250;</p>	<p>Office of Building, State and Community Programs: <i>Building America</i> \$300, <i>Rebuild America</i> \$1,200, and Training and Assistance for State Building Energy Codes \$4,200;</p>	<p>Office of Building, State and Community Programs: <i>Building America</i> \$300, <i>Rebuild America</i> \$1,200, Training and Assistance for State Building Energy Codes \$4,200;</p>
	<p>Federal Energy Management Program: \$950;</p>	<p>Federal Energy Management Program: \$950;</p>	<p>Federal Energy Management Program: \$400;</p>
	<p>Office of Industrial Technologies: Industries of the Future - Specific \$800, Industries of the Future - Crosscutting including Industrial Assessment Centers (IACs), NICE3 grants, Motor and Steam Challenge, Inventions and Innovation grants, and Technical Assistance \$1,200;</p>	<p>Office of Industrial Technologies: Industries of the Future - Specific \$1,200, Industries of the Future - Crosscutting including Industrial Assessment Centers (IACs), NICE3 grants, Motor and Steam Challenge, Inventions and Innovation grants, and Technical Assistance \$1,600;</p>	<p>Office of Industrial Technologies: Industries of the Future - Specific \$1,340, Industries of the Future - Crosscutting \$1,460;</p>
<p>Office of Transportation Technologies: Clean Cities \$2,700;</p>	<p>Office of Transportation Technologies: Clean Cities \$2,700;</p>	<p>Office of Transportation Technologies: Clean Cities \$3,250;</p>	

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	Office of Power Technologies: Included efforts from Wind, Solar Thermal, Biomass Power, Geothermal Heat Pumps, Solar Roofs, and Remote Renewable Energy Applications \$1,750.	Office of Power Technologies: Includes efforts from Wind, Solar Thermal, Biomass Power, Geothermal Heat Pumps, Solar Roofs, and Remote Renewable Energy Applications \$1,750.	Office of Power Technologies: Solar and Renewable Resources Technologies \$1,750.
	Subtotal, Energy Conservation (\$11,350)	Subtotal, Energy Conservation (\$12,150)	Subtotal, Energy Conservation (\$12,150)
	Subtotal, Solar and Renewable (\$1,750)	Subtotal, Solar and Renewable (\$1,750)	Subtotal, Solar and Renewable (\$1,750)
	Total, SEP Special Project State Grants \$13,100.	Total, SEP Special Project State Grants \$13,900.	Total, SEP Special Project State Grants \$13,900.

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Technical/Prog. Management Support	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p> <p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request identifies the funding requirements for Technical/Program Management Support as shown below.</p>		
	Funding of \$100,000 from within the State Energy Program described above was used to provide Technical/Program Management Support.	An estimated \$100,000 from within the State Energy Program described above provides for the continuation of critical Technical/ Program Management Support.	A total of \$100,000 from within the State Energy Program described above provides for the continuation of critical Technical/ Program Management Support.
	\$33,000	\$33,500	\$37,000
Community Energy Program	COMMUNITY ENERGY PROGRAM:	COMMUNITY ENERGY PROGRAM:	COMMUNITY ENERGY PROGRAM:

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Community Energy Program (Cont'd)	<p>INTRODUCTION: The consolidated Community Energy Program provides integrated information, technical assistance, and financial assistance to communities to increase their use of innovative and cost-effective building technologies, strategies, and practices. The Program has four thrusts: <i>Rebuild America</i>, Information Outreach, Partnership for Advancing Technology in Housing (PATH), and Training Assistance for State Building Energy Codes. <i>Rebuild America</i> helps designated communities design and implement energy-saving programs that respond to their own circumstances and goals, providing access to a portfolio of technical assistance including affordable housing, volume purchasing and reflective surface technologies, with a core focus on existing commercial and institutional buildings. Information Outreach provides citizens and businesses in communities nationwide with informative and educational materials to help them improve the energy efficiency of their buildings. PATH, a multi-agency effort, links key Federal agencies with leaders from the home building and related industries. One of the DOE roles is broad dissemination of advanced technologies to residential partners. Training and Assistance for State Building Energy Codes helps build the expertise to implement building energy codes at the community level. These four aspects of the Community Energy Program respond directly to community needs and opportunities for increased energy efficiency, in collaboration with States, throughout the country.</p>		

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	<p>TRANSFER FROM: Building Systems Design:</p> <p><i>REBUILD AMERICA:</i> Recruited 85 additional partnerships, increasing the total number of <i>Rebuild America</i> communities to 240. Continued two-tiered strategy that provides information and assistance to help locally-led partnerships retrofit buildings and maintain successful alliances with national organizations, such as the U.S. Conference of Mayors and the Association of Higher Education Facility Officers, to reach national representatives of key local decision makers. Provided products and technical assistance tailored to meet the unique needs of partnerships; e.g., assistance in adopting whole building retrofits, access to hot lines and electronic bulletin boards, peer-to-peer workshops and training seminars, and customized assistance from DOE National Laboratory staff and private sector experts.</p>	<p><i>REBUILD AMERICA:</i> Increase <i>Rebuild America</i> partnerships by 50 to 290, providing assistance to more communities and helping them develop and implement community action plans. New partners in FY 2000 will commit to renovating more than 100 million square feet of floor space over 4 years, reducing annual costs by \$28 million when local actions are completed. Assistance includes outreach materials; workshops; tools and training on advanced technologies, financing options, affordable housing, volume purchasing, highly reflective surfaces, and the construction and retrofit process; and design assistance to increase adoption of whole-building approaches.</p>	<p><i>REBUILD AMERICA:</i> Establish 50 new <i>Rebuild America</i> community partnerships and assist these communities to retrofit 100 million square feet of floor space in K-12 schools, colleges, public housing, state and local governments, and commercial buildings. Assist these communities to increase use of innovative and cost-effective building technologies, strategies, and practices through energy-saving programs that respond to their own circumstances and goals. Assistance includes outreach materials; workshops; tools and training on advanced technologies, financing options, affordable housing, volume purchasing, highly reflective surfaces, and the construction and retrofit process; and design assistance.</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Community Energy Program (Cont'd)	<p>Expanded support to community partnerships to increase the use of innovative strategies that will reduce energy costs. Maximized the market penetration of <i>Rebuild America</i> by institutionalizing the use of performance contracting, integrating energy improvements with the Department of Housing and Urban Development's Enterprise and Empowerment Zones, and working within local chambers of commerce as part of local economic development strategy.</p> <p>Affordable Housing: Sponsored 15 residential build/design training programs in partnership with local communities. Improved the performance and affordability of housing through a competitive solicitation that provided training and on-site technical assistance to local communities, State agencies, nonprofit community development organizations, and national associations of housing and financial industries.</p> <p>Volume Purchases: Organized volume buyers to commit to</p>	<p>Assist partners in evaluating and increasing investment in energy efficiency, and promote the use of new, advanced commercial equipment and appliances, including products with the Energy Star label. Lessons learned from earlier BTS programs will be applied. Expand training programs to optimize energy savings in <i>Rebuild America</i> communities and ensure that the latest technologies and practices are incorporated into designs and retrofits.</p>	<p>Document the success of 100 community energy projects for dissemination to other communities. Establish a national network of <i>Rebuild America</i> partnerships to accelerate the transfer of best practices, lessons learned, and resources among partnerships. Promote the Energy Star building label for completed retrofit projects through <i>Rebuild America</i> partners. Increase education and outreach activities with <i>Rebuild America</i> industry partners, e.g. utilities, energy service companies, and major equipment manufacturers.</p> <p>Using <i>Rebuild America</i> partnerships, continue to support K-12 schools through the EnergySmart Schools initiative, a national public/private partnership to improve energy efficiency in schools and reinvest the savings in education. Activities include: targeting the school sector within existing and new <i>Rebuild America</i> community energy program; developing strategic partnerships with national organizations representing policy, facility, and</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Community Energy Program (Cont'd)	<p>Municipal Energy Management Program: Co-funded approximately 14 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provided technical assistance to local jurisdictions in replicating successful projects. (LBNL, ORNL, PNNL, ANL, NREL, American Public Power Association, U.S. Conference of Mayors, Florida Solar Energy Center, Habitat for Humanity, National Congress for Community Economic Development, Global Green USA, Southface Energy Institute, American Forests, Urban Consortium) (Special Project State Grants includes \$1,250 from <i>Rebuild America.</i>) (\$9,859; includes <i>Rebuild America</i> \$7,122, Affordable Housing \$590, Volume Purchases \$491, Highly Reflective Surfaces \$120, Municipal Energy Management Program \$1,536)</p>	<p>No activities in FY 2000. (LBNL, ORNL, PNNL, ANL, NREL, American Public Power Association, U.S. Conference of Mayors) (Includes \$1,200 for the State Energy Program Special Project State Grants) (<i>Rebuild America</i> \$9,424, Affordable Housing \$0, Volume Purchases \$0, Highly Reflective Surfaces \$0, Municipal Energy Management Program \$0) (\$9,424)</p>	<p>As part of <i>Rebuild America</i>, provide 6 to 8 demonstration Community Energy Grants to competitively-selected communities to support community-wide energy projects that save energy, create jobs, promote growth, and protect the environment through improved energy efficiency and sustainable building design and operation. This updates and replaces the grants formerly supplied for city facilities through the Municipal Energy Management Program. Community Energy Grants are available to a larger audience. (LBNL, ORNL, PNNL, ANL, NREL, American Public Power Association, US Conference of Mayors) (Includes \$1,200 for the State Energy Program Special Project State Grants) (\$15,712; includes <i>Rebuild America</i> \$9,700 EnergySmart Schools \$2,500 and Community Energy Grants \$3,512)</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Community Energy Program (Cont'd)	<p>INFORMATION OUTREACH: Promoted and tested the Energy Star building performance label in collaboration with EPA to increase demand for energy-efficient buildings in the commercial real estate market. Conducted pilot projects in partnership with States and utilities to test automatic energy code compliance strategies through the awarding of the Energy Star label. Began training building facility managers and operators using the building operation/facility management curricula designed in FY 1998 in partnership with the International Facilities Management Association and the Association of Higher Education Facilities Officers. (ORNL, NREL) (\$1,018)</p>	<p>INFORMATION OUTREACH: Provide outreach and educational materials to promote energy-efficient technologies and practices that are essential to influencing consumer demand for new, high-efficiency buildings, equipment, and appliances and the energy retrofit of existing buildings. (ORNL, NREL) (\$1,018)</p>	<p>INFORMATION OUTREACH: Increase efforts that target builders, homeowners, and building owners by providing information and education materials on energy efficiency through a variety of media outlets to help them make the best decisions related to new construction, renovations, and purchasing of products. (NREL, ORNL) (\$1,988)</p>
	<p>PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING: (New Initiative in FY 2001.)</p>	<p>PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING: (New Initiative in FY 2001.)</p>	<p>PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING: Participate and contribute to outreach activities of the public/private Partnership for Advancing Technology in Housing (PATH), providing customized technical assistance to residential partners through PATH. (\$2,000)</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Community Energy Program (Cont'd)	<p>TRANSFER FROM: Codes and Standards:</p> <p>TRAINING AND ASSISTANCE FOR STATE BUILDING ENERGY CODES: (Formerly Update State Codes, Training, Assistance, Analysis, and Process): Provided technical assistance and co-funded incentive grants to assist states in establishing, updating, and expanding their residential and commercial building codes. Monitored and evaluated the progress of local governments relative to building energy efficiency codes. Processed State certifications of compliance updating their energy codes with respect to the 1998 IECC and processed State requests for deadline extensions. Developed and implemented programs tailored to specific States and user groups to increase code awareness and support adoption of codes. Expanded training to 7,000 code officials, designers, architects, engineers, builders, and Federal facility managers through regional workshops and distance learning activities that addressed compliance</p>	<p>TRAINING AND ASSISTANCE FOR STATE BUILDING ENERGY CODES: Provide technical and financial assistance to accelerate the availability of building code compliance trainers, information, and core materials. Train approximately 4,000 code officials, designers, and builders on 1998 and 2000 International Energy Conservation Code (IECC) via Train-the-Trainer and distance learning. (PNNL, International Council of Building Officials (ICBO), ASHRAE) (Includes \$4,200 for the State Energy Program Special Project State Grants) (\$7,793)</p>	<p>TRAINING AND ASSISTANCE FOR STATE BUILDING ENERGY CODES: Provide technical and financial assistance to support the availability of building energy code compliance trainers, information, and materials. Train approximately 4,000 code officials, designers, and builders on 2000 International Energy Conservation Code (IECC) via Train-the-Trainer and distance learning. Increase Federal use of the upgraded Federal commercial energy code by working with FEMP. Evaluate differences between the Federal code and the 2000 IECC to assist Federal agencies to increase the use of the Federal code. Develop core materials for the implementation of advanced building construction practices and new energy-efficient technologies for private sector and Federal buildings. (PNNL, International Council of Building Officials (ICBO), ASHRAE) (Includes \$4,200 for the State Energy Program Special Project State Grants) (\$7,800)</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Technical/Prog. Management Support	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p>		
Technical/Prog. Management Support (Cont'd)	<p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request identifies the funding requirements for Technical/Program Management Support as shown below.</p>		
	<p>Funding of \$0 from within the Community Energy Program described above was used to provide Technical/Program Management Support.</p>	<p>An estimated \$90,000 from within the Community Energy Program described above provides for the continuation of critical Technical/Program Management Support.</p>	<p>A total of \$90,000 from within the Community Energy Program described above provides for the continuation of critical Technical/Program Management Support.</p>
	\$18,589	\$18,235	\$27,500

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Energy Star Program	<p>TRANSFER FROM: Building Equipment and Materials:</p> <p>ENERGY STAR: Added commercial products like chillers and boilers to the Energy Star product portfolio, and added gas products like water heating technology to the Energy Star consumer education portfolio. Signed agreements with all major appliance manufacturers to apply voluntary Energy Star labels at the factory.</p>	<p>ENERGY STAR: Collaborate with EPA to expand the Energy Star program. The program increases consumers' awareness of the benefits and cost savings of energy-efficient appliances and products. Establish higher energy efficiency qualifying levels for Energy Star refrigerators. Add new residential and commercial appliances and products, such as water heaters and motors, to the Energy Star product portfolio.</p>	<p>ENERGY STAR: Expand the Energy Star product portfolio by developing a commercial Energy Star window specification with industry and converting three Federal product recommendations into Energy Star products. Converting the FEMP-produced product recommendations will help increase the purchase of energy-efficient products, extending the benefits beyond the Federal market. Phase in the new qualifying levels for Energy Star refrigerators and establish higher energy efficiency qualifying levels for Energy Star room air conditioners. Based on the sales data developed in FY 1999, increase market share of Energy Star appliances by 5 percent over the FY 2000 level.</p>
Energy Star Program (Cont'd)			

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	<p>Recruited an additional 1,500 retail stores to label Energy Star appliances, bringing the total number of stores that label highly-efficient appliances to 4,500. Added new appliances, such as water heaters and compact fluorescent lamps, to the Energy Star portfolio. Incorporated Energy Star as a voluntary element of the FTC "Energy Guide" label. Monitored sales of Energy Star products to measure success of the program. Initiated a campaign to educate consumers about the benefits of early retirement of inefficient residential appliances.</p>	<p>Recruit 5 utility partners to promote Energy Star products and 40 partners to promote Energy Star windows that were developed in BTS' Building Envelope R&D program. New windows, such as high-performance, spectrally-selective windows that use advanced glazing to reduce the cooling load in Sun Belt homes by 40 to 70 percent, provide first-cost savings to the builder by allowing for smaller, less expensive air conditioning equipment, as well as energy savings to the owners.</p>	<p>Recruit 5 additional utility partners, particularly in the Southeast and Southwest U.S., to promote Energy Star products and an additional 160 partners to promote Energy Star windows. Recruit an additional 500 retail stores to label Energy Star appliances. Work with two manufacturers to incorporate the Energy Star logo into the FTC label. Collaborate with EPA to increase consumers' awareness of the benefits and cost savings of energy-efficient appliances and products by promoting the Energy Star building label, educating consumers about the benefits of replacing inefficient residential appliances, and providing technical assistance and software tools to manufacturers.</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Energy Star Program (Cont'd)	<p>Provided technical support to the Efficient Windows Collaborative and to industry to develop advanced technologies. Continued developing and adapting DOE/LBNL computer tools (WINDOW 5 and RESFEN), information products, and industry-based training tools. Expanded regional projects and technical assistance program to manufacturers. Provided demonstration projects, analysis of results, and technically sound guidelines and design and training tools. Duplicated the demonstration results from FY 1998 that showed significant energy savings and first-cost savings for builders who used high-performance spectrally-selective windows in several Sun Belt States. New glazing technologies can reduce the cooling load in Sun Belt homes by 40 to 70 percent. (ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance, LBNL, University of Minnesota, FSEC, ASE) (\$2,674)</p>	<p>Work with the Efficient Windows Collaborative to increase the awareness and demand for the latest window technologies through demonstrations and training for builders. Extend the use of the Energy Star appliance program from manufactured homes to other home builders throughout the U.S. Recruit an additional 500 retail stores to label Energy Star appliances. Extend the Energy Star label to buildings that meet the DOE/EPA performance level and the requirements of ASHRAE 90.1-1989. Provide new buildings in the design phase with a provisional Energy Star label when they can demonstrate through simulations that they meet these criteria. The label can help building owners market the features of the buildings to attract tenants. Continue campaign to educate consumers about the benefits of early retirement of inefficient residential appliances. Monitor sales of Energy Star products to measure success of the program. Expand technical assistance to manufacturers through the development and adaptation of DOE/LBNL computer tools</p>	<p>Continue support of the Efficient Windows Collaborative regional initiatives, including the Sunbelt Project, providing technical assistance to architects, builders, and manufacturers in their application and development of advanced window products. The Collaborative promotes wider participation in the Energy Star windows program. (ASE, ORNL, D&R, ADL, Gallup) (\$5,500)</p>

III. Performance Summary: BUILDING TECHNOLOGY ASSISTANCE (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Technical/Prog. Management Support	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p> <p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request identifies the funding requirements for Technical/Program Management Support as shown below.</p>		
Technical/Prog. Management Support (Cont'd)	Funding of \$0 from within the Energy Star Program described above was used to provide Technical/Program Management Support.	An estimated \$120,000 from within the Energy Star Program described above provides for the continuation of critical Technical/ Program Management Support.	A total of \$120,000 from within the Energy Star Program described above provides for the continuation of critical Technical/ Program Management Support.
	\$2,674	\$2,724	\$6,500
Building Technology Assistance, Total	\$187,263	\$189,459	\$225,000

BUILDING TECHNOLOGIES
BUILDING TECHNOLOGY, STATE, AND COMMUNITY SECTOR
(Dollars in Thousands)

COOPERATIVE PROGRAMS WITH STATES

I. Mission Supporting Goals and Objectives

I. A. Program Strategy

The goal of the new FY 2000 Cooperative Programs with States initiative is to pursue collaborative applied research, development, and demonstration (RD&D) that accelerates the use of clean energy technologies. This collaboration provides opportunities to leverage funding for important RD&D that might not receive adequate support at either the Federal or the state level. States and the Federal Government can collaborate on comprehensive programs in both applied research and technology field tests designed to maximize the benefits of clean and efficient buildings technologies. In the buildings sector, competitive grants will be awarded to accelerate the feasibility of new technologies that improve the energy efficiency of school facilities. The need for advanced technologies and design strategies in both new and existing schools is great. By 2003 more than 2,400 new schools will be built to relieve overcrowding. Furthermore, the average existing public school in America is 42 years old and the GAO estimates that more than \$100 billion is needed to repair or upgrade tens of thousands of school facilities. The grants will focus on applied research and field test projects in building technologies and/or distributed generation. The results of the projects will be part of technical design guidelines developed for new school construction and used by architects, engineers, and product manufacturers. In addition, the results will be communicated to researchers, engineers, facility managers, and others to promote further cost-sharing, continued technology improvement, and commercial applications. This type of applied RD&D can further the common goals that the Federal and State Governments have in enhancing energy security (i.e., reduction of oil imports) and air quality (i.e., reduced emissions).

I. B. Performance Goals

FY 2000 Planned Accomplishments

- Award competitive grants to increase collaborative applied research and accelerate the adoption of new building technologies and/or distributed generation to improve the energy efficiency of school facilities.

II. A. Funding Table: COOPERATIVE PROGRAMS WITH STATES

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Cooperative Program with States	\$ 0	\$ 2,000	\$ 0	\$ -2,000	-100.0%
Other	0	0	0	0	0.0%
Total, Cooperative Program with States	\$ 0	\$ 2,000	\$ 0	\$ -2,000	-100.0%

II. B. Laboratory and Facility Funding Table: COOPERATIVE PROGRAMS WITH STATES

	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Argonne National Lab	\$ 0	\$ 0	\$ 0	\$ 0	0.0%
National Renewable Energy Lab	0	0	0	0	0.0%
Oak Ridge National Lab	0	0	0	0	0.0%
All Other	0	2,000	0	-2,000	-100.0%
Total, Cooperative Programs with States	\$ 0	\$ 2,000	\$ 0	\$ -2,000	-100.0%

III. Performance Summary: (New BA in thousands of dollars)

Program Activity	FY 1999	FY 2000	FY 2001
Cooperative Programs with States		<p>COOPERATIVE PROGRAMS WITH STATES: Award competitive grants to accelerate the adoption of new technologies to improve the energy efficiency of school facilities. The grants will focus on building technologies and/or distributed generation. In the area of building technologies, conduct applied research and field test projects through an integrated buildings approach in a range of technology areas, such as space conditioning and refrigeration, super-efficient windows and lighting; and other energy-efficient appliances. Results of the projects will be part of technical design guidelines developed for new school construction and used by architects, engineers, and product manufacturers. In the area of distributed generation technologies, field test the technologies in school facilities and conduct applied research to adapt advanced energy technologies for use in school facilities. The results of these efforts will be communicated to researchers, engineers, facility managers, and others to promote non-federal, State, and industry cost-share, continued technology improvement, and commercial applications. (TBD)</p>	
Cooperative Programs with States (Cont'd)			

III. Performance Summary: COOPERATIVE PROGRAMS WITH STATES (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	\$0	\$2,000	\$0
Other	\$0	\$0	\$0
Cooperative Programs with States, Total	\$0	\$2,000	\$0

BUILDING TECHNOLOGIES
BUILDING TECHNOLOGY, STATE, AND COMMUNITY SECTOR
(Dollars in Thousands)

ENERGY EFFICIENCY SCIENCE INITIATIVE

I. Mission Supporting Goals and Objective

I. A. Program Strategy

The goal of the FY 2000 Energy Efficiency Science Initiative is to focus funding and effort on “bridge” research and development (R&D) that falls between fundamental exploratory science and pre-commercial applied R&D. EERE’s goal is to stimulate R&D in the public and private sectors in ways that maximize synergies among different research fields, technologies, investigator communities, and end-use applications.

This cross-cutting approach seeks to expand EERE’s R&D activities among energy efficiency technologies, with particular focus on distributed power generation applications, to industrial and buildings systems; and its work on technologies with applications to both transportation and stationary power. This approach also seeks to expand existing cooperation with the Office of Fossil Energy in such areas as natural gas-fueled turbine and fuel cell technologies, buildings cooling, heat, and power applications, hydrogen production and carbon emission sequestration. It also aims at more extensive coordination with the Office of Science and pursuing fundamental research in areas that are critical to energy efficiency and clean energy development. Approximately 4 to 8 competitive grants/agreements will be awarded to stimulate breakthroughs in energy-efficient building technologies and integrated systems.

I. B. Performance Goals

FY 2000 Planned Accomplishments

- Increase fundamental strategic research, which advances the use of energy-efficient technologies.
- Award 4 to 8 competitive grants/agreements to support R&D that “bridges” fundamental exploratory science with pre-commercial applied R&D.

II. A. Funding Table: ENERGY EFFICIENCY SCIENCE INITIATIVE

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Energy Efficiency Science Initiative	\$ 0	\$ 3,900	\$ 0	\$ -3,900	-100.0%
Other	0	0	0	0	0.0%
Total, Energy Efficiency Science Initiative	\$ 0	\$ 3,900	\$ 0	\$ -3,900	-100.0%

II. B. Laboratory and Facility Funding Table: ENERGY EFFICIENCY SCIENCE INITIATIVE

	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Argonne National Lab	\$ 0	\$ 0	\$ 0	\$ 0	0.0%
National Renewable Energy Lab	0	0	0	0	0.0%
Oak Ridge National Lab	0	0	0	0	0.0%
All Other	0	3,900	0	-3,900	-100.0%
Total, Energy Efficiency Science Initiative	\$ 0	\$ 3,900	\$ 0	\$ -3,900	-100.0%

III. Performance Summary: (New BA in thousands of dollars)

Program Activity	FY 1999	FY 2000	FY 2001
Energy Efficiency Science Initiative		<p>Energy Efficiency Science Initiative: Award 4 to 8 competitive grants/agreements to support R&D that “bridges” fundamental exploratory science with pre-commercial applied R&D. The goal is to stimulate R&D in the private and public sectors that maximizes funding and investment opportunities by exploring and exploiting synergies among different research fields, technologies, investigator communities, and end-use applications. (TBD) (\$3,900)</p>	
	\$0	\$3,900	\$0
Other	\$0	\$0	\$0
Energy Efficiency Science Initiative, Total	\$0	\$3,900	\$0

BUILDING TECHNOLOGIES
BUILDING TECHNOLOGY, STATE, AND COMMUNITY SECTOR
(Dollars in Thousands)

MANAGEMENT AND PLANNING

I. Mission Supporting Goals and Objectives

The mission of the BTS Management and Planning program is to provide the information, analyses, and personnel to skillfully conduct the building sector program. The goal of Management and Planning is to provide a well-planned and efficiently-managed program that will lead to the achievement of the BTS Strategic Plan and building sector goals in the most cost-effective manner possible. Effective management requires efficient organizational design, adequate human resources, sufficient and quality information, and good communication, both within the organization and with outside parties. A solid analytical foundation is basic to understanding the potential for increasing the penetration of energy-efficient and renewable technologies in the building sector, and for achieving the correct balance and direction of programmatic activities. The Management and Planning program will provide this foundation by carrying out its mission through Evaluation, Planning, and Analysis; and Program Direction functions necessary to effectively guide and support all BTS programs.

I. A. Program Strategy:

Evaluation, Planning, and Analysis is responsible for the data, analytical tools, and analyses required for program planning, prioritization, and management. The unit will collect and process technology and sector data, develop tools and models, conduct analyses, prepare studies to support program planning, and provide customer-focused services for State and local grants programs and regional planning, as well as services to in-state customers. The organization maintains strong capabilities in data analysis and model development to ensure that decisions regarding program direction and resource allocation are guided by the best possible information. Analytical capabilities and the supporting database are continually refined and strengthened to improve the information available for program guidance decisions and to better evaluate the energy, economic, and environmental impacts of programmatic alternatives.

Program Direction provides BTS' personnel to manage the sector programs. It includes salaries, benefits, travel, and support for 81 FTEs located at DOE headquarters in Washington.

I. B. Program Benefits:

Benefits from a successful Management and Planning program are reflected in progress toward achieving the overall sector goals. The Management and Planning program provides the information, guidance, and direction necessary for the BTS staff to implement the Strategic

Mission Supporting Goals and Objectives: MANAGEMENT AND PLANNING (Cont'd)

Plan and to realize the program benefits. These benefits include energy and consumer cost savings, employment increases, balance of trade improvements, and emissions reductions. The program also develops information that is used by the private sector to assess the costs and benefits of improving the efficiency of energy use in buildings.

I. C. Performance Measures:

Accomplishment of the following performance measures during FY 2001 will indicate success for the Management and Planning program:

1. Development of annual performance measures/milestones as required by the Government Performance and Results Act (GPRA) that are used to measure progress toward achievement of BTS program benefits.
2. Development of annual performance accomplishments as required by GPRA.
3. Implementation of the recommendations of the President's Committee of Advisors on Science and Technology (PCAST) contained in the report *Federal Energy Research and Development for the Challenges of the 21st Century*, including portfolio analysis, continuation of international activities, and assistance with the development of a cogent plan for an expanded buildings R&D program.
4. Maintenance and improvement of the analytical capability of Management and Planning's personnel, especially in the areas of planning and background information development to support quick-response tasks.

II. A. Funding Table: MANAGEMENT AND PLANNING

Program Activity	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Management and Planning					
Evaluation and Planning	\$ 5,871	\$ 5,321	\$ 5,539	\$ 218	4.1%
Program Direction	7,670	7,910	9,120	1,210	15.3%
Total, Management and Planning	\$ 13,541	\$ 13,231	\$ 14,659	\$ 1,428	10.8%

II. B. Laboratory and Facility Funding Table: MANAGEMENT AND PLANNING

	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request	\$ Change	% Change
Brookhaven National Lab	\$ 400	\$ 400	\$ 400	\$ 0	0.0%
Lawrence Berkeley Lab	600	600	600	0	0.0%
National Renewable Energy Lab	100	100	100	0	0.0%
Oak Ridge National Lab	100	100	100	0	0.0%
Pacific Northwest Lab	1,300	1,300	1,300	0	0.0%
All Other	11,041	10,731	12,159	1,428	13.3%
Total, Management and Planning	\$ 13,541	\$ 13,231	\$ 14,659	\$ 1,428	10.8%

III. Performance Summary: (New BA in thousands of dollars)

III. Performance Summary: MANAGEMENT AND PLANNING (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Management and Planning			
Evaluation, Planning and Analysis	<p>EVALUATION, PLANNING, AND ANALYSIS: Developed, organized, interpreted, and disseminated the basic data required to formulate energy policy for buildings and the planning, management, and evaluation of the BTS program. This data includes building and technology characteristics, disaggregated information on energy use in the buildings sector (by end-use, fuel, economics, demographic parameters, etc.), environmental data, building industry characteristics, and market data.</p> <p>Cooperated with the EIA to refine and update buildings energy use data. Conducted topical analyses on research needs and opportunities, international technology development, potential carbon savings and associated costs, impacts of utility deregulation, and other subjects. Activities supported included portfolio analysis, GPRA evaluation and benefits analysis, analysis of emerging trends in</p>	<p>EVALUATION, PLANNING, AND ANALYSIS: Develop, organize, interpret, and disseminate the basic data required to formulate energy policy for buildings and to plan, manage, and evaluate the BTS program. Provide guidance and direction to implement BTS' Strategic Plan.</p> <p>Collaborate with EIA to refine and update buildings energy use data. Conduct topical analyses on research needs and opportunities, international technology development, potential carbon and pollution savings and associated costs, impacts of utility restructuring on the building sector, and other subjects as appropriate. Activities supported will include portfolio analysis, GPRA evaluation</p>	<p>EVALUATION, PLANNING, AND ANALYSIS: Develop, organize, interpret, and disseminate the basic data required to formulate energy policy for buildings and to plan, manage, and evaluate the BTS program. Activities supported include portfolio analysis, GPRA evaluation of benefits and accomplishments, and analysis of emerging trends in buildings energy use. Provide guidance and direction to implement BTS' Strategic Plan.</p> <p>Collaborate with EIA to refine and update buildings energy use data. Conduct topical analyses on research needs and opportunities, regulatory and technology deployment opportunities, international technology and program opportunities. Evaluate the potential carbon and pollution savings and associated costs and employment impacts of BTS programs and the impacts of utility</p>
Evaluation, Planning and			

III. Performance Summary: MANAGEMENT AND PLANNING (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
Technical/Prog. Management Support and Management Support Services	<p>INTRODUCTION: Consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provide funding for: (a) Technical/Program Management Support; and (b) Management Support Services.</p> <p>Technical/Program Management Support includes activities such as R&D feasibility studies; R&D option development and trade-off analysis; and technical, economic, market evaluations of R&D, and contract audit costs. These activities provide important benefits directly to the R&D program described above and are therefore an integral part of the R&D program.</p> <p>Management Support Services include activities such as improving the effectiveness, efficiency and economy of management and general administrative services. These activities are critical to the planning, formulation, and execution of the Energy Conservation programs.</p> <p>As directed by Congress, the FY 2001 Congressional Budget Request identifies the funding requirements for Management Support Services as shown below. Funding for Technical/Program Management Support continues to be funded in the R&D programs described above.</p>		
Technical/Prog. Management Support and Management Support Services (Cont'd)	Funding of \$350,000 from within the Management and Planning Program described above was used to provide Technical/Program Management Support.	An estimated \$350,000 from within the Management and Planning Program described above provides for the continuation of critical Technical/Program Management Support.	A total of \$350,000 from within the Management and Planning Program described above provides for the continuation of critical Technical/Program Management Support.
	\$5,871	\$5,321	\$5,539

III. Performance Summary: MANAGEMENT AND PLANNING (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001																								
Program Direction	<p>The following is a breakdown of the funding by Object Class:</p> <table border="0"> <tr> <td>11.9 Personnel compensation</td> <td style="text-align: right;">\$5,558</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,137</td> </tr> <tr> <td>21.0 Travel and transportation of person</td> <td style="text-align: right;">\$ 466</td> </tr> <tr> <td>25.2 Other services</td> <td style="text-align: right;">\$ 509</td> </tr> </table> <p>Provided salaries, benefits, travel, support, and realignment costs for 73 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. Funding for other services supported employee training and permanent change-of-station moves, and \$400,000 internally reprogrammed from Conservation prior year funds derived from contract close outs to support the Office of Hearing and Appeals. (\$7,670)</p>	11.9 Personnel compensation	\$5,558	12.1 Civilian personnel benefits	\$1,137	21.0 Travel and transportation of person	\$ 466	25.2 Other services	\$ 509	<p>The following is a breakdown of the funding by Object Class:</p> <table border="0"> <tr> <td>11.9 Personnel compensation</td> <td style="text-align: right;">\$6,535</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,339</td> </tr> <tr> <td>21.0 Travel and transportation of persons</td> <td style="text-align: right;">\$ 590</td> </tr> <tr> <td>25.2 Other services</td> <td style="text-align: right;">\$ 150</td> </tr> </table> <p>Provide salaries with cost of living increase, benefits, travel, and support for 81 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. Supports staffing adjustments resulting from Workforce 21 plans. Funds for other services support employee training, permanent change-of-station moves, and a contingency. Total obligational authority of \$8,614,000 for Program Direction includes an estimated \$704,000 of FY 1999 unobligated carryover in Program Direction to cover FY 2000 requirements. (\$7,910)</p>	11.9 Personnel compensation	\$6,535	12.1 Civilian personnel benefits	\$1,339	21.0 Travel and transportation of persons	\$ 590	25.2 Other services	\$ 150	<p>The following is a breakdown of the funding by Object Class:</p> <table border="0"> <tr> <td>11.9 Personnel compensation</td> <td style="text-align: right;">\$6,930</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,420</td> </tr> <tr> <td>21.0 Travel and transportation of persons</td> <td style="text-align: right;">\$ 620</td> </tr> <tr> <td>25.2 Other services</td> <td style="text-align: right;">\$ 150</td> </tr> </table> <p>Provide salaries with cost of living increase, benefits, travel, and support for 81 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. The FY 2001 Congressional Request for Program Direction provides for continued implementation of Workforce 21 plans. The request for other services supports employee training, and a contingency. Overall Program Direction of \$9,120,000 increases approximately 6% over the FY 2000 total obligational authority for inflation and payraise.</p> <p>The Department of Energy has conducted detailed workforce analyses that have identified current and projected staffing disciplines. During 1999, DOE conducted a systematic analysis of critical</p>	11.9 Personnel compensation	\$6,930	12.1 Civilian personnel benefits	\$1,420	21.0 Travel and transportation of persons	\$ 620	25.2 Other services	\$ 150
11.9 Personnel compensation	\$5,558																										
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25.2 Other services	\$ 150																										
Program Direction (Cont'd)																											

III. Performance Summary: MANAGEMENT AND PLANNING (Cont'd)

Program Activity	FY 1999	FY 2000	FY 2001
	\$7,670	\$7,910	\$9,120
Management and Planning Total	\$13,541	\$13,231	\$14,659