

**DEPARTMENT OF ENERGY
FY 2000 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 gases.

Situation

Though much progress has been made in recent years, the building sector still offers significant opportunities for energy efficiency improvements.

• ***Increasing Energy Use in the Building Sector***

In 1996, Americans spent approximately \$232 billion to heat, cool, light, and run the equipment and appliances in our Nation's buildings. Buildings use well over a third of our Nation's total energy consumption. This usage is split fairly even between residential buildings (56 percent) and commercial buildings (44 percent). Annual U.S. building energy consumption alone—34.4 quadrillion Btu (quads)—is equal to the total annual energy consumption of China in 1993. In addition, between now and 2010, 21 million new homes and more than 19 billion square feet of new commercial and industrial buildings are expected to be constructed in the United States. If our current rate of energy use continues unimpeded, the Energy Information Administration projects

**Energy Star Appliance Sales See
Phenomenal Increase**

Saving Energy—Cutting Pollution

Style, function, design, efficiency, and pollution prevention—the achievements of the DOE/EPA's **Energy Star** labeling and consumer education program are being realized by manufacturers at the cash register. Maytag's **Energy Star** appliance sales are up 31 percent and Frigidaire can not manufacture enough of its **Energy Star** clothes washers to meet customer demand. In 1998, more than 50 manufacturing partners signed on to produce and label **Energy Star** windows, doors, and skylights. Home Depot will stock only **Energy Star** windows in California and will replace all of its window inventory in the Southwest with **Energy Star** products during 1999. More than 2,000 retail store partners (including Circuit City and Montgomery Ward), 33 utilities, and 9 major appliance manufacturers nationwide stock and promote **Energy Star** products.

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

annual energy use in buildings will rise to 36.8 quads by the year 2010, an increase of 7 percent, needlessly wasting money and resources and further increasing our energy dependence and level of pollution.

- ***Environmental Impact of the Building Industry***

Energy use in buildings is responsible for 35 percent of the Nation's carbon dioxide emissions, 48 percent of the sulfur dioxide emissions, and 23 percent of the nitrogen oxide emissions. Emissions of carbon attributable to U.S. buildings alone are roughly equal to the total carbon emissions of Japan and the United Kingdom combined. With the projected growth in the building sector, emissions are expected to increase by more than 25 percent between now and 2010 if current efficiency trends continue.

- ***Economic Contribution of the Building Sector***

The building sector exerts a large influence on the economy and contributes positively to economic competitiveness. In 1996, the building industry contributed \$656 billion to the Gross Domestic Product (GDP), more than 8 percent of the GDP. New construction represented \$389 billion of this amount. Building renovations and modifications contributed another \$267 billion. As a result, when housing starts increase, the economy improves; when housing starts fall, the economy falters.

- ***Fragmentation of the Building Sector***

The building sector is a highly diverse and fragmented industry that includes commercial and residential buildings, new construction, modifications, and renovations. The sector includes approximately 500,000 builders, architects, and equipment and material suppliers, and is comprised of thousands of decisionmakers, including developers, designers, manufacturers, builders, utilities, engineers, and occupants. Unlike other sectors that have a few major firms responsible for final assembly and product delivery, the building sector has thousands of builders who put together individual components into a complete structure. As a result, product integration is less than optimal and the number of decisionmakers to influence is much greater.

- ***Low Rate of Private Investment in Building Energy R&D***

Research and development is a key driver of long-term economic development. However, the building industry significantly underinvests: the national average for R&D expenditures is only 3.5 percent of sales for all industries while expenditures by the building sector are much lower—0.5 percent—with only a fraction of this going to building energy research. With private investment in buildings R&D so low, Federal investment in R&D plays an extremely important role, is an important catalyst for increased private R&D investment, and is critical for future cost-saving technological advancements.

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

STRATEGIC GOAL AND APPROACH

The BTS Strategic Plan has established challenging, but attainable, goals for building energy savings. The FY 2000 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, will accomplish the following:

- Save 70 trillion Btu of primary energy,
- Reduce carbon emissions by nearly 1.4 million metric tons, and
- Lessen the energy burden of commercial and residential customers by \$515 million.

BTS' goal, as identified in the 1998 Strategic Plan, is 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' Strategic Plan initiated a cultural change that is revolutionizing the way BTS serves and works with its stakeholders. Working side-by-side with its customers, BTS is implementing its Strategic Plan and creating technology road maps to better guide future research, development, and deployment (RD&D). Using input from more than 200 public comments, BTS has developed three strategies to meet its goals:

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

BTS Completes Eight Programs and Streamlines its Organization

In FY 1999, BTS will complete 8 programs:

- Residential Energy Efficiency,
- Home Energy Rating System,
- Furnace and Boiler/Combustion Research,
- Urban Heat Island Research,
- Volume Purchases,
- Municipal Energy Management Program,
- Affordable Housing, and
- Highly Reflective Surfaces.

Furthermore, under BTS' reorganization another 12 programs are being consolidated into 4 programs. *Building America* will be the sole Residential R&D program and includes R&D in Industrialized Housing. Space Conditioning and Refrigeration will combine the activities of Residential Absorption Heat Pumps, Desiccants and Chillers, and Refrigeration into a unified program. The Building Envelope Technologies R&D program now includes Thermal Insulation and Building Materials, Electrochromic Research, SuperWindows Technologies, and Advanced Glazing. Finally, the Community Partnerships Program includes *Rebuild America* and the activities formerly under Outreach and Update State and Federal Codes.

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

- Encourage the use of energy-efficient and renewable energy technologies and practices through technology transfer and financial assistance.

Comprehensive Planning and Program Design

Implementation of the Strategic Plan is a keystone of BTS' budget request. BTS is committed to expanding partnerships and cost sharing, improving peer review, and enhancing the program review process to better measure the quality and effectiveness of ongoing programs. The FY 2000 budget reflects the new organizational structure and the ongoing transition of BTS' agenda toward a more focused "whole buildings" approach that considers the systems nature of buildings and integrates the various components to obtain higher performance throughout the building life-cycle. This approach, *Buildings for the 21st Century*, minimizes energy use, environmental impact, and initial and operating costs while maximizing users' comfort.

Streamlined Organization

To more effectively implement these strategies, BTS is restructuring its four offices into two offices. The Office of Building Research and Standards will advance long-term scientific development by implementing the first two strategies, while the Office of Building Technology Assistance will increase the deployment of new technologies and practices by implementing the third strategy. With the reorganization, several programs are being consolidated; eight others will have been completed, with the research results being applied in the Building Technology Assistance programs. BTS' new approach places greater emphasis on industry-driven collaborative RD&D and on working with industry, States, and community partners to transfer research results to the residential and commercial sectors.

Need for Federal RD&D

BTS' strategy is to collaborate with industry to conduct R&D and to focus on overcoming market barriers that inhibit investment in energy-efficient technologies and practices. With sufficient Federal RD&D, the *Buildings for the 21st Century* approach could become the norm, delivering buildings with reduced operating costs and higher overall quality and asset value. Furthermore, the Federal role, which provides leadership and coordinates activities of the diverse building sector, minimizes duplication and fragmentation of industry's efforts, increases cooperative initiatives, and maximizes potential returns for industry and society at large. With the BTS technology road maps, funds will be directed to the highest priority RD&D areas.

Transferring Results to the Marketplace

Technical assistance to State and local governments, communities, and consumers, as well as new building codes, new appliance standards, and the adoption cost-effective energy technologies and materials developed from RD&D programs will provide near-term savings in FY 2000. New codes and standards will help accelerate the transfer of the most life-cycle cost-effective technologies and building practices and help eliminate those that are inefficient. BTS' new approach, technology road maps, and key partnerships will allow the U.S. to realize the vast potential for saving energy and reducing harmful emissions in the building sector.

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

PROGRAM BENEFITS - BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR

Office of Building Technology, State and Community Programs

| Benefit | FY 2000 | FY 2010 | FY 2020 |
|----------------------------------------------|----------------|----------------|----------------|
| Total Primary Energy Displaced (Quads) | 0.07 | 2.29 | 5.69 |
| Total Energy Cost Savings (Billion Dollars) | \$0.5 | \$16.1 | \$38.7 |
| Total Carbon Reduction (Million Metric Tons) | 1.4 | 35.9 | 82.3 |

As shown above, BTS' FY 2000 programs will displace 70 trillion Btu, equivalent to the typical amount of energy consumed by 363,000 Americans annually. By 2010, more than 2 quads will be displaced, equivalent to the typical amount of energy consumed by almost 12 million Americans annually. By 2020, BTS' programs will displace 5.7 quads, equivalent to the typical amount of energy consumed by more than 29 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.

DEPARTMENT OF ENERGY
FY 2000 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

PROGRAM FUNDING PROFILE

Building Technology, State and Community Sector

| Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Base | FY 2000 Request | Program Change Request vs. Base | |
|-------------------------------------------|-------------------------------|--------------------|-------------------|--------------------|------------------------------------|---------------|
| | | | | | Dollar | Percent |
| Building Research and Standards | \$ 45,007 | \$ 61,525 | \$ 61,525 | \$ 88,163 | +\$26,638 | +43.3% |
| Building Technology Assistance | 174,877 | 187,525 | 187,525 | 232,400 | +44,875 | +23.9% |
| Management and Planning | 12,818 | 13,171 | 13,171 | 15,318 | +2,147 | +16.3% |
| TOTAL | \$ 232,702 | \$ 262,221 | \$ 262,221 | \$ 335,881 | +\$73,660 | +28.1% |
| Summary | | | | | | |
| Operating Expenses | \$ 232,702 | \$ 262,221 | \$ 262,221 | \$ 335,881 | +\$73,660 | +28.1% |
| Total Program | \$ 232,702^a | \$ 262,221 | \$ 262,221 | \$ 335,881 | +\$73,660 | +28.1% |
| Staffing (FTEs) | | | | | | |
| HQ FTEs | 76 | 75 | 75 | 73 | | |
| Total FTEs | 76 | 75 | 75 | 73 | | |

^{a/} Reflects adjustment for approved reprogrammings 98-R-6 of \$-1,107.0 thousand for the Small Business Innovative Research (SBIR) program and \$-66.0 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities.

PROGRAM FUNDING PROFILE - Building Technology, State and Community Sector (Cont'd)

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"

SUMMARY OF CHANGES - Building Technology, State And Community Sector

**DEPARTMENT OF ENERGY
 FY 2000 CONGRESSIONAL BUDGET REQUEST
 ENERGY CONSERVATION
 (dollars in thousands)**

SUMMARY OF CHANGES

Building Technology, State and Community Sector

| | |
|---------------------------|------------|
| FY 1999 Enacted | \$ 262,221 |
| - Non-Discretionary | 0 |
| FY 2000 Base | \$ 262,221 |

Building Research and Standards:

| | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| - Technology Road Maps and Competitive R&D - The increase will expand the funding available for the competitive R&D solicitation | +1,115 |
| - Residential Buildings Integration - The Residential Energy Efficiency Program (600) and the Home Energy Rating System (1,535) will be completed in FY 1999. | -2,135 |
| The increase supports efforts to double <i>Building America</i> partnerships to 200, fund competitive grants for Special Project State Grants, and provide <i>Building America</i> results to the President's Partnership for Advancing Technology in Housing (PATH) | +6,091 |
| - Commercial Buildings Integration - The increase is to accelerate cost-shared R&D projects and to make awards based on a competitive solicitation to implement activities identified in the Commercial Building Road Map, and to develop a simplified compliance approach to assist States in implementing ASHRAE/IESNA Standard 90.1 | +3,781 |
| - Equipment, Materials, and Tools - The Furnace and Boiler/Combustion Research (500) and Urban Heat Island Research (700) will be completed in FY 1999. Research results are being applied in the Building Technology Assistance Program | -1,200 |
| - The increase supports additional research and competitive solicitations for Lighting, Space Conditioning and | |

SUMMARY OF CHANGES - Building Technology, State And Community Sector

Refrigeration, Cogeneration/Fuel Cells, Appliances, Analysis Tools and Design Strategies, and acceleration of Lighting and Appliance Standards..... +18,986

Building Technology Assistance:

- State Energy Program - The increase supports State energy program priorities and reinforces State infrastructure. ... +4,000
- Weatherization Assistance Program - The increase supports weatherization of 9,615 more homes of low-income families than in FY99..... +21,000
- Community Partnerships - The Volume Purchases (500), the Municipal Energy Management Program (1,600), the Affordable Housing (600), and the Highly Reflective Surfaces (122) programs will be completed in FY 1999. Research results are being applied in the Building Technology Assistance program -2,822
- These funds will bolster the deployment of energy efficiency and renewable energy technologies in communities by increasing *Rebuild America* partnerships to 330, awarding a competitive solicitation for communities to improve energy efficiency, supporting PATH and the new Energy Smart Schools initiative, and training approximately 10,000 code officials, designers, and builders..... +19,421
- Energy Star Program - The increase will be used to expand the program to validate more appliances and products, to encourage consumers to retire inefficient appliances, and to support the cooperative efforts with EPA to increase consumer awareness of benefits and cost savings of energy-efficient appliances and products..... +3,276

Management and Planning:

- Evaluation and Planning - The increase will be used to expand the evaluation to all BTS programs +1,787
 - Program Direction - The increase will support on-board FTEs..... +360
- FY 2000 Congressional Budget Request \$ 335,881

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 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.

The FY 2000 Building Research and Standards program is expected to displace almost 47 trillion Btu, saving consumers \$372 million. By FY 2010, the energy displaced as a result of these programs will increase to more than 1.8 quads, saving consumers nearly \$13 billion. By FY 2020, energy savings will increase to more than 4.7 quads and \$32.5 billion. The Building Research and Standards Office will provide most of the expected energy savings from BTS' overall program, accounting for 67 percent of the energy savings for FY 2000 and rising to 84 percent in FY 2020.

The Building Research and Standards program will achieve these goals through two strategies outlined in BTS' Strategic Plan:

- 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.

2000 by 2000

Building America

Through *Building America*, builder and developer teams, working side-by-side, have committed \$30 million to implement housing technology innovations. Teams construct test houses and develop community-scale projects that incorporate their systems innovations. By the year 2000, there will be more than 2000 of these innovative new homes, 1400 more than in 1998. BTS is working with builders to transfer these innovations into more than 350,000 new homes by 2010.

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

Whole Buildings Approach

The FY 2000 Building Research and Standards program reflects the ongoing transition of BTS' building agenda toward a more focused "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, as well as on the building as a whole. This research is used to develop energy-saving approaches that improve the integration of systems so that the overall building performance is enhanced throughout the building's life. The outcome of BTS' whole buildings approach will result in highly efficient buildings with improved air quality, which in turn increases occupant comfort and productivity.

Stronger Partnerships and Increased Collaboration

BTS will conduct its energy R&D through partnerships with industry, National Laboratories, universities, and States often with significant cost sharing. New partners will be sought through competitive solicitations. The industry-driven technology road-mapping process will help to identify opportunities, set priorities, review goals, and expand partnerships. By using industry-led, public/private collaborations to demonstrate and commercialize new energy technologies, R&D programs will be appropriately targeted with R&D investment, leading to improved market penetration and providing the greatest benefits to consumers. Stronger partnerships with States and communities directly and through other EERE sectors and regional support offices will result in greater success.

Better Focused, Streamlined Offices

As part of BTS' restructuring, the R&D and Building Codes and Appliance Standards offices have been combined. This will bring staff who now work in different phases of the same building and equipment areas together, thereby facilitating more-effective collaboration and better aligning BTS' organization with the whole buildings approach that this program is now fostering. BTS' FY 2000 budget structure reflects this new organization. Several programs have been consolidated to minimize duplication, while four others—Residential Energy Efficiency Program, Home Energy Rating System, Furnaces and Boiler/Combustion Research, and Urban Heat Island Research—will be completed in FY 1999. The research results are being applied in the Building Technology Assistance programs.

To best address the different institutional, technical, and financial challenges of residential and commercial buildings, the Building Research and Standards budget is organized in four sections:

- Technology Road Maps and Competitive R&D,
- Residential Buildings Integration,
- Commercial Buildings Integration, and
- Equipment, Materials, and Tools.

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

Technology Road Maps and Competitive R&D

In FY 2000, BTS will continue development and begin funding strategic R&D road maps to better guide its research efforts for appliances and combined cooling, heating, and power in collaboration with industry partners, academia, States, and other public and private stakeholders. The projects resulting from the Technology Road Maps and Competitive R&D planning unit are estimated to displace 100 trillion Btu in FY 2010, increasing to 347 trillion Btu in FY 2020, saving more than \$654 million and \$2 billion, respectively.

The road-mapping process helps the private and public sectors reach consensus on future R&D direction and improves collaboration. Five road maps are nearing completion: lighting; windows; commercial buildings; heating, ventilating, and air conditioning (HVAC) and refrigeration; and residential buildings. The road-mapping process better aligns limited Government and industry resources with high-priority, high-return research areas to optimize energy efficiency and reduce greenhouse gases and other pollutants. 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.

To continue the momentum developed during the appliance and combined cooling, heating, and power road-mapping process, BTS will solicit competitive proposals to jump start promising research in these areas. BTS will also 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 2000 Residential Buildings Integration program will displace 2 trillion Btu and save \$11 million, increasing to 131 trillion Btu and \$986 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. 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. In FY 2020, more than 341 trillion Btu will be displaced, saving \$2.6 billion.

Building America is BTS' partnership with industry to jointly fund, develop, demonstrate, and deploy housing that integrates energy-efficient technologies and practices, resulting in new homes that save consumers money, are more environmentally benign, and provide more comfortable living space. The number of partners in the 4 *Building America* consortia will increase by 100 each year through FY 2004 from 80

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

in 1998 to accelerate 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 superefficient building designs add a prudent balance to the R&D portfolio and will contribute to the longer term energy and environmental goals.

Through its regulatory activities, such as supporting improvements to the next generation of residential model building energy codes, publishing a determination on the 1998 International Energy Code Council (formerly the Model Energy Code 1998), and promulgating updated Federal residential building energy codes, the Residential Buildings Integration program helps to transfer the most 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 2000 activities will displace 10 trillion Btu and save \$63 million. By 2010, energy consumption in new commercial buildings will be reduced by 30 percent compared to FY 1996. In FY 2010, more than 207 trillion Btu will be displaced, saving more than \$1.5 billion. By 2020, energy savings will increase to 535 trillion Btu, saving more than \$4 billion.

In FY 2000, BTS will continue its work to realize the energy-saving opportunities provided by the whole buildings approach during the construction and major renovation of existing commercial buildings. 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 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 developed in the road-mapping process, 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 several mechanisms the Commercial Buildings Integration program uses to transfer the most energy-efficient building techniques and practices into commercial buildings through its regulatory activities. The office supports the upgrade of voluntary (model) building energy codes in partnership with the building industry consensus and model code organizations, State code officials, design professions, builders, and

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

other stakeholders; promulgates upgraded Federal commercial building energy codes; and assists States in implementing the complex commercial building 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 2000 activities will displace 36 trillion Btu and save \$298 million. In FY 2010, 1.4 quads will be displaced, saving nearly \$10 billion. In 2020, more than 3.5 quads will be displaced, saving more than \$23.5 billion, equivalent to eliminating nearly half of the energy used for residential space heating 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 will also collaborate with other EERE sectors in combined heat and power and application of biofuels. 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 improving analytical tools to effectively integrate all elements affecting building energy use and assist building designers, owners, and operators to develop the best design strategies for new or existing buildings. In a 1995 survey, users of DOE-2 building design software reported that it saved building owners in the U.S. alone more than \$5 billion in energy costs. BTS will also accelerate the lighting and appliance energy efficiency standards program to realize even greater savings of energy, consumer energy cost, and air emissions. This acceleration will build upon recent progress in improving 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. Additional funding will also enable the Department to consider standards for products and equipment for which statutory authority exists, but could not be pursued due to modest past budgets. 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 2000, BTS-developed efficient technologies and products, combined with the accelerated promulgation of appliance standards, will provide 67 percent of the energy and carbon emissions displaced by all of BTS' programs.

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

I.B. Program Benefits

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

| <u>METRIC</u> | <u>2000</u> | <u>2010</u> | <u>2020</u> |
|----------------------------------------|-------------|-------------|-------------|
| Total Primary Energy Displaced (Quads) | 0.05 | 1.81 | 4.76 |
| Total Energy Cost Savings (\$Billion) | 0.4 | 12.9 | 32.5 |
| Total Carbon Reduction (MMTons) | 1.0 | 28.2 | 67.9 |

The benefits in FY 2020 correspond to approximately the amount of energy used in 25 million households.

I.C. Performance Measures

Pre-FY 1998 Accomplishments

Residential Buildings Integration:

- Began construction of the first community-scale project of 330 houses under *Building America*. (FY 1997)
- Established new community housing partnerships to retrofit 100,000 public and assisted housing units. (FY 1997)
- Assisted in the updating and simplification of the Model Energy Code for residential buildings. (FY 1997)

Commercial Buildings Integration:

- Demonstrated the Building Automation Communication network (BACnet)TM, a communication protocol that allows building owners to integrate control systems from multiple vendors. (FY 1997)
- Assisted in the development of the next generation voluntary commercial building energy standard (American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA) Standard 90.1-1989R) for public review. The new standard is expected to cost-effectively achieve savings of 25 percent over the current voluntary standard. (FY 1997)
- Assisted in the development and issuance of ASHRAE Standard 129, "Effective Ventilation." (FY 1997)

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

Equipment, Materials, and Tools:

- Released the design tool Softdesk Energy versions 1.1 and 1.2. The new versions incorporate an energy module in the most widely used computer-aided design software so that energy efficiency can be added easily to buildings in the design stage. (FY 1995)
- Published *Buildings Tools Directory* and released a World Wide Web-based version that compiles all the available tools related to building energy. (FY 1996)
- Initiated six new Cooperative Research and Development Agreements (CRADAs) with thermal insulation and building materials industry. (FY 1997)
- Received approval by United Laboratories (UL) for the fan atomized burner, the culmination of cooperative R&D between a small business burner manufacturer and Brookhaven National Laboratory. (FY 1997)
- Distributed *Passive Solar Design Strategies for Low-Rise Buildings* with the latest DOE-developed software tool, ENERGY-10, to the architectural community. (FY 1997)
- Issued energy conservation standards for refrigerators and room air conditioners that are expected to save nearly 7 quads of energy by 2030. (FY 1997)
- Completed preliminary design of a low-powered sulfur lamp laboratory prototype using solid-state power source. (FY 1997)

FY 1998 Accomplishments

Residential Buildings Integration:

- Expanded cost-shared participation to 80 industry members in the four *Building America* teams.
- Began construction of the second and third community scale projects of 100 houses each under *Building America*.
- Completed the first 150 houses under *Building America*.
- Assisted in updating the International Energy Code Council (IECC), formerly called the Model Energy Code.

Commercial Buildings Integration:

- Began whole building design study on school buildings with Southern California Edison.
- Supported improvements in the next generation of ASHRAE/IESNA Standard 90.1.
- Provided technical support to organizations, such as the National Realty Council and the National Electric Manufacturers Association's Energy Cost Savings Council, and to major construction projects, such as the Conde Nast building located at 4 Times Square in New York City.

Equipment, Materials, and Tools:

- Constructed prototype and tested a series of low-cost compact fluorescent lamps.
- Completed laboratory R&D to determine feasibility of prototype low-power sulfur lamp for residential application.

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

- Constructed prototype power source for a new type of cathode-luminescent lamp that uses diamondlike carbon filament.
- Demonstrated a new method of producing fluorescent light without using mercury.
- Completed development, testing, and evaluation of full-scale laboratory prototype of a natural gas absorption chiller using DOE's advanced double-condenser coupled (DCC) technology.
- Demonstrated a "drop-in" heat pump water heater with industry and initiated plans for major field testing.
- Selected three of the best reforming fuel cell technologies and began design of critical components.
- Established "total equivalent warming index" as the analytical comparative basis for insulating foam-blowing agents.
- Completed the Mobile Window Thermal Testing facility, tested the first prototype electrochromic skylights, and compared them with conventional and advanced spectrally selective skylights.
- Completed beta testing of the Building Design Advisor, a building design support program that allows uniform interfaces to other programs.
- Issued test procedures for water heaters and plumbing equipment.
- Issued final rules for electric kitchen ranges and ovens standards.
- Issued determination concerning electric distribution transformer standards.
- Developed and successfully demonstrated the Whole Wall Rating System.
- Completed *Energy and Global Warming Impact of HFC Refrigerants and Emerging Technologies*.

FY 1999 Planned Accomplishments

Technology Road Maps and Competitive R&D:

- Complete the development of technology road maps for lighting, windows, commercial buildings, and HVAC and refrigeration in collaboration with industry and the research community.
- Begin developing the technology road map for residential buildings in collaboration with industry, the research community, and the public/private Partnership for Advancing Technology in Housing (PATH) and for building envelope technologies (emphasizing insulation).
- Announce and award the first broad-based competitive solicitation in response to industry-derived road maps in lighting, windows, and HVAC and refrigeration.

Residential Buildings Integration:

- Expand *Building America* to include 100 industry members and begin construction of 5 additional community-scale projects, totaling 1,000 houses.
- In coordination with PATH, begin major outreach and technology transfer effort for *Building America* technologies and building practices.
- Issue and award a competitive solicitation that addresses the demand for industrialized housing.

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

- Begin cooperative work with manufactured housing industry on incorporating component efficiency improvements into a systems integrated approach.
- Complete home energy rating system for seven pilot States that will help overcome barriers to energy efficiency financing.
- Support improvements to the next generation voluntary residential code.
- Publish determination on the IECC, 1998.
- Issue Final Rule regarding standards for energy-efficient construction in Federal residential buildings.

Commercial Buildings Integration:

- Issue and award a competitive solicitation to increase research on whole building concepts that improve energy and other performance characteristics.
- Complete and publish findings from the lighting/controls system integration study.
- Establish database of project performance data on commercial building retrofits.
- Promulgate upgraded Federal commercial building standards.
- Support completion of the next generation voluntary commercial code.
- Complete development of code compliance manuals and builders guides.
- Establish partnerships with commercial construction companies to incorporate whole buildings design in three major projects.

Equipment, Materials, and Tools:

- Test integrated improved power supply and lamp systems.
- Complete the lighting controls project in a large Federal office building and report results to General Services Administration.
- Fabricate and laboratory test the engineering prototype methane reformers and incorporate into the proton exchange membrane (PEM) fuel cell reformers.
- Test, evaluate, and fabricate a laboratory prototype commercial Hi-Cool branched generator absorber heat exchange (GAX) heat pump using advanced natural gas absorption technology.
- Begin testing a prototype desiccant-based preconditioner and complete desiccant systems field testing.
- Begin field testing several preproduction prototypes of a 3-ton residential GAX heat pump and a commercial prototype double-condenser coupled chiller.
- Complete the successful jointly-funded materials compatibility and lubricants research program that paved the way for the new generation of chlorine-free refrigerants.
- Demonstrate energy-efficient supermarket refrigeration and heat recovery systems in two new or remodeled supermarkets.
- Refine design of a "drop-in" heat pump water heater with industry and perform 15 field site tests.
- Issue and award a competitive solicitation for building envelope technologies.
- Fabricate and demonstrate full-sized electrochromic windows.

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

- Demonstrate full-sized, high-performance, spectrally selective windows using enhanced ion-beam deposition.
- Complete and release the final version of DOE-2.2, which is easier to use and simulates building envelope and HVAC technologies.
- Release 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.
- Complete development of test procedures for duct distribution systems with ASHRAE and issued First Public Review.
- Issue Final Rules concerning test procedures for residential central air conditioners/heat pumps.
- Issue Proposed Rules concerning test procedures for commercial HVAC equipment and water heaters, electric distribution transformers, and residential central air conditioners/heat pumps.
- Issue Proposed Rules concerning standards for fluorescent lamp ballasts, water heaters, and clothes washers.
- Issue test procedures for large electric motors.
- Revise Advanced Notice of Proposed Rulemaking (ANOPR) concerning clothes washer standards.
- Publish 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 residential building road map in collaboration with PATH.
- In collaboration with industry and the research community, begin the development of road map for appliances.
- In collaboration with industry, the research community, and DOE's Office of Industrial Technologies (OIT), begin the development of the roadmap for combined cooling, heating, and power.
- Develop, announce, and award the second broad-based competitive solicitation.

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 PATH.
- Conduct evaluation to determine if upgraded model residential code (2000 IECC) will save energy.

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 commercial buildings road map.

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

- Prepare determination of building energy savings that could result from States adopting the upgraded model commercial code (Standard 90.1-1999).
- Issue the Final Rule on the Federal Commercial 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 development and test system efficiency of the final prototype low-power sulfur lamps that have the potential to be 6 to 8 times more efficient than incandescent lamps and up to 2 times more efficient than fluorescent lamps.
- 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.
- Demonstrate high efficiency clothes dryer prototypes.
- Complete beta testing and release EnergyPlus Version 1.0 for general use.
- Issue Proposed and Final Rules concerning standards for fluorescent lamp ballasts, water heaters, and clothes washers, and Proposed Rules concerning standards for residential central air conditioners.
- Initiate determinations concerning test procedures and standards for high-intensity discharge lamps and small electric motors.
- Issue Final Rules concerning test procedures for residential central air conditioners/heat pumps and distribution transformers.
- Publish ANOPR concerning standards for commercial HVAC and water heaters.
- Issue Final Rule incorporating legislated standards and test procedures for commercial HVAC and water heaters.

FY 2001 - FY 2004 Planned Accomplishments

Technology Road Maps and Competitive R&D:

- Complete the development of road maps for appliances, combined cooling, heating, and power, and building envelope in collaboration with industry and the research community. (FY 2001)

Residential Buildings Integration:

- Continue transferring systems innovations derived from *Building America* to more than 4,100 homes. (FY 2001)
- Complete prototype whole house factory production with manufactured housing industry. (FY 2002)
- Publish Final Federal Residential Code Rule (10 CFR 435). (FY 2003)
- Transfer major systems innovations to a total of nearly 30,000 homes. (FY 2004)

Commercial Buildings Integration:

- Retrofit 2 billion square feet of existing commercial space through *Rebuild America*. (FY 2003)

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

- Publish Federal Commercial Code Final Rule. (FY 2004)
- Complete the initial projects that will be identified in the FY 1999 commercial building road map. (FY 2004)

Equipment, Materials, and Tools:

- Begin production of commercial DCC absorption chiller. (FY 2001)
- Complete development of industry-consensus standard on residential ventilation. (FY 2001)
- Conduct test procedure and standards rulemakings for priority products. (FY 2001 and 2002)
- Begin designing critical components for a laboratory 50-kW PEM fuel cell. (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 GAX heat pumps for residential applications. (FY 2004)
- Begin testing Hi-Cool absorption heat pumps. (FY 2004)

II.A. Funding Table: BUILDING RESEARCH AND STANDARDS

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request | \$ Change | % Change |
|--------------------------------------------------------|--------------------|--------------------|--------------------|------------------|----------------|
| Technology Road Maps and Competitive R&D | \$ 0 | \$ 6,385 | \$ 7,500 | \$+1,115 | +17.5% |
| Residential Buildings Integration | | | | | |
| Research and Development | 4,537 | 5,662 | 12,863 | | |
| Energy Efficiency in Industrialized Housing | 1,300 | 1,300 | a/ | | |
| Residential Energy Efficiency Program | 700 | 600 | 0 | | |
| Home Energy Rating Systems | 1,535 | 1,535 | 0 | | |
| Residential Building Energy Codes | 669 | 485 | 675 | | |
| Total, Residential Buildings Integration | 8,741 | 9,582 | 13,538 | +3,956 | +41.3% |
| Commercial Buildings Integration | | | | | |
| Research and Development | 1,920 | 1,950 | 5,500 | | |
| Commercial Building Energy Codes | 829 | 594 | 825 | | |
| Total, Commercial Buildings Integration | 2,749 | 2,544 | 6,325 | +3,781 | +148.6% |
| Equipment, Materials, and Tools | | | | | |
| Lighting Research and Development | 2,350 | 5,530 | 6,000 | | |
| Space Conditioning and Refrigeration R&D | 11,390 | 11,750 | 15,457 | | |
| Cogeneration/Fuels Cells | 1,000 | 1,750 | 5,500 | | |
| Appliances and Emerging Technologies R&D . . | 942 | 1,500 | 2,100 | | |
| Building Envelope Research and Development . . | 7,887 | 11,723 | 11,900 | | |
| Analysis Tools and Design Strategies | 4,054 | 4,058 | 6,500 | | |
| Lighting and Appliance Standards. | 5,894 | 6,703 | 13,343 | | |
| Total, Equipment, Materials, and Tools. | 33,517 | 43,014 | 60,800 | +17,786 | +41.3% |
| Total, Building Research and Standards. . . . | \$ 45,007 | \$ 61,525 | \$ 88,163 | \$+26,638 | +43.3% |

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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request | \$ Change | % Change |
|--------------------------------------------------|--------------------|--------------------|--------------------|-----------|----------|
| Argonne National Lab (East) | \$ 100 | \$ 200 | \$ 200 | \$ 0 | 0.0% |
| Brookhaven National Lab | 810 | 600 | 600 | 0 | 0.0% |
| Lawrence Berkeley National Lab | 7,351 | 8,500 | 8,500 | 0 | 0.0% |
| National Renewable Energy Lab | 7,572 | 5,881 | 8,600 | +2,719 | +46.2% |
| Oak Ridge National Lab | 10,873 | 12,300 | 12,500 | +200 | +1.6% |
| Pacific Northwest National Lab | 4,214 | 3,682 | 4,000 | +318 | +8.6% |
| All Others | 14,087 | 30,362 | 53,763 | +23,401 | +77.1% |
| Total, Building Research and Standards | \$ 45,007 | \$ 61,525 | \$ 88,163 | \$+26,638 | +43.3% |

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

Building Research
and Standards

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request |
|------------------------------------------------|--------------------|--------------------|--------------------|
| Technology Road Maps and Competitive R&D. | \$ 0 | \$ 6,385 | \$ 7,500 |

| Activity | FY 1998 | FY 1999 | FY 2000 |
|------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Technology Road Maps and Competitive R&D | <p>TECHNOLOGY ROAD MAPS AND COMPETITIVE R&D: No activity. (\$0)</p> | <p>TRANSFER FROM: Building Equipment and Materials</p> <p>TECHNOLOGY ROAD MAPS AND COMPETITIVE R&D: This effort represents a new approach to conducting research for the building sector. Based upon the direction identified in the BTS strategic plan, complete four technology road maps in collaboration with industry and the research community. The technology road maps include lighting; windows; commercial buildings; and heating, cooling, ventilation, and refrigeration. BTS will begin technology road maps for building envelope technologies and residential buildings. Participants</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 map for residential buildings, continue developing the building envelope technologies road map, and will begin developing long-term strategic road maps for appliances, and combined 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 five completed road maps and for</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|---------------------------------------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Technology Road Maps and Competitive R&D (Cont'd) | \$0 | <p>will include industry leaders, academia, National Laboratories, States, and other road map contributors. The goal is to identify and implement R&D necessary to develop and deliver new energy-efficient technologies to the marketplace. Metrics will be developed in concert with industry partners as the road maps are designed. Research and development actions that are identified as appropriate for DOE will be undertaken through competitive procurements that will have significant cost sharing with industry partners. Another objective is to increase the percentage of R&D that is fully competitive. Announce solicitation and award the first competitive cooperative agreements in response to industry-derived road maps. (Road Maps \$1,885, Competitive R&D \$4,500) (\$6,385)</p> <p style="text-align: center; vertical-align: bottom;">\$6,385</p> | <p>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. (Road Maps \$1,885, Competitive R&D \$5,615) (\$7,500)</p> <p style="text-align: center; vertical-align: bottom;">\$7,500</p> |

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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request |
|-------------------------------------------------------|--------------------|--------------------|--------------------|
| Residential Buildings Integration | | | |
| Research and Development | \$ 4,537 | \$ 5,662 | \$ 12,863 |
| Energy Efficiency in Industrialized Housing | 1,300 | 1,300 | ^{b/} |
| Residential Energy Efficiency Program | 700 | 600 | 0 |
| Home Energy Rating Systems | 1,535 | 1,535 | 0 |
| Residential Building Energy Codes | <u>669</u> | <u>485</u> | <u>675</u> |
| Total, Residential Buildings Integration | \$ 8,741 | \$ 9,582 | \$ 13,538 |

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
| Residential Buildings Integration | <p>RESEARCH AND DEVELOPMENT:</p> <p>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 (<i>Building America</i>) works with the <i>Building America</i> consortia to demonstrate, test, and integrate the innovative technologies and practices into new and existing</p> | <p>RESEARCH AND DEVELOPMENT:</p> | <p>RESEARCH AND DEVELOPMENT:</p> |

^{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 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | <p>housing to improve energy efficiency and performance. <i>Building America</i> will provide research recommendations to the public/private Partnership for Advancing Technology in Housing (PATH) through BTS' Community Partnerships program.</p> <p>TRANSFER FROM: Building Systems Design</p> <p><i>Building America</i>: Worked with more than 80 industry members of <i>Building America</i> in 12 States to complete a total of 605 demonstration houses. Applied lessons learned from test houses and prototype production houses by working with major homebuilders and with additional builder members to develop two new, first-generation communities of 200 houses. Analyzed performance data on completed buildings built to passive solar standards. Used the data to enhance passive solar design, re-engineer the concepts, and adapt them to multiple subdivision/planned unit developments. Developed additional passive and hybrid solar</p> | <p>TRANSFER FROM: Building Systems Design</p> <p><i>Building America</i>: Expand <i>Building America</i> to include 100 industry members. Complete the development of 825 highly energy-efficient, environmentally friendly, and cost-effective houses. Share 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. Provide systems integration research recommendations from <i>Building America</i> to PATH. Continue the learning process from test and prototype production houses, expand upon existing developments, and start five new, first-generation communities of 200 homes each.</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 broad 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,</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | cooling concepts. Used lessons learned from these advanced buildings to enhance the capabilities of the analysis software, Passive Solar Design Strategy Guidelines and Design Tool. (The Integrated Building and Construction Solutions of Pittsburgh, Building Science Consortium, Consortium for Advanced Residential Buildings, the Hickory Consortium, NREL, Passive Solar Industries Council (PSIC), and the Florida Solar Energy Center) (\$4,537) | Continue 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. Improve thermal distribution using validation, demonstration, and training to define quantitatively the benefits of efficient distribution systems. Improve and simplify advanced concepts used in the passive solar design houses constructed and monitored in FY 1997 and 1998. Replicate 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. Validate the design and analysis tools used for these buildings. In an effort to push performance levels higher, expand the <i>Building America</i> program to the next generation of systems integration research—e.g., “zero net- | durability, and environmental quality of homes. Begin developing a subdivision or community using tested, advanced design strategies with one <i>Building America</i> consortium member. 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. Develop and test more-effective natural and hybrid cooling strategies and the means to integrate the auxiliary heating and cooling systems with other renewable energy technologies. 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. New activities to develop and demonstrate retrofit technologies include working with the private sector and other agencies |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | | energy home”—and incorporate emerging technologies and design techniques. (The Integrated Building and Construction Solutions of Pittsburgh, Building Science Consortium, Consortium For Advanced Residential Buildings, the Hickory Consortium, NREL, NAHBRC, LBNL, ORNL) (\$5,662) | through PATH’s existing buildings programs. 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. Conduct field tests and apply results to modify and improve building systems using a systems engineering approach. Improve affordable housing design to ensure that the homes incorporate a whole buildings approach to energy efficiency and use passive solar design. Using data from completed and monitored buildings, test re-engineered, advanced design strategies to verify their improved performance and appropriateness. Create models to predict duct behavior and radiant effects of residential heating and cooling systems in low-energy buildings. 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. |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | <p>ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: Monitored the two Energy Star Palm Harbor homes and the three entry-level houses constructed in FY 1997; worked with additional manufactured housing manufacturers; partnered with the Structural Insulated Panel Association (SIPA), American Engineered Wood Association (AEA), and Habitat for Humanity (Habitat) to develop a pair of houses in Plains, GA; assisted the American Lung Association in developing an entry-level Health House™; monitored the performance of the FY 1997 Health Houses; provided</p> | <p>ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: Disseminate results from research completed in FY 1998. Issue and award a competitive solicitation that addresses 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, and assembling the large-scale components on site. Use a prototype manufacturing facility computer simulation to demonstrate adaptability of production facilities and assist in the continuing effort to improve the energy efficiency of the</p> | <p>(The Integrated Building and Construction Solutions of Pittsburgh, Building Science Consortium, Consortium for Advanced Residential Buildings, the Hickory Consortium, NREL, National Association of Homebuilders' Research Center (NAHBRC), LBNL, ORNL, others TBD) (Special Project State Grants includes \$300 from <i>Building America</i>) (\$12,863)</p> <p>ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: (Activities incorporated into <i>Building America</i>.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | <p>design assistance, workshops, and seminars to individual Habitat affiliates and other nonprofit housing providers; and field tested the Florida Solar Energy Center (FSEC)-invented FanRecycler that economically maintains indoor air quality (IAQ). Emphasis was on developing energy- and resource-efficient housing and meeting the needs of local communities. (FSEC, LBNL, Pennsylvania State University (PSU), ORNL, University of Oregon (UO)) (\$1,300)</p> <p>RESIDENTIAL ENERGY EFFICIENCY PROGRAM: Integrated whole-building system technologies in new building design. Trained builders, building trades, and other housing stakeholders in the use of existing products and processes to improve new and existing homes. Rewrote building design specifications, cost- and energy-saving estimates, and operation and construction procedures for new and existing residential buildings, including low-cost affordable housing.</p> | <p>construction processes in two manufactured housing plants. Continue cooperative research with the American Lung Association for the construction, monitoring, and evaluation of Health Houses. (TBD) (\$1,300)</p> <p>RESIDENTIAL ENERGY EFFICIENCY PROGRAM: Train builders and building-related stakeholders in the latest <i>Building America</i> technologies and building practices, how to overcome financial and technology barriers, and practices to improve new and existing homes. The trainees will be able to use 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</p> | <p>RESIDENTIAL ENERGY EFFICIENCY PROGRAM: (Program completed.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | (NAHBRC, Energy Efficient Building Association (EEBA), Southface Energy Institute) (\$700) | housing, while continuing to improve and expand the choices available for residential energy-efficient and renewable technologies. (NAHBRC, EEBA, Southface Energy Institute) (\$600) | |
| | <p>HOME ENERGY RATING SYSTEMS: Continued the fourth year of financial support for seven pilot states. Provided support to other competitively selected states to overcome barriers to energy efficiency financing through Home Energy Ratings and related activities. (Special Project State Grants includes \$250 from Home Energy Rating Systems.) (\$1,535)</p> | <p>HOME ENERGY RATING SYSTEMS: Complete the fifth and final year of financial support for the seven pilot states. Provide support to other competitively selected states to overcome barriers to energy efficiency financing through Home Energy Ratings and related activities. (Special Project State Grants includes \$250 from Home Energy Rating Systems.) (\$1,535)</p> | <p>HOME ENERGY RATING SYSTEMS: (Program completed.)</p> |
| | <p>TRANSFER FROM: Codes and Standards</p> | <p>TRANSFER FROM: Codes and Standards</p> | |
| | <p>RESIDENTIAL BUILDING ENERGY CODES (Formerly Analysis): INTRODUCTION: The activity develops and promulgates Federal residential codes and participates in developing and disseminating voluntary (model)</p> | <p>RESIDENTIAL BUILDING ENERGY CODES (Formerly Analysis):</p> | <p>RESIDENTIAL BUILDING ENERGY CODES:</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | <p>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 Community Partnerships under Building Technical Assistance programs.</p> <p>As part of the voluntary code process, supported the updating and simplification of the International Energy Code Council (IECC), formerly called the Model Energy Code (MEC) for residential buildings. Updated MEC<i>check</i> materials and computer compliance program. Developed and proposed recommendations for simplifying the energy provisions of the developing International Residential Code while maintaining equivalency with the IECC. Helped develop the IECC</p> | <p>Develop and propose improvements and simplification in the IECC of nonwood frame requirements. Continue to work with the ASHRAE Standard 90.2 Committee on developing a simplified compliance approach for that residential standard. Publish Determination concerning whether the 1998 IECC would improve residential buildings' efficiency. Upgrade MEC<i>check</i> compliance materials to reflect the 1998 IECC, pending a positive determination. As part of the Federal code process, promulgate final Energy Code for</p> | <p>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</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential Buildings Integration (Cont'd) | residential energy code official's certification test. Conducted comparative analyses of State residential building codes' relative energy efficiency as compared to the 1998 IECC. Developed and proposed a simpler ASHRAE Standard 90.2 compliance approach for single family residential buildings. As part of the Federal code process, prepared a response to comments on the Federal residential code and initiated revisions for final rule. (\$669) | Federal residential buildings. Analyze passive and active solar space cooling and heating technologies for inclusion in the next-generation Federal residential code. (\$485) | voluntary codes. Propose upgraded Federal residential building standards that include the use of solar space cooling and heating technologies. (\$675) |
| | \$8,741 | \$9,582 | \$13,538 |

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request |
|-----------------------------------------------|-----------------|-----------------|-----------------|
| Commercial Buildings Integration | | | |
| Research and Development | \$ 1,920 | \$ 1,950 | \$ 5,500 |
| Commercial Building Energy Codes | <u>829</u> | <u>594</u> | <u>825</u> |
| Total, Commercial Buildings Integration | \$ 2,749 | \$ 2,544 | \$ 6,325 |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>Conducted research on whole-building concepts to quantify energy performance and other characteristics. Completed performance measurement of exemplary buildings and published findings on the effectiveness of the integrated systems. With GSA and</p> | <p>RESEARCH AND DEVELOPMENT (Formerly Building Performance):</p> <p>TRANSFER FROM: Building Systems Design</p> <p>Develop and advertise a competitive solicitation to implement whole-building activities based on the commercial buildings road map. With industry teams of manufacturers, designers, and builders, work to improve and</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. Accelerate R&D on advanced technologies in collaboration with the design and construction</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commercial Buildings Integration (Cont'd) | <p>Pacific Gas and Electric, tested and demonstrated the effectiveness of ASHRAE's open communication protocol, Building Automation and Control Network (BACnet)TM system, which connects equipment of various manufacturers. Worked with the National Science Foundation at Carnegie Mellon University to develop the "Intelligent Workplace." Began whole-building design study on school buildings with Southern California Edison (SCE). Completed, with Federal agencies and a collection of private organizations, the national strategy for incorporating building commissioning as a vital component of the industry construction process that will ensure a building is built and operates according to design specifications. Completed and distributed a commissioning planning guide for <i>Rebuild America</i>. Expanded an energy benchmarking tool that is pivotal to identifying potential candidates for efficiency renovation to include additional building types. Completed the final version of a tool that provides early</p> | <p>accelerate research and adoption of building processes and technical innovations that increase efficiency and affordability. Conduct monitoring and analysis activities at two exemplary passive solar buildings. Complete the "Intelligent Workplace" office laboratory at Carnegie Mellon University that allows performance testing of commercial building operating systems integration. Complete and publish findings from the lighting/controls systems integration study on the 450 Golden Gate building in San Francisco. Continue building commissioning and performance monitoring of school buildings with SCE. With industry, begin implementing actions defined in the national strategy for incorporating building commissioning as a vital component of the industry construction process. Complete commissioning equipment/system performance technical specifications. The energy benchmarking tool will be distributed widely for use by architects and engineers. In partnership with industry, promote</p> | <p>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, work will continue on several projects, such as building commissioning; transferring the Whole Building Diagnostician, a performance monitoring system, to the private sector for commercialization; and the Intelligent Workplace, an office laboratory 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 six major commercial real estate developments with private sector partners to test and evaluate BTS-developed technologies. Document the worker productivity gains from improved indoor environments in commercial buildings through on-site measurement and analysis of data. Scientifically validate techniques and</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commercial Buildings Integration (Cont'd) | <p>detection of problems in building energy systems in partnership with Honeywell and the University of Colorado. Published results, including the effects of filtration, from the fundamental productivity studies conducted with the National Institute for Occupational Safety and Health (NIOSH). Contributed to the international efforts to develop scientifically valid basis for energy monitoring and verification protocols. (LBNL, PNNL, Honeywell Technology Center, National Science Foundation, University of Colorado (UC)) (\$1,920)</p> <p>TRANSFER FROM: Codes and Standards</p> <p>COMMERCIAL BUILDING ENERGY CODES (Formerly Voluntary and Federal Energy Codes):</p> <p>INTRODUCTION: The activity develops and promulgates Federal commercial codes and participates in developing and disseminating</p> | <p>the widespread use of the early problem detection tool developed with Honeywell and UC. Establish project performance database, which documents commercial building retrofits, including energy use, financing, and measurement and verification methods. Fundamental studies with NIOSH will report on a second hypothesis for ventilation rates, developed in cooperation with industry and academia. Shift efforts on Energy Monitoring and Verification protocols to the implementation and promotion stage. (LBNL, PNNL, Honeywell Technology Center, National Science Foundation, UC) (\$1,950)</p> <p>TRANSFER FROM: Codes and Standards</p> <p>COMMERCIAL BUILDING ENERGY CODES (Formerly Voluntary and Federal Energy Codes):</p> | <p>technologies for indoor environment assessment in collaboration with industry, NIOSH, and other Federal agencies. Monitor and analyze performance of advanced passive solar buildings, using the results to develop better methods of controlling energy systems in very low-energy commercial buildings. (PNNL, NREL, Honeywell Technology Center, UC, Advanced Buildings Systems Integration Consortium) (\$5,500)</p> <p>COMMERCIAL BUILDING ENERGY CODES:</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commercial Buildings Integration (Cont'd) | <p>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 Community Partnerships under Building Technology Assistance programs.</p> <p>Prepared final rule regarding Federal commercial buildings. Prepared technical assistance materials, such as code compliance and user manuals and various software, in support of 1998 Federal codes. Initiated a national training effort to teach 1998 Federal code provisions to Federal employees and their contractors. Supported interim Federal code to facilitate transition to the new 1998 Federal codes. Supported development of</p> | <p>Promulgate final Energy Code for Federal Commercial Buildings. Complete preparation and distribute technical assistance materials in support of 1999 Federal code. Implement training programs to teach Federal employees and their contractors the provisions of the 1998 Federal code. Issue proposed rules amending the Federal commercial code to further support Federal energy efficiency goals.</p> | <p>Promulgate the final Energy Code for Federal Commercial Buildings (10 CFR 434, based on Standard 90.1-1999). Determine if the 1999 voluntary commercial 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</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commercial Buildings Integration (Cont'd) | <p>voluntary energy codes, including proposed revision, analysis and response to public comments on the proposed upgrading of ASHRAE/Illuminating Engineering Society of North America (IESNA) Standard 90.1-1989 for commercial buildings. Developed and proposed for inclusion in the 1998 IECC a simplified compliance approach for small commercial buildings. Developed simplified compliance tool, <i>COMcheck-EZ</i>, to facilitate compliance with the new IECC approach. Continued development of a tool, <i>COMcheck-Plus</i>, to demonstrate compliance on more complex buildings and to support a Multistate Commercial Code. (EPAct Section 101) (\$829)</p> | <p>Support 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. Conduct a comparative analyses of the relative energy efficiency of State commercial building codes compared to the proposed ASHRAE/IESNA Standard. Develop and propose improvements to the simplified compliance path for commercial buildings in the IECC. Complete the initial version of <i>COMcheck-PLUS</i> to facilitate compliance with the Multistate Commercial Code and the IECC. Upgrade <i>COMcheck-EZ</i> to reflect changes in the IECC. (EPAct Section 101) (\$594)</p> | <p>approach similar to the IECC for inclusion in ASHRAE/IESNA Standard 90.1 to assist States in implementing the standard as a code. 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. (EPAct Section 101) (\$825)</p> |
| | \$2,749 | \$2,544 | \$6,325 |

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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request |
|---------------------------------------------------------|--------------------|--------------------|---------------------------|
| Equipment Materials and Tools | | | |
| Lighting Research and Development | \$ 2,350 | \$ 5,530 | \$ 6,000 |
| Space Conditioning and Refrigeration R&D | | | |
| Residential Absorption Heat Pumps | 5,400 | 5,910 | 6,500 ^{c/} |
| Desiccants and Chillers | 2,350 | 2,480 | 4,500 ^{c/} |
| Furnaces and Boiler/Combustion Research | 500 | 500 | 0 |
| Refrigeration | <u>3,140</u> | <u>2,860</u> | <u>4,457^{c/}</u> |
| Total, Space Conditioning and Refrigeration R&D | 11,390 | 11,750 | 15,457 |
| Cogeneration/Fuels Cells | 1,000 | 1,750 | 5,500 |
| Appliances and Emerging Technologies R&D | 942 | 1,500 | 2,100 |
| Building Envelope Research and Development | | | |
| Competitive Solicitation | 0 | 1,700 | 11,900 |
| Thermal Insulation and Building Materials | 2,228 | 3,094 | |
| Urban Heat Island Research | 700 | 700 | |
| Electrochromic Research | 3,715 | 4,285 | |
| Superwindow Technologies | 350 | 350 | |
| Advanced Glazing | <u>894</u> | <u>1,594</u> | |
| Total, Building Envelope Research and Development | 7,887 | 11,723 | 11,900 ^{d/} |
| Analysis Tools and Design Strategies | 4,054 | 4,058 | 6,500 |
| Lighting and Appliance Standards | <u>5,894</u> | <u>6,703</u> | <u>13,343</u> |
| Total, Equipment Materials and Tools | \$ 33,517 | \$ 43,014 | \$ 60,800 |

^{c/} Proposed funding represents planning estimates.

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

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools | <p>LIGHTING R&D: INTRODUCTION: In partnership with R&D firms, manufacturers, utilities, and professional organizations, develop highly efficient, advanced lighting technologies, such as low-power sulfur lamps and cathodoluminescent lamps, and improved distribution and controls that could cut lighting costs in half over the next 15 years. Incandescent and fluorescent lamps currently cost U.S. consumers \$34 billion a year. The industry-driven lighting road map that will be completed in FY 1999 will help direct the R&D of future lighting systems, including light sources, tracking sunlight concentrators, and light distribution systems.</p> <p>TRANSFER FROM: Building Equipment and Materials</p> <p>Conducted a comprehensive technical peer review of all lighting activities using an independent panel of outside experts. Initiated an industry-DOE road map for lighting R&D to assist in developing</p> | <p>LIGHTING R&D:</p> <p>TRANSFER FROM: Building Equipment and Materials</p> <p>Accelerate cost-shared effort to develop a low-cost CFL with industry. Optimize the selected power supply circuit for performance and low-cost manufacture, construct an improved</p> | <p>LIGHTING R&D:</p> <p>Issue a competitive solicitation to fund R&D activities identified in the lighting road map. In addition, substantially expand work in lighting R&D through the following activities. Complete cost-shared</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>advanced, highly efficient light sources. Began developing a cost-shared, low-cost compact fluorescent lamp (CFL) with an internal electronic power supply. Evaluated several new electronic circuit designs and constructed and tested a breadboard prototype circuit of the one most capable of low-cost manufacture. Began modifying lamp components to operate with the new electronic circuit. Continued cost-shared effort to develop a low-power sulfur lamp and power source by optimizing the design of the laboratory prototype. Continued development of the diamond lamp, a unique cathodoluminescent lamp, with cost-sharing by DOE Basic Energy Science (ER) and industry. Investigated methods to improve efficiency and operability based on initial efficiency measurements. Evaluated the performance of the low-energy phosphors; determined power source requirements and constructed a prototype power source. Evaluated the impact of lighting on vision and began R&D to improve the visual quality and</p> | <p>laboratory prototype, and develop and test lamp components compatible with the integrated power supply and lamp systems. Continue to optimize design and integrate new sulfur lamps with highly efficient solid-state power source. Estimate manufacturing cost for the lamps and power supplies and perform market studies to identify candidate market entry points. Examine alternative incandescent prototype diamond lamp designs with cost-sharing by industry, and test more-efficient fluorescent phosphors. Begin evaluating new, state-of-the-art light sources for instruments and displays (e.g., light-emitting diodes and electroluminescent displays) to determine their applicability to building lighting. Issue a competitive to fund lighting R&D activities. Evaluate initial experimental results of mesopic lighting and complete testing of subjects in a modified automobile simulator. Begin planning field tests for mesopic street light with technical assistance and cofunding from the four largest manufacturers</p> | <p>R&D of a low-cost CFL so that a laboratory-scale prototype can be constructed and tested. Complete development and test system efficiency of the final prototype sulfur lamps for industrial and residential use and prepare a commercialization plan. Continue to evaluate the state-of-the-art light sources for instruments and displays (e.g., light-emitting diodes and electroluminescent displays) to determine their applicability to building lighting. Consider in context of the lighting road map the promise of hybrid lighting systems by developing methods to efficiently use optical fibers and hollow light guides to distribute light from highly efficient centralized light sources and/or solar concentrators and daylighting systems. Complete the study on ways to increase use of newly emerging lighting technology in lighting-intense facilities. With cofunding and technical assistance from the four largest U.S. manufacturers of lighting, conduct field test of impact of lighting on vision using mesopic street lights.</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>energy efficiency of street and highway lighting. Initiated cost-shared testing of the feasibility of "mesopic" high-intensity outdoor lighting, which has the potential to be 50 percent more energy efficient by optimizing the lamp light spectrum to maximize color quality and visual effectiveness. Conducted a cofunded industry workshop with EPA and New York State to identify R&D and technology transfer needs for lighting controls. Evaluated the use of state-of-the-art lighting controls in a Federal office building and prepared a comprehensive interim report. Continued to assist manufacturers in developing new fixtures for compact fluorescent lamps. Developed a reference manual for designing efficient fixtures and conducted workshops in fixture design. Installed and evaluated new types of CFL fixtures in a large hotel chain. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center) (\$2,350)</p> | <p>of lighting in the U.S. Complete the lighting controls project in a large Federal office building and report results to the GSA for application at other Federal facilities. Initiate an effort to evaluate several new technologies from other industries that may have application to building lighting, such as nonimaging optics, solid-state optical devices, and materials science. Begin developing methods to efficiently use optical fibers and hollow light guides to distribute light from highly efficient centralized light sources and/or solar concentrators and daylighting systems (hybrid lighting). Perform a study to determine how to increase use of newly emerging lighting technology in lighting-intense facilities, such as schools and hospitals. Initiate the national design competition for CFL fixtures for students in industrial arts and engineering cosponsored with industry. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center) (\$5,530)</p> | <p>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. Complete the fixture design competition by transferring the winning student designs to participating manufacturers and making arrangements for market introduction by retail partners. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center) (\$6,000)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>SPACE CONDITIONING AND REFRIGERATION R&D: 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. 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</p> | <p>SPACE CONDITIONING AND REFRIGERATION R&D:</p> | <p>SPACE CONDITIONING AND REFRIGERATION R&D:</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | from the air and improve air quality. (See individual paragraphs below, which have been consolidated in FY 2000.) | (See individual paragraphs below, which have been consolidated in FY 2000.) | 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. 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 |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|---------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | | | <p>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. Continue cost-shared, industry-driven refrigeration research on high-priority areas of integrating equipment and distribution systems and improving quality of conditioned air. Establish a CRADA with a compressor manufacturer to develop a high-efficiency/low-capacity compressor design for high-efficiency refrigerator/freezer applications. Complete field tests and demonstrate a new, highly efficient supermarket refrigeration/HVAC systems with industry partners. Conduct research on low-cost heat pump water heaters as a replacement for conventional electric water heaters. Continue developing the proposed ASHRAE</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>RESIDENTIAL ABSORPTION HEAT PUMPS: In collaboration with manufacturers, designed and began fabricating various heat pump components, including a preproduction prototype GAX, heat exchangers, and absorption sealed module (ASM) that houses the GAX technology. Completed the initial laboratory testing and fabrication of the first-generation, 3-ton residential GAX heat pump. Completed laboratory testing of critical components for two Hi-Cool heat pump design concepts, an 8-ton commercial unit using branched</p> | <p>RESIDENTIAL ABSORPTION HEAT PUMPS: Design, build, and complete laboratory testing of heat exchangers in collaboration with a major HVAC manufacturer. Build multiple prototype GAX heat pumps in collaboration with a small business manufacturer and initiate field testing and evaluation at a gas industry site. With the industry-led consortium, build critical components for the scale-up design of the ASM that will house the GAX technology and complete manufacturing cost analysis to verify</p> | <p>Standard 152 for thermal distribution efficiency by field validation testing improved designs. (Phillips, Robur, Lennox, Energy Concepts, Rocky Research, ORNL, York International, Semco/Trane, ICC Technologies, American Institute of Learning (AIL), NREL, National Institute of Standards and Technology (NIST), LBNL, University of Maryland, Arthur D. Little) (Heat Pumps ≈ \$6,500, Desiccants ≈ \$4,500, Refrigeration ≈ \$4,457) (\$15,457)</p> <p>RESIDENTIAL ABSORPTION HEAT PUMPS: (Activities incorporated into SPACE CONDITIONING AND REFRIGERATION R&D.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>GAX technology and a 3-ton residential/light commercial unit using Solid/Vapor technology. Began fabrication and testing of the Hi-Cool laboratory prototypes. (EPAct Section 2102) (Phillips, Robur, Lennox, Energy Concepts, Rocky Research, ORNL) (\$5,400)</p> | <p>first cost and marketability of a commercial product. Complete fabrication of the ASM for a prototype small commercial Hi-Cool branched GAX heat pump. Complete laboratory testing of high-temperature heat exchanger for the residential Solid/Vapor Hi-Cool heat pump. (Phillips, Robur, Lennox, Energy Concepts, Rocky Research, ORNL) (\$5,910)</p> | <p>DESICCANTS AND CHILLERS: (Activities incorporated into SPACE CONDITIONING AND REFRIGERATION R&D.)</p> |
| | <p>DESICCANTS AND CHILLERS: The goal of this activity is to develop natural gas-fired desiccants and chillers to reduce energy used for air conditioning, reduce electric peak loads and improve indoor air quality in commercial buildings. Field test and evaluate of additional desiccant systems for comparative testing with standard HVAC cooling equipment and initiate concept evaluation of liquid desiccant systems in laboratory testing. For the chiller, complete testing of a high performance commercial size chiller. Develop two solid desiccant concepts in competitively-selected projects with cost-sharing by industry partners. Expand the comparative field test of a desiccant</p> | <p>DESICCANTS AND CHILLERS: Begin testing of a prototype desiccant based pre-conditioner into a modular HVAC system. Complete field testing of desiccant systems in comparative testing with standard HVAC cooling equipment and laboratory test advanced components. For the chiller, begin field testing of a modified high efficiency pre-production commercial size chiller. Continue to develop two desiccant concepts in competitively-selected projects with cost-sharing industry partners. Monitor comparative field tests of a desiccant air-conditioner concept at large restaurants and schools and complete a report on costs, energy</p> | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Equipment, Materials and Tools (Cont'd) | <p>air-conditioner concept to include large restaurants and schools. Begin a field pilot test of the desiccant pre-conditioner for treating ventilation air in combination with conventional air-conditioning systems and initiate development of fully integrated combined unit. Continue to work with manufacturers in testing and evaluating prototype solid desiccant wheels. Begin initial tests of a new liquid desiccant absorber. Continue cost-shared development of a DCC absorption chiller at York International. Complete performance test of a full-scale laboratory prototype. Complete cost analysis and market study as a prelude to field test of a commercial prototype based on materials characterized in the dynamic corrosion studies. Complete development of the critical components for a commercial prototype unit for field test. (Semco/Trane, ICC Technologies, AIL, NREL, York International, ORNL) (\$2,350)</p> | <p>savings, and indoor air quality benefits in the field installations. Complete a field pilot test of the desiccant pre-conditioner for treating ventilation air and complete development and initiate a field test of a unit with integrated desiccants and conventional air-conditioning. Complete the second round of testing of manufacturer prototype solid desiccant wheels. Expand liquid desiccant efforts by initiating industry cost-shared development of high efficiency liquid dehumidifiers. Continue cost-shared development of a DCC absorption chiller at York International. Perform a field test of a commercial prototype DCC chiller in cooperation with York International. A successful field test will complete the project. Evaluate opportunities for increasing performance and reducing emissions of gas engine-driven chillers, as an alternative to absorption chillers. (Semco/Trane, ICC Technologies, AIL, NREL, York International, ORNL) (\$2,480)</p> | |

FURNACES AND
BOILER/COMBUSTION

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p> FURNACES AND BOILER/COMBUSTION RESEARCH: Continued research with small business manufacturers on several designs for a low-firing rate fan atomized burner (FAB) that includes self-tuning and low-cost design. Using the NYSERDA cofunding, conducted field testing of the basic low-excess-air FAB and developed a low-cost, low-NOx version to evaluate commercial potential. Demonstrated a prototype self-tuning FAB and continue refinements to control excess air. Continued developing a Computational Fluid Dynamics (CFD) design tool to improve accuracy. Provided technology transfer to industry by supporting a 1998 Oil Heat Technology Conference. (BNL) (\$500) </p> <p> REFRIGERATION: Building on industry's <i>HVAC&R Research for the 21st Century</i>, revised program plans to increase program potential to achieve energy savings of 20 to 50 percent. Began the last phase of an industry-led, jointly funded research program on materials </p> | <p> RESEARCH: Complete development of a simplified design of the FAB, improving design for lower cost, lower power, application and field testing, and demonstrations for potential industry partners. Demonstrate reduced fouling capability of the FAB in accelerated testing of boilers. Demonstrate the use of CFD in the design of a new oil burner in collaboration with manufacturer. Provide technology transfer to industry by supporting a 1999 Oil Heat Technology Conference. (BNL) (\$500) </p> <p> REFRIGERATION: Initiate cooperative agreement with industry to support the <i>HVAC&R Research for the 21st Century</i> plan. Focus 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, </p> | <p> FURNACES AND BOILER/COMBUSTION RESEARCH: (Program completed.) </p> <p> REFRIGERATION: (Activities incorporated into SPACE CONDITIONING AND REFRIGERATION R&D.) </p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Equipment, Materials and Tools (Cont'd) | <p>compatibility and lubricants research for a new generation of chlorine-free refrigerants. Continued the CRADA with DuPont to improve air conditioning performance at high outdoor temperatures by developing new heat exchangers that efficiently use new refrigerant blends. With industry cost sharing, conducted research to develop and demonstrate high-efficiency technology breakthroughs for supermarket refrigeration systems, residential refrigerators, and soft drink vending machines. Initiated development of an innovative design concept for a heat pump water heater much lower in cost and easier to install than today's technology. Developed a nationally recognized method of testing thermal distribution system efficiency for implementation through ASHRAE. (ORNL, NIST, LBNL, BNL, University of Maryland, Arthur D. Little) (\$3,140)</p> | <p>refrigeration, and water heating sectors. Complete 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. Complete laboratory support to CRADA partner DuPont and a heat pump manufacturer in testing of a heat pump with improved performance at high outdoor temperatures. For refrigeration systems, initiate CRADA with soft drink vending machine manufacturer. Demonstrate supermarket refrigeration/HVAC energy savings in field tests of new systems with industry partners. Begin field testing innovative heat pump water heater concepts much lower in cost and easier to install than conventional technology. Continue developing the ASHRAE Standard for thermal distribution efficiency through publication of an ASHRAE method of test procedure public review and by field validation testing. (ORNL, NIST, LBNL, BNL, University of Maryland, ASHRAE) (\$2,860)</p> | |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>COGENERATION/FUELS CELLS (Formerly Fuel Cells for Buildings):</p> <p>INTRODUCTION: Work with industry in cost-shared programs to develop and demonstrate fuel cell technologies that are cost-effective and unique to buildings and that are not being addressed by other fuel cell programs. Fuel cells offer an excellent opportunity to cogenerate electric power and use heat energy, significantly reducing consumption of primary energy and emissions of carbon dioxide. Building fuel cells are unique compared to automotive fuel cells because they need to operate at higher temperature and atmospheric pressure, need to produce low noise and increased power density, and need to 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</p> | <p>COGENERATION/FUELS CELLS (Formerly Fuel Cells for Buildings):</p> | <p>COGENERATION/FUELS CELLS:</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>reforming natural gas to hydrogen. Generating electricity at the site also minimizes electrical transmission and distribution losses.</p> <p>Selected the best of three reforming concepts for building-specific applications and began designing critical components for the selected process. In the Small Business Innovative Research (SBIR) program, completed development of carbon monoxide (CO)-tolerant anodes and low-cost bipolar plates. (International Fuel Cells, H₂Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, ANL) (\$1,000)</p> | <p>Fabricate and laboratory test the selected methane reformer that extracts hydrogen from natural gas to power the fuel cell. Initiate the design of a laboratory breadboard proton exchange membrane (PEM) fuel cell for building applications. Initiate research into high-temperature membrane materials and advanced CO-tolerant and high-temperature catalysts. With an industrial partner, continue working with low-cost bipolar plates derived from the SBIR program. (International Fuel Cells, H₂Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, ANL) (\$1,750)</p> | <p>Fuel cells have the potential to revolutionize building energy use (heating, cooling, hot water, and electricity). Conduct competition to solicit the best R&D proposals to further develop building fuel cell technology. Build on work to-date to build and test the next phase in buildings fuel cell development: an engineering prototype methane reformer. Incorporate the methane reformer into a PEM fuel cell and begin field testing. Accelerate research of high-temperature membrane materials and advanced CO-tolerant and high-temperature catalysts. This R&D program will lead to a first-generation prototype PEM fuel cell system being installed in a building in FY 2002. In addition to fuel cell R&D that is unique to building applications, actively pursue adoption of technologies being developed in transportation and military programs</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>APPLIANCES AND EMERGING TECHNOLOGIES R&D (Formerly Emerging Technology Demonstrations): Demonstrated sulfur lamp in Air Force and U.S. Post Office installations and disseminated results to aerospace and other industries. Demonstrated efficient water heating and hot water energy recovery technologies with industry. (\$942)</p> | <p>APPLIANCES AND EMERGING TECHNOLOGIES R&D: Demonstrate a “drop-in” heat pump water heater for residential use with a major manufacturer, based on DOE R&D programs. Develop a specification for room air conditioners to be used in organizing volume purchases. Conduct demonstrations of promising designs for high-efficiency laundry systems, including detailed clothes dryer evaluation and monitoring. (\$1,500)</p> | <p>into the buildings Cogeneration/Fuel Cells program. Continuously seek early applications of fuel cells in buildings such as 4 Times Square. (International Fuel Cells, H₂Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, ANL) (\$5,500)</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. Develop prototypes of high-efficiency laundry equipment and advanced heat pump water heaters that are much lower in cost and easier to install than conventional technology. Conduct large-scale demonstration of innovative heat pump water heater with at least 25 utilities in every region of the country. With a major manufacturer and gas utility partner, demonstrate a new engine-driven, integrated gas cooling and water heating technology. (\$2,100)</p> |
| | | <p>BUILDING ENVELOPE R&D:</p> | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>BUILDING ENVELOPE R&D: INTRODUCTION: This program develops proven, energy-efficient materials and building envelope components with industry. Envelope research focuses on developing insulation and building materials, electrochromic windows, and advanced glazing technologies that will lower the heating, cooling, and lighting loads of buildings, reduce construction waste, and improve the environment by developing environmentally benign products.</p> <p>(See individual paragraphs below, which have been consolidated in FY 2000.)</p> | <p>(See individual paragraphs below, which have been consolidated in FY 2000.)</p> | <p>BUILDING ENVELOPE R&D:</p> <p>Focus research on building envelope components, including advanced window technologies identified in the FY 1999 windows road map, thermal insulation, and building materials. Develop and award a competitive solicitation for activities identified in the windows road map (\$300,000). 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</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------------------|----------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | | | industry on improving insulations using environmentally benign materials. Complete the development of the Whole Wall Rating System, which analytically measures the thermal performance of wall systems. 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. 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. Complete a roof coating study with the Roof Coating Manufacturers Association. Complete the |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>COMPETITIVE SOLICITATION: No activity. (\$0)</p> <p>THERMAL INSULATION AND BUILDING MATERIALS: Continued industry-driven R&D. Expanded use of the National User facility by industry. Conducted R&D on wind-resistant roofing,</p> | <p>COMPETITIVE SOLICITATION: Develop, announce, and award a competitive solicitation for innovative building envelope technologies R&D. (\$1,700)</p> <p>THERMAL INSULATION AND BUILDING MATERIALS: Continue the energy performance focus activities while further engaging industry in its efforts to address the environmental context of advanced materials and structures. The methodology developed by the Total Environmental Warming Impact</p> | <p>development of metrics that define an energy-efficient roofing system. Deploy an Internet calculator to allow roofing professionals to design these systems. Complete research on reflectivity of roofing and paving materials that will be used to develop standards for measuring and labeling reflectivity. (ORNL, LBNL, NREL, National Fenestration Rating Council, University of Massachusetts, Florida Solar Energy Center) (Window Technologies \$6,400, Other Envelope Technologies \$5,500) (\$11,900)</p> <p>COMPETITIVE SOLICITATION: (Activities incorporated in BUILDING ENVELOPE R&D.)</p> <p>THERMAL INSULATION AND BUILDING MATERIALS: (Activities incorporated into BUILDING ENVELOPE R&D.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Equipment, Materials and Tools (Cont'd) | <p>manufacturing processes for superinsulations, a thermal performance label for whole wall R-value, and developing a R-30/30 roof (30-year life/R-value of 30). Participated in international efforts to quantify total wall performance, continue resolving technical issues regarding replacement blowing agents for thermal insulating foams and establishing a new program on sustainable insulation and envelopes. (ORNL, LBNL) (\$2,228)</p> | <p>study that was cofunded by an industry-government consortium, will be used as a basis for evaluating the energy and environmental performance of the new generation of plastic foam blowing agents. FY 1999 projects include 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 (baled and sheaves), 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 will measure and evaluate overall system thermal performance for walls and roofs under real-world</p> | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>URBAN HEAT ISLAND RESEARCH: Coordinated heat island studies, demonstrations, and technology marketing with roofing products manufacturers and other Federal agencies, including EPA, NASA, DOT, HUD, USDA, and USAID. Analyzed urban air temperature, air quality, and satellite imagery data in several U.S. cities. Modeled cooling effects of light surfaces and vegetation on building energy use, air temperature, and ozone formation in urban communities. Continued collaboration with pavement and roofing industry to adopt standardized reflectivity measurement and product labeling. Prepared a database of highly reflective roofing and pavement</p> | <p>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. (ORNL, LBNL) (\$3,094)</p> <p>URBAN HEAT ISLAND RESEARCH: Complete heat island studies with other Federal agencies and roofing and pavement product manufacturers. With the National Laboratories, conduct analysis of urban air temperature, air quality, and satellite imagery data in additional U.S. cities. Develop tools for cities to use in quantifying community-wide cooling effects of light surfaces and vegetation on building energy use, air temperature, and ozone formation. Implement standardized and voluntary reflectivity measurement and product labeling in conjunction with the Energy Star program. Expand the database of highly reflective roofing and pavement materials. Continue technical support to air quality management districts establishing air pollution credits for reflective surfaces and vegetation</p> | <p>URBAN HEAT ISLAND RESEARCH: (Program completed.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>materials. Provided technical support establishing a system for air pollution control credits for using highly reflective surfaces and vegetation plantings in urban areas to offset anticipated pollution from new development. Coordinated procurement specifications with GSA and other Federal agencies to facilitate use of highly reflective surfaces on Government facilities. (LBNL, ORNL) (\$700)</p> <p>ELECTROCHROMIC RESEARCH: Continued Phase II of the cooperative agreement for the electrochromics Government-industry partnership to develop advanced window technologies using the core research team of the National Laboratories. Selected the winning teams to develop a preproduction line for intermediate-size windows. Tested the first prototype electrochromic skylights at the Mobile Window Thermal Testing facility. Conducted research on the next generation of lower cost systems for widespread adoption. Completed test of linear</p> | <p>for urban development as an offset to ozone standards. Continue work with GSA on using highly reflective surfaces on Federal facilities. Collaborate with roofing industry representatives through the newly incorporated Cool Roof Rating Council to reach consensus on reflective roofing standards. (LBNL, ORNL) (\$700)</p> <p>ELECTROCHROMIC RESEARCH: Complete industry designs for an automated production line for full-size windows. Production of full-size windows that are acceptable in terms of cost and performance will be ready for demonstration in FY 2001. Fabricate nonautomated full-size prototype windows and skylights and complete interim field testing. Provide technical support to industry in durability testing. Provide technical assistance for ion-beam deposition technology for upgrades based on industry tests and scale-up and evaluate new coatings optimized for this process. (LBNL, NREL, GO) (\$4,285)</p> | <p>ELECTROCHROMIC RESEARCH: (Activities incorporated into BUILDING ENVELOPE R&D.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>arrays and provided technical assistance to transfer ion-beam deposition technology to industry, which is applicable to both electrochromic and durable low-E/spectrally selective coatings. Industry partners are expected to demonstrate ion-beam technology in pilot plants after 1998. (LBNL, NREL, GO) (\$3,715)</p> <p>SUPERWINDOW TECHNOLOGIES: Supported industry development of high-performance SuperWindow and spectrally selective window technologies by providing materials, and systems analytic and testing capability. Expanded durable coatings research using ion-beam, enhanced deposition technology to provide industry with a detailed assessment of performance and benefits. The new thermal and solar coating technologies more than double the "capture potential" of energy-efficient windows produced by small- to medium-sized manufacturers for the retrofit and export market. (LBNL) (\$350)</p> | <p>SUPERWINDOW TECHNOLOGIES: Continue materials and systems analytic and testing capability to support industry development of high-performance SuperWindow and spectrally selective window technologies, particularly for small- to medium-sized window companies. Continue support for development of durable coatings utilizing ion-beam, enhanced deposition technology. (LBNL) (\$350)</p> <p>ADVANCED GLAZING: (Performance and Simulation Research): Work with the NFRC</p> | <p>SUPERWINDOW TECHNOLOGIES: (Activities incorporated into BUILDING ENVELOPE R&D.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>ADVANCED GLAZING: (Performance and Simulation Research): Performed laboratory and field tests of advanced glazing technology per industry priorities. Developed WINDOW 5X to optimize the design of a wider range of products. Completed technical support for the basic voluntary rating system and continued research to support National Fenestration Rating Council's (NFRC) rating program. Provided technical support to the Efficient Window Collaborative, which works with industry to foster market transformation that will lead to the doubling of the average energy efficiency of window sales. Completed technical support of NFRC's initial commercial building windows guidelines. Worked with an ad hoc review team (e.g., NFRC, Primary Glass Manufacturers' Council, American Architectural Manufacturers Association, American Institute of Architects, etc.) to develop the initial guidelines and to define future products and projects. (FSEC, LBNL, NFRC,</p> | <p>and other technical associations to guide the research for the voluntary energy rating system for windows and glazing products. The NFRC rating program is being used for the new International Standards Organization (ISO) standards, which will aid U.S. firms' ability to compete in foreign markets. Complete draft of the <i>Commercial Buildings Fenestration Handbook</i> and initial modules supporting computer design tools. Initiate key architect pilot demonstration project to evaluate and revise the design tools and strategies for use of the handbooks and tools. Results from this project will identify future product development needs. (Florida Solar Energy Center, LBNL, NFRC, University of Massachusetts.) (\$1,594)</p> | <p>ADVANCED GLAZING: (Activities incorporated into BUILDING ENVELOPE R&D.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>University of Massachusetts) (\$894)</p> <p>ANALYSIS TOOLS AND DESIGN STRATEGIES: (Formerly Design Strategies for Commercial and Residential Buildings):</p> <p>INTRODUCTION: 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. DOE-2 is available from 11 private sector companies that provide technical support and the final version will be released in FY</p> | <p>ANALYSIS TOOLS AND DESIGN STRATEGIES: (Formerly Design Strategies for Commercial and Residential Buildings):</p> | <p>ANALYSIS TOOLS AND DESIGN STRATEGIES:</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------|
| Equipment, Materials and Tools (Cont'd) | <p>1999. DOE-2 will be replaced by EnergyPlus, a new, modular, easily 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> | TRANSFER FROM: Building Systems Design | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>TRANSFER FROM: Building Systems Design</p> <p>Significant advances were made in the development of EnergyPlus, of which a beta version will be ready for testing in FY 1999. Completed beta testing of Version 1.0 of the Building Design Advisor. Completed development and began beta testing of SPARK. Released ENERGY-10, Version 1.2 with new modules. Began developing version 1.3 of ENERGY-10. Working with the Industry Alliance for Interoperability, released Version 1.5 of the Industry Foundation Classes, a specification for sharing information among building-related software tools. Completed final testing of DOE-2.2 building analysis simulation program, which contains new residential and commercial HVAC systems, natural ventilation, roof calculations, and other features. Supported the industry consensus process with ASHRAE for thermal distribution and techniques to meet residential indoor air quality standards. Completed the multizone infiltration model developed in</p> | <p>Develop software modules to simulate complex innovative building systems performance for use in EnergyPlus. Begin beta testing EnergyPlus. Release Version 1.0 of the Building Design Advisor. Begin developing links from the Building Design Advisor to DOE-2 and Radiance (a realistic lighting simulation program). Release Version 1.0 of SPARK. Complete, test, and release Version 1.3 of ENERGY-10 software for making informed decisions among solar and other efficiency strategies. Begin developing Version 2.0 of ENERGY-10. Release Version 2.0 of Industry Foundation Classes and continue participation in the Industry Alliance for Interoperability to ensure that energy efficiency can be considered in building-related software. Release DOE-2.2, the last version of DOE-2, with new features for residential and commercial buildings. Incorporate new technologies, simulation capabilities, and strategies and methodologies developed under <i>Building America</i> and other projects into residential design tools.</p> | <p>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. Complete much anticipated building integration software by beta testing and releasing EnergyPlus, Version 1.0. Based on the commercial buildings roadmap and industry partner feedback, begin developing Version 2.0 of EnergyPlus to include new modules that simulate performance of complex, innovative building systems and components. 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. Begin developing Version 2.0 of SPARK. Complete, test, and release Version 2.0 of the ENERGY-10 software that incorporates advanced concepts learned in buildings studies.</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
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| Equipment, Materials and Tools (Cont'd) | <p>cooperation with the International Energy Agency. Researched advanced concepts in passive solar heating and cooling, which are used in combination with efficiency and other renewable energy measures and system engineering to create building designs that minimize energy loads. Adapted and tested these concepts in the <i>Building America</i> program. (LBNL, NREL, ORNL, Passive Solar Industries Council, University of Illinois/Construction Engineering Research Laboratories, University of Oregon) (\$4,054)</p> | <p>Develop the next-generation designs of low-energy building concepts that will be demonstrated by the <i>Building America</i> consortia. Develop 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). Provide technical contributions to the ASHRAE Standard for residential ventilation. Incorporate ventilation and mitigation strategies from the indoor air quality research into all whole-building simulation tools. Complete test procedures for duct distribution systems. (LBNL, NREL, ORNL, Passive Solar Industries Council, University of Illinois/Construction Engineering Research Laboratories, University of Oregon) (\$4,058)</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. 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. Continue participation in the Industry Alliance for Interoperability to ensure that energy efficiency can be considered and incorporated in building-related software. (NREL, LBNL, ORNL, University of Illinois/Construction Engineering Research Laboratories,</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | <p>LIGHTING AND APPLIANCE STANDARDS:</p> <p>INTRODUCTION: This program develops and publishes test procedures and labels, and develops and issues mandatory energy conservation standards for residential appliances and certain commercial equipment. These standards are central to meeting the energy efficiency goals and reducing carbon emissions.</p> <p>TRANSFER FROM: Codes and Standards</p> <p>Researched and revised test procedures to ensure innovative designs can be fairly tested. Published determination regarding test procedures and standards for distribution transformers. Published final rule to amend test procedures</p> | <p>LIGHTING AND APPLIANCE STANDARDS:</p> <p>TRANSFER FROM: Codes and Standards</p> <p>Issue final rule to incorporate legislated standards and test procedures for large electric motors. Publish NOPR for test procedures for residential central air conditioners/heat pumps and for distribution transformers. Publish NOPR to incorporate legislated standards and test procedures for commercial HVAC and water heaters. Initiate rulemaking to</p> | <p>University of Oregon, Passive Solar Industries Council) (\$4,500 for software development; \$2,000 for design analysis and support) (\$6,500)</p> <p>LIGHTING AND APPLIANCE STANDARDS:</p> <p>The Department's commitment to issuing three energy conservation standards (fluorescent lamp ballasts, water heaters, and clothes washers) in one year reflects a highly accelerated schedule and a greatly increased level of effort. Devote resources to developing new analytical tools and conducting more robust analyses to address complex</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
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| Equipment, Materials and Tools (Cont'd) | <p>for water heaters, including small and instantaneous water heaters. Issued final rule to incorporate legislated standards and test procedures for plumbing equipment. Tested appliances for enforcement actions and processed manufacturer requests for test procedure waivers. Worked with international standards organizations, particularly those from Canada and Mexico, to align testing, which will reduce testing requirements for manufacturers and enhance foreign sales of U.S. products. Supported voluntary efficiency rating and labeling programs for commercial office equipment and luminaries. Worked with industry to develop mandatory labeling requirements for EPA-covered commercial products. Implemented the new standards process. Issued the final rule for energy conservation standards for electric kitchen ranges and ovens. Initiated energy conservation standards rulemaking for residential central air conditioners/heat pumps. Supported the consensus standards organization in regard to covered commercial products. Worked with</p> | <p>amend test procedures for dishwashers. Support voluntary efficiency rating and labeling programs for commercial office equipment and luminaires. Work with industry to develop mandatory labeling requirements for EPA-covered commercial products. Promulgate amended energy conservation standards designed to achieve the maximum improvements in energy efficiency that is technically feasible and economically justified. Implementing the new process for standards, publish the Supplemental ANOPR for energy conservation standards for clothes washers and the ANOPR for energy conservation standards for residential central air conditioners/heat pumps. Support the consensus standards organization with regard to covered commercial products. Begin rulemaking to revise standards, as required by the legislation, in response to changes in the consensus standards. Work with equipment manufacturers to ensure products are properly certified and that they meet the standards. With</p> | <p>issues raised by the Appliance Efficiency Standards Advisory Committee. Issue final rule for test procedures for residential central air conditioner/heat pumps and for distribution transformers. Issue final rule incorporating legislated standards and test procedures for commercial HVAC and water heaters. Work with the Federal Trade Commission (FTC) to support mandatory energy rating and leveling 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. 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, water heaters and clothes washers. Publish NOPR concerning standards for residential central air conditioners/heat pumps. Publish</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment, Materials and Tools (Cont'd) | equipment manufacturers to ensure products meet the standards and are properly certified. Worked with interested stakeholders on investigating alternative means of accomplishing the goals of the program without revising mandatory standards. (NIST, LBNL, PNNL, NREL) (\$5,894) | stakeholders, continue investigating alternative means of accomplishing the goals of the program without revising mandatory standards. (NIST, LBNL, PNNL, NREL) (\$6,703) | ANOPR concerning standards for commercial HVAC and water heaters. Initiate energy conservation standards rulemaking for distribution transformers. Initiate determinations regarding test procedures and standards for small electric motors and high-intensity discharge (HID) lamps. Work with equipment manufacturers to ensure products are properly certified and that they meet the standards. (NIST, LBNL, PNNL, NREL) (\$13,343) |
| | \$33,517 | \$43,014 | \$60,800 |
| Building Research and Standards Total | \$45,007 | \$61,525 | \$88,163 |

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

BUILDING TECHNOLOGY ASSISTANCE

I. Mission Supporting Goals and Objectives

1. 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 future.

The FY 2000 BTS Technology Assistance programs are expected to displace 23 trillion Btu, saving consumers \$143 million. In FY 2010, the energy displaced will be 483 trillion Btu, saving consumers more than \$3 billion. In FY 2020, energy savings will increase to 928 trillion Btu, saving consumers more than \$6 billion -- more than the entire energy consumption of the State of West Virginia. In FY 2000, the Building Technology Assistance programs will provide 33 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 16 percent of the Sector's total energy savings.

The Building Technology Assistance programs will meet these goals through the strategy outlined in BTS' Strategic Plan: Encourage the use of energy-efficient and renewable energy technologies and practices through technology transfer and financial assistance. The program will implement this strategy by continuing to strengthen its partnerships with States and local communities in order to better respond to BTS' customers and stakeholders.

Partnerships with States and Communities

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

Rebuild America
Helping Communities Thrive

From New York to Hawaii, North Dakota to the Virgin Islands, more than 200 community partnerships are revitalizing their communities by improving buildings and cutting energy costs. For example, the Portland Oregon Energy Office has completed retrofits on 35.8 million square feet, exceeding their target goals and using only 30 percent of their expected budget. The EnergyWorks partnership in Kansas City is well on its way to achieving \$2.5 million in annual energy cost savings in 6.5 million square feet of commercial floor space.

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

satisfaction, and helps speed the widespread adoption of energy-efficient technologies 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.

BTS' approach is based upon several activities:

- Demonstrating the performance, cost, and reliability of new technologies, thus helping remove market barriers. These barriers include hesitancy to use unproven 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.
- Applying R&D results and the tools developed in the Building Research and Standards programs 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 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.

Restructured Offices

As part of BTS' restructuring, the Office of Building Technology Assistance replaces the former Office of State and Community Programs, reflecting BTS' emphasis on accelerating the adoption of energy-efficient technologies. BTS' FY 2000 budget structure follows this new organization as well. Several programs are being consolidated to minimize duplication and better serve BTS' customers. Four others—Volume

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

Purchases, Municipal Energy Management Program, Affordable Housing, and Highly Reflective Surfaces—will be completed in FY 1999. The lessons learned are being applied in BTS' Building Technology Assistance programs.

To best address the different needs of States, communities, and citizens, the Building Technology Assistance budget is now organized in four sections:

- The State Energy Program provides grants to States, allowing them to tailor energy efficiency programs to local needs and leverage non-Federal resources. The Special Projects State Grants assists state efforts to deploy EERE's technologies leveraging funding from the EERE Sector offices.
- The Weatherization Assistance Program extends the benefits of energy efficiency technologies and practices to families that can least afford them and that pay a disproportionate amount of their income for energy, with priority on households with elderly members, persons with disabilities, and children.
- Community Partnerships help communities, towns, and cities save energy, create jobs, promote growth, and protect the environment through improved energy efficiency and sustainable building design and operation.
- The Energy Star Program educates the public on the energy use of equipment, appliances, and buildings and helps them make economically and environmentally sound purchase decisions. The Energy Star Program also promotes BTS' research results, such as the development of high-efficiency windows.

State Energy Program (SEP)

The mission of BTS' State Energy Program is to provide a supportive framework with sufficient flexibility to enable States to address their energy priorities in concert with national priorities. SEP assists State Energy Offices to effectively implement and coordinate activities that address their unique energy priorities, opportunities, and barriers. The FY 2000 State Energy Program expects to displace 6 trillion Btu and save \$34 million. In FY 2010, the energy displaced will increase to 56 trillion Btu and save more than \$355 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

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

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.

Weatherization Assistance Program

The mission of the Weatherization Assistance Program is to provide cost-effective energy efficiency services to 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 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 2000 goal of the Weatherization Assistance Program is to achieve annual average savings of 25 percent of home heating energy in more than 76,900 low-income family households. Based on the FY 2000 budget request, 7 trillion Btu will be displaced in FY 2000, saving \$38 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, 96 trillion Btu will be displaced, saving \$533 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

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

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 2000, the Weatherization Assistance Program will implement the “millennium strategy” that is being developed by the Weatherization network in FY 1999. The strategy is expected to complement proposals for regulatory and legislative change that will further enhance the program’s effectiveness in accomplishing its mission and realizing significant socioeconomic and environmental benefits. The program will apply technologies that address global climate and will incorporate PATH strategies.

Community Partnerships Program

The mission of the Community Partnerships Program is to provide technical assistance, demonstrations, training, and education to its community partners to accelerate the introduction of innovative and cost-effective energy technologies, strategies, and methods.

The FY 2000 Community Partnerships Program will displace 8 trillion Btu, saving communities \$51 million. In FY 2010, 225 trillion Btu are expected to be displaced, saving almost \$1.5 billion. BTS’ deployment and outreach activities have been consolidated under a single Community Partnerships Program that will improve the delivery of services and best serve each community’s needs. This represents a new way of doing business that will improve operational efficiency and initiate a lasting transformation of retrofit practices. The Community Partnerships Program which includes *Rebuild America* and the former Update State and Federal Codes and Outreach programs, provides integrated information, technical assistance, and competitive financial assistance tailored to communities’ needs.

BTS’ Community Partnerships 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 sustain ability. 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. Community Partnerships leverage \$10 for each Federal dollar invested.

By the end of FY 1998, BTS had established more than 190 partnerships through *Rebuild America*, BTS’ comprehensive energy-upgrade program for existing commercial and institutional buildings. These *Rebuild America* community partnerships have committed to improving energy efficiency and reducing energy costs of more than 400 million square feet of building space, equal to more than 550,000 U.S. Capitol-sized buildings, thereby putting \$5.6 billion a year back into their communities. BTS is expanding its outreach to increase the number of

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

community partnerships that can benefit from its support and technical assistance. With the goal of increasing *Rebuild America* partnerships by 50 each year, this initiative will save communities 187 trillion Btu annually by 2010. This is equivalent to the amount of energy used by more than 163,000 average-sized (14,000-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. In FY 2000, *Rebuild America* will apply lessons learned from the former Municipal Energy Management, Volume Purchases, Affordable Housing, and Highly Reflective Surfaces programs, which have been completed, consolidating numerous individual outreach and deployment programs. In addition, *Rebuild America* partners receive technical assistance in using the most current BTS-developed design tools to evaluate retrofit options and help select the most effective retrofits. BTS also provides technical assistance through national experts on buildings, energy, and finance and prepares outreach materials on new, cost-effective energy technologies and practices.

Using partnerships such as *Rebuild America*, the Community Partnerships Program will support the public/private Energy Smart Schools initiative to improve energy efficiency in schools. The initiative will work with national organizations and provide technical assistance to the school sector.

BTS also provides training resources to builders and State and local code officials to increase their awareness of new commercial, Federal, and residential codes to ensure that communities are using the latest technologies and practices in building designs and retrofits. BTS is also assisting States and communities to update and implement the multistate commercial code and update the 1998 model residential code. In FY 2000, BTS will increase the education and training support provided to State and local governments. Outreach and educational campaigns will be expanded and strengthened to promote energy-efficient and renewable energy technologies and practices and to influence consumer demand for new, high-efficiency homes and energy retrofits of existing homes.

In FY 2000, BTS will initiate a number of competitive grants that can support community-wide partnerships and expand the use of new, energy-efficient technologies and practices. In addition, funding will be provided to the Special Project State Grants component of the State Energy Program, through competitive solicitations, to permit communities to submit proposals in partnership with States for technical assistance. The award criteria will be based on energy savings and innovative concepts.

Energy Star Program

The mission of the Energy Star Program is to identify and promote appliances, equipment, homes, and buildings that significantly exceed present energy efficiency standards. Energy Star products are typically 20 percent more efficient than the minimum mandated energy efficiency standards or guidelines.

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

In FY 2000, through the use of Energy Star equipment and appliances, the Energy Star label will further increase the public's awareness of equipment and appliance energy use, resulting in savings of 3 trillion Btu and \$20 million. In FY 2000, BTS will recruit 5 utility partners, 500 retail stores, and 40 window partners to promote Energy Star products. By 2004, 20 percent of all appliances sold will display the Energy Star label and 65 percent of all windows sold will qualify under Energy Star. In FY 2010, 106 trillion Btu will be displaced, saving consumers almost \$791 million.

BTS' strategy is to work with manufactures and retailers to expand the joint EPA-DOE Energy Star program and increase collaboration with manufacturers and utilities. In conjunction with these partners, the voluntary program of identifying products and buildings with the Energy Star label has helped consumers choose more-efficient models. By raising awareness through the Energy Star label, significant energy savings and carbon emission reductions can be achieved. The label provides consumers with a highly visible, recognized symbol to identify energy-efficient products that can save money and help protect the environment. BTS will work with EPA to expand the Energy Star program to include DOE's building energy technologies. 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. In an era of deregulation, utility partners will see increased benefits from marketing energy efficiency via the Energy Star label and are likely to increase their cost sharing of this program.

I.B. Program Benefits

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

| <u>METRIC</u> | <u>2000</u> | <u>2010</u> | <u>2020</u> |
|----------------------------------|-------------|-------------|-------------|
| Primary Energy Displaced (Quads) | 0.02 | 0.48 | 0.93 |
| Energy Cost Savings (\$Billion) | 0.1 | 3.2 | 6.2 |
| Carbon Reduction (MMTons) | 0.4 | 7.7 | 14.4 |

In FY 2010, the benefits of all Building Technology Assistance programs are equivalent to the energy use of 2.5 million households, or almost the entire energy use of New Mexico. In FY 2020, the benefits are equivalent to the energy use of 4.8 million households, or the entire energy use of Mississippi.

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

I.C. Performance Measures

Pre-FY 1998 Accomplishments

State Energy Program:

- In FY 1996, awarded 104 Special Project State Grants totaling more than \$11 million that support deployment of targeted sector technologies with funding from end-use sector programs. Special Project State Grants were awarded in the following categories: Alternative Fuels, the Federal Energy Management Program (FEMP), National Industrial Competitiveness through Energy, Environment, Economics (NICE³), Motor Challenge, Climate Wise, Industrial Assessments, Advanced Building Technologies, *Rebuild America*, and Building Codes and Standards.
- In FY 1997, awarded an additional 116 Special Project State Grants totaling nearly \$10.5 million that support deployment of targeted sector technologies with funding from end-use sector offices. Special Project State Grants were awarded in the following categories: Alternative Fuels/Clean Cities, FEMP, Industrial Technologies, Building Codes and Standards, *Rebuild America*, Biomass Power, Geothermal Heat Pumps, Hydrogen Technology, Photovoltaics for Utility Scale Applications, and Wind Resource Assessments.

Weatherization Assistance Program:

- Increased the Weatherization Assistance Program benefit-cost ratio for energy saving from \$1.06 in 1989 to \$1.79. (FY 1996)
- Over the life of the program, developed and supported nationwide network of professional weatherization service providers, which have utilized DOE and leveraged funding to weatherize the homes of more than 4 million low-income families. (FY 1997)

Community Partnerships Program:

- Established *Rebuild America*, a community-wide commercial and institutional building retrofit program. (FY 1995)
- With the Association of Higher Education Facilities Officers, conducted more than 100 training sessions on energy management strategies for facility management staff and business officers. (FY 1996 and 1997)
- Formed 50 new *Rebuild America* partnerships for a total of 140 partnerships, which started more than \$1 billion of energy efficiency renovations for 500 million square feet of floor space. (FY 1997)
- Leveraged more than \$27 million in contracts for private investment in energy-related improvements for housing agencies through the Affordable Housing program. (FY 1997)
- Assisted 32 States in updating or implementing their residential building energy efficiency codes, achieving more than \$2.7 million in cost sharing with State and utility partners. (FY 1997)
- Developed and disseminated tools that simplify the process of complying with the upgraded International Energy Conservation Code (IECC), formerly called the Model Energy Code (MEC). (FY 1997)

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

Energy Star Program:

- Launched the Energy Star appliance program nationally in conjunction with manufacturers and utilities to promote appliances significantly exceeding present efficiency standards. (FY 1997)
- Added clothes washers that use 53 percent less energy and 38 percent less water than the minimum standards to the portfolio of Energy Star products. (FY 1997)
- Promoted sales of 20 laundry hot wastewater recycling and reuse systems, saving 300 million gallons of water and 2 billion Btu. (FY 1997)
- Conducted a major demonstration of high efficiency clothes washers in Bern, KS. (FY 1997)

FY 1998 Accomplishments

State Energy Program:

- Implemented streamlined application and reporting procedures.
- Awarded more than 100 Special Project State Grants totaling more than \$13 million that support deployment of targeted sector technologies with funding from end-use sector offices. Special Project State Grants were awarded in the following categories: Alternative Fuels/Clean Cities, Building Codes and Standards, *Rebuild America*, Home Energy Rating Systems, Industrial Technologies, FEMP, and Remote Applications of Renewable Technologies.

Weatherization Assistance Program:

- Provided State grants to weatherize 63,335 homes for low-income families, saving \$1.80 in energy costs for every dollar invested.

Community Partnerships Program:

- Recruited 55 new *Rebuild America* partners, increasing the total number of *Rebuild America* communities to 195.
- Obtained commitment of new *Rebuild America* partners to retrofit 400 million square feet of floor space, reducing annual energy costs by \$143 million when complete in FY 2003.
- Established commitments for the energy rehabilitation of 100,000 additional housing units, bringing the total to 200,000 units.
- Provided 12 regional planning and training workshops on building technologies, financing, and retrofit process.
- Developed and published three *Rebuild America* handbooks and guidelines for partners and building owners on financing, commissioning, and energy project planning.
- Provided technical assistance to communities and nonprofit organizations to purchase 85,000 compact fluorescent light bulbs, high-efficiency clothes washers, and refrigerators through volume purchases.
- Co-funded 14 competitive applied research projects in municipal buildings, municipal processes, transportation and sustainable urban energy systems.

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

- Developed standards for measuring and labeling reflectivity on roofing and paving products and developed a database of materials available with high-reflectivity coatings.
- Assisted 10 States in updating or implementing their residential building energy efficiency codes to the 1998 Model Energy Code or to an early adopters version of the next-generation code, Standard 90.1-1989R.
- Improved and disseminated tools that simplify the process of complying with ASHRAE/IESNA Standard 90.1 - 1989 and the upgraded successor for commercial building energy consumption.
- Trained 500 code officials, designers, and builders on the 1998 IECC and 10 CFR 435.

Energy Star Program:

- Added energy-efficient windows to the Energy Star portfolio.
- Increased the number of retail stores labeling Energy Star appliances to more than 2,000 and recruited 4 major appliance manufacturers to label and promote Energy Star appliances.
- Recruited additional utility partners, bringing the total to 21, representing service to more than 20 million households.

FY 1999 Planned Accomplishments

State Energy Program:

- Successfully implement 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.
- Provide report to EERE sector offices on value added by State involvement in technology deployment via Special Project State Grants.
- Begin design of SEP evaluation.

Weatherization Assistance Program:

- Provide State grants to weatherize approximately 67,300 homes for low-income families, saving \$1.80 in energy costs for every dollar invested.

Community Partnerships Program:

- Recruit 85 new *Rebuild America* partners, increasing the total number of *Rebuild America* communities to 280.
- Provide technical assistance to communities and nonprofit organizations to purchase heat pump water heaters and high-efficiency gas appliances.
- Co-fund 18 competitive, applied research projects in municipal buildings and processes, and transportation and sustainable urban energy systems.

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

- Target the award of 5 to 10 Special Project grants to community partnerships for school-related initiatives using funds from building and transportation sector program areas within the State Energy Program.
- Sponsor more than two dozen residential build/design training programs.
- Develop and disseminate software tools and materials for implementing new Federal residential and commercial energy codes.
- Assist 5 States in updating their residential building codes to the 1995 MEC and assist 10 States in updating their residential building codes to the 1998 IECC.
- Provide technical assistance and incentive funding to support the training of 10,000 designers, builders, and code officials so they can implement the newly adopted State codes and recently promulgated Federal codes.
- Assist 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.
- Establish “one-stop shopping” for building energy consumers seeking information.

Energy Star Program:

- Work with the Federal Trade Commission to allow manufacturers to add the Energy Star logo to the “energy guide” label for covered products.
- Add water heaters and compact fluorescent lamps to the Energy Star portfolio.
- Recruit an additional 1,500 stores to label Energy Star appliances, bringing the total number of stores that label high-efficiency appliances and equipment to 3,500.
- Sign agreements with all five major U.S. appliance manufacturers to promote Energy Star products.

FY 2000 Planned Accomplishments

State Energy Program:

- Launch nationwide evaluation of the impact of State energy efficiency and renewable energy programs.
- 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.

Weatherization Assistance Program:

- Provide State grants to weatherize approximately 76,900 low-income homes, saving 7 trillion Btu.

Community Partnerships Program:

- Recruit 50 new *Rebuild America* partners, increasing the total number of communities to 330.

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

- 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.
- Assist States and communities to update and implement the multistate commercial code and to update the 1998 model residential code (98 IECC).
- Develop and disseminate tools for implementing new Federal commercial energy code.
- Train 10,000 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 4,000.
- Recruit 5 utility partners to promote Energy Star products and 40 window partners to promote Energy Star windows.

FY 2001 - FY 2004 Planned Accomplishments

State Energy Program:

- Formalize State Energy Office involvement in meeting EPA Clean Air Act goals. (FY 2001)
- Publish final 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 2001 - 2004)
- Implement changes in program emphasis based on results of national evaluation. (FY 2003)

Weatherization Assistance Program:

- Provide State grants to weatherize approximately 309,660 homes for low-income families. (FY 2001 - 2004)

Community Partnerships Program:

- Recruit 50 new *Rebuild America* partners, increasing the total number of *Rebuild America* communities to 380. (FY 2001)

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

- Assist States and communities to update and implement the multi state or Standard 90.1 - 1999 commercial code and the upgraded model residential energy code (2000 IECC). (FY 2001)
- Develop and disseminate tools for implementing the new Federal residential energy code. (FY 2001)
- Each year, recruit 50 new *Rebuild America* partners, increasing the total number of *Rebuild America* communities to 530 by 2004. (FY 2002 - 2004)
- Develop and disseminate tools for implementing new voluntary commercial and new Federal commercial energy codes. (FY 2002)
- Initiate broad peer-to-peer training effort to replicate *Rebuild America* successes in 100 communities with minimal DOE involvement. (FY 2002)
- Assist 165 school districts achieve a 25 percent increase in energy efficiency through the Energy Smart 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 residential energy code (03 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 (03 IECC). (FY 2004)
- Disseminate tools for implementing upgraded residential energy code (03 IECC). (FY 2004)

Energy Star Program:

- Phase in new qualifying levels for Energy Star refrigerators. (FY 2001)
- Promotion of Energy Star products by more than 4,000 retail stores. (FY 2001)
- Promotion of Energy Star products by thirty utility partners. (FY 2001)
- Promotion of Energy Star windows by at least 200 window partners. (FY 2001)
- Incorporation of the Energy Star logo into the FTC label by two manufacturers. (FY 2001)
- 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 40 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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request | \$ Change | % Change |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------------------|---------------|
| State Energy Program | \$ 30,250 | \$ 33,000 | \$ 37,000 | \$+4,000 | +12.1% |
| Weatherization Assistance Program | 124,845 | 133,000 | 154,000 | +21,000 | +15.8% |
| Community Partnerships (Includes <i>Rebuild America</i> , Update State and Federal Codes, Outreach, and the former Municipal Energy Management, Affordable Housing Programs, Highly Reflective Surfaces, Volume Purchases) | 17,332 | 18,801 | 35,400 | +16,599 | +88.3% |
| Energy Star Program | 2,450 | 2,724 | 6,000 | +3,276 | +120.3% |
| Total, Building Technology Assistance Programs . | <u>\$ 174,877</u> | <u>\$ 187,525</u> | <u>\$ 232,400</u> | <u>\$+44,875</u> | <u>+23.9%</u> |

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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Request | \$ Change | % Change |
|-----------------------------------------------------|--------------------|--------------------|--------------------|------------------|---------------|
| 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 | 4,000 | 3,500 | -500 | -12.5% |
| Oak Ridge National Lab | 4,150 | 4,150 | 4,150 | 0 | 0.0% |
| Pacific Northwest National Lab | 4,000 | 4,000 | 3,500 | -500 | -12.5% |
| All Others | 159,977 | 172,625 | 218,500 | +45,875 | +26.6% |
| Total, Building Technology Assistance Programs. . . | <u>\$ 174,877</u> | <u>\$ 187,525</u> | <u>\$ 232,400</u> | <u>\$+44,875</u> | <u>+23.9%</u> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Building Technology Assistance | | | |
| State Energy Program | <p>STATE ENERGY PROGRAM: Provided grants to 50 States, D.C., and 5 Territories for energy efficiency programs. Promoted broad-based program to support innovative approaches, such as incentive funding, revolving loan funds, and energy technology commercialization services. Increased program emphasis on technology transfer and on partnering with States to explore leveraging strategies. In addition to basic support provided under Program Direction, provided technical assistance and training, with focus on developing State-level capabilities to use partnerships for EERE utilization. (\$30,250)</p> <p>SPECIAL PROJECT STATE GRANTS: Awarded 120 Special Project State Grants to help deploy end-use sector technologies in</p> | <p>STATE ENERGY PROGRAM: Provide grants to 50 States, D.C., and 5 Territories for energy efficiency programs. Continue to promote broad-based program to support innovative approaches, such as incentive funding, revolving loan funds, and energy technology commercialization services. Increase program emphasis on technology transfer and on partnering with States to explore leveraging strategies. In addition to basic support provided under Program Direction account, provide technical assistance/training, with the focus on developing State-level capabilities to use collaborative partnerships for EERE utilization. Involve States in providing better performance measures for State Energy Program activities. (\$33,000)</p> <p>SPECIAL PROJECT STATE GRANTS: Award at least 100 Special Project State Grants to</p> | <p>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. Evaluate impact of State energy efficiency and renewable energy programs nationwide. (\$37,000)</p> <p>SPECIAL PROJECT STATE GRANTS: Award at least 100 Special Project State Grants to</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| State Energy Program (Cont'd) | <p>several EERE programs. The special projects and funding provided by each EERE program office follow. Clean Cities: Accelerated the introduction of and increased the use of alternative fuels and alternative-fueled vehicles through the development of infrastructure and “clean” corridors. (OTT \$2,665).</p> <p>Federal Energy Management Program: Developed Federal-State partnerships to increase technical capability and funding for energy efficiency, renewable energy, and water conservation measures in Federal and State buildings. (FEMP \$750).</p> <p>Industrial Programs: Accelerated industrial and “clean” production opportunities with regional industries through the programs of the Industrial Alliance (Inventions and Innovation, NICE³, Industrial Assessment Centers, Motor Challenge, Climate Wise, and Steam Partnership). (OIT \$2,480).</p> <p><i>Rebuild America</i>: Helped community and regional partnerships improve commercial</p> | <p>States on a competitive basis to help deploy end-use sector technologies in the following EERE programs: Transportation Technologies (OTT \$2,700), Federal Energy Management Program (FEMP \$950), Industrial Programs (OIT \$2,800), <i>Rebuild America</i> (BTS \$1,250), Codes and Standards (BTS \$4,200), Home Energy Rating Systems (BTS \$250), and Renewable Technologies (OPT \$1,750).</p> | <p>states on a competitive basis to help deploy end-use sector technologies in the following EERE programs: Clean Cities (OTT \$2,700); Federal Energy Management Program (FEMP \$950); Industrial Programs (OIT \$2,800); <i>Building America</i>, Community Partnerships (competitively-selected community projects), <i>Rebuild America</i>, and State code activities (BTS \$5,700); and Renewable Technologies (OPT \$1,750). This is the first year that funding is specified in sector budgets under the Interior Appropriations account.</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| State Energy Program (Cont'd) | <p>and multifamily building energy efficiency. (BTS \$1,001). Codes and Standards: Supported States' actions to update, implement, and enforce residential and commercial building energy codes. (BTS \$4,000). Home Energy Rating System: Supported states to overcome barriers to energy efficiency financing. (BTS \$250). Power Technologies: Demonstrated and increased use of renewable energy sources, such as biomass, geothermal heat pumps, hydrogen technology, photovoltaics for utility-scale applications, and wind energy. (OPT \$1,736).</p> | | |
| | \$30,250 | \$33,000 | \$37,000 |
| Weatherization Assistance Program | <p>WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 63,335 low-income homes. (\$122,945)</p> | <p>WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 67,330 low-income homes, less than 1 percent of the eligible homes nationwide. The relative scarcity of funds means that only the very neediest can be served. Latest performance data indicates that</p> | <p>WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 76,900 low-income homes, less than 1 percent of eligible homes. The States perform weatherization measures through local organizations. Measures include installing insulation and ventilation fans, performing heating and cooling</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Weatherization Assistance Program (Cont'd) | <p>TRAINING AND TECHNICAL ASSISTANCE: Provided training and technical assistance, including improved techniques to identify and install the most cost-effective weatherization measures; analyzing health/safety issues; and promoting the use of advanced residential technologies, including those from DOE's R&D efforts. (\$1,900)</p> | <p>TRAINING AND TECHNICAL ASSISTANCE: Continue training and technical assistance activities to improve techniques to identify and install the most cost-effective weatherization measures; analyze health/safety issues; and promote the use of advanced residential technologies, including those from DOE's R&D efforts. (\$2,300)</p> | <p>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 yields \$1.80 in energy savings and \$0.60 in economic and environmental benefits. (\$151,700)</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. (\$2,300)</p> |
| | \$124,845 | \$133,000 | \$154,000 |
| Community Partnership Program | <p>COMMUNITY PARTNERSHIPS: INTRODUCTION: The Community Partnerships Program provides information and technical and financial assistance to communities to increase their use of</p> | <p>COMMUNITY PARTNERSHIPS:</p> | <p>COMMUNITY PARTNERSHIPS:</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>innovative and cost-effective buildings technologies, strategies, practices, and building codes. The program assists community partners in working with national organizations, manufacturers, and utilities to improve energy efficiency, and works with national organizations representing community interests and local governments to increase participation, demonstrate, and deploy energy-efficient solutions tailored to community needs.</p> <p>(See individual paragraphs below, which have been consolidated in FY 2000.)</p> | <p>(See individual paragraphs below, which have been consolidated in FY 2000.)</p> | <p>Through the consolidated Community Partnership Program, provide integrated information, technical assistance, and financial assistance to communities to increase their use of innovative and cost-effective building technologies, strategies, and practices and provide communities increased flexibility to design energy-saving programs that respond to their own circumstances and goals. Participate and contribute to outreach activities of the public/private Partnership for Advancing Technology in Housing (PATH). Increase <i>Rebuild America</i></p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|----------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | | | partnerships by 50 to 330, 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. Provide customized technical assistance to residential partners through PATH and commercial partners through <i>Rebuild America</i> . Assistance includes outreach materials; workshops; tools and training on advanced technologies, financing options, and the construction and retrofit process; and design assistance to increase adoption of whole buildings approaches. Assist partners in evaluating and increasing investment in energy efficiency, and promote the use of new, advanced commercial and residential equipment and appliances, including products with the Energy Star label. Expand training programs to optimize energy savings in <i>Rebuild America</i> and <i>Building America</i> communities and ensure that the |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|----------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | | | latest technologies and practices are incorporated into designs and retrofits. Support the Energy Smart School 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 partnerships; developing strategic partnerships with national organizations representing policy, facility, and business officials; identifying best practices in school renovation and new school design; demonstrating advanced technologies; and developing energy specifications for school design and construction. Provide technical and financial assistance to accelerate the availability of building code compliance trainers, information, and materials. Train approximately 10,000 code officials, designers, and builders on 1998 International Energy Code Council (IECC) and 10 CFR 435 via Train-the-Trainer and distance learning. Issue a competitive solicitation for community projects to select |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|----------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | | | innovative proposals that allow communities with public/private partners to design energy-efficient and renewable energy programs and projects. Evaluate and award the funding based on short- and medium-term energy and dollar savings, innovation, job creation, cost sharing, benefits to the environment, and overall benefit to the community. One of the implementation mechanisms for Competitively-selected Community Projects, <i>Rebuild America</i> , and State code activities is participation in the State Energy Program Special Project State Grants. Grants are provided to States on a competitive basis. (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) (Special Project State Grants includes \$400 from Competitively-selected Community Projects, \$1,000 from <i>Rebuild America</i> , and |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>TRANSFER FROM: Building Systems Design:</p> <p><i>REBUILD AMERICA:</i> Recruited 55 new partners to join the community-wide commercial and institutional building retrofit program, increasing the total number <i>Rebuild America</i> communities to 195, representing all 50 States and 6 Territories. Developed and published three handbooks on technology performance and financing strategies; developed World Wide Web home pages, newsletters, and technology briefs; provided access to hot lines and electronic bulletin boards, peer-to-peer workshops, training seminars, and expertise; and provided customized technical</p> | <p>TRANSFER FROM: Building Systems Design:</p> <p><i>REBUILD AMERICA:</i> Recruit 85 additional partnerships to exceed the initial goal of 250 partners. Continue 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. Expand support to community partnerships to increase the use of innovative strategies that will reduce energy costs in buildings across the Nation. Maximize the</p> | <p>\$4,000 from Building Codes) (<i>Rebuild America</i> \$11,100, PATH \$3,000, Energy Smart Schools \$3,000, Competitively-selected Community Projects \$5,000, Information Outreach \$2,000, Training and Assistance for Codes \$11,300) (\$35,400)</p> <p><i>REBUILD AMERICA:</i> (Incorporated into COMMUNITY PARTNERSHIPS PROGRAM.)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Community Partnership Program (Cont'd) | <p>assistance to partners. New partners, such as national organizations representing local government, private business, schools, utilities, and energy service and financing companies, are implementing Action Plans that will result in the renovation of more than 400 million square feet of floor space, the creation of 5,720 jobs in the construction trades, and the reduction of energy costs by \$143 million annually when local actions are completed. The <i>Rebuild America</i> partners are providing almost all of the funds for building improvements and are leveraging \$40 to \$50 million in performance contracts for public and assisted housing, with 100,000 additional housing units to be committed for rehabilitation, bringing the total to 200,000. (Special Project State Grants includes \$1,001 from <i>Rebuild America</i>.) (LBNL, ORNL, PNNL, ANL, NREL, American Public Power Association, U.S. Conference of Mayors) (\$6,920)</p> <p>VOLUME PURCHASES: Provide technical performance monitoring</p> | <p>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. Provide 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. (Special Project State Grants includes \$1,250 from <i>Rebuild America</i>.) (LBNL, ORNL, PNNL, ANL, NREL, American Public Power Association, U.S. Conference of Mayors) (\$7,196)</p> <p>VOLUME PURCHASES: Organize volume buyers to commit to purchase high efficiency room air conditioners. Promote purchases of</p> | <p>VOLUME PURCHASES: (Program Completed)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>and evaluation of 60,000 apartment-sized refrigerators in public housing units and organize buyers groups for compact fluorescent lighting and high-efficiency clothes washers. (\$500)</p> <p>MUNICIPAL ENERGY MANAGEMENT PROGRAM: Co-fund approximately 14 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provide technical assistance to local jurisdictions in replicating successful projects and conduct regional workshops to disseminate information to a broad urban audience. (Urban Consortium) (\$1,572)</p> <p>AFFORDABLE HOUSING: Provide training and education in partnership with local communities, housing and financial industries. Sponsor more than 12 regional training seminars and assist 20 communities to develop energy efficient and/or sustainable development housing practices.</p> | <p>compact fluorescent lamps by local, State, and Federal partners. (\$500)</p> <p>MUNICIPAL ENERGY MANAGEMENT PROGRAM: Co-fund approximately 14 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provide technical assistance to local jurisdictions in replicating successful projects. Continue regional workshops and dissemination of information. (Urban Consortium) (\$1,572)</p> <p>AFFORDABLE HOUSING: Sponsor 15 residential build/design training programs in partnership with local communities. Improve the performance and affordability of housing through a competitive solicitation that will provide training and on-site technical assistance to local communities, State agencies, nonprofit community development organizations, and national</p> | <p>MUNICIPAL ENERGY MANAGEMENT PROGRAM: (Program Completed)</p> <p>AFFORDABLE HOUSING: (Program Completed)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>Provide training materials to Habitat for Humanity (HFH) and assist other affordable housing organizations in developing energy-efficient, low-cost housing. Work with the National Association Home Builders Research Center, National Center for Appropriate Technology and the Southface Energy Institute to develop training programs for builders and local contractors. (ORNL, ANL, Florida Solar Energy Center, HFH, National Congress for Community Economic Development, Global Green USA, Southface Energy Institute) (\$600)</p> <p>HIGHLY REFLECTIVE SURFACES: Developed cost-effective strategies and materials to manage urban heat islands, established partnerships to leverage support from other agencies and industry organizations, and helped private and public sector groups implement the research recommendations. Enlisted additional partners to expand use of highly reflective roofing and pavement materials as an integral</p> | <p>associations of housing and financial industries. Target public housing providers that provide housing to families with incomes less than 80 percent of an area's median income. (ORNL, ANL, Florida Solar Energy Center, HFH, National Congress for Community Economic Development, Global Green USA, Southface Energy Institute) (\$600)</p> <p>HIGHLY REFLECTIVE SURFACES: Implement the recommendations from urban heat island research and promote the benefits of using highly reflective roofing and paving products in cities to achieve energy efficiency, and improve human health and environmental conditions. Expand the program to 15 more target cities for a total of 28 cities by the end of the year. (LBNL, American Forests, ORNL) (\$122)</p> <p>TRANSFER FROM: Codes and Standards:</p> | <p>HIGHLY REFLECTIVE SURFACES: (Program Completed)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>part of sustainable development. (LBNL, American Forests) (\$100)</p> <p>TRANSFER FROM: Codes and Standards:</p> <p>UPDATE STATE CODES: (Formerly Update State Codes, Training, Assistance, Analysis, and Process): Implemented a cooperative, co-funded incentive grants program and a technical assistance program to assist States in updating and implementing their residential and commercial building codes. Developed and implemented programs tailored to meet the needs of specific States and user groups to increase code awareness and support adoption of codes. Provided a variety of materials, including Train-the-Trainer and distance learning activities, that address the need for compliance and enforcement training for architects, engineers, code officials, and home builders. Conducted national conference on updating and implementation of State codes for State and local stakeholders. Trained 500 code officials,</p> | <p>UPDATE STATE AND FEDERAL CODES: (Formerly Update State Codes, Training, Assistance, Analysis, and Process): Provide technical assistance and co-funded incentive grants to assist states in establishing, updating, and expanding their residential and commercial building codes. Monitor and evaluate the progress of local governments relative to building energy efficiency codes. Process State certifications of compliance updating their energy codes with respect to the 1998 IECC and process State requests for deadline extensions. Develop and implement programs tailored to specific States and user groups to increase code awareness and support adoption of codes. Expand training to 10,000 code officials, designers, architects, engineers, builders, and Federal facility managers through regional workshops and distance learning activities that address compliance and enforcement training. The distance learning training activities will increase overall market penetration by 25 percent. Assist five States in updating their</p> | <p>UPDATE STATE AND FEDERAL CODES: (Activities incorporated into COMMUNITY PARTNERSHIPS PROGRAM.)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> | |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--|
| Community Partnership Program (Cont'd) | <p>designers, and builders on the 1995 Model Energy Code (MEC) and upgraded International Energy Conservation Code (IECC). Assisted States in upgrading their codes for new residential and commercial buildings and assisted States in implementing the building upgrade provisions of their code during permitting for renovation and retrofit. Established cooperative funding agreements with consortia of States, utilities, trade and professional associations, and representatives of energy-efficiency industries and energy and environmental advocacy groups to accelerate the availability of code compliance trainers and financial and in-kind resources. Processed State certifications of compliance in updating their energy codes with respect to the 1995 MEC and processed State requests for deadline extensions. Monitored, evaluated, and reported on the progress of local governments relative to building energy efficiency codes, as required by EAct Section 101. (Selected States, PNNL)</p> | <p>residential building code to the 1995 MEC and assist 10 States in updating their residential building code to the 1998 IECC. Assist 10 States in implementing ASHRAE/IESNA Standard 90.1 - 1989R using DOE-developed tools. Assist States in upgrading their codes for new residential and commercial buildings and assist States in implementing the building upgrade provisions of their code during permitting for renovation and retrofit. (Includes \$4,200 for Special Project State Grants) (Selected States, PNNL) (\$7,793)</p> | | |
| | | <p>OUTREACH: Continue to promote and test the Energy Star building performance label in collaboration</p> | | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Community Partnership Program (Cont'd) | <p>(Includes \$4,000 for Special Project State Grants) (\$6,601)</p> <p>OUTREACH: Introduced and promoted the Energy Star building performance label, a benchmark for energy-efficient commercial buildings, in collaboration with the Environmental Protection Agency (EPA). Designed building operations and facility management training curriculums in partnership with the International Facilities Management Association, the Association of Higher Education Facilities Officers, and other organizations. Provided design assistance to new, large-scale commercial construction projects to increase adoption of the Energy Star label. Promoted the use of industry standards and guidelines relating to energy-conserving designs of commercial buildings that are being developed by ASHRAE, ASTM, ISO, and other groups. (International Union of Stationary Engineers, American Public Power Association) (\$1,039)</p> | <p>with EPA to increase demand for energy-efficient buildings in the commercial real estate market. With the Office of Codes and Standards, conduct pilot projects in partnership with States and utilities to test automatic energy code compliance strategies through the awarding of the Energy Star label. Begin 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. (\$1,018)</p> | <p>OUTREACH: (Activities incorporated into COMMUNITY PARTNERSHIPS PROGRAM.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | \$17,332 | \$18,801 | \$35,400 |
| Energy Star Program | TRANSFER FROM: Building Equipment and Materials: | TRANSFER FROM: Building Equipment and Materials: | |
| Energy Star Program (Cont'd) | ENERGY STAR: (See individual paragraphs below, which have been consolidated in FY 2000.) | ENERGY STAR: (See individual paragraphs below, which have been consolidated in FY 2000.) | 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 dryers and commercial boilers and chillers, to the Energy Star product portfolio. 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 |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|------------------------------|----------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Energy Star Program (Cont'd) | | | equipment, as well as energy savings to the owners. 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 |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Energy Star Program (Cont'd) | <p>CONSUMER EDUCATION: Established Energy Star as the common program aegis for regional market transformation efforts and utility marketing and demand-side management programs. Began recruiting high-efficiency appliance and window manufacturers to label Energy Star products at the factory. Developed a protocol with the FTC to allow incorporation of the Energy Star logo on the yellow "Energy Guide" label for qualified appliances. Monitored sales of Energy Star products to measure success of consumer education. (ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance) (\$1,450)</p> | <p>CONSUMER EDUCATION: Add commercial products like chillers and boilers to the Energy Star product portfolio; add gas products like water heating technology to the Energy Star consumer education portfolio. Sign agreements with all major appliance manufacturers to apply voluntary Energy Star labels at the factory. Recruit 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. Add new appliances, such as water heaters and compact fluorescent lamps, to the Energy Star portfolio. Incorporate Energy Star as a voluntary element of the FTC "Energy Guide" label. Monitor</p> | <p>the development and adaptation of DOE/LBNL computer tools (WINDOW 5 and RESFEN) and provide information products and industry-based training tools. (American Public Power Association, ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance) (\$6,000)</p> <p>CONSUMER EDUCATION: (Activities incorporated into Energy Star.)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Energy Star Program (Cont'd) | <p>SUPERWINDOW COLLABORATIVE: Provided support to the new industry-sponsored Efficient Windows Collaborative (EWC), which provides education, training, and technical assistance. Developed and adapted DOE/LBNL computer tools (WINDOW 5 and RESFEN), information products, and industry-based training tools. Evaluated pilot regional projects, revised new tools and information products, and completed the first cycle of regional projects. Began the second cycle of expanding projects to new locations. With the EWC, provided detailed training to manufacturers who produce over 70 percent of all windows with another 20 percent receiving tools and other</p> | <p>sales of Energy Star products to measure success of the program. Initiate a campaign to educate consumers about the benefits of early retirement of inefficient residential appliances. (ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance) (\$1,924)</p> <p>SUPERWINDOW COLLABORATIVE: Provide technical support to the EWC and to industry to develop advanced technologies. Continue developing and adapting DOE/LBNL computer tools (WINDOW 5 and RESFEN), information products, and industry-based training tools. Expand regional projects and technical assistance program to manufacturers. Provide demonstration projects, analysis of results, and technically sound guidelines and design and training tools. Duplicate 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</p> | <p>SUPERWINDOW COLLABORATIVE: (Activities incorporated into ENERGY STAR)</p> |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Energy Star Program (Cont'd) | <p>information products. Expanded technical assistance to manufacturers, particularly small to medium companies, in response to increased demand. Provided outreach to more than half of all window customers. EWC teams are leveraging DOE investments by more than 20 to 1 and are facilitating a major transformation of the industry. As a result, companies selling over 90 percent of all windows are making incremental improvements in more than half of their products. (LBNL, University of Minnesota, FSEC, ASE) (\$1,000)</p> | <p>Belt States. New glazing technologies can reduce the cooling load in Sun Belt homes by 40 to 70 percent. (LBNL, University of Minnesota, FSEC, ASE) (\$800)</p> | |
| | \$2,450 | \$2,724 | \$6,000 |
| Building Technology Assistance Total | \$174,877 | \$187,525 | \$232,400 |

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

MANAGEMENT AND PLANNING

I. Mission Supporting Goals and Objectives

The mission of the 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 building sector goals in the most cost-effective manner possible. Effective management requires efficient organizational design, adequate human resources, sufficient 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 73 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 to implement the Strategic Plan and to realize

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

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 2000 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. Implementation of the recommendations of the President's Committee of Advisors on Science and Technology 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.
3. 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 1998 Enacted | FY 1999 Enacted | FY 2000 Request | \$ Change | % Change |
|--------------------------------------|--------------------|--------------------|--------------------|-----------|----------|
| Management and Planning | | | | | |
| Evaluation and Planning | \$ 5,468 | \$ 5,321 | \$ 7,108 | \$+1,787 | +33.6% |
| Program Direction | 7,350 | 7,850 | 8,210 | +360 | +4.6% |
| Capital Equipment | 0 | 0 | 0 | 0 | 0.0% |
| Total, Management and Planning | \$ 12,818 | \$ 13,171 | \$ 15,318 | \$+2,147 | +16.3% |

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

| Program Activity | FY 1998 Enacted | FY 1999 Enacted | FY 2000 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 | 10,318 | 10,671 | 12,818 | +2,147 | +20.1% |
| Total, Management and Planning | \$ 12,818 | \$ 13,171 | \$ 15,318 | \$+2,147 | +16.3% |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Management and Planning | | | |
| Evaluation, Planning and Analysis | <p>EVALUATION, PLANNING, AND ANALYSIS: (See individual paragraphs below, which have been consolidated in FY 2000.)</p> | <p>EVALUATION, PLANNING, AND ANALYSIS: (See individual paragraphs below, which have been consolidated in FY 2000.)</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. Collaborate with EIA to refine and update buildings energy use data. Conduct topical analyses on research needs and opportunities, international technology development, potential carbon 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 and benefits analysis, and analysis of emerging trends in buildings energy use. Continue the evaluation of all BTS programs. (\$3,008)</p> |
| | <p>TECHNOLOGY AND SECTOR DATA: Developed and upgraded data required for the planning and evaluation of buildings RD&D and</p> | <p>TECHNOLOGY AND SECTOR DATA: Develop, organize, interpret, and disseminate the basic data required to formulate energy</p> | <p>TECHNOLOGY AND SECTOR DATA: (Activities incorporated into Evaluation, Planning, and Analysis.)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Evaluation, Planning and Analysis (Cont'd) | <p>grants programs. Updated and expanded the Core Databook and Core Presentation Catalog to include information on program successes, renewable technologies, energy-efficient technologies, and building sector imports and exports. Upgraded data on the performance of energy-efficient residential buildings and compared their predicted and actual performance. Compiled standardized, current technology characterization information for advanced building technologies and materials. Expanded database on costs and performance of options for improving the efficiency and expanding the use of renewables in residential buildings. Collaborated with the Energy Information Administration (EIA) in end-use data gathering and analysis. (\$788)</p> <p>MODELING AND TOOLS: Cooperated with the EIA and supported incorporation of such advanced technologies as the GAX heat pump, building- integrated photovoltaics, spectrally selective glazings, sulfur lamps, and passive</p> | <p>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. Where necessary, develop data (e.g., measured data on energy use). In other cases, gather data from other sources, interpret, and compile in a useful form. Continue collaboration with EIA in end-use data gathering and analysis. (\$795)</p> <p>MODELING AND TOOLS: Cooperate with the EIA to refine and update buildings energy use data. Support incorporation of data on advanced technologies. Maintain computer software to allow easy access to and manipulation of</p> | <p>MODELING AND TOOLS: (Activities incorporated into Evaluation, Planning, and Analysis.)</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluation, Planning and Analysis (Cont'd) | <p>and active solar heating into the National Energy Modeling System. Continued a standardized market penetration approach for emerging building technologies. (\$290)</p> | <p>buildings characteristics and consumption data. (\$290)</p> | <p>ANALYTICAL STUDIES AND PLANNING SUPPORT: (Activities incorporated into Evaluation, Planning, and Analysis.)</p> |
| | <p>ANALYTICAL STUDIES AND PLANNING SUPPORT: Provided credible estimates of the benefits of BTS activities, as reflected in the evaluations of external reviewers. Compiled BTS' contributions to the EERE Strategic and Multi-Year Plans, Budget Requests, and other planning documents. Improved understanding of risk and its role in program planning. Updated and expanded information on consumer economics. Analyzed and evaluated the BTS program portfolio under a variety of future scenarios to optimize performance, accounting for time frame, risk, environmental impacts, and costs. (\$690)</p> | <p>ANALYTICAL STUDIES AND PLANNING SUPPORT: Conduct topical analyses on research needs and opportunities, international technology development, potential carbon savings and associated costs, impacts of utility deregulation, and other subjects, as appropriate. Activities supported will include portfolio analysis, GPRA evaluation and benefits analysis, analysis of emerging trends in buildings energy use, estimates of potential carbon savings, and implications of utility deregulation. Design and implement an evaluation process for all BTS programs and services to more effectively identify resource allocation improvement opportunities. (\$645)</p> | |
| | <p>SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Provided customer-focused services in the State and local grant</p> | <p>SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Continue to provide customer-focused services in the State and</p> | <p>SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Provide technical assistance to State partners in areas such as utility restructuring, newly developed</p> |

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

| <u>Activity</u> | <u>FY 1998</u> | <u>FY 1999</u> | <u>FY 2000</u> |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluation, Planning and Analysis (Cont'd) | <p>programs. Funds were used to respond to State requests for assistance in implementing consolidated State grants, to conduct regional planning and provide high-quality services to in-state customers, to increase the number of States connected electronically to the program information system, and to help states access energy-related resources of other Federal agencies. Also supported program oversight, provided advisory board support, and responded to Congressionally mandated reporting requirements. (\$3,700)</p> | <p>local grant programs. Respond to State requests for assistance in implementing State grants, conducting regional planning, and providing high-quality services to in-state customers; increase the number of states connected electronically to an upgraded, Windows-based program information system; cooperatively develop performance metrics with States; and help States access energy-related resources of other Federal agencies. Support program oversight, provide advisory board support, and respond to Congressionally mandated reporting requirements. (\$3,591)</p> | <p>energy efficiency technologies, and urban/regional planning for sustainability. Foster strengthened partnerships between EERE end-use sector offices and the States through activities that support the successful implementation of the Special Project State Grants. Prepare report for the end-use sector offices on the accomplishments of Special Project State Grant activities. Implement methodologies for assessing the impacts of the State Energy Program at the State level and nationwide. Support program oversight, provide advisory board support, and respond to Congressionally mandated reporting requirements. (\$4,100)</p> |
| | \$5,468 | \$5,321 | \$7,108 |

| Program Direction | The following is a breakdown of the funding by Object Class: | The following is a breakdown of the funding by Object Class: | The following is a breakdown of the funding by Object Class: | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|----------------------------------|---------|-------------------------------------------|-------|---------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------|----------------------------------|---------|------------------------------------------|-------|---------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------|----------------------------------|---------|-------------------------------------------|-------|---------------------|-------|
| | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">11.9 Personnel compensation</td> <td style="text-align: right;">\$5,415</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,100</td> </tr> <tr> <td>21.0 Travel and transportation of persons</td> <td style="text-align: right;">\$354</td> </tr> <tr> <td>25.2 Other services</td> <td style="text-align: right;">\$481</td> </tr> </table> | 11.9 Personnel compensation | \$5,415 | 12.1 Civilian personnel benefits | \$1,100 | 21.0 Travel and transportation of persons | \$354 | 25.2 Other services | \$481 | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">11.9 Personnel compensation</td> <td style="text-align: right;">\$5,400</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,350</td> </tr> <tr> <td>21.0 Travel and transportation of person</td> <td style="text-align: right;">\$550</td> </tr> <tr> <td>25.2 Other services</td> <td style="text-align: right;">\$550</td> </tr> </table> | 11.9 Personnel compensation | \$5,400 | 12.1 Civilian personnel benefits | \$1,350 | 21.0 Travel and transportation of person | \$550 | 25.2 Other services | \$550 | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">11.9 Personnel compensation</td> <td style="text-align: right;">\$5,975</td> </tr> <tr> <td>12.1 Civilian personnel benefits</td> <td style="text-align: right;">\$1,495</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> | 11.9 Personnel compensation | \$5,975 | 12.1 Civilian personnel benefits | \$1,495 | 21.0 Travel and transportation of persons | \$590 | 25.2 Other services | \$150 |
| 11.9 Personnel compensation | \$5,415 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12.1 Civilian personnel benefits | \$1,100 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21.0 Travel and transportation of persons | \$354 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25.2 Other services | \$481 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11.9 Personnel compensation | \$5,400 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12.1 Civilian personnel benefits | \$1,350 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21.0 Travel and transportation of person | \$550 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25.2 Other services | \$550 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11.9 Personnel compensation | \$5,975 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12.1 Civilian personnel benefits | \$1,495 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21.0 Travel and transportation of persons | \$590 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25.2 Other services | \$150 | | | | | | | | | | | | | | | | | | | | | | | | | | |

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

| Activity | FY 1998 | FY 1999 | FY 2000 |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Direction (Cont'd) | Provided salaries with cost of living increase, benefits, travel, support, and realignment costs for 76 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. The request for other services supported employee training, permanent change-of-station moves, and a contingency. Funding provided staffing requirements to conduct BTS programs. (\$7,350) | Provide salaries with cost of living increase, benefits, travel, support, and realignment costs for 75 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. The request for other services supports employee training, permanent change-of-station moves, and a contingency. Funding will provide staffing requirements to conduct BTS programs. (\$7,850) | Provide salaries with cost of living increase, benefits, travel, and support for 73 FTEs to manage Building Technology, State and Community programs, including responsibilities under the Energy Policy Act of 1992. The FY 2000 Congressional Request for program direction provides for staffing adjustments resulting from Workforce 21 plans. The request for other services supports employee training, permanent change-of-station moves, and a contingency. Funding will provide staffing requirements to conduct BTS programs. (\$8,210) |
| | \$7,350 | \$7,850 | \$8,210 |
| Management and Planning Total | \$12,818 | \$13,171 | \$15,318 |