

Fuel Cell Technologies

Funding Profile by Subprogram^a

| | FY 2003 Comparable Appropriation | FY 2004 comparable Appropriation ^b | FY 2005 Base | FY 2005 Request | FY 2005 Request vs. Base | |
|----------------------------------------------|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|-----------------------------|----------|
| | | | | | \$ Change | % Change |
| Fuel Cell Technologies | | | | | | |
| Transportation Systems . | 6,160 | 7,506 | 7,506 | 7,600 | +94 | +1.3% |
| Distributed Energy Systems..... | 7,268 | 7,408 | 7,408 | 7,500 | +92 | +1.2% |
| Stack Component R&D .. | 14,803 | 25,186 | 25,186 | 30,000 | +4,814 | +19.1% |
| Fuel Processor R&D | 23,489 | 14,815 | 14,815 | 13,858 | -957 | -6.5% |
| Technology Validation.... | 1,788 | 9,877 | 9,877 | 18,000 | +8,123 | +82.2% |
| Technical/Program Management Support..... | 398 | 395 | 395 | 542 | +147 | +37.2% |
| Total, Fuel Cell Technologies | 53,906 | 65,187 | 65,187 | 77,500 | +12,313 | +18.9% |

Public Law Authorizations:

P.L. 93-275, "Federal Energy Administration Act" (1974)
P.L. 93-577, "Federal Non-Nuclear Energy Research and Development Act" (1974)
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-413, "Electric and Hybrid Vehicle Research, Development and Demonstration Act" (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-238, Title III - "Automotive Propulsion Research and Development Act" (1978)
P.L. 96-512, "Methane Transportation Research, Development and Demonstration Act" (1980)
P.L. 100-494, "Alternative Motor Fuels Act" (1988)
P.L. 102-486, "Energy Policy Act" (1992)

Mission

The Fuel Cell Technologies Program is part of the overall integrated Hydrogen, Fuel Cells and Infrastructure Technologies Program (HFCIT) in DOE's Office of Energy Efficiency and Renewable Energy.^c The mission of the integrated HFCIT Program is to research, develop, and validate fuel cell and hydrogen production, delivery, and storage technologies for transportation and stationary

^a SBIR/STTR funding in the amount of \$1,232,984 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are \$1,703,783 and \$1,595,335 respectively.

^b Programs in the Energy Conservation appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

^c The integrated HFCIT program receives funds from Energy Supply (for the Hydrogen Technology Program) and Energy Conservation (for the Fuel Cell Technologies Program) appropriations. This budget description is for the Fuel Cell Technologies portion of the integrated HFCIT Program.

applications. The program aims to have hydrogen from diverse domestic resources used in a clean, safe, reliable, and affordable manner in fuel cell vehicles, central station electric power production and distributed thermal electric and combined heat and power applications.

Benefits

The Fuel Cell Technologies Program is a key component of both the President's Hydrogen Fuel Initiative and the FreedomCAR Partnership, which allow the Nation to aggressively move forward to achieve the vision of a diverse, secure, and emissions-free energy future. To the extent that hydrogen is produced from domestic resources in an environmentally sound manner, the Fuel Cell Technologies Program will provide a significant environmental benefit for the nation. Research undertaken by the Fuel Cell Technologies Program is targeted to reduce the cost of transportation fuel cell systems by a factor of 10 and increase the efficiency while reducing the cost of stationary fuel cell systems. Together, the FreedomCAR Partnership and the Hydrogen Fuel Initiative will facilitate a decision by industry to commercialize hydrogen-powered fuel cell vehicles in the year 2015. Widespread commercialization of hydrogen-powered vehicles will support our national security interests by significantly reducing our reliance on foreign oil.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals, one each for defense, energy, science, and environmental aspects of the mission, plus seven general goals that tie to the strategic goals. The HFCIT program supports the following goals:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The HFCIT program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.01.02.00: Fuel Cell Technologies. The Hydrogen, Fuel Cells and Infrastructure Technologies Program goal is to develop hydrogen production, storage, and delivery technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. As such, the Program will expand and make our clean domestic energy supplies more flexible dramatically reducing or even ending dependence on foreign oil.

Contribution to Program Goal 04.01.02.00 (Fuel Cell Technologies)

The Fuel Cell Technologies Program will contribute to General Goal 4, Energy Security, through its transportation systems/stack components/fuel processor R&D activities by developing transportation fuel cell systems, stack components and fuel processing technology to improve durability and performance and reduce cost to allow rapid commercialization in the light-duty vehicle market. Specifically, transportation fuel cell R&D activities will reduce the production cost of the hydrogen-fueled, 50 kW vehicle fuel cell power system from \$275/kW in 2002 to \$45/kW in 2010 at

production levels of 500,000 units per year (projected cost).

The program also contributes to General Goal 4, Energy Security through its distributed generation fuel cells/stack components/fuel processor R&D activities by increasing the electrical efficiency and reducing the cost of stationary fuel cell systems operating on natural gas or propane and through its technology validation activities by validating fuel cell performance and durability in real world conditions.

Annual Performance Results and Targets

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|------------------------------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Goal 04.01.02.00 (Fuel Cell Technology) | | | | | |
| Fuel Cell Technologies/Transportation Systems, Fuel Processor R&D, and Stack Component R&D | | | | | |
| There were no related targets | There were no related targets | \$275/kW for a hydrogen-fueled 50kW fuel cell power system. | Achieved \$225/kW for a hydrogen-fueled 50kW fuel cell power system. | Achieve \$200/kW for a hydrogen-fueled 50 kW fuel cell power system. | DOE-sponsored research will reduce technology cost to \$125/kW for a hydrogen-fueled 50kW fuel cell power system. |
| Fuel Cell Technologies/Distributed Energy Systems, Fuel Processor R&D, and Stack Component R&D | | | | | |
| There were no related targets | There were no related targets | 35% efficiency at full power for natural gas or propane fueled 50kW stationary fuel cell system. | Achieved 30 percent efficiency at full power for a natural gas or propane fueled 50-250kW stationary fuel cell system. | Achieve 31 percent efficiency at full power for a natural gas or propane fueled 50-250kW stationary fuel cell system. | Achieve 32 percent efficiency at full power for a natural gas or propane fueled 50-250kW stationary fuel cell system. |
| Fuel Cell Technologies/Technology Validation | | | | | |
| No activity | No activity | No activity | Plan technology validation activity. | Industry contracts are awarded and initial vehicles delivered that support the 1,000 hour durability target. | Fuel Cell demonstration vehicles achieve 1,000 hours durability. |
| Management of Funds | | | | Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. | Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met. |

Means and Strategies

The Fuel Cell Technologies Program will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

The Fuel Cell Technologies Program will implement the program through the following means:

- Conduct research, development, and technology validation activities that address stationary, transportation, APU, and portable power applications and include fuel cell stack components, fuel processors, and balance-of-plant components.
- For transportation applications, focus R&D on critical requirements to support an industry decision in 2015 to enter into full scale commercialization, primarily focusing on lowering the high-volume system cost of fuel cells to \$30/kW. Other significant criteria for transportation fuel cell commercialization include the need to have fuel cell technologies developed and validated that enable: (1) full performance over 5,000 hours of life; (2) 60 percent efficiency (hydrogen-fueled) at 1/4 rated power; and (3) operation in vehicles with comparable performance, safety, and reliability to the gasoline internal combustion engine.
- For stationary applications, focus R&D on critical requirements to support the industry decision to enter into commercialization as the fuel cell system cost falls below \$1,500/kW over the next few years; with large markets being attained in the 2010 time frame when the fuel cell system costs are reduced to \$400-800/kW (dependent on application) with 40,000 hours durability and 40 percent electrical efficiency operating on natural gas or propane.
- For distributed energy applications, work towards removing technical barriers to facilitate the near-term introduction of fuel cells in a variety of applications that include energy generation for buildings, uninterruptible power systems, and portable power devices such as consumer electronics.
- Demonstration and validation activities support the introduction of pre-commercial fuel cell vehicles and stationary systems to controlled user-groups such as utilities or military installations. These demonstrations validate technology performance in staged increments while providing the experience needed by both manufacturers and end-users to allow the eventual successful introduction of commercial products.
- Invest in technical program and market analyses and performance assessments in order to direct effective strategic planning.

The Fuel Cell Technologies Program will implement the program through the following strategies:

- Utilize the Multi-year Research, Development and Demonstration Plan, developed by the HFCIT Program. The Plan identifies barriers, technical targets, and schedule for carrying out the program mission. Focus on addressing the high risk, critical technology barriers as described in the Plan.
- Utilize the National Hydrogen Energy Roadmap, released in November 2002 by Energy Secretary Abraham. This document, developed by over 200 technical experts from public and private organizations, lays out research and development pathways, and serves as a guide to public and private investment in hydrogen and fuel cell technologies.
- Coordinate with the FreedomCAR Partnership, which was announced by the Secretary of Energy and senior executives of DaimlerChrysler, Ford, and General Motors in January 2002, and is a key

component of the President's FreedomCAR and Hydrogen Fuel Initiative.

- Coordinate with other DOE programs and with other Federal agencies involved in hydrogen and fuel cell-related research and development. (See list of collaborative activities below)
- Align the program to the goals of the Hydrogen Fuel Initiative. For mobile applications of fuel cells, program strategies are aligned with the FreedomCAR Partnership goals (see FreedomCAR Partnership goals below). The Hydrogen Fuel Initiative, along with the FreedomCAR Partnership, aims to facilitate an industry decision to commercialize hydrogen-powered fuel cell vehicles by the year 2015.
- Perform formal merit reviews, closely coordinated with those supported within the Hydrogen Technology program (under the Energy Supply appropriations), to evaluate projects which develop and demonstrate highly efficient, integrated hydrogen-powered fuel cell systems for stationary and transportation applications. The Merit Review evaluation incorporates the principles of the Administration's R&D investment criteria.
- Conduct cross-cutting analyses and focus on life cycle cost, emissions, and efficiency of transportation and stationary fuel cell systems in the near (2015), mid (2030), and long term (post 2050).

These means and strategies will result in improving energy security by increasing the generation of reliable, affordable, and environmentally sound hydrogen, adding to the diversity and security of the Nation's energy supply --- thus putting the taxpayers' dollars to more productive use.

The following external factors could affect the Fuel Cell Technologies Program's ability to achieve its strategic goal:

- The sustainability of program funding over the long-term which is required for development of these technologies.
- Once a commercialization decision is made by industry in 2015, the price and availability of alternative technologies (such as gasoline hybrid vehicles) and conventional fuels that will compete with hydrogen-fueled vehicles will affect the market outcomes.
- Decisions on the nature and timing of supporting policy instruments to help stimulate end-use markets.
- Public acceptance and concerns regarding the safe use of hydrogen.

In carrying out the program's mission, the Fuel Cell Technologies Program performs the following collaborative activities:

- Collaborating with other DOE offices and Federal agencies, including closely coordinating vehicle related activities with the DOE's FreedomCAR and Vehicles Technologies Program.
- For activities that support transportation applications, cooperating with the U.S. Council for Automotive Research (USCAR) and energy companies. This collaboration, implemented through technical teams, provides a mechanism for developing requirements, industry consensus, and recommendations for program direction. These technical teams are composed of government and industry experts that meet on a periodic basis to review and provide guidance on projects.
- Coordinating on utility-scale fuel cell development, which is the responsibility of the DOE's Office of Fossil Energy (FE), as well as collaborating with the EERE Distributed Energy Program, the EERE Buildings Technologies Program, and the Office of Fossil Energy's Solid State Energy Conversion Alliance (SECA) research effort.

- Developing and publishing a comprehensive planning document, in collaboration with the Department's Offices of Science, Fossil Energy, and Nuclear Energy, Science and Technology (and with input by DOT).

Hydrogen Fuel Initiative (HFI)

| | (dollars in thousands) |
|---------------------------------------|------------------------|
| | FY 2005 Budget Request |
| Hydrogen Fuel initiative | |
| EERE | 172,825 |
| FE | 16,000 |
| NE | 9,000 |
| SC | 29,183 |
| Total, DOE | 227,008 |
| DOT | 832 |
| Total, Hydrogen Fuel Initiative | 227,840 |

- Conducting R&D and demonstration activities through competitive, cost-shared cooperative agreements with industry, as well as collaborating with national laboratories and universities.
- Through the Department's newly formed partnership with the energy industry, expand upon FreedomCAR's 2010 technology specific goals initially formed with the U.S. automotive industry partners. These additional technology goals will more specifically address hydrogen technology barriers.

FreedomCAR Partnership Goals

The Office of FreedomCAR and Vehicle Technologies has responsibility for these goals:

- Electric Propulsion Systems with a 15-year life capable of delivering at least 55 kW for 18 seconds and 30 kW continuous at a system cost of \$12/kW peak.
- Internal Combustion Engine Powertrain Systems costing \$30/kW, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards.
- Electric Drivetrain Energy Storage with 15-year life at 300 Wh with discharge power of 25 kW for 18 seconds and \$20/kW.
- Material and Manufacturing Technologies for high volume production vehicles which enable/support the simultaneous attainment of: 50 percent reduction in the weight of vehicle structure and subsystems, affordability, and increased use of recyclable/renewable materials.
- Internal Combustion Engine Powertrain Systems operating on hydrogen with cost target of \$45/kW by 2010 and \$30/kW in 2015, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards. *(Shared responsibility with HFCIT)*

The Office of Hydrogen, Fuel Cells, and Infrastructure Technologies has responsibility for these goals:

- 60 percent peak energy-efficient, durable direct hydrogen Fuel Cell Power Systems (including hydrogen storage) that achieves a 325 W/kg power density and 220 W/L operating on hydrogen. Cost targets are \$45/kW by 2010 and \$30/kW by 2015.
- Fuel Cell Systems (including an on-board fuel processor) having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards with a cost target of \$45/kW by 2010 and \$30/kW by 2015.
- Hydrogen Refueling Systems demonstrated with developed commercial codes and standards and diverse renewable and non-renewable energy sources. Targets: 70 percent energy efficiency well-to-pump; cost of energy from hydrogen equivalent to gasoline at market price, assumed to be \$1.50 per gallon (2001 dollars).
- Hydrogen Storage Systems demonstrating an available capacity of 6 weight percent hydrogen, specific energy of 2.0 kWh/kg and energy density of 1.5 kWh/l at a cost of \$4/kWh.
- Internal Combustion Engine Powertrain Systems operating on hydrogen with cost target of \$45/kW by 2010 and \$30/kW in 2015, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards. (*Shared responsibility with HFCIT*)

Validation and Verification

To validate and verify program performance, the Fuel Cell Technologies Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. Specific milestones, go/no-go decision points, and technical progress are systematically reviewed through the HFCIT program's merit review process. The table below summarizes validation and verification activities:

Data Sources: Merit Review and Peer Evaluation of R&D and Program Peer Reviews are conducted.

Baselines: The following are the key baselines used in Fuel Cell Technology program:

- transportation systems/ stack component/ fuel processor R&D (2002): \$275/kW cost
- distributed energy systems/ stack component/ fuel processor R&D (2002): 29% electrical efficiency.^{a, b}
- technology validation (2003, laboratory): 1,000 hours durability of fuel cell vehicle systems.

^a Efficiency target met for 2002 based on PEM fuel cell systems with combined heat and power (efficiency defined as total energy realized by the fuel cell system, electrical and thermal, divided by the lower heating value of the input fuel). In FY 2003, the efficiency target was redefined to be based on the electrical efficiency, defined as the ratio of dc output energy to the lower heating value of the input fuel.

^b The change of the stationary fuel cell systems power level from 50kW to a range of 50-250kW reflects an update of technical targets (HFCIT multi-year program plan, draft) to encompass a range of stationary power systems as a better representation of industry plans to develop power plants of various power ratings.

| | |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frequency: | GPRA Benefits are estimated annually, Merit Review and Peer Evaluation of R&D projects are conducted annually, and Program Peer Review is conducted biennially. |
| Data Storage: | EE Strategic Management System. |
| Verification: | <p>Evaluation -- Merit reviews and peer evaluations by energy, hydrogen, and fuel cell experts from outside of the U.S. Department of Energy are used to ensure that the directions and priorities of the program are focused on appropriate long term research. The program conducts peer review meetings and supports the development of industry-driven technology roadmaps.^a These efforts are used to focus the program's investments on activities that are within the Federal Government's role and that address top priority needs.</p> <p>The National Laboratories receive direct funds for hydrogen and fuel cell technology research and development of a very high risk and basic nature, based on their capabilities and performance. Hydrogen and fuel cell industry experts review each laboratory and industry project at the annual Merit Review and Peer Evaluation meeting. Projects are evaluated based on the following criteria: 1) Relevance to overall DOE objectives and the degree the project supports the President's Hydrogen Fuel Initiative; 2) Approach to performing the research and development; 3) Technical Accomplishments and Progress toward project and DOE goals; 4) Technology Transfer/Collaborations with Industry/Universities/Laboratories; and 5) Approach and relevance of proposed future research. Principles of the Administration R&D investment criteria for research have been incorporated into this evaluation. The review panel also evaluates the strengths and weaknesses of each project, and recommends additions to or deletions from the scope of work. The program organization facilitates supplier-customer relationships to ensure that R&D results from federally sponsored laboratories are transferred to industry suppliers and that industry supplier developments are made available to automakers, energy industry and stationary power producers.</p> |

^a See the following reports. Fuel Cell Report to Congress, Feb. 2003. A National Vision of America's Transition to a Hydrogen Economy, March 2002. National Hydrogen Energy Roadmap, November 2002. FreedomCAR Fuel Cell Technical Roadmap, HFCITP Multi-Year Research, Development and Demonstration Plan (Draft).

Funding by General and Program Goal

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------------------------------|---------|---------|---------|-----------|----------|
| General Goal 4, Energy Security | | | | | |
| Program Goal 04.01.02.00, Fuel Cell Technologies | | | | | |
| Transportation Systems | 6,160 | 7,506 | 7,600 | +94 | +1.3% |
| Distributed Energy Systems..... | 7,268 | 7,408 | 7,500 | +92 | +1.2% |
| Stack Component R&D | 14,803 | 25,186 | 30,000 | +4,814 | +19.1% |
| Fuel Processor R&D | 23,489 | 14,815 | 13,858 | -957 | -6.5% |
| Technology Validation..... | 1,788 | 9,877 | 18,000 | +8,123 | +82.2% |
| Technical/Program Management.... | 398 | 395 | 542 | +147 | +37.2% |
| Total, Program Goal 04.01.02.00, Fuel Cell Technologies | 53,906 | 65,187 | 77,500 | +12,313 | +18.9% |
| Total, General Goal 4 (Fuel Cell Technologies) | 53,906 | 65,187 | 77,500 | +12,313 | +18.9% |

Expected Program Outcomes

The Fuel Cell Technologies Program pursues its mission through integrated activities designed to improve the energy efficiency, flexibility, and productivity of our energy economy. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the Fuel Cell Technologies Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates for energy savings, energy expenditure savings carbon emission reductions, oil savings, and natural gas savings that result from the realization of the integrated Hydrogen, Fuel Cells and Infrastructure Technologies Program goals are shown in the tables below through 2050, reflecting the increasing availability of commercial fuel cells and hydrogen sources. When hydrogen-powered fuel cell vehicles are introduced in substantial numbers and fuel cells reach the mass consumer market for electronics and other stationary applications, the oil savings and other benefits to the Nation are expected to be significant. Achievement of the program goals could result in mid-term oil savings of 0.4 million barrels per day (MBPD) in 2025 (based on the GPRA05-NEMS model) and in the long term ramp up to savings of 6 MBPD in 2050 (based on preliminary estimates using the GPRA05-MARKAL model).

The full long-term potential for renewable-based hydrogen is not reflected in this FY05 benefits analysis. Further improvements in the analysis for renewable-based hydrogen technology are underway. In addition, these estimates do not include an assessment of the role of policy measures in facilitating the development of the infrastructure necessary to provide hydrogen at refueling stations nationwide, or in

stimulating consumer demand for hydrogen fuel cell vehicles.

FY 2005 GPRA Benefits Estimates for Hydrogen, Fuel Cells and Infrastructure Technologies Program^a

Mid-term benefits^b

| | 2010 | 2015 | 2020 | 2025 |
|----------------------------------------------------|------|------|-------|-------|
| Primary Non-Renewable Energy Savings (Quads) | ns | 0.1 | 0.1 | 0.5 |
| Energy Expenditure Savings (Billion 2000\$) | ns | 0.3 | 1 | 5 |
| Carbon Emission Réductions (MMT)..... | ns | 1 | 4 | 12 |
| Oil Savings (MBPD)..... | ns | ns | 0.1 | 0.4 |
| Natural Gas Savings (Quads) ^c | ns | ns | -0.13 | -0.42 |

Long-term benefits^d

| | 2030 | 2040 | 2050 |
|----------------------------------------------------|-------|-------|------|
| Primary Non-Renewable Energy Savings (Quads) | 2.8 | 6.4 | 9.2 |
| Energy System Cost Savings (Billion 2000\$) | 16 | 51 | 79 |
| Carbon Emission Reductions (MMT)..... | 54 | 105 | 138 |
| Oil Savings (MBPD)..... | 2.0 | 4.3 | 6.2 |
| Natural Gas Savings (Quads)..... | -0.56 | -0.09 | 0.40 |

^a Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

^b Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

^c Although these results show a small negative impact on natural gas demand in the short and mid-term, an analysis by the Office of Energy Efficiency and Renewable Energy (EERE) of its entire research and deployment portfolio indicates that by 2020 the industrial, buildings, and other portions of this EERE portfolio will be freeing up significant natural gas demand to more than offset the estimated small impacts on natural gas of the HFCIT program during the early phases of the transition to a hydrogen economy. In the long term, the program is targeting more renewable-based hydrogen.

^d Long-term benefits were estimated utilizing the GPRA05 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Transportation Systems

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|------------------------------------|---------|---------|---------|-----------|----------|
| Transportation Systems | | | | | |
| Transportation Systems | 6,160 | 7,506 | 7,600 | +94 | +1.3% |
| Total, Transportation Systems..... | 6,160 | 7,506 | 7,600 | +94 | +1.3% |

Description

Transportation Systems conducts R&D and analysis activities that address key barriers to fuel cell systems for transportation applications. Key systems level barriers include attainment of extremely low cost and high durability technical targets. Because of the strong level of industry development of complete systems, this activity does not develop complete, integrated systems. The activity supports the development of individual component technology critical to systems integration as well as systems level modeling activities that serve to guide R&D and integration activities, benchmark systems progress, and explore alternate systems configurations on a cost-effective basis. Other activities of Transportation Systems include studies that appraise the status of critical performance measures (such as cost) and assess important materials issues such as catalyst usage. Transportation Systems also supports the development of vehicle Auxiliary Power Units (APU's) for automotive or heavy vehicle applications and the demonstration of the feasibility of fuel cells for portable power applications. Systems components developed under Transportation Systems include compressor/expanders, sensors, actuators, heat exchangers and water management devices. The Transportation Systems activity will include competitively selected R&D projects that include significant industry cost share.

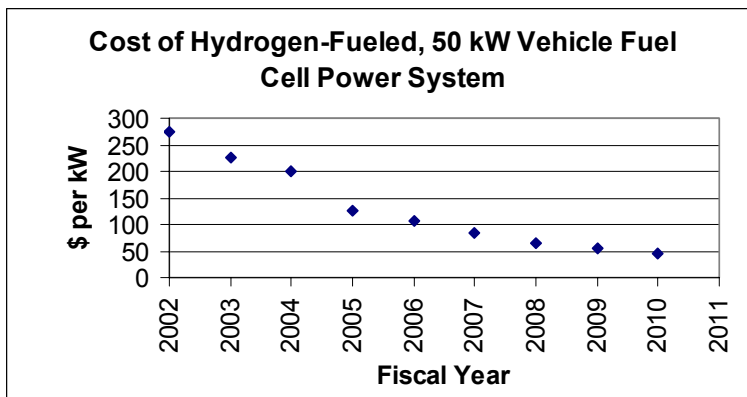
Benefits

Transportation Systems R&D supports the HFCIT Program's mission by improving performance and durability, while lowering the cost of vehicle-specific components, materials, and operating strategies that enable the widespread use of fuel cells in transportation. The improvements will help to accelerate commercialization of fuel cells by making them competitive with conventional technologies so that the potential benefits of energy security and environmental quality can then be realized.

Research activities^a will reduce the cost of the hydrogen-fueled, 50 kW vehicle fuel cell power systems as indicated below.^b

^a Activities include research in transportation systems, stack component R&D and Fuel Processor R&D.

^b Cost of 50kW vehicle fuel cell power systems estimated for production rate of 500,000 units yearly and includes fuel cell stack, balance of plant, and hydrogen storage.



Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|-------------------------------------|--------------|--------------|--------------|
| Transportation Systems | 6,160 | 7,506 | 7,600 |
|-------------------------------------|--------------|--------------|--------------|

In FY 2005, annual performance improvements will be measured and shown to meet year 2005 performance targets of 500 W/L system power density, 500 W/kg system specific power, 60 percent efficiency (direct hydrogen fuel cell system) at 25 percent power, and more than 2,000 hours durability in a direct hydrogen fuel cell system (excluding hydrogen storage). Evaluate system cost and trade-off analyses to include the scenarios for an ambient pressure system and for high temperature operation (120EC). Complete test and evaluation of fuel cell system sensors (CO, H₂, NH₃, H₂S, temperature, pressure, relative humidity, etc.) in full-scale systems. Test and evaluate compact humidifiers/heat exchangers in full scale systems. Evaluate prototype fuel cell systems for auxiliary power in trucks to support the 21st Century Truck initiative. Continue R&D projects to demonstrate feasibility of fuel cells for portable power applications in terms of performance, cost, and durability. Conduct testing and evaluation of a turbocompressor which meets established pressure-ratio turndown requirements in a full-scale fuel cell system, and competing air management technologies. *Participants include: Mechanology, UTC Fuel Cells, TIAX, Honeywell, SAE, NREL, LLNL, PNNL, ANL, LANL.*

| | | | |
|--------------------------------------------|--------------|--------------|--------------|
| Total, Transportation Systems | 6,160 | 7,506 | 7,600 |
|--------------------------------------------|--------------|--------------|--------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Transportation Systems

| | |
|---------------------------------------------------------------------------------------|-----|
| Increase supports research in Auxiliary Power Units for heavy vehicle applications... | +94 |
|---------------------------------------------------------------------------------------|-----|

| | |
|-----------------------------------------------------------|------------|
| Total Funding Change, Transportation Systems | +94 |
|-----------------------------------------------------------|------------|

Distributed Energy Systems

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------|---------|---------|---------|-----------|----------|
| Distributed Energy Systems | | | | | |
| Distributed Energy Systems | 7,268 | 7,408 | 7,500 | +92 | +1.2% |
| Total, Distributed Energy Systems | 7,268 | 7,408 | 7,500 | +92 | +1.2% |

Description

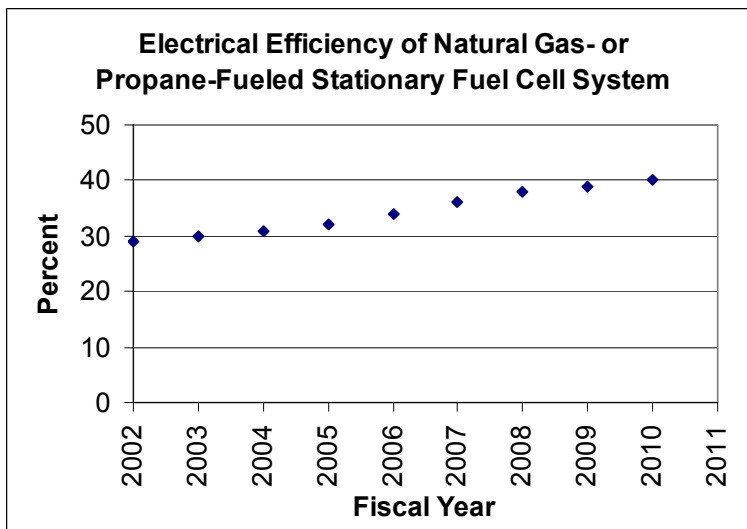
This subprogram activity develops high-efficiency Polymer Electrolyte Membrane (PEM) fuel cell power systems as an alternative power source to grid-based electricity for buildings and other stationary applications. The Distributed Energy Systems activity focuses on overcoming the barriers to stationary fuel cell systems, including cost, durability, heat utilization, start-up time, and managing power transients and load-following requirements. Improved heat usage and recovery are addressed for combined heat and power generation to maximize overall efficiency of (thermal and electrical) systems. This activity also will take advantage of the synergy between transportation systems and distributed energy systems, particularly in the areas of developing improved materials for high temperature membranes, improving fuel cell component durability, and water thermal management. The Distributed Energy Systems activity will include competitively selected R&D projects that include significant industry cost share.

Benefits

Distributed Energy Systems R&D supports the HFCIT Program's mission by focusing on overcoming barriers to stationary fuel cell systems, including improving durability and performance, while lowering cost, to enable the widespread use of fuel cells in distributed energy applications. The improvements will help to accelerate commercialization of fuel cells by achieving an ultimate durability requirement of 40,000 hours, making fuel cells competitive with conventional technologies.

Research activities will improve the electrical efficiency of natural gas or propane fueled stationary fuel cell systems. Specifically, stationary fuel cell R&D activities will increase the electrical efficiency of natural gas or propane fueled 50-250kW stationary fuel cell systems from 29 percent in 2002 to 40 percent in 2010^a as indicated in the performance indicator graph below.

^a The change of the stationary fuel cell systems power level from 50kW to a range of 50-250kW reflects an update of technical targets (HFCIT multi-year program plan, draft) to encompass a range of stationary power systems as a better representation of industry plans to develop power plants of various power ratings.



Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|-----------------------------------------|--------------|--------------|--------------|
| Distributed Energy Systems | 7,268 | 7,408 | 7,500 |
|-----------------------------------------|--------------|--------------|--------------|

In FY 2005, conduct development of market-driven integrated stationary fuel cell systems (including fuel cell stack, air and thermal management system, and power grid interface) to make progress toward achieving 2010 efficiency, cost, and durability targets. Perform research and development of materials for high temperature membranes and continue to improve Polymer Electrolyte Membrane (PEM) fuel cell stack durability to ultimately achieve the 40,000 hour durability target by 2010.^a Develop critical balance of plant components for stationary fuel cells. Conduct stationary fuel cell demonstrations to show potential energy saved, emissions reduced, and economic potential. Continue research and development of water and thermal management systems for stationary fuel cells and combined heat and power applications. Perform economic analysis of stationary fuel cell market. In FY 2003, this activity was reduced by \$182,984 for SBIR/STTR and these funds transferred to the Science Appropriation. *Participants include: ANL, IdaTech, UTC Fuel Cells, Plug Power, and Battelle.*

| | | | |
|------------------------------------------------|--------------|--------------|--------------|
| Total, Distributed Energy Systems | 7,268 | 7,408 | 7,500 |
|------------------------------------------------|--------------|--------------|--------------|

^a 2003 status for stationary fuel cell systems is 6,000 hours durability.

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Distributed Energy Systems

Increase supports development of high efficiency Polymer Electrolyte Membrane Fuel Cell Power Systems as an alternative to grid-based electricity for buildings.

+92

Total Funding Change, Distributed Energy Systems

+92

Stack Component R&D

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|----------------------------------|---------|---------|---------|-----------|----------|
| Stack Component R&D | | | | | |
| Stack Component R&D | 14,803 | 25,186 | 30,000 | +4,814 | +19.1% |
| Total, Stack Component R&D | 14,803 | 25,186 | 30,000 | +4,814 | +19.1% |

Description

Collaborative research and development efforts with industry, National Laboratories and academia focus on the most critical technical hurdles for Polymer Electrolyte Membrane (PEM) fuel cell stack components for both stationary and transportation applications. Critical technical hurdles include cost, durability, efficiency and overall performance of components such as the polymer electrolyte membranes, oxygen reduction electrodes, advanced catalysts, bipolar plates, etc. The success of these research and development efforts will assist the industry in making their decision regarding commercialization of fuel cells. In previous years, the program supported efforts to integrate fuel cell systems and develop full-scale fuel cell stacks; however, a programmatic shift came about because industry now has the capability to carry out systems integration efforts on their own. Technical targets established at the component level support the FreedomCAR Partnership technical targets for transportation fuel cells and industrial targets for stationary fuel cells. Component research and development activities for these two applications are synergistic. Transportation fuel cell components depend on the early market success of stationary fuel cells to establish the component manufacturing facilities, while stationary fuel cells benefit from the investment of the automotive manufacturers, which are motivated by large transportation markets.

Benefits

Stack Components R&D supports the HFCIT Program's mission by focusing on overcoming critical technical hurdles at the *component level* to improve overall fuel cell performance and durability, while lowering cost. Addressing these hurdles at the component level supports the industrial effort to integrate the fuel cell system and develop full-scale fuel cell stacks. The research that brings down the inherent cost to produce and operate fuel cells while maintaining performance and durability characteristics comparable to or better than conventional technology will ultimately help get fuel cells into the marketplace so that national energy and environmental benefits can be realized.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|--------------------------------------|---------------|---------------|---------------|
| Stack Component R&D | 14,803 | 25,186 | 30,000 |
|--------------------------------------|---------------|---------------|---------------|

In FY 2005, demonstrate 120°C membrane with areal resistance of < 0.1 ohm-cm² in membrane electrode assembly (MEA)/single cell to allow high operating voltage of the fuel cell, maximizing system efficiency. Increase efforts to synthesize and characterize polymers and proton-conducting membranes which operate at a temperature of 120°C for transportation applications and ≥150°C for stationary applications. Develop increased understanding of proton conduction and membrane degradation in high-temperature polymer membrane systems. Fabricate membranes with non-aqueous proton-conducting phases for stationary fuel cell membranes for operation at T>120°C. Investigate membranes capable of functioning at low hydration levels, preventing membrane dry-out under high temperature operation and simplifying the overall system by reducing or eliminating water management issues.

Verify reproducibility, both the physical properties and the performance, of full-size MEAs in high-volume manufacturing processes. Develop improved understanding of the nature of local structure in catalyst layer. Design, synthesize, and evaluate alternative catalyst formulations and structures (to reduce or eliminate precious metal loading) for both CO tolerance and oxygen reduction. Investigate new catalyst systems (such as those with Iron-Nickel-Carbon, Tungsten Carbide, or hydrogenase enzyme catalytic sites) which demonstrate the potential to perform at least as well and cost at least 50% less than those which contain conventional precious metal catalysts. Investigate biomimetic complexes as an alternative to Platinum, and implement advances in quantum chemistry, combinatorial synthesis and in situ characterization to identify promising non-Platinum catalyst systems. Demonstrate catalyst durability of >2000 hours (2005 target for fuel cell stack systems). Investigate and develop alternative bipolar plate materials/coatings that are low-cost, lightweight, corrosion-resistant, and impermeable. Demonstrate low-cost, high performance components to meet FreedomCAR Partnership fuel cell stack system 2005 target of \$100/kW and durability target of >2,000 hours while increasing power density. Develop an advanced cost-driven membrane technology that is not fully fluorinated, tolerates a strong oxidizing environment, and operates at conventional temperature and operating conditions. Develop cell component durability diagnostics and accelerated tests to establish and improve MEA stability, and to establish the role of changes to the hydrophilic and hydrophobic nature of components in cell durability. Develop platinum recycling technology applicable to MEA's. Support the Los Alamos Fuel Cell National Resource Center to address technology barriers through R&D and the requisite facilities and instrumentation improvements. *Participants include: UTC Fuel Cells, 3M, DeNora, Superior Micropowders, Englehard, Atofina Chemicals, DuPont, Plug Power, Ion Power, Ballard, U. of South Carolina, LANL, ANL, LBNL, ORNL, BNL.*

| | | | |
|---------------------------------------------|---------------|---------------|---------------|
| Total, Stack Component R&D | 14,803 | 25,186 | 30,000 |
|---------------------------------------------|---------------|---------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Stack Component R&D

Increase supports development of advanced membrane technology to increase performance at high temperature, reduce humidification requirements, improve durability and tolerance to feed gas impurities and lower cost for both stationary and transportation applications. Develop increased understanding of proton conduction and membrane degradation in high-temperature polymer membrane systems. Develop program for cost reduction of catalyst-coated membranes using nonprecious metal catalysts and ultra-low platinum built upon non-oxidizing substrates.....

+4,814

Total Funding Change, Stack Component R&D

+4,814

Fuel Processor R&D

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------|---------|---------|---------|-----------|----------|
| Fuel Processor R&D | | | | | |
| Fuel Processor R&D | 23,489 | 14,815 | 13,858 | -957 | -6.5% |
| Total, Fuel Processor R&D | 23,489 | 14,815 | 13,858 | -957 | -6.5% |

Description

The program is pursuing the development of fuel processors for transportation, stationary, APU, and portable power applications. Fuel processing technology is fuel flexible and capable of reforming fuels such as gasoline, methanol, ethanol, natural gas and propane into hydrogen. Distributed generation fuel cells could be fueled by natural gas, propane, or renewable fuels while auxiliary power units in trucks will likely be fueled by diesel or propane.

Benefits

Fuel Processor R&D supports the HFCIT Program's mission by developing the subsystem that aids the widespread use of fuel cell power technology by making the fuel source flexible. Because an extensive hydrogen fueling infrastructure does not currently exist, fuel cells could operate on more conventional fuels such as gasoline, natural gas, and diesel and reap some of the environmental and efficiency advantages until hydrogen becomes more readily available. Even in a future hydrogen economy, the option of using a diversity of fuels to produce energy will be a significant contributor to energy independence.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Fuel Processor R&D 23,489 14,815 13,858

In FY 2005, increase the emphasis on developing compact, efficient fuel processing technology for natural gas, propane or renewably fueled stationary fuel cells. Develop diesel or propane fuel processing technology for Auxiliary Power Unit (APU) applications. Redirect on-board fuel processing activities based on the results of the FY 2004 go/no-go evaluation and, if applicable, focus transportation on-board fuel processing efforts on systems that meet 2005 technical targets of 78 percent efficiency, 700 W/L, 700 W/kg, less than 1 minute start-up, and less than Tier 2 Bin 5 emissions. For all applications, develop advanced water-gas shift catalysts and reactor design that

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

meet requirements for space velocity. Develop fuel processor catalysts (reforming, preferential oxidation, desulfurization, etc.) having higher activities, greater durability, lower cost, and that enable lower reactor operating temperatures. Develop efficient, compact heat exchangers for fuel processor systems. Verify and improve fuel processor model and system analysis. Use data collected from the Technology Validation projects to feed back into technology development. In FY 2003, this activity was reduced by \$1,050,000 for SBIR/STTR and these funds were transferred to the Science Appropriation. *Participants include: Nuvera, University of Michigan, Catalytica, Texaco Energy Systems, ANL, LANL, and PNNL.*

| | | | |
|-------------------------------------------|---------------|---------------|---------------|
| Total, Fuel Processor R&D..... | 23,489 | 14,815 | 13,858 |
|-------------------------------------------|---------------|---------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Fuel Processor R&D

The net reduction reflects the decrease in mortgages for on-board fuel processing R&D and an increase in stationary reforming, auxiliary power reforming and fundamental fuel processing R&D based on the recommendations of the on-board fuel processing go/no-go decision

-957

| | |
|----------------------------------------------------------|-------------|
| Total Funding Change, Fuel Processor R&D..... | -957 |
|----------------------------------------------------------|-------------|

Technology Validation

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|------------------------------------|---------|---------|---------|-----------|----------|
| Technology Validation | | | | | |
| Technology Validation..... | 1,788 | 9,877 | 18,000 | +8,123 | +82.2% |
| Total, Technology Validation | 1,788 | 9,877 | 18,000 | +8,123 | +82.2% |

Description

The Technology Validation activity of the Fuel Cell program will be implemented in close coordination with the Hydrogen Infrastructure Validation activity (funded through the Energy Supply appropriation). These two activities together make up the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project. This project is a 50/50 cost shared effort between the government and industry and will include automobile manufacturers, energy companies, suppliers, universities, and State governments. The validation effort will be an important opportunity to validate component R&D in a systems context under real-world operating conditions, and for industry to gain experience in the safety, maintenance and fueling of hydrogen fueled vehicles. By operating these vehicles in a controlled manner, all participating parties will be able to quantify the performance and durability, document any problem areas, and provide valuable information to researchers to help refine and direct future R&D activities related to fuel cell vehicles.

Benefits

In order for the automotive, utility, and fuel industries to make commercialization decisions by 2015, integrated vehicle and infrastructure systems need to be validated and individual component targets need to be met under real-world operating conditions. This activity supports HFCIT's mission by providing critical statistical data that fuel cell vehicles can meet efficiency and durability targets, storage systems can efficiently meet 300+ mile range requirements and fuel costs are less than for existing gasoline vehicles. Technology Validation also provides information so that standards can be written and vehicle and infrastructure safety can be demonstrated.

Research activities will improve the durability of fuel cell vehicle systems operated under real-world conditions. Specifically, the program validates the performance and vehicle interfaces of hydrogen fuel cell vehicles to demonstrate an increase in durability from approximately 1,000 hours in 2003 (laboratory) to 2,000 hours by 2008 in a vehicle fleet (2000 hours is equal to approximately 50,000 vehicle miles).

| | 2004 | 2005 | 2006 | 2007 | 2008 |
|------------------|----------|-------------|------|------|-------------|
| Durability | Initiate | 1,000 hours | | | 2,000 hours |

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Technology Validation **1,788** **9,877** **18,000**

In FY 2005, continue the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project to collect data on first generation vehicles. The validation project is collecting data to validate performance, reliability, durability, maintenance requirements, environmental benefits and to develop a better understanding of vehicle and infrastructure interface issues of hydrogen fueled vehicles. By 2008, this activity will demonstrate the ability of hydrogen fuel cell vehicles to operate for 2,000 hours under real-world conditions. Data collected will be provided to a systems analysis group that will initiate a modeling effort to determine the composite system efficiency of state-of-the-art and future fuel cell vehicles. For hydrogen-fueled vehicles, continue the evaluation of advanced storage systems, advanced hydrogen vehicle development, and advanced fueling interface and safety devices by collecting appropriate data in the Validation Project. Participation in the California Fuel Cell Partnership will be continued. Field evaluations of distributed fuel cell systems under real world conditions to validate system durability and performance will continue in coordination with the hydrogen infrastructure validation activity. *Participants include: Automobile manufacturers, utilities, energy providers, suppliers, universities, States, NREL, ANL, California Fuel Cell Partnership members and others.*

| | | | |
|-------------------------------------------|--------------|--------------|---------------|
| Total, Technology Validation | 1,788 | 9,877 | 18,000 |
|-------------------------------------------|--------------|--------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Technology Validation

Increase supports demonstrations to validate performance, durability, and reliability of fuel cell systems and to aid in managing risk in the early commercialization period through data gathering and analysis of vehicle performance and subsequent refocusing of R&D efforts. In combination with the infrastructure validation effort being carried out under the Hydrogen Technologies Program (Energy Supply appropriation), will also characterize an understanding of vehicle and infrastructure interface issues.....

+8,123

Total Funding Change, Technology Validation.....

+8,123

Technical/Program Management

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-------------------------------------------|---------|---------|---------|-----------|----------|
| Technical/Program Management | | | | | |
| Technical/Program Management..... | 398 | 395 | 542 | +147 | +37.2% |
| Total, Technical/Program Management | 398 | 395 | 542 | +147 | +37.2% |

Description

Technical/Program Management activities include preparation of program strategic and operating plans; evaluation of the impact of new legislation on R&D programs; identification and application of performance methodologies (including GPRA); and data collection to assess program and project performance, efficiency and impacts on accomplishing the mission.

Benefits

Technical/Program Management activities support the HFCIT Program's mission by preparing program plans, tracking program progress, and evaluating impacts of legislation on the program. Program planning, performance monitoring, decision support, program control implementation, and change control, are all important aspects of this activity to support and optimize complex pathway decisions needed for the overall program to achieve its goals.

Detailed Justification

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|
| Technical/Program Management | 398 | 395 | 542 |
| In FY 2005, representative activities will include preparation of program, strategic plans, and operating plans; evaluation of the impact of new legislation on R&D programs; identification of performance methodologies (including GPRA); data collection to assess program and project performance, efficiency and impacts; and development of performance agreements with management. | | | |
| Total, Technical/Program Management | 398 | 395 | 542 |

Explanation of Funding Changes

| | FY 2005 vs. FY 2004 (\$000) |
|--------------------------------------------------------------------------------------------------|-----------------------------------|
| Technical/Program Management | |
| Increase reflects a consolidation into this activity of Information Technology investments | +147 |
| Total Funding Change, Technical/Program Management | +147 |

Distributed Energy Resources

Funding Profile by Subprogram^a

(dollars in thousands)

| | FY 2003 Comparable Appropriation | FY 2004 Comparable Appropriation ^b | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
|-----------------------------------------------------------|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|----------------------------|----------|
| | | | | | \$ Change | % Change |
| Distributed Energy Resources | | | | | | |
| Distributed Generation Technology Development | 39,796 | 40,413 | 40,413 | 32,689 | -7,724 | -19.1% |
| End-Use System Integration and Interface..... | 19,732 | 20,086 | 20,086 | 19,861 | -225 | -1.1% |
| Technical/Program Management Support... | 526 | 524 | 524 | 530 | +6 | +1.1% |
| Total, Distributed Energy Resources..... | 60,054 | 61,023 | 61,023 | 53,080 | -7,943 | -13.0% |

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (1975)
P.L. 94-385, "Energy Conservation and Production Act" (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)

Mission

The mission of the Distributed Energy Resources (DER) Program is to strengthen America's aging energy infrastructure and provide utilities and consumers with a greater array of energy efficient technology choices for the on-site generation of electricity and use of thermal energy. By 2015, the Distributed Energy Resources Program will develop and deploy a diverse array of high efficiency integrated distributed generation and thermal energy technologies at market competitive prices so that homes, businesses, industry, communities, and electricity companies elect to use them.

^a SBIR/STTR funding in the amount of \$1,080,067 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are \$1,400,251 and \$1,215,780 respectively.

^b Programs in the Energy Conservation appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

Benefits

The Distributed Energy Resources Program supports DOE's mission of advancing the national, economic, and energy security of the United States. The program will help protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy. Distributed energy technologies can expand the use of our Nation's aging electricity power infrastructure, relieve congestion on transmission and distribution systems, increase supplies during periods of peak demand, support the transition from traditional monopoly regulation to more competitive markets and reduce environmental emissions, including greenhouse gases. Additionally, consumers should have a choice between installing on-site generation and/or electricity provided by central station generators. Consumers (or third party owners such as utilities) install these systems to reduce their energy costs, enhance energy security and/or improve the reliability and quality of energy services they receive from the local utility. Distributed energy devices can sustain "mission-critical" operations when grid-connected power is not available or not sufficient. Local utilities are looking to distributed energy systems to improve the utilization of distribution assets by reducing the peak or altering the shape of energy demand. One of the recent benefits to come from this research is the Mercury 50, manufactured by Solar Turbines Inc. announced as a commercial product offering in 2004. This turbine was developed under the Advanced Turbine Systems Program at DOE. The Mercury 50 demonstrated 40% efficiency and emissions of less than 9 parts per million (ppm). Other major benefits that have come from this research program have included the development of a melt desulfurization process that produced critical alloy materials with six times better material properties at one-sixth the cost, and operation of a single ceramic combustion liner for over 14,000 hours in an industrial gas turbine which was a world record for the industry.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission plus seven general goals that tie to the strategic goals). The DER program supports the following goals:

Energy Strategic Goal, General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The DER program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.59.00.00: Distributed Energy Resources. The Distributed Energy Resources Program goal is to develop and facilitate market adoption of a diverse array of cost competitive integrated distributed generation and thermal energy technologies in homes, businesses, industry, communities, and electricity companies, increasing the efficiency of electricity generation, delivery, and use, improving electricity reliability, and reducing environmental impacts.

Contribution to Program Goal 04.59.00.00: (Distributed Energy Resources)

Work in Distributed Generation Technology Development contributes to Program Goal 04.59.00.00 by advancing the development of more efficient, low emission distributed power generation technologies. Work within the End-Use Systems Integration and Interface area contributes to this Program Goal by combining efficient power generation technologies with thermally activated heating and cooling applications that further enhance on-site efficiency. The combination of on-site distributed generation and the use of waste heat improves the energy security of the power grid while reducing consumption of precious domestic fossil energy supplies.

The subprogram activities presented below demonstrate key technology pathways that contribute to achievement of these benefits:

- By 2008, the DER Program will contribute to the program goal by completing development and testing of a portfolio of distributed generation and thermally activated technologies that show an average 25 percent increase in efficiency (compared to 2000 baseline) and/or NO_x emissions less than 0.15 lbs/MWh.
- By 2008, the DER Program will contribute to the program goal by demonstrating the feasibility of integrated systems; these systems will achieve 70 percent efficiency and customer payback in less than 4 years, assuming commercial-scale production.

Annual Performance Results and Targets

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Goal 04.59.00.00 (Distributed Energy Resources) | | | | | |
| Distributed Energy Resources/Distributed Generation Technology Development | | | | | |
| Demonstrated two advanced industrial turbine system engines at end-user sites. | Completed 5,000 durability, performance, and emissions testing of the Mercury 50 Advanced Turbine System engine. | | Completed 4,000 hour field test of ceramic composite shroud components to demonstrate performance and emission benefits to a gas turbine. | Complete final design and initiate field testing of low emission technology with less than 7 ppm NO _x . | Demonstrate NO _x emission levels of 0.25 lbs/MWh from catalytic-combustion. |
| | | | Completed the 12 Beta field test units of high efficiency natural gas-fired heat pump (60 percent better than pulse combustion furnace) and install at field test sites hosted by major U.S. Gas Utilities. | Complete and demonstrate heating coefficient of performance of 1.4 for commercial introduction of a thermally activated system (approximately 40 percent more efficient than a conventional heating system) | |
| | | | Contracted with three companies to support research on demonstrating a 5 percent increase in efficiency for an advanced microturbine. | Demonstrate 6 percentage point increase in efficiency for an advanced reciprocating engine. | |
| Distributed Energy Resources/End-Use Systems Integration and Interface | | | | | |
| | | Demonstrated a microturbine package (highly efficient for reducing peak loads) at a university site. | | Complete final design and initiate field testing and evaluation of a complete, fully functional integrated CHP system consisting of a turbine, absorption chiller and control system. | Complete a case study on a CHP installation that uses heat from a microturbine to provide plate tank heating and sludge drying at an industrial facility, contributing to the PART long-term measure of developing a 70 percent efficient CHP integrated system. |
| | | | | | Complete and document two DER/CHP demonstration projects within the high tech industry, contributing to the PART long-term measure of developing a 70 percent efficient CHP integrated |

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|

system.

Management of Funds

Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.

Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

Means and Strategies

The Distributed Energy Resources Program will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

The Distributed Energy Resources Program uses several means (processes, technologies, and resources), and program, policy, management and market-based strategic approaches to achieve its program goals. Significant external factors outside the control of the program are important to achieving the program goals and intended impacts. Collaboration with industry and experts are integral to the investments, means and strategies planned and to addressing the external factors.

The Department will implement the program through the following means:

- By advancing performance and reducing technology cost of integrated energy systems including: increasing ceramic durability, completing an organic rankine cycle heat utilization system, improving the efficiency and emissions of combustion systems, and improving advanced controls.
- By supporting the integration of distributed energy technologies on the distribution system and at customer’s sites to achieve the maximum efficiency, reliability, power quality and load management.

The Department will implement the program using the following strategies:

- Investigate responsive load issues to help customers understand load management.
- Develop standards for siting/permitting/interconnection procedures.
- Work to develop rate and cost transparency in the generation and delivery of electricity (including fair and reasonable standby/backup rates)
- Expand utility business strategies to include distributed technologies as a tool to support the distribution system
- Recognize the value of heating/cooling in combined heat and power systems.

These strategies will result in significant cost savings and a significant improvement in the utility’s load demand profile from large blocks of central generation and transmission and distribution investments.

The following external factors could affect the Distributed Energy Resources program’s ability to achieve its strategic goal:

- The state of the economy for the electric sector including utilities, transmission and distribution companies, electric suppliers, and manufacturers.
- The state of the economy to give consumers the ability to finance distributed energy technologies.
- Utility rate structure and regulatory environment that will stifle customers’ ability to choose and install distributed energy systems in a timely and cost-effective manner.
- The pace of development in alternative energy supply technology.
- The price of energy inputs, primarily natural gas.
- The ability of technologies to be fuel flexible.

In carrying out the program's mission, the Distributed Energy Resources program performs the following collaborative activities:

- The program operates a comprehensive set of research development and demonstration partnerships including competitively awarded cost-shared projects.
- Federal partnerships include participation with the Federal Energy Management Program (FEMP) to promote and install distributed energy systems at Federal facilities.
- The program supports Hydrogen, Fuel Cells, and Infrastructure Technologies Program by developing technologies that can use hydrogen based fuels for electricity generation or cooling, heating and power applications.
- The program coordinates with the Industrial Technologies Program and Building Technologies Program to identify co-funding projects that involve the use of distributed energy systems in manufacturing plants and commercial buildings.
- The program works with the State Energy Program to increase awareness, promote benefits, and remove barriers to distributed energy.
- Small businesses are supported through the Small Business Innovation Research program.
- The program partners with the U.S. Environmental Protection Agency (Interagency Agreement) on education and outreach efforts to address environmental siting and permitting of combined heat and power (CHP) and other distributed energy devices through the EPA CHP Partnership.
- The program also partners (leveraging cost share and technical reviewers) with the California Energy Commission and the New York State Energy Research and Development Authority on distributed generation and CHP research.

Validation and Verification

To validate and verify program performance, DER conducts internal and external reviews and audits. DER's programmatic activities are subject to continuing review by Congress (National Research Council *Energy Research at DOE: Was it Worth it?*), the General Accounting Office, the Department's Inspector General. The U.S. Combined Heat and Power Association (USCHPA), the Gas Turbine Association (GTA), and Engine Manufacturing Association (EMA) are representative of the distributed energy industry and provided reviewers and recommendations on the current and future direction of the DER program in the last Distributed Energy Peer Review held Dec 2003. The next programmatic peer review will be held in the Fall 2005.

Data Sources: The Energy Information Administration's (EIA) Annual Energy Review and Annual Energy Outlook, EIA Form 860 data analyzed by the Resource Dynamics Corporation, Merit Review and Peer Evaluation of R&D, and engineering and economic modelling

Baselines: The following are the key baselines used in the Distributed Energy Resources program (for the year 2000, unless otherwise noted):

- Industrial Turbines emissions: 0.35 (lb/MWh)
- Microturbines emissions: 0.7 (lb/MWh)
- Reciprocating Engines emissions: 3.1 (lb/MWh)
- Industrial Turbines efficiency: 39% (2001)

- Microturbines efficiency: 26%
- Reciprocating Engines efficiency: 36%

Frequency: GPRA benefits are estimated annually, Merit Review and Peer Review projects are evaluated annually, and Program Peer Review is conducted annually.

Data Storage: EE Strategic Management System.

Verification: A trade association working group reviews DER data. The EIA uses and verifies the REPIS database. The November 2001 Distributed Energy Resources Peer Review verified the distributed generation data. Merit reviews and peer evaluations by experts from outside of the U.S Department of Energy are used to evaluate individual project and overall program efforts. The National Academy of Sciences also conducts program peer reviews. These efforts are used to focus the program's investments on activities that are within the Federal Government's role and that address top priority needs.

Within these peer reviews, DER experts review each project. Principles of the Administration R&D investment criteria for research been incorporated into this evaluation. The panel also evaluates the strengths and weaknesses of each project and recommends additions or deletions to the scope of work. The program organization facilitates supplier-customer relationships to ensure that R&D results from federally sponsored efforts are transferred to industry suppliers and that industry supplier developments make their way to the energy market.

Program Assessment Rating Tool (PART)

PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The DER Program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The FY 2005 PART review included strong ratings for purpose, planning, and management. These ratings reflect the commitment of EERE program management at all levels to the basic management and planning principles of the President's Management Agenda including the criteria scored in the PART and the implementation of the EERE reorganization employing those principles. The PART recommended that the program develop performance measures to account for outreach activities and that the program focus R&D funding on systems integration while decreasing emphasis on component technology R&D that is within industry's capability. The PART also recommended that the Department develop a consistent framework to analyze the costs and benefits of its R&D investments to inform budget decisions. These efforts are underway.

Funding by General and Program Goal

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------------------------------|---------|---------|---------|-----------|----------|
| General Goal 4, Energy Security | | | | | |
| Program Goal 04.59.00.00, Distributed Energy Resources | | | | | |
| Distributed Generation Technology Development..... | 39,796 | 40,413 | 32,689 | -7,724 | -19.1% |
| End-Use Systems Integration and Interface | 19,732 | 20,086 | 19,861 | -225 | -1.1% |
| Technical Program Management Support | 526 | 524 | 530 | +6 | +1.1% |
| Total, Program Goal 04.59.00.00, Distributed Energy Resources..... | 60,054 | 61,023 | 53,080 | -7,943 | -13.0% |
| Total, Distributed Energy Resources..... | 60,054 | 61,023 | 53,080 | -7,943 | -13.0% |

Expected Program Outcomes

The DER Program pursues its mission through integrated activities designed to improve the energy efficiency and productivity of our economy, as well as providing opportunities for local development of domestic renewable resources. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the DER Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, natural gas savings, and distributed electricity capacity additions that result from the realization of DER Program goals are shown in the table below through 2025. Not all kilowatt hours (kWh) of electricity have equal value to consumers. Market experience suggests that at least a portion of consumers are willing to pay more for electricity that is more reliable, of higher quality, locally controllable, available during emergency, or cleaner. As a result, these benefit estimates are likely based on an underestimate of the demand for these products under baseline market assumptions. In addition, these estimates do not account for the synergies between improved DER technologies and end-use applications of those technologies being developed by other EERE programs.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. Final documentation is estimated to be completed and posted by March 15, 2004.

FY 2005 GPRA Benefits Estimates for the Distributed Energy Resources Program^a

Mid-Term Benefits

| | 2010 | 2015 | 2020 | 2025 |
|----------------------------------------------------|-------|-------|-------|-------|
| Primary Non-Renewable Energy Savings (Quads) | 0.03 | 0.08 | 0.23 | 0.38 |
| Energy Expenditure Savings (Billion 2001\$) | 2 | 3 | 7 | 11 |
| Carbon Emission Reductions (MMTCE)..... | 1 | 6 | 10 | 15 |
| Natural Gas Savings (Quads)..... | -0.06 | -0.30 | -0.35 | -0.50 |
| Program Specific Electric Capacity (GW)..... | 14 | 35 | 48 | 64 |

^a Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

Distributed Generation Technology Development

Funding Schedule by Activity

| (dollars in thousands) | | | | | |
|-----------------------------------------------------------|---------|---------|---------|-----------|----------|
| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
| Distributed Generation Technology Development | | | | | |
| Industrial Gas Turbines..... | 4,769 | 3,950 | 3,000 | -950 | -24.1% |
| Microturbines | 6,955 | 6,914 | 7,000 | +86 | +1.2% |
| Advanced Reciprocating Engines..... | 11,792 | 13,828 | 9,000 | -4,828 | -34.9% |
| Technology Based – Advanced Materials and Sensors | 7,925 | 8,155 | 8,279 | +124 | +1.5% |
| Fuel Flexibility | 745 | 0 | 250 | +250 | |
| Thermally-Activated Technologies..... | 7,610 | 7,566 | 5,160 | -2,406 | -31.8% |
| Total, Distributed Generation Technology Development..... | 39,796 | 40,413 | 32,689 | -7,724 | -19.1% |

Description

The mission of the Distributed Generation Technology Development subprogram is to improve the energy and environmental performance of distributed technologies so that the Nation can have more energy choices to achieve a more flexible and smarter energy system. The Technology Development area focuses on a portfolio of electricity generation technologies as well as heat utilization technologies and focuses on efficiency, emissions, RAMD (reliability, availability, maintainability and durability) and cost targets.

Benefits

This subprogram provides the high-risk R&D on component technology development such as combustion, materials, component design, thermal recovery cycles and failure analysis to develop the next generation high-efficiency, low emission technologies for industrial gas turbines, microturbines, and reciprocating engines as well as thermally activated technologies. The program is developing a better understanding of fluid dynamics, the combustion and flame stability process, heat/mass transfer, materials processing and system design. Balancing the need for near-zero emissions, high-efficiency and low-cost is a challenge that goes beyond incremental improvements. By improving the efficiency of thermally activated systems and advancing the efficiency and emissions characteristics of these power generation technologies, the Distributed Generation Technology Development subprogram provides the building blocks necessary to develop advanced integrated systems envisioned in the Program Goal. Indicators of progress toward achieving this goal include measures of emissions and efficiency, as set out below:

Expected Results (verified by rig or prototype engine results)

| | Actual | | | | Expected | | | | |
|----------------------------------------|--------|------|------|------|----------|------|------|------|-------------------|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 ^a |
| Emissions (lb/MWh) | | | | | | | | | |
| Industrial Turbines | 0.35 | 0.35 | 0.35 | 0.35 | 0.30 | 0.25 | 0.20 | 0.20 | 0.15 |
| Microturbines..... | 0.7 | 0.7 | 0.7 | 0.4 | 0.4 | 0.3 | 0.30 | 0.3 | 0.15 |
| Reciprocating Engines ^b .. | 3.1 | 3.1 | 3.1 | 3.1 | 1.5 | 1.5 | 1.5 | 0.75 | 0.75 |
| Efficiency (% LHV- Low Heating Value) | | | | | | | | | |
| Microturbines..... | 26 | 28 | 28 | 33 | 33 | 35 | 35 | 35 | 37 |
| Reciprocating Engines... | 36 | 38 | 38 | 38 | 43 | 44 | 44 | 46 | 47 |
| Industrial Turbines ^c | | 39 | | | | | | | N/A |

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Industrial Gas Turbines..... 4,769 3,950 3,000

Industrial gas turbines are used in many industrial and commercial applications ranging from 1MW to 20MW. A key effort in the Industrial Gas Turbine research has been to enhance the efficiency and environmental performance of gas turbines for applications up to 20MW. The focus of this effort is to advance materials research, such as composite ceramics and thermal barrier coatings, which will continue to improve performance and durability. This builds upon previous research to test and demonstrate innovative high temperature materials such as prime reliant coatings and silicon nitride ceramics. Efficiency gains can be achieved with materials like ceramics, which allow a significant increase in engine operating temperature. Low emissions technology research and development will improve the combustion system by greatly reducing the NO_x and CO produced without negatively impacting turbine performance. This emissions work will follow previous research to develop methods to measure, verify very low emissions levels and model these impacts. The goal of the activity is to achieve less than 0.15 lb/MWh in NO_x emissions. These technologies use techniques to control the conditions for combustion so that NO_x is not formed in the first place. Additional testing

^a Goal – Phase II of program.

^b Out of exhaust – no after treatment.

^c Previous EERE research has yielded an improvement from 28% in 1992 to 39% in 2001. Therefore, the program has focused Gas Turbine research on emissions improvements.

and validation on recent breakthroughs (i.e., catalytic combustion) will allow these important systems to move forward.

Research will test cost effective low emissions technologies to verify emissions of less than 5 ppm NO_x (approximately 0.25 lb/MWh) and component life in advanced gas turbines. Research and development will continue on low emissions technologies with the more stringent goal of 3 to 5 ppm NO_x (less than 0.15 lb/MWh). Continue efforts to lower the manufacturing costs and increase the durability of ceramics, catalytic combustion systems, and combustor designs for gas turbines. Continue R&D and testing to demonstrate innovative high temperature materials such as coatings, ceramics, and ceramic composites for combustor liners, shrouds, blades and vanes in gas turbines to improve endurance levels beyond 8,000 hours. Modify material systems to improve durability and life. Investigate additional components (such as shrouds and injector tips) to improve efficiency and/or emission reduction. Research technology attributes will be compared to competing technologies to assess and quantify expected benefits and market acceptance. In FY 2003, this activity was reduced by \$198,500 for SBIR/STTR and transferred to the Science Appropriation.

Participants: Alzeta, Argonne National Laboratory (ANL), Catalytica, California Energy Commission, General Electric Power System Composites (GEPSC), General Electric Corporate Research & Development, Goodrich Corporation, Oak Ridge National Laboratory (ORNL), Precision Combustion, Inc., Siemens Westinghouse, Solar Turbines, United Technologies Research Center (UTRC), and Honeywell Engines and Systems.

| | | | |
|---------------------------|--------------|--------------|--------------|
| Microturbines..... | 6,955 | 6,914 | 7,000 |
|---------------------------|--------------|--------------|--------------|

Microturbines are a new type of combustion turbine for use in distributed energy generation applications. About the size of a refrigerator, microturbines produce 25 to 500 kW of energy and can be located on sites with limited space for power production. Waste heat recovery can be used in combined cooling, heating, and power (CHP) systems with the potential to achieve energy efficiency levels greater than 70 percent. Microturbines offer many advantages over other technologies for small-scale power generation, including the ability to provide reliable backup power, provide power for remote locations, and peak shave. Other advantages include less maintenance and longer lifetimes because of a small number of moving parts, compact size, lighter weight, greater efficiency, lower emissions, and quicker starting. Microturbines also offer opportunities to use waste fuels such as landfill gas. The microturbine research will lead a national effort to design, develop, test, and demonstrate a new generation of microturbines for DER applications that are cleaner, more affordable, reliable, and efficient than products that are currently available. The goal of the microturbine research is to achieve 37 percent efficiency with less than 7 ppm NO_x (approximately 0.15 lb/MWh) at a competitive cost, by 2008.

Building on previous design work, research will fabricate and rig-test subsystems such as recuperators, turbine, combustor, turbine hot section, generator, and power electronics to improve efficiency, reliability, and durability to go beyond the intermediate design target of 33 percent efficiency in FY 2004. Research will take these subsystems and integrate them into microturbine system and initiate rig testing of modified engine systems as well as a field evaluation of a 33 percent efficient system. Utilizing previous design verification work, the program will begin to verify advanced microturbine goals of 40 percent electrical efficiency and single digit emissions (ppm) through advancements in the organic rankine cycle, and ceramics. Research will continue on fuel flexibility while still meeting environmental targets. Research technology readiness and advancements with respect to current state of the art and end use applications. *Participants: Argonne National Laboratory (ANL), Capstone Turbine Corporation, California Energy Commission,*

Honeywell Engines and Systems (ES), Ingersoll-Rand, Oak Ridge National Laboratory (ORNL), Solar Turbines, Southern California Edison (SCE), United Technologies Research Center (UTRC), and General Electric Corporate Research & Development

| | | | |
|---------------------------------------------|---------------|---------------|--------------|
| Advanced Reciprocating Engines | 11,792 | 13,828 | 9,000 |
|---------------------------------------------|---------------|---------------|--------------|

Gas-fired reciprocating engines offer a wide range of power generation at an economical cost over other technologies. With their operating flexibility, reciprocating engines can be used for many purposes, such as, local power grid and substation support, peak-shaving, remote power, on-site generation, combined cooling, heating, and power (CHP) applications, high-density electric loads, standby power, and as mechanical drives used for compressors and pumps in industrial, commercial, institutional, and residential applications. The Advanced Reciprocating Engine System (ARES) will lead a national effort to design, develop, test, and demonstrate a new generation of gas-fired reciprocating engines for Distributed Energy applications that are cleaner, more affordable, reliable, and efficient than products that are commercially available today. The goal of the research is to achieve a 47 percent efficient reciprocating engine system with less than 0.15 lb/MWh of NO_x emissions at a competitive cost by 2008.

Research in the ARES program requires high risk research to meet the program goals and will focus on critical component design to meet Phase 2 targets of 45 percent efficiency and 0.15 lb/MWh of NO_x. The program will build on the initial designs, research, and testing from Phase I. With assistance and guidance from industry, universities, and laboratory research, the effort will develop and integrate critical component to the engine platform, designed in Phase I, to include advanced air handling system, improved turbochargers, improved spark plugs, improved cylinder re-design that will enhance combustion efficiency. Advanced design and development of a laser ignition system will improve combustion efficiency, reliability, durability and cost-effectiveness. Investigation of the viability of a novel Homogeneous Charge Compress Ignition (HCCI) combustion system, that will increase engine efficiency and reduce NO_x considerably, will be developed and tested with a closed loop controller. To meet NO_x emissions standards development of improved catalysts and after treatment technologies for emission controls will be a priority. Research environmental issues, modeling and fuel flexibility technology impacts. In FY 2003, this activity was reduced by \$130,223 for SBIR/STTR and transferred to the Science Appropriation. *Participants: Argonne National Laboratory (ANL), Caterpillar, Colorado State University, Cummins Engine Co., Inc, Los Alamos National Laboratory (LANL), Massachusetts Institute of Technology, Michigan Technological University, National Energy Technology Laboratory (NETL), Northwestern University, Oak Ridge National Laboratory (ORNL), Ohio State University, Pacific Northwest National Laboratory (PNNL), Purdue University, Sandia National Laboratory (SNL), University of Southern California (USC), University of Tennessee, University of Texas at Austin, Waukesha Engine, Dresser, Inc., and West Virginia University*

| | | | |
|-------------------------------------------------------------|--------------|--------------|--------------|
| Technology Based – Advanced Materials and Sensors. . | 7,925 | 8,155 | 8,279 |
|-------------------------------------------------------------|--------------|--------------|--------------|

Advanced materials, such as ceramics and thermal barrier coatings, are some of the key enabling technologies for stationary industrial gas turbines, microturbines and reciprocating engines to improve the efficiency. Engineered ceramics, such as ceramic matrix composites offer all of the advantages of ceramics-resistance to heat, corrosion, erosion, and chemical activity-while adding strength and thermal shock resistance that conventional ceramics do not demonstrate. Advanced microturbines will require improved high-temperature performance and reliability from their recuperators in order to achieve higher efficiency. Researchers are working with microturbine manufacturers and materials

suppliers to develop metallic alloys with more oxidation/corrosion resistance and tensile/creep strength at higher temperatures must be developed. This research provides long-term R&D in the area of materials, sensors, information technologies, power electronics, combustion modeling and assessments of cross-cutting impacts and benefits of the developments of distributed generation systems and end-use applications.

Following on material properties research, advanced materials such as ceramics, coatings and high temperature metals will be developed for components in the hot section, recuperator, exhaust, and valve train. Methods will be developed to improve material environmental resistance and fabrication technologies to produce cost effective high quality engine parts will be developed. In FY 2003, this activity was reduced by \$276,676 for SBIR/STTR and transferred to the Science Appropriation.

Participants: Allegheny Ludlum, Argonne National Laboratory (ANL), Capstone Turbine Corporation, Connecticut Reserve Technology, LLC, Cummins Engine Co., Inc, Haynes International, Honeywell Engines and Systems, Ingersoll-Rand, Kennametal Inc., General Electric Power System Composites (GEPSC), and Oak Ridge National Laboratory (ORNL), Poco Graphite, Inc., Saint-Gobain Ceramics and Plastics, University of Dayton Research Institute (UDRI), United Technologies Research Center (UTRC), and Solar Turbines.

| | | | |
|------------------------------|------------|----------|------------|
| Fuel Flexibility..... | 745 | 0 | 250 |
|------------------------------|------------|----------|------------|

The fuel flexibility research was originally performed to develop ultra-low emissions combustion technologies for oil based fuels that could be applied to distributed generation and cooling. Based on the research conducted in FY 2003 to improve the environmental performance of oil combustion systems, no further activity will be conducted in the area of oil heat. All oil heat activities have been transferred to the Building Technologies Program.

New efforts will be focused on the use of alternative or opportunity fuels such as anaerobic digester gas, industrial waste gas, landfill gas, well head gas in distributed generation technologies. Crosscutting issues such as fuel combustion dynamics, fuel processing and clean-up prior to combustion and corrosion issues will be investigated. A market study and assessment will be conducted to prioritize the technical research issues. *Participants: TBD.*

| | | | |
|-----------------------------------------------|--------------|--------------|--------------|
| Thermally-Activated Technologies | 7,610 | 7,566 | 5,160 |
|-----------------------------------------------|--------------|--------------|--------------|

Thermally-Activated Technologies (TAT) use the recoverable heat from gas-fired systems and rejected/waste heat from industrial processes or electricity generation. TAT provide important keys for achieving the overall efficiency benefits of distributed energy technologies by converting natural gas, exhaust, or rejected heat into useful energy services like heating, cooling, humidity control, thermal storage, or bottoming cycles. TAT are the essential building blocks for CHP integrated systems, which are widely recognized as the next wave of energy-efficient power generation devices that will transform central power station electric power generation into discrete, economical, reliable, and secure distributed power generation. The TAT effort facilitates research, development, testing, and integration of advanced heating, cooling, dehumidification, and refrigeration equipment.

TAT research will focus on implementing activities in accordance with the Thermally Activated Technology Roadmap developed in 2003 that will enable recovery and use of thermal energy to level utility load profiles and improve output-based efficiency and emissions. Funding will be completed for the Ambient heat pump technologies and the “hi-cool” refrigeration contracts. All solid desiccant research activities will be completed at ORNL. Research also will be completed on the anthrax surrogate capture work with liquid desiccants. Liquid desiccant technologies have been proven at National Renewable Energy Laboratory to capture and eliminate anthrax type airborne particles.

Following on more basic desiccant and absorption research, undertake efforts to reduce cost and improve performance of desiccant systems at NREL for humidity control and indoor air quality as it relates to energy consumption.

Research will continue on advanced humidity sensors. New awards will be initiated in the areas of heat/mass transfer and low-grade temperature utilization. Research novel cycles and materials, compact TAT design concepts, and cost reduction of absorption chiller technologies that can benefit advanced integrated CHP systems. Feasibility studies on TAT technologies and systems for residential heat/cooling CHP systems (if proven potentially viable), will be transferred to the packaged CHP systems integration activity. *Participants: Ambian Climate Technologies,, Carrier Corporation, Gas Technology Institute (GTI), Georgia Tech Research Institute (GTRI), Kathabar, Inc., Mississippi State University, Munters, National Renewable Energy Laboratory (NREL), Oak Ridge National Laboratory (ORNL), Trane, Rocky Research, University of Central Florida, York International, and United Technologies Research Center (UTRC).*

| | | | |
|-------------------------------------------------------------------|---------------|---------------|---------------|
| Total, Distributed Generation Technology Development | 39,796 | 40,413 | 32,689 |
|-------------------------------------------------------------------|---------------|---------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Industrial Gas Turbines

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Support for hydrogen-related activities is transferred to the Hydrogen program. Several low emission technology demonstrations will be completed in FY 2004 | -950 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|

Microturbines

| | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| This increase is the result of general reductions authorized against this program in FY 2004. Initial Congressional authorizations would hold this budget flat | +86 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

Advanced Reciprocating Engines

| | |
|---------------------------------------------------------------------------------------------------|--------|
| Reduces scope in industrial contracts that are perceived to be within industry's capability | -4,828 |
|---------------------------------------------------------------------------------------------------|--------|

Technology Based – Advanced Materials and Sensors

| | |
|--------------------------------------------------------------------------------------------|------|
| This increase will support additional activities in developing ceramic matrix composites . | +124 |
|--------------------------------------------------------------------------------------------|------|

Fuel Flexibility

| | |
|-------------------------------------------------------------------------------------|------|
| A new effort will be focused on the use of alternative fuels, primarily gases. | +250 |
|-------------------------------------------------------------------------------------|------|

Thermally Activated Technologies

| | |
|-----------------------------------------------------------------|--------|
| Complete existing efforts on heat pumps and refrigeration | -2,406 |
|-----------------------------------------------------------------|--------|

| | |
|----------------------------------------------------------------------------------|---------------|
| Total Funding Change, Distributed Generation Technology Development. | -7,724 |
|----------------------------------------------------------------------------------|---------------|

End-Use System Integration and Interface

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-------------------------------------------------------------------------------------------|---------|---------|---------|-----------|----------|
| End-Use System Integration and Interface | | | | | |
| Distributed Energy Systems Applications Integration | | | | | |
| Distributed Energy Systems Applications Integration | 8,284 | 7,246 | 7,861 | +615 | +8.5% |
| Congressionally Directed Activity, Distributed Energy Systems Applications Integration .. | 0 | 988 | 0 | -988 | -100.0% |
| Subtotal, Distributed Energy Systems Applications Integration..... | 8,284 | 8,234 | 7,861 | -373 | -4.5% |
| Cooling, Heating and Power Integration | 11,448 | 11,852 | 12,000 | +148 | +1.2% |
| Total, End-Use System Integration and Interface..... | 19,732 | 20,086 | 19,861 | -225 | -1.1% |

Description

Distributed energy devices provide utilities and consumers with more choices and control over how their energy needs are met, and are essential for more openly competitive electricity and natural gas markets to flourish. The focus of the End-Use Integration and Interface activities is to develop highly-efficient integrated energy systems that can be replicated across an end-use sector which will help demonstrate a R&D objective or address a technical barrier.

Benefits

This subprogram develops the knowledge base and technologies necessary to integrate energy systems efficiently in end-use applications. The focus is on heat/mass transfer, air/fluid flows, optimizing performance, adaptive controls for building load management, and sensors/communications technologies for use with building energy systems. The End-Use System Integration and Interface subprogram integrates the technologies developed in the Distributed Generation Technology Development subprogram into the efficient packaged systems envisioned in the Program Goal. An indicator of the progress toward achieving this goal is the number of successful integrated system demonstrations, on the following chart:

Expected Results

| | Actual | | | | Expected | | | | |
|---------------------------------------------|--------|------|------|------|----------|------|------|------|-------------------|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 ^a |
| # Successful ^b Demonstrations .. | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Distributed Energy Systems Applications Integration 8,284 8,234 7,861

▪ **Distributed Energy Systems Applications Integration .. 8,284 7,246 7,861**

This activity facilitates acceptance of distributed energy resources (DER) in end-use sectors by forming partnerships with industry consortiums in the commercial building, merchant stores, light industrial, supermarkets, restaurants, hospitality, healthcare and high-tech industries. In high-tech industries such as telecommunications, commercial data processing and internet services, the use of electronic data and signal processing have become a cornerstone in the US economy. These industries represent a high potential for DER due to the ultra-high reliability and power quality requirements and related large cooling loads. Projects include development of decision and design tools and integration of DER technologies at customer sites to meet power and thermal needs and quantify value (such as energy and emissions benefits, installation and retrofit costs and high efficiency, reliability, etc.). Results from assessments are disseminated as information and education materials among the industries, utilities and States.

Research will continue to strengthen partnerships with industry consortia (commercial building, education facilities, light industrial, supermarkets, restaurants, hospitality, and health care industries) and identify promising applications for distributed energy/CHP technologies to meet power and specialized thermal needs. Building upon research initiated last year work will be undertaken to: 1) quantify the energy and emissions benefits and installation and retrofit costs, and other benefits; 2) research integration issues and recommend improvements; and 3) correlate data to analytical models and tools for end use customers. Building upon previous research to design integrated distributed energy systems, efforts will begin field testing of these systems and validate anticipated benefits and replicability with industry consortiums. Research will be completed on data centers documenting the integration issues, operation and benefits. Research will continue on systems for the hospitality industry. R&D issues in using distributed energy as a technology option for upgrading and supporting the distribution system to improve capacity and work with the distribution system to resolve technical issues will be evaluated. *Participants: American Gas*

^a Goal.

^b A successful demonstration is defined as an integrated CHP project that demonstrates a 70 percent overall efficiency.

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Association, Bowman Power, Capstone Turbine Corporation, Energy Solutions Center, Exergy Partners, Gas Technology Institute (GTI), New York State Energy Research and Development Authority (NYSERDA), National Accounts Energy Alliance, Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), and Sure Power Corporation.

▪ **Congressionally Directed Activity, Distributed Energy**

| | | | |
|---------------------------------------------|----------|------------|----------|
| Systems Application Integration..... | 0 | 988 | 0 |
|---------------------------------------------|----------|------------|----------|

National Accounts Energy Alliance (FY 2004 \$987,640).

Total, Distributed Energy Systems Applications

| | | | |
|--------------------------|--------------|--------------|--------------|
| Integration | 8,284 | 8,234 | 7,861 |
|--------------------------|--------------|--------------|--------------|

| | | | |
|-----------------------------------------------------------|---------------|---------------|---------------|
| Cooling, Heating and Power (CHP) Integration | 11,448 | 11,852 | 12,000 |
|-----------------------------------------------------------|---------------|---------------|---------------|

Cooling, Heating and Power Integration (CHP) reduces energy costs and emissions by using energy resources more efficiently. In conventional conversion of fuel to electricity, over two-thirds of the energy input is discarded as heat to the environment and not used for productive purposes. CHP makes greater use of fuel inputs by utilizing the discarded heat with system potential efficiencies from 60 to 80 percent. The industry's CHP Program goal, which DOE is supporting, is to double the capacity of CHP in the United States to 92 GW by 2010 and develop and test CHP packages for integration into overall building system design. Using the viable heat energy rejected from the making of electricity, high efficiencies can be achieved and package technologies can be integrated and optimized for end-use application. By capturing and using this rejected heat energy, these packaged systems could achieve efficiencies greater than 70 percent. The National CHP Roadmap will be used to guide the program's activities in the areas of raising awareness, eliminating barriers and developing technologies and markets. Research and development is focused on the integration of prime movers such as turbines, microturbines, and reciprocating engines with thermally activated technologies (chillers, dehumidification, etc) for plug-and-play integrated CHP systems. This work includes the development of necessary controls for seamless integration into buildings systems.

Activities will support the CHP technology roadmap through the development of CHP analytical tools and the maintenance of regional technical assistance centers. Activities will include projects that examine the benefits of CHP, develop analytic tools, develop case studies and lessons learned that can benefit future CHP installations, collect relevant data on CHP installations, and analyze emissions data and emissions credits for CHP and propose guidance for future standards. The data and information from these activities will be disseminated at the national and regional levels to aid in the installation of CHP facilities. These projects will increase awareness of and confidence in CHP technologies including their benefits in efficiency and emissions.

Building on previous research, the DER Program will continue the effort to design and develop seven industry cost Integrated Energy System projects. Following previous fabrication activities, will undertake testing of critical components, interface needs, controls, heat exchangers, and distribution systems. Research will investigate alternate applications and methods of heat recovery from reciprocating engines cooling-jacket water and flue gas. Systems will use advanced absorption chillers and desiccants in a variety of building applications for system efficiencies approaching 80 percent. In FY 2003, this activity was reduced by \$474,668 for SBIR/STTR and transferred to the Science

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Appropriation. *Participants: American Council for an Energy Efficient Economy (ACEEE), American Gas Association (AGA), Broad USA, Burns & McDonnell, Capstone Turbine Corporation, Carrier Corporation, Distributed Utility Associates. Energy and Environmental Analysis, Inc. (EEA), Energetics, Energy Concepts Co., LLC, Exergy Partners, Gas Technology Institute, Honeywell Laboratories, I C Thomasson Associates, Inc., Ingersoll-Rand, International District Energy Association (IDEA), Northeast-Midwest Institute (NEMW), NiSource, Oak Ridge National Laboratory (ORNL), Resource Dynamics, Solar Turbines, TIAX, Trane, United Technologies Research Center (UTRC), University of Maryland, University of Chicago – Illinois, California Energy Commission, University of California-Berkley, University of California- Irvine, San Diego State University, New York State Energy Research and Development Authority (NYSERDA), Pace University, University of Massachusetts-Amherst, Rutgers University, West Virginia University, US Combined Heat and Power Association, Washington State University, and Waukesha Engine, Dresser, Inc.*

| | | | |
|--------------------------------------------------------------|---------------|---------------|---------------|
| Total, End-Use System Integration and Interface | 19,732 | 20,086 | 19,861 |
|--------------------------------------------------------------|---------------|---------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Distributed Energy Systems Applications Integration

▪ Distributed Energy Systems Applications Integration

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| The increase will fund additional system integration activities selected from the FY 2004 general solicitation supporting the hospitals, hotels, schools, and grocery sectors | +615 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|

▪ Congressionally Directed Activity, Distributed Energy Systems Applications Integration

| | |
|-------------------------------------------------------------------------------------------------------|------|
| Complete Congressionally-directed activity and focus on activities contributing to program goals..... | -988 |
|-------------------------------------------------------------------------------------------------------|------|

| | |
|------------------------------------------------------------------------|-------------|
| Total, Distributed Energy Systems Applications Integration..... | -373 |
|------------------------------------------------------------------------|-------------|

Cooling, Heating and Power Integration

| | |
|------------------------------------------------------------------------------------|------|
| Complete testing of one combined heat and power system at a end-user facility..... | +148 |
|------------------------------------------------------------------------------------|------|

| | |
|----------------------------------------------------------------------------|-------------|
| Total Funding Change, End-Use System Integration and Interface..... | -225 |
|----------------------------------------------------------------------------|-------------|

Technical/Program Management Support

Funding Schedule by Activity

| (dollars in thousands) | | | | | |
|---------------------------------------------------|---------|---------|---------|-----------|----------|
| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
| Technical/Program Management Support | | | | | |
| Technical/Program Management Support | 526 | 524 | 530 | +6 | +1.1% |
| Total, Technical/Program Management Support | 526 | 524 | 530 | +6 | +1.1% |

Description

The addition of distributed energy resources as a power choice is a complex issue. This task forms the technical foundation that assists and guides the DER research activities to ensure relevance to the market. Markets, technology advances, and regulations are dynamic, and this task continually monitors available information and adjusts the program direction as necessary to be responsive.

Benefits

The technical/program management subprogram provides the analysis framework and technical support to meet the requirements of Department's planning process, Congress, GPRA, and PART (planning, management and purpose). This subprogram also analyzes program gaps and new R&D opportunities. This planning and management analysis is necessary to keep the program's research agenda on target to meet the Program Goal, in the face of dynamic market and technology developments.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|---------------------------------------------|------------|------------|------------|
| Technical/Program Management Support | 526 | 524 | 530 |
|---------------------------------------------|------------|------------|------------|

The DER Program will undertake activities which are an integral part of the distributed generation technology development and end-use systems integration. Activities will include preparation of program strategic plans, multi-year plans, technology roadmaps, and operating plans, peer reviews and technical workshop/conferences specific to Distributed Energy Resources Technology Development and End-Use Systems Integration, technical data collection and methodology to support DER performance goals, DER technology assessments and market status. The funds will be split proportionally between the needs of the Distributed Generation Technology Development activity and the End-Use Systems Integration and Interface activity. *Participants include: Energetics.*

| | | | |
|---------------------------------------------------------|------------|------------|------------|
| Total, Technical/Program Management Support..... | 526 | 524 | 530 |
|---------------------------------------------------------|------------|------------|------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Technical/Program Management Support

| | |
|-----------------------------|----|
| No significant change | +6 |
|-----------------------------|----|

| | |
|------------------------------------------------------------------------|-----------|
| Total Funding Change, Technical/Program Management Support..... | +6 |
|------------------------------------------------------------------------|-----------|

Building Technologies

Funding Profile^a

(dollars in thousands)

| FY 2003 Comparable Appropriation | FY 2004 Comparable Appropriation ^b | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|----------------------------|----------|
| | | | | \$ Change | % Change |

Building Technologies

| | | | | | | |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---------|
| Residential Buildings Integration | 12,133 | 13,067 | 13,067 | 18,932 | +5,865 | +44.9% |
| Commercial Buildings Integration .. | 4,386 | 4,440 | 4,440 | 4,995 | +555 | +12.5% |
| Emerging Technologies..... | 30,564 | 29,997 | 29,997 | 25,057 | -4,940 | -16.5% |
| Equipment Standards and Analysis..... | 9,635 | 10,387 | 10,387 | 7,800 | -2,587 | -24.9% |
| Oil Heat Research for Residential Buildings | 0 | 494 | 494 | 0 | -494 | -100.0% |
| Technical/Program Management Support | 1,609 | 1,481 | 1,481 | 1,500 | +19 | +1.3% |
| Total, Building Technologies | 58,327 | 59,866 | 59,866 | 58,284 | -1,582 | -2.6% |

Public Law 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" (1978)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Power Plant and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Conservation Act" (1987)
P.L. 100-357, "National Appliance Energy Conservation Amendments" (1988)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act" (1992)

^a SBIR/STTR funding in the amount of \$1,048,982 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are \$765,388 and \$735,330 respectively.

^b Programs in the Energy Conservation appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

Mission

The mission of the Building Technologies Program (“BT”) is to develop technologies, techniques and tools for making residential and commercial buildings more energy efficient, productive, and affordable. The portfolio of activities includes efforts to improve the energy efficiency of building components and equipment, and their effective integration using whole-building-system-design techniques, the development of building codes and equipment standards, and integration of renewable energy systems into building design and operation.

Benefits^a

The Building Technologies Program supports DOE’s goal to improve energy security by developing reliable, affordable and environmentally sound technologies that significantly reduce the energy consumption and peak electrical demands of residential and commercial buildings, which account for about two thirds of the electric energy consumption in the Nation, thereby enhancing the reliability and efficiency of the Nation’s energy supply infrastructure, and therefore reducing potential grid failures at period of system peak demand.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department’s Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Building Technologies program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

Program Goal 04.04.02.00: Building Technologies. The Buildings Technologies Program goal is to develop cost effective tools, techniques and integrated technologies, systems and designs for buildings that generate and use energy so efficiently that buildings are capable of generating as much energy as they consume.

^a Benefits estimates are annual (not cumulative) and reflect expected additional market adoption of efficient technologies or renewable energy resources due to the technology and market improvements being developed by EERE's programs activities from FY 2005 to the benefit year or to activity completion (whichever is nearer). These estimates do not include those efficiency and renewable improvements developed by program activities to date, or those improvements that would be expected to occur in the absence of future absent these program efforts. These estimates assume business-as-usual expectations regarding future energy markets and current policies; differences in future energy market conditions or policies would result in different levels of benefits. A summary of the methods, assumptions, sensitivities, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. Final documentation estimated to be completed and posted by March 15, 2004.

Contribution to Program Goal 04.04.02.00 (Building Technologies)

The Building Technologies Program has one program goal that contributes to General Goal 4 in the “goal cascade”:

Key technology pathways that contribute to achievement of these benefits include:

- **Residential Buildings Integration R&D Activities:** provide the energy technologies and solutions that will catalyze 70 percent reduction in energy use of new prototype residential buildings that when combined with onsite energy technologies result in Zero Energy Homes (ZEH)^a by 2020 and 20 percent reduction in energy use of existing homes. By 2010, five design packages that can achieve an average of 40 to 70 percent reduction in whole house energy use and 20 percent reduction in existing buildings will be developed. Performance indicators include the number of: subsystem technological solutions developed, researched, and evaluated; design packages developed, researched, and evaluated against Zero Energy benchmark for homes; design packages developed and number of existing homes retrofitted to achieve 20% or more improvement in energy efficiency; project and demonstration homes developed in the Building America (BA) program; building code change proposals developed and submitted to code development bodies; and upgrades of Federal building codes completed.
- **Commercial Buildings Integration R&D Activities:** By 2010, develop five to seven technology packages that can achieve an average of 50 percent reduction in the purchased energy use in new, small commercial buildings relative to the International Energy Conservation Code (IECC) or 30 percent reduction in energy use in existing small commercial buildings. Performance indicators include the number of: technology packages developed, researched, and evaluated against 50 percent reduction of energy use in new buildings or 30 percent reduction in existing buildings; building code change proposals developed and submitted to code development bodies; upgrades of Federal building standards issued.
- **Emerging Technologies (ET) Activities:** accelerate the introduction of highly-efficient technologies and practices for both residential and commercial buildings. The ET activities support the net Zero Energy Building (ZEB)^a goal through research and development of advanced lighting, building envelope, windows, space conditioning, water heating and appliance technologies. Without advanced components developed in the Emerging Technologies activities, this goal will not be met. The performance indicators include the number of potentially market viable technologies demonstrated and patents awarded.
- **Equipment Standards and Analysis:** Increase minimum efficiency levels of buildings and equipment through codes, standards, and guidelines that are technologically feasible, economically justified, and saves significant energy. By 2010, issue 13 formal proposals, consistent with enacted law, for enhanced product standards and test procedures. Performance indicators include: product standards and test procedures proposed/issued; and analyses completed for labeling and Energy Star update and expansion to include new products.

^a The Zero Energy Building (ZEB) (referred to as Zero Energy Homes (ZEH) in the residential sector) research initiative is bringing a new concept to homebuilders across the United States. A Zero Energy Home combines state-of-the-art, energy efficient construction and appliances with commercially available renewable energy systems such as solar water heating and solar electricity. This combination can result in a net zero energy consumption. A ZEH, like most houses, is connected to the utility grid, but can be designed and constructed to produce as much energy as it consumes on an annual basis. With its reduced energy needs and renewable energy systems, a ZEH can, over the course of a year, give back as much energy to the utility as it takes.

Annual Performance Results and Targets

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Goal 04.04.02.00 (Building Technologies) | | | | | |
| Residential Buildings Integration | | | | | |
| In partnership with Building America, developed more than 2,000 highly energy-efficient, environmentally sound, and cost-effective houses and disseminate results to builders of 15,000 other houses through PATH. (NEARLY MET GOAL) | With Building America Partners, completed 3,000 energy-efficient environmentally sound high performance homes. (EXCEEDED GOAL) | Building America completed 1,700 homes in Fiscal Year 2002, bringing the total number of homes built through the program to more than 5,350. More homes were built than the original goal due to increased program success, increased builder participation, and reduced lead times to house completion. (MET GOAL) | <p>Pursued six promising technological solutions considering regional and housing type differences targeting 40 percent reductions in residential space conditioning, hot water, and lighting loads. Based on Building America systems research results, developed regional Building System Performance Packages for five climate zones describing "best practice" systems that reduced space conditioning energy use by 30 percent.</p> <p>Completed at least 800 highly resource-efficient, cost-effective project homes through the Building America consortia, bringing the total number of homes built through the program to more than 5,300.</p> <p>Developed retrofit best practices guidelines and seven case studies for existing residential buildings.</p> <p>Issued a proposal to upgrade Federal Residential Building codes.</p> | Initiate 5 design packages that provide promising technological solutions considering regional and housing type differences targeting 40 - 50 percent reductions in residential space conditioning loads, compared to IECC 2000, through Building America Consortia. Strategies to reduce the major loads, including energy used for hot water, lighting and clothes dryers will also be investigated. | <p>Complete 3 design technology packages for new residential buildings that are 30 percent more efficient than the whole-house Building America benchmark.</p> <p>Analyze and develop code change proposals that are expected to result in a cost-effective improvement in energy efficiency in residential buildings of approximately five percent.</p> |
| Commercial Buildings Integration | | | | | |
| N/A | N/A | All supporting documents for commercial codes including the draft Notice of Proposed Rule are in the General | Facilitated a 10 percent increase in commercial building designs that have meaningful consideration of | | Complete assessments of technology and market opportunities, optimization methods and design |

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | <p>Counsel's office of DOE for concurrence. Preliminary concurrence from various agencies and FEMP has been obtained. Federal code staff work has been completed; significant comment response and redesign and timing of review currently underway by general counsel may result in delay for publication by one quarter. (NOT MET)</p> <p>The draft framework from the High Performance Building Roadmap was tested multiple times with actual building design projects in FY 2002. Draft guides for achieving low-energy commercial buildings are being reviewed, and final guidelines are to be published in early FY 2003. (MET GOAL)</p> | <p>energy efficiency by developing improved design tools, including code compliance tools, and completing six research assisted design case studies in cooperation with industry.</p> <p>Completed preliminary development of wireless control systems for 2 different types of HVAC systems and began long-term operational evaluation.</p> <p>Issued a proposal to upgrade Federal Commercial Building codes</p> | | <p>strategies and, with substantial input from designers, building owners and others, establish programmatic pathways to achieve 50% or better energy performance in significant numbers of buildings, enabling development of design technology packages for new commercial buildings.</p> <p>Analyze and develop code change proposals that are expected to result in a cost-effective improvement in energy efficiency in commercial buildings of approximately five percent</p> |
| Emerging Technologies N/A | <p>WINDOW 5 was released and approved by NFRC; algorithms were adopted as an International Standards Organization (ISO) standard. (MET GOAL)</p> <p>Completed Phase I field demonstrations of heat pump water heaters, with utility partners. (MET GOAL)</p> | <p>Seven research areas were completed. Specific research projects include: energy performance of insulated, unvented attics; development of low cost wood shear panels; energy impacts of ICS (Integral Collector Storage) solar domestic hot water preheat systems; evaluation of mixing performance of residential mechanical ventilation systems; development of high performance affordable housing; evaluation and mitigation of moisture problems in manufactured housing; evaluation of dehumidification systems for residential buildings; and evaluation of low energy buildings with onsite power</p> | <p>Implemented research plan for development of practical and efficient solid-state devices for general illumination.</p> <p>Developed 1 lighting control system that can reliably be utilized to reduce peak demand loads while minimizing the disruption to occupants.</p> <p>Completed investigation of 5 methods to increase the optimum selection of equipment components for air conditioning and heat pumps.</p> <p>Field tested 3 approaches to</p> | <p>Complete a solicitation and award five or more competitively based research awards for cost-shared research on technology (such as substrate materials and light extraction) to contribute to the goal of 160 Lumens/watt (lpw) & \$11/klm of white light from solid-state devices with industry, national labs, and universities.</p> <p>Complete a thermodynamic study of emerging refrigerants. Based on study results, make go/no-go decision on initiation of first stage development of a laboratory prototype, high efficiency residential 1-ton air-conditioning and heat pump unit that uses a novel approach to the vapor</p> | <p>Select five new competitively based research awards for cost-shared research on technology (such as optical materials and device structures) to achieve 50 lpw of white light from solid-state devices with industry, national labs, and universities.</p> |

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | <p>generation systems. (MET GOAL)</p> <p>WINDOW version 5.1 was released to Industry on October 2, 2002 at a NFRC meeting. A Simulation Training Manual and an improved optics database editor (allows for the formulation of advanced glazings including laminated glass) were also released with Windows. An improved heat transfer model, THERM 5.0, was also released. The suite of programs allows for heat transfer modeling of new designs that promote energy efficient product development at significantly lower cost than conventional prototype development. (MET GOAL)</p> <p>Concluded field demonstrations of heat pump water heaters with utility partners. Data was collected from 16 units over a year. Data analysis was performed and a draft report was produced in June. (MET GOAL)</p> | <p>retrofit space-conditioning systems in existing homes to improve energy efficiency.</p> <p>Developed a prototype leak-tight duct system.</p> <p>Field-tested radiant enhanced gas water heater.</p> <p>Analyzed and field tested affordable automatically controlled integrated system using outside air for cooling and warm attic air for ventilation.</p> <p>Completed development of the two-dimensional hydrothermal model and material property measurements.</p> <p>Completed WINDOW 5.2, for basic retrofit product – National Fenestration Rating Council (NFRC) rating & labeling- begin algorithm development for complex retrofit/new products and high performance products.</p> <p>Released EnergyPlus Version 1.1 building energy efficiency design tool.</p> | | <p>compression refrigeration cycle and has the potential for a SEER of over 20.</p> <p>Complete a prototype dynamic window that will have a solar heat gain coefficient range of 0.05 to 0.6 and will meet ASTM durability standards for cycling in a high temperature, high ultraviolet light environment.</p> |
| Equipment Standards and Analysis | <p>Issued three proposals for upgrades and three upgrades to appliance standards and test procedures. (MET GOAL)</p> | <p>Two proposals for appliance standard upgrades have resulted in Final Rules. The Residential Central Air Conditioner and Heat Pump, and the Final Rule for Dishwasher Test Procedure for Non-Sensor type machines were issued in the Federal Register in May</p> | <p>Conducted 4 rulemakings to amend appliance standards and test procedures: Residential Furnaces, Boilers, and Mobile Home Furnaces; Electrical Distribution Transformers; Commercial Unitary Air-Conditioners and Heat Pumps; Residential Niche</p> | <p>Prepare for DOE issuance up to 4 rules to amend appliance standards and test procedures for some of the following products: Residential Furnaces, Boilers, and Mobile Home Furnaces; Electrical Distribution Transformers; Commercial Unitary Air-</p> | <p>Develop for DOE issuance up to 4 rules, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings. Develop final rule regarding energy conservation standards for</p> |

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|---------------------|-----------------|------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | 2002. (MET GOAL) | Product Air-Conditioners. | Conditioners and Heat Pumps; and Residential Niche Product Air-Conditioners and Heat Pumps. | electric distribution transformers and commercial unitary air conditioners and heat pumps. |
| Management of Funds | | | | Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. | Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met. |

Means and Strategies

The Building Technologies Program will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

While the need for increased energy efficiency in building design and operation is clear, from a national perspective, both in terms of economic and strategic terms, the marketplace has not been fully capable of responding. This failure is due both to market structure (fragmentation) and a host of barriers to the development and adoption of cost-effective energy efficient technologies. BT’s challenge is to bring the appropriate strategies to bear to address these needs, while designing programs that give appropriate consideration to this marketplace and the barriers presented to energy efficiency.

The Building Technologies Program has identified six portfolio strategies to achieve its mission:

- Accelerate the introduction of highly-efficient technologies and practices through research and development;
- Modernize the R&D portfolios to ensure that the most promising, revolutionary, technologies and techniques are being explored, and align the Residential and Commercial Integration subprograms to a vision of zero net energy buildings;
- Use a “whole buildings” approach to energy efficiency that takes into account the complex and dynamic interactions between a building and its environment, among a building’s energy systems, and between a building and its occupants. This approach has achieved energy savings of 30 percent beyond those obtainable by focusing solely on individual building components, such as energy-efficient windows, lighting, and water heaters. (Building Science Corporation, Final Report: Lessons Learned from Building America Participation, February 1995 – December 2002, February 2003, NREL/SR-550-33100);
- Enable integration of energy efficiency and renewable energy technologies and practices;
- Increase minimum efficiency levels of buildings and equipment through codes, standards, and guidelines that are technologically feasible and economically justified; and
- Appropriately exit those technologies that are sufficiently mature or proved to the marketplace, and close efforts where investigations prove to be technically or economically infeasible (“off ramps”).

The Residential Buildings Integration subprogram focus on improving the efficiency of the approximately 1.3 million new homes built each year and the 100 million existing homes, including multifamily units — this will be accomplished through research, development, demonstrations, and technology transfer strategies. The strategies include efforts to improve the energy efficiency of residential energy uses such as space heating and cooling, ventilation, water heating, lighting, and home appliances. It includes support for the development of residential building codes and standards to enable application of whole building design techniques. These activities support efforts to develop strategies to integrate solar energy applications and other renewable technologies into buildings and the concept for Zero Energy Buildings.

The Commercial Buildings Integration subprogram addresses opportunities in new commercial buildings (\$254 billion annual capital construction and \$113 billion renovation) by working with

competitively selected industry groups on cost-shared projects that accelerate the development and adoption of new building technologies and design practices, and address the need for commercial building codes. It includes technology development efforts to validate energy efficiency designs and practices, improve sensors and controls, and develop more energy efficient ventilation systems. It also includes efforts to improve commercial building codes and standards and supports the net Zero Energy Buildings goal.

The strategy of the Emerging Technologies subprogram is to include R&D and technology transfer of energy-efficient products and technologies for both residential and commercial buildings. These efforts address high-impact opportunities within the multitude of building components such as lighting, building envelope technologies including advanced windows, and new designs for appliances, and analysis tools and design strategies. Efficiency advances for this equipment will support the Zero Energy Buildings goal.

The Equipment Standards and Analysis subprogram leads to improved efficiency of appliances and equipment by conducting analyses and developing standards that are technologically feasible and economically justified, under the Energy Policy and Conservation Act, as amended (EPCA). Analysis performed under this program will support related program activities such as ENERGY STAR, to ensure a consistent methodology is used in setting efficiency levels for each related program.

The management strategy for developing affordable net Zero Energy Buildings requires a high level of coordination with other programs in the Office of Energy Efficiency and Renewable Energy. These include the Solar Energy Technology Program and the Distributed Energy Resources Program. In addition, the Biomass Program, Wind and Hydropower Technologies Program, Geothermal Technologies Program, and Hydrogen, Fuel Cells and Infrastructure Technologies Program have important technologies to contribute. The Building Technologies Program also invests in technical program and market analysis and performance assessment in order to direct effective strategic planning.

These means and strategies will result in significant cost savings and a significant reduction in the consumption of energy cross build fuel types—increase the substitution of clean fuels—cost effectively reducing America’s demand for energy, lowering carbon emissions, and decreasing energy expenditures—thus putting taxpayers’ dollars to more productive use.

There are a number of external factors affecting the Building Technologies Program ability to achieve its strategic goals which need to be addressed. For example, there are several factors that interfere with the private sector making R&D investments in energy efficient building technologies. These include a fragmented industry comprised of thousands of builders and manufacturers, none of which has the capacity to sustain research and development activities over multi-year periods. Another factor is the compartmentalization of the building professions, in which architects and designers, developers, construction companies, engineering firms, and energy services providers do not typically apply integrated strategies for siting, construction, operations, and maintenance. (Scott Hussell, Amy Wong, Ari Houser, Debra Knopman, Mark Bernstein, RAND Corporation: *Building Better Homes: Government Strategies for Promoting Innovation in Housing*, 2003). This fragmentation and compartmentalization of the buildings industries means there is a need for a facilitator to build consensus on research directions and priorities, industry-wide codes and standards, technology transfer, and education, outreach, and information exchange.

In carrying out the program’s mission, Building Technologies Program collaborates with several groups on its key activities. Partnerships and cost share arrangements with industry and other Federal agencies become critical management tools which can build a critical mass to address these barriers. The program’s management strategy involves four key elements: a customer-focused, team-based

organization for greater accountability and improved results; collaboratively developed technology roadmaps to provide for a more integrated, customer driven R&D portfolio; greater competition in project solicitations to increase innovation and broaden research participation; and increased peer review to assure scientifically sound approaches. The program has developed six related road maps: High Performance Commercial Buildings, Windows, Lighting (which includes specific roadmaps on solid state lighting), Building Envelope, Appliances and Controls, and Zero Energy Homes, now part of the conservation budget that are being updated and incorporated into the R&D portfolio.

Validation and Verification

To validate and verify program performance, the Building Technologies Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. The table below summarizes validation and verification activities.

| | |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Sources: | EIA Annual Energy Review (AER); Commercial Building Energy Consumption Survey (CBECS); Residential Energy Consumption Survey (RECS); and Annual Energy Outlook (AEO). U.S. DOC Current Industrial Reports (CIR). Various trade publications. Information collected directly from Building Technologies performers or partners. |
| Baselines: | <p>The following are key baselines used in the Building Technology Program</p> <ul style="list-style-type: none"> ▪ Residential Buildings Energy Use Intensity Index (2000): 1 (Building America Benchmark) ▪ Commercial Buildings Energy Use Index (1980): 1 (Energy Information Administration) ▪ Solid State Lighting (2003): 30 Lumens/watt efficacy ▪ Windows (2003): 0.33 to 0.5 U-value (varies by region) ▪ Residential Heating and Cooling (2003): 6.8 HSPF and 10 SEER |
| Frequency: | Complete revalidation of assumptions and results can only take place every three to four years, due to the reporting cycle of two crucial publications: CBECS and RECS. However, updates of most of the baseline forecast and BT program outputs will be undertaken annually. |
| Data Storage: | EIA and DOC data sources are publicly available. Trade publications are available on a subscription basis. BT program output information is contained in various reports and memoranda. |
| Verification: | Calculations are based on assumptions of future market status, equipment or technology performance, and market penetration rates. These assumptions can be verified against actual performance through technical reports, market survey and product shipments. |

Program Assessment Rating Tool (PART)

The FY 2004 PART review of the Building Technologies Program contained a recommendation to

redirect existing funding for lighting R&D towards high-risk, high-payoff technologies that support the Department's proposed Solid State Lighting Initiative. In response to this recommendation, DOE issued a solicitation, through the National Energy Technology Laboratory, seeking projects to significantly reduce energy use in buildings by targeting appliances and water heaters, building envelopes, lighting, and space conditioning. Seven of the thirteen projects selected are lighting projects, including solid state lighting projects. Another PART recommendation suggested the development of adequate long-term and annual performance measures, and the Building Technologies program is developing multi-year program plans and annual operating plans that will include these measures.

The FY 2005 PART recognized the program's improvements, finding that the program has a clear purpose and improved management, citing its prioritization process in its standards activities and increasing focus on longer term R&D. However, work remains on addressing needed improvements in performance measures. The net result was that the program's overall score remained relatively constant and its rating remained adequate.

Funding by General and Program Goal

(dollars in thousands)

| FY 2003 Comparable Appropriation | FY 2004 Request | FY 2005 Request | \$ Change | % Change |
|----------------------------------------|--------------------|--------------------|--------------|-------------|
|----------------------------------------|--------------------|--------------------|--------------|-------------|

General Goal 4, Energy Security

Program Goal 04.04.02.00

| | | | | | |
|-----------------------------------------------------|--------|--------|--------|--------|---------|
| Residential Buildings Integration..... | 12,133 | 13,067 | 18,932 | +5,865 | +44.9% |
| Commercial Buildings Integration | 4,386 | 4,440 | 4,995 | +555 | +12.5% |
| Emerging Technologies | 30,564 | 29,997 | 25,057 | -4,940 | -16.5% |
| Equipment Standards and Analysis .. | 9,635 | 10,387 | 7,800 | -2,587 | -24.9% |
| Oil Heat Research for Residential Buildings..... | 0 | 494 | 0 | -494 | -100.0% |
| Technical/Program Management Support..... | 1,609 | 1,481 | 1,500 | +19 | +1.3% |
| Total, Program Goal 04.04.02.00 | 58,327 | 59,866 | 58,284 | -1,582 | -2.6% |
| Total, Building Technologies | 58,327 | 59,866 | 58,284 | -1,582 | -2.6% |

Expected Program Outcomes

The Building Program pursues its mission through integrated activities designed to improve the energy efficiency and productivity of our economy. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the Building Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, oil savings, natural gas savings, and the reduced need for electricity capacity additions that result from the realization of Building Program goals are shown in the table below through 2050. In addition to the types of benefits quantified above, building efficiency and renewable technologies often provide non-energy benefits, such as improved lighting quality and building occupant productivity. The benefits estimates reported in this table do not include any expected acceleration in the deployment of these new technologies due to the unique field partnerships that provide the basis for the Residential Building Integration R&D, or synergies with the EPA Energy Star Home program.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. Final documentation estimated to be completed and posted by March 15, 2004. Uncertainties are larger for longer term estimates. The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible

program production technologies; nonetheless, they provide a useful picture of growing national benefits over time.

FY 2005 GPRA Benefits Estimates for the Buildings Program^a

Mid-Term Benefits^b

| | 2010 | 2015 | 2020 | 2025 |
|-----------------------------------------------------------|------|------|------|------|
| Primary Non-Renewable Energy Savings (Quads) | 0.3 | 0.7 | 1.1 | 2.0 |
| Energy Expenditure Savings (Billion 2001\$) | 4 | 10 | 16 | 27 |
| Carbon Emission Reductions (MMTCE)..... | 6 | 13 | 22 | 43 |
| Oil Savings (MBPD)..... | 0.02 | 0.03 | 0.04 | 0.08 |
| Natural Gas Savings (Quads)..... | 0.15 | 0.33 | 0.54 | 0.78 |
| Total Displaced Need for New Electric Capacity (GW) | 5 | 10 | 21 | 36 |

Long-Term Benefits^c

| | 2030 | 2040 | 2050 |
|-----------------------------------------------------------|------|------|------|
| Primary Non-Renewable Energy Savings (Quads) | 2.3 | 2.3 | 2.8 |
| Energy System Cost Savings (Billion 2001\$)..... | 23 | 34 | 45 |
| Carbon Emission Reductions (MMTCE)..... | 43 | 43 | 50 |
| Oil Savings (MBPD)..... | 0.1 | 0.2 | 0.2 |
| Natural Gas Savings (Quads)..... | 1.12 | 1.54 | 1.82 |
| Total Displaced Need for New Electric Capacity (GW) | 46 | 48 | 53 |

^a Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

^b Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

^c Long-term benefits were estimated utilizing the GPRA05 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Residential Buildings Integration

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-------------------------------------------------|---------|---------|---------|-----------|----------|
| Residential Buildings Integration | | | | | |
| Research and Development: Building America..... | 11,558 | 12,484 | 18,342 | +5,858 | +46.9% |
| Residential Building Energy Codes | 575 | 583 | 590 | +7 | +1.2% |
| Total, Residential Buildings Integration..... | 12,133 | 13,067 | 18,932 | +5,865 | +44.9% |

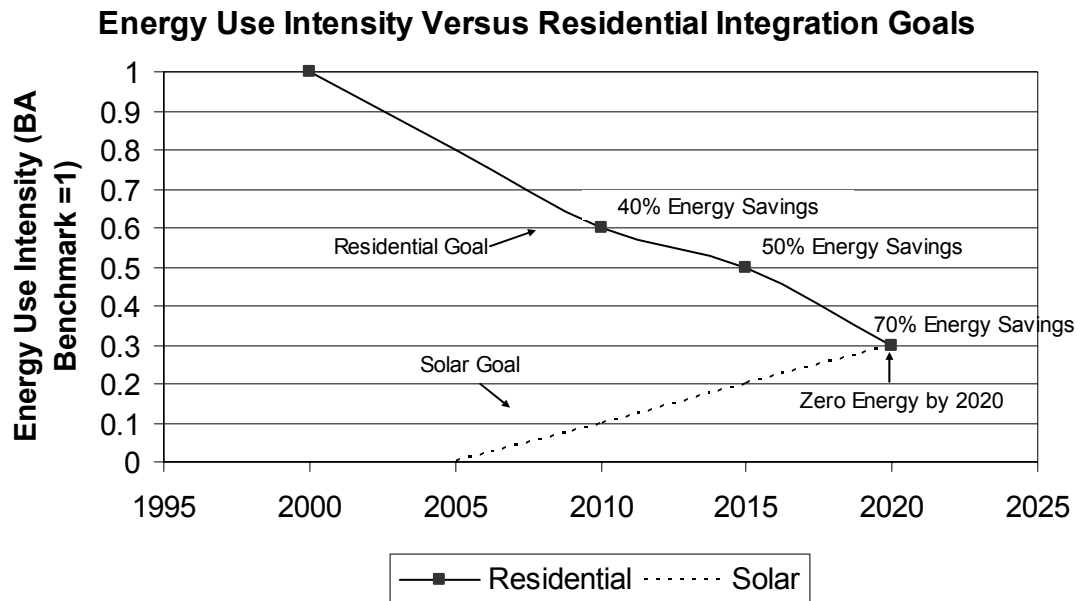
Description

The long-term goal of the Residential Buildings Integration subprogram is to develop cost effective designs for houses that produce as much energy as they use on an annual basis.

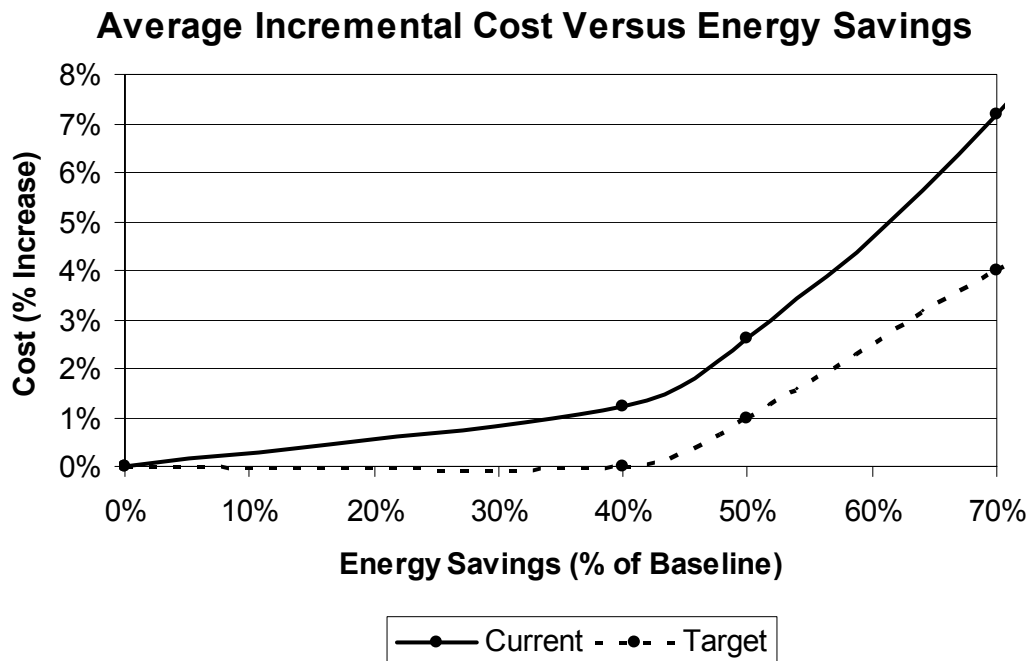
Benefits

Research will focus on finding ways to reduce the total energy use in a new home by 40 to 70 percent. This improvement in energy efficiency when coupled with research to integrate onsite renewable energy supply systems into the homes will result in marketable net zero energy designs. During FY 2005, in partnership with designers, builders and component manufactures, the Residential Buildings Integration subprogram will focus research on development and evaluation of practical strategies to reduce whole house energy use in new homes by 40 to 70 percent and also evaluate the application of these strategies in existing homes to achieve savings of 20 percent.

The following graphs show the progress, and targets, towards reaching the Residential Buildings Integration goal of achieving the technical capability to produce net Zero Energy Buildings by 2020, as well as the required cost targets needed if the research is to be adopted by the industry. The baseline for the Energy Use Intensity measure is the Building America Research Benchmark Definitions. The BA benchmark was developed for tracking and measuring the success of the Residential Building Integration goals. The Residential Building Integration goals are designed to achieve levels of conservation in residential buildings that will be complemented by renewable energy from the Solar Program to produce zero energy buildings in 2020. (Building America, Building America Research Benchmark Definition, Version 3.1, November 11, 2003, National Renewable Energy Laboratory.)



The goals of the Residential Building Integration program not only involve achieving conservation at the 40 to 70 percent levels, but also specify cost targets that will allow for market adoption. An optimization analysis determined the portfolio of technologies that could achieve each level of conservation for the lowest added cost. For lowest levels of conservation, the incremental cost is near the target cost, but for high levels of conservation the incremental cost far exceeds the target. In addition to developing new technologies, cost reduction research and development will be crucial to reaching high levels of conservation and the goal of net zero energy buildings. The average incremental costs for each Residential Integration goal are captured in the graph below along with the target costs.



Related indicators of progress include:

- By 2007, develop 5 regional Builder System Performance Packages to incorporate cost-effective “best practice” systems that reduce space conditioning energy use by 40 to 70 percent.
- Development and testing of 5 promising technological solutions required to reduce whole house energy use by 50 percent in the different climate regions of the U.S. and for different housing types.
- Design, construct and test research houses having whole house energy savings of a least 40 percent with 20 builders from the Building America Consortia.
- Validate the performance of at least 300 houses, representing the five climate zones that were constructed to meet this performance goal.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Research and Development: Building America 11,558 12,484 18,342

In FY 2005, conduct systematic research on conservation technologies that will contribute to marketable designs for net zero energy homes (ZEH). The research plan for Building America involves development and field testing of subsystems having the energy use efficiency with renewable energy technologies and performance required for ZEH; construction and evaluation of prototype homes using a combination of these subsystems, built under the careful supervision of the Building America scientists and engineers; construction of entire developments which apply these design strategies to confirm that they can be replicated by builders and trades people and still achieve the same level of performance as the prototype homes; and finally documentation of the design strategies for general use.

Subsystem research: Pursue research, development and testing of 5 promising technological solutions required to reduce whole house energy use by 50 percent in the different climate regions of the U.S. and for different housing types. The primary areas of research include: continued evaluation of cooling equipment that effectively manages humidity in homes to ensure comfort and minimize mold problems; field testing of efficient heating and cooling distribution and ventilation systems required to maintain a comfortable and healthy home; research on efficient lighting system designs that are aesthetically pleasing; and development of whole house controls to optimize the use of energy in the home and reduce peak demand.

Prototype and production homes: Work with 20 builders from the Building America Consortia to design, construct and test research houses having whole house energy savings of a least 40 percent based on the lessons learned from research conducted in FY 2003 and FY 2004. Conduct system engineering evaluations to validate the performance of at least 300 houses, representing the five climate zones that were constructed to meet this performance goal. Develop designs for homes that use 70 percent less energy through the full integration of renewable energy systems with efficient

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

house designs.

Existing homes research: Leverage research being conducted by States and other organizations to improve the performance of existing homes. Test 5 system approaches to improve energy efficiency in existing buildings with a target of reducing overall energy use by 20 percent.

Documentation: Develop 5 regional Builder System Performance Packages to incorporate cost-effective “best practice” systems that reduce space conditioning energy use by 40 percent. In addition to builders’ guides, work with the different segments of the housing and construction industry to develop documentation designed to communicate the value and benefits of the high performance homes and to define the methods that builders can use to easily build homes that meet the Energy Star criteria and to take advantage of the proposed residential energy tax credit. Prepare case studies of results from the first generation net Zero Energy Homes constructed and monitored in FY 2003 and FY 2004. Develop Remodeler System Performance Packages that describe “best practice” system retrofits for existing buildings for each climate region that show home owners ways to take advantage of the existing homes energy tax credit and maximize energy savings. In FY 2003 this activity was reduced by \$208,068 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include ConSol, Building Science Corporation, Steven Winter Associates, IBACOS, Inc., NREL, ORNL, FSEC and Others TBD*

Residential Building Energy Codes

In FY 2005, develop revisions to the International Energy Code Council (IECC) 2006 Edition (building energy codes standard); the National Fire Protection Association (NFPA) and the National Fenestration Rating Council (NFRC) to promote window assemblies that would be more cost-effective and energy efficient than under the IECC 2003 (FY 2004 \$261,735). Evaluate emerging technologies and develop appropriate revisions to the residential building codes that will support the inclusion of systems engineering approaches enabling the cost-effective design, construction, and operation of Zero Energy Homes. In FY 2003, this activity was reduced by \$10,951 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include: PNNL, and others TBD.*

| | | | |
|-------------------------------------------------------|---------------|---------------|---------------|
| Total, Residential Building Energy Codes | 575 | 583 | 590 |
| Total, Residential Buildings Integration | 12,133 | 13,067 | 18,932 |

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Residential Buildings Integration

Research and Development: Building America

Accelerate research and development activities to improve whole-house energy efficiency by 40-50 percent, develop whole house controls to optimize energy use and reduce peak demands and allow full integration of renewable energy technologies required to achieve net zero energy home goals..... +5,858

Residential Building Energy Codes

No significant change +7

Total Funding Change, Residential Buildings Integration +5,865

Commercial Buildings Integration

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------------|---------|---------|---------|-----------|----------|
| Commercial Buildings Integration | | | | | |
| Research and Development..... | 3,858 | 3,905 | 4,454 | +549 | +14.1% |
| Commercial Building Energy Codes | 528 | 535 | 541 | +6 | +1.1% |
| Total, Commercial Buildings Integration | 4,386 | 4,440 | 4,995 | +555 | +12.5% |

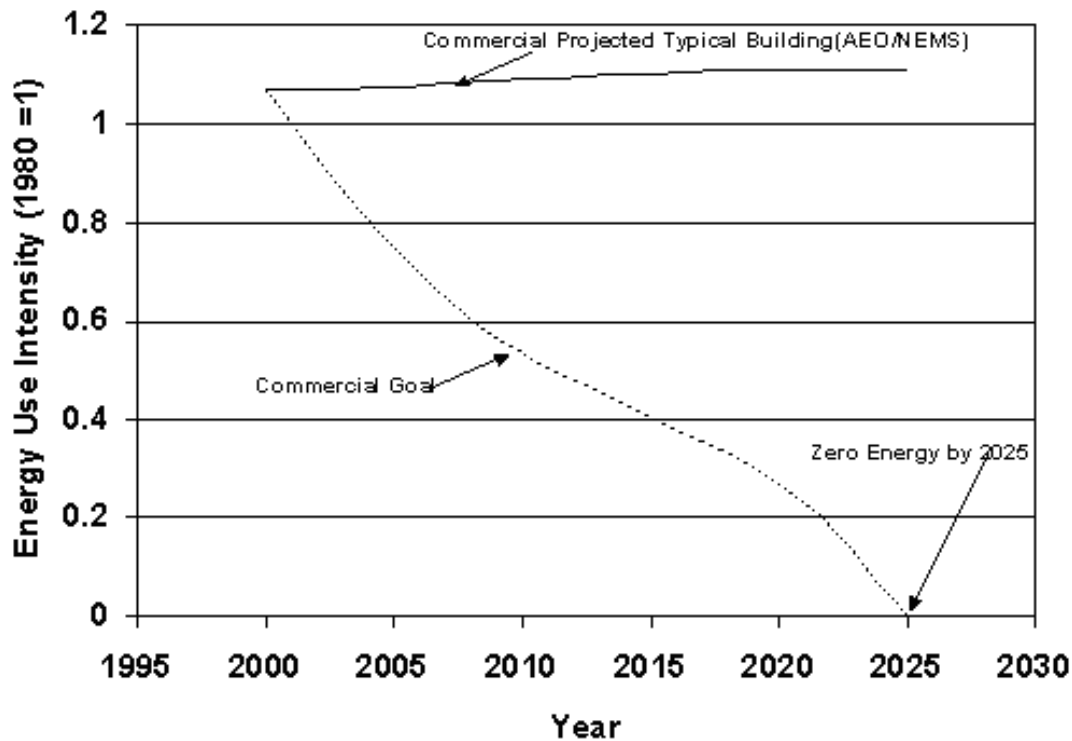
Description

The long-term goal of the Commercial Buildings Integration subprogram is to develop cost effective designs for commercial buildings such that they produce as much energy as they use on an annual basis. Research will focus on finding ways to reduce the total energy use in a commercial building by 60 to 70 percent. This improvement in energy efficiency when coupled with research to integrate onsite renewable energy supply systems into the commercial building will result in marketable net zero energy designs. During FY 2005, in partnership with designers, builders and component manufactures, the Commercial Buildings Integration subprogram will focus research on development and evaluation of practical strategies to reduce building energy use in new small commercial buildings by 50 percent and by 20 percent in existing small commercial buildings.

Benefits

The Commercial Building Integration sub-program will improve energy security by reducing energy consumption and peak electrical demands of commercial building.

The following graph conceptually illustrates the progress, and targets, towards reaching the Commercial Buildings Integration goal of achieving the technical capability to produce net Zero Energy Buildings by 2025.



Analytical assessments completed in FY 2005 will define the pathway more definitively, across the wide range of commercial building types and climates.

Related indicators of progress include:

- Identify integrated packages of technologies from simulation optimization studies of small commercial buildings in multiple climates throughout the U.S.
- Identify potential partners to document and test the packages with 50 percent lower energy use in new construction and 30 percent lower use in existing buildings.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Research and Development **3,858** **3,905** **4,454**

In FY 2005, technology assessment activities will be completed and the focus will begin to shift to developing packages of cost-effective technologies for small commercial buildings to reach 50 percent, 75 percent, or zero net energy. These packages will build on the knowledge gained from completing the intensive case studies of six high performance buildings in FY 2003 and 2004, completing the broad-based assessments of technology and market opportunities, system optimization methods and design strategies begun in FY 2004 and continuing work with designers, developers and

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

owners of high performance buildings. Begin to develop integrated packages of technologies from simulation optimization studies of small commercial buildings in multiple climates throughout the U.S. Begin to determine the technology advancements required for routinely creating zero energy buildings within 20 years. Identify potential partners to test the packages with 50 percent lower energy use in new construction and 30 percent lower use in existing buildings. Continue research projects on advanced whole building control devices and systems as identified in the research plan developed with industry in FY 2003. Complete two field evaluation projects to establish the technical viability of two key wireless technologies which could enable cost effective retrofit of existing buildings with state-of-the-art control systems.

In collaboration with a manufacturer, complete field testing and monitoring of a manufacturer's prototype improved ventilation and air conditioning system for portable school classrooms that will reduce energy use by 25 percent. Collaborate with manufacturers to develop standard test procedures and ventilation rate measurement and control systems to reduce ventilation energy use by 40 percent. In FY 2003, this activity was reduced by \$69,662 for SBIR/STTR and transferred to the Science appropriation. *Participants will include: LBNL, National Institute of Standards & Technology (NIST), NREL, PNNL, University of California, and others TBD.*

| | | | |
|-----------------------------------------------|------------|------------|------------|
| Commercial Building Energy Codes | 528 | 535 | 541 |
|-----------------------------------------------|------------|------------|------------|

In FY 2005, begin developing a series of code change proposals that will make it easier for code officials to accept newer technologies in support of the 2025 goal of marketable zero energy commercial buildings. Develop revisions to the IECC 2006 Edition/ASHRAE Standard 90.1 – 2004 including energy efficient revisions to the NEPA and NERC to promote energy efficient window assemblies. Coordinate efforts with the Federal commercial codes activities to ensure that private sector and Federal codes work together to develop consistent and more stringent codes. Sponsor 3-5 workshops to develop new ideas and mechanisms for code change proposals that can be realistically adopted into code. Provide technical assistance to states and local government as well as Federal agencies to accelerate the adoption of energy efficient building codes. Begin active discussions with code organizations to form joint task groups that will develop and produce advanced building guidelines to achieve energy savings in new construction of 30 percent beyond current code in 2005. In FY 2003, this activity was reduced by \$9,499 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include: PNNL and others TBD.*

| | | | |
|------------------------------------------------------|--------------|--------------|--------------|
| Total, Commercial Buildings Integration | 4,386 | 4,440 | 4,995 |
|------------------------------------------------------|--------------|--------------|--------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Research and Development

| | |
|------------------------------------------------------------------------------------|------|
| Increase to enable design package development for small commercial buildings | +549 |
|------------------------------------------------------------------------------------|------|

Commercial Building Energy Codes

| | |
|-----------------------------|----|
| No significant change | +6 |
|-----------------------------|----|

| | |
|---------------------------------------------------------------------|-------------|
| Total Funding Change, Commercial Buildings Integration | +555 |
|---------------------------------------------------------------------|-------------|

Emerging Technologies

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------------|---------|---------|---------|-----------|----------|
| Emerging Technologies | | | | | |
| Lighting R&D..... | 9,982 | 11,402 | 12,500 | +1,098 | +9.6% |
| Space Conditioning and Refrigeration R&D..... | 5,580 | 5,337 | 3,000 | -2,337 | -43.8% |
| Appliances and Emerging Technologies R&D..... | 1,703 | 1,980 | 1,755 | -225 | -11.4% |
| Building Envelope R&D..... | 8,041 | 8,190 | 5,000 | -3,190 | -38.9% |
| Analysis Tools and Design Strategies..... | 3,032 | 3,088 | 2,802 | -286 | -9.3% |
| Technology Road Maps..... | 2,226 | 0 | 0 | 0 | 0.0% |
| Total, Emerging Technologies... | 30,564 | 29,997 | 25,057 | -4,940 | -16.5% |

Description

The long-term goal of the Emerging Technologies subprogram is to develop cost effective technologies, e.g., lighting, windows, and space heating and cooling, for residential and commercial buildings. Research will focus on finding technologies to support the residential and commercial building goal to reduce the total energy use in buildings by 60 to 70 percent. The improvement in component and system energy efficiency when coupled with research to integrate onsite renewable energy supply systems into the commercial building will result in marketable net zero energy designs.

Specifically, we will focus on:

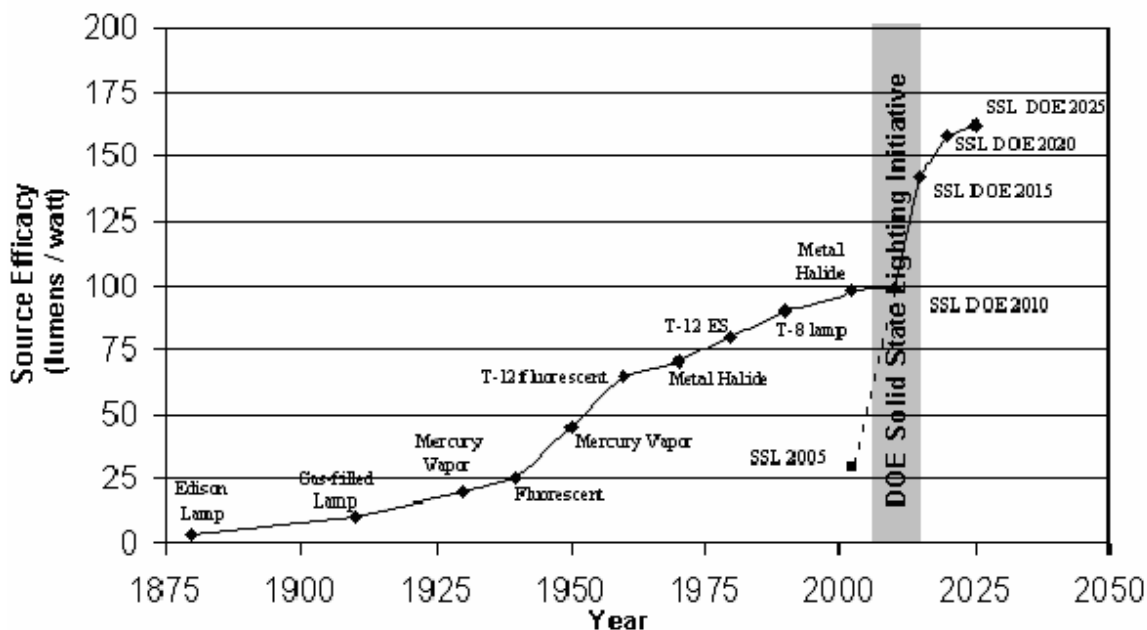
- Solid state lighting, which have long term efficiencies that have the potential to approach 200/lpw, compared to most conventional technologies maximum efficiencies in the 85 to 115 range.
- Advanced windows, which have the potential to move from a net energy loss to a net energy provider by incorporating advanced insulation materials and technologies that enable dynamic control of thermal and tight transmittance performance.

Benefits

The Emerging Technologies sub-program improves energy security through support of the technology development needs of the Residential Integration and Commercial Integration sub-programs, and as well as the need for replacement technologies in the existing building stock.

The two graphs below are examples of critical technologies required to reduce whole building energy use, both new and existing, and represent areas of major focus in Emerging Technologies. The lighting graph is illustrative of the efficacy improvement possible.

Electric Lamp White Light Efficacy Improvement



| Characteristics | (calendar year) | | | |
|---------------------------------------------------------------|-----------------|----------|---------------------|---------------------|
| | 1985 | 2003 | 2005 | 2010 |
| Whole Window Thermal Performance (U-Value) | 0.4 | 0.33-0.5 | 0.3 | 0.17 |
| Solar Control (Solar Heat Gain Coefficient) (in winter)..... | .04 | .03 | 0.6 to gain heat | 0.6 to gain heat |
| Solar Control (Solar Heat Gain Coefficient) (in summer) | .04 | .03 | 0.05 to reject heat | 0.05 to reject heat |

Detailed Justification

| (dollars in thousands) | | |
|------------------------|---------|---------|
| FY 2003 | FY 2004 | FY 2005 |

Lighting R&D **9,982** **11,402** **12,500**

In FY 2005, implement the solid state lighting research activities resulting from the FY 2003 solicitation to develop and deploy projects for general illumination that could achieve energy efficiencies upwards of 70 percent through creation of a technical foundation to revolutionize the energy efficiency, appearance, visual comfort, and quality of lighting. Solid state lighting can capture at least a 50 percent electricity peak demand reduction in commercial buildings' lighting load, while continuously saving energy during all operating hours. These activities will focus on several areas: quantum efficiency, lifetime, performance, packaging, infrastructure, and first cost. The R&D plan will be updated to reflect recent achievements in science/engineering and build on results of DOE-

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

funded projects, such as light emitting diodes (LEDs) for spot source lighting, and organic LEDs for general lighting. Solid State Lighting Funding of \$10.2 million is requested in FY 2005.

Perform light source research on technology breakthroughs for conventional types of lamps to improve efficiency by 20 to 50 percent. Produce high-value outcomes such as: high-performance multi-photon phosphors, non-mercury containing fluorescent lamps, or advanced high intensity discharge lighting with dimming and quality of light controls.

In close collaboration with the Commercial Buildings activity, develop lighting system technologies, strategies, and guidelines, which support optimum building performance and ZEB goals. Develop solutions to overcome technological barriers to widespread use of lighting control systems in commercial buildings including daylight harvesting controls and load shedding capabilities. These solutions will enable a 20 to 30 percent electricity peak demand reduction in a commercial building's lighting load. Demonstrate the impact of lighting quality and also spectral power distribution (wavelength) on occupant satisfaction and performance producing additional reasons for building owners to invest in energy efficiency and high quality lighting. In FY 2003, this activity was reduced by \$245,217 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include: LBNL, Lighting Research Center, NETL, universities and others that are competitively selected.*

Space Conditioning and Refrigeration R&D..... 5,580 5,337 3,000

In FY 2005, focus research on space conditioning technology applications that will reduce peak electric demand in residential and commercial buildings by 50 percent for new construction and 30 percent for existing buildings. Based on a thermodynamic study of emerging refrigerants, complete development of a laboratory prototype, high efficiency residential 1-ton air-conditioning and heat pump unit that uses a novel approach to the vapor compression refrigeration cycle and has the potential for a Seasonal Energy Efficiency Rating (SEER) of over 20. Investigate the impact of desiccants and thermal storage systems for peak air conditioning electric demand reduction. Other research and development activities include: a novel refrigeration cycle, a leak tight duct system, integrated options for improved space conditioning and domestic hot water and increased HVAC air distribution system efficiency.

Building integrated controls based on low-cost sensors, advanced control logic, and communications has the market potential to save almost 0.3 Quads of energy per year according to recent studies of Heating, Ventilation, Air Conditioning and Refrigeration (HVAC&R) technology opportunities. New technologies in this area could enable real-time pricing, controls responsive to weather forecasting, and make HVAC&R systems that satisfy user needs in ways that both save energy and increase comfort. Research and development is timely because of opportunities to leverage advances in communication including wireless and the internet to enable intelligent communications and controls at low cost. To pursue these opportunities, prototype equipment diagnostic systems with remote monitoring capability will be investigated to quantify the performance benefits of timely maintenance. In FY 2003, this activity was reduced by \$137,068 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include: BNL, LBNL, NIST, ORNL, Academia, manufacturers and others that are competitively selected.*

Appliances and Emerging Technologies R&D 1,703 1,980 1,755

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

In FY 2005, focus new project development on products with highest potential to contribute to building energy reduction. Investigate opportunities to speed commercial introduction of new solid-state lighting products. Continue developing public-private partnerships to improve the cost and performance attributes of selected products by late-stage engineering and development; establish the viability and reliability of products by engineering field evaluations and lab testing as input to design improvements; verify the cost-performance of products as applied in buildings by field demonstration; and support market development of technology by procurement actions with large volume buyers and manufacturers.

Conclude field demonstrations of heat pump water heaters (HPWH), commercial unitary air conditioners, and reflector compact fluorescent lamps (CFLs). In cooperation with manufacturers, electric utility industry, large volume buyers and other industry partners, co-develop and implement projects to speed commercial introduction and uptake of (1) CFL recessed downlights, (2) HPWHs, (3) unitary air conditioners, (4) and reflector CFLs. Initiate the second national efficient residential fixture lighting design competition in cooperation with American Lighting Association. In FY 2003, this activity was reduced by \$41,806 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include: ORNL, PNNL, Dawnbreaker, and others TBD.*

| | | | |
|----------------------------------|--------------|--------------|--------------|
| Building Envelope R&D | 8,041 | 8,190 | 5,000 |
|----------------------------------|--------------|--------------|--------------|

- | | | | |
|---------------------------------------------------|--------------|--------------|----------|
| ▪ Thermal Insulation and Building Materials | 3,166 | 3,224 | 0 |
|---------------------------------------------------|--------------|--------------|----------|

In FY 2005, Thermal Insulation and Building Materials activities are suspended due to advanced state of technologies, which are being demonstrated in the Residential Integration sub-program. In FY 2003, this activity was reduced by \$77,753 for SBIR/STTR and transferred to the Science Appropriation.

- | | | | |
|-----------------------------|--------------|--------------|--------------|
| ▪ Window Technologies | 4,875 | 4,966 | 5,000 |
|-----------------------------|--------------|--------------|--------------|

In FY 2005, competitive research, cost-shared with industry, will be conducted to further improve product performance, manufacturer yields, and fundamental manufacturing processes of electrochromic devices that have successfully passed rigorous laboratory durability and field tests. This will pave the way for a range of competing products in the market place with greater market appeal through uniform coatings, high reliability, and reduced cost.

Competitive fundamental science research will be conducted to develop the second generation of materials, chemical applications, and processes that can offer “leap frog” reductions in cost while maintaining a high level of reliability and durability with a broad range of optical properties. The second generation of dynamic windows should enter the market in the 2010 to 2015 timeframe, with full market transformation occurring in the commercial market around 2020. It is believed that fundamental science breakthroughs will be needed to reach price points that will allow for full market transformation.

Limited exploratory research will be conducted to pursue highly insulating windows and daylighting technologies. Promising technologies and applications will be further characterized and investigated to lay the foundation for future R&D as funds become available after completing higher priority dynamic window research. Several promising projects may be awarded competitively to industry to market these technologies at affordable prices within the next 5 to 10

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

years. Highly insulated windows can drastically reduce heating loads in colder climates that account for about 2 quads annually. The development of daylighting technologies that deliver natural light deeper into commercial spaces have the potential to save approximately 1 quad of energy annually.

Technology support research will be conducted to assist the windows industry to rate, label and promote highly efficient fenestration products on the market. The suite of software design and rating tools, Windows 6.0 and associated programs, will be completed for use by manufacturers and adoption by NFRC to rate complex glazing systems. Such glazing systems are widely available in the commercial buildings market, but currently cannot be rated by a simulation tool that reduces cost to manufacturers and encourages the introduction of highly efficient systems. Basic maintenance of existing technical support tools for the residential market will be maintained, including support for the NFRC labeling and rating process. In FY 2003, this activity was reduced by \$119,774 for SBIR/STTR and transferred to the Science Appropriation. (Item of Congressional Interest: National Administration Rating Council, funded at \$265,000 in FY 2003, \$265,000 in FY 2004, and \$265,000 in FY 2005). *Participants will include: LBNL, Florida Solar Energy Center, ORNL, University of Massachusetts, University of Minnesota, PNNL, CA Energy Commission, NFRC, Alliance to Save Energy, NREL, and a variety of other performers based on competitive awards.*

| | | | |
|---------------------------------------------------|--------------|--------------|--------------|
| Analysis Tools and Design Strategies | 3,032 | 3,088 | 2,802 |
|---------------------------------------------------|--------------|--------------|--------------|

In FY 2005, research, develop, and implement new EnergyPlus simulation software modules which enable development and compliance with current and near-term building energy standards incorporating new building energy efficiency technologies, such as displacement cooling and ventilation, integrated building systems, and equipment control systems and strategies, multispeed heating and cooling equipment and fans, and hybrid heating and cooling systems and equipment. Identify and prioritize builder, designer, operator, and researcher needs for natural and mechanical ventilation and air flow modeling capabilities. Provide technical support to the 15 private sector interface developers and the more than 50 organizations currently developing new EnergyPlus modules. Work with developers of the two major HVAC design sizing programs to incorporate Energy Plus into their software. Work with the International Alliance for Interoperability to ensure that building thermophysical and energy characteristics are embedded in release 3X of their Industry Foundation Classes (IFCs). Update EnergyPlus utilities to reflect IFC extensions and updates. Working with the Commercial and Residential teams, identify and prioritize the simulation capabilities necessary for the 50 percent, 75 percent energy reduction, and net zero energy building levels. In FY 2003, this activity was reduced by \$74,466 for SBIR/STTR and transferred to the Science Appropriation. *Participants include: Florida, Solar Energy Center, GARD Analytics, LBNL, J. Neymark Associates, NREL, Oklahoma State University, University of Illinois, and others TBD.*

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|
| Technology Road Maps | 2,226 | 0 | 0 |
| In FY 2005, roadmapping activities will continue to be implemented within the different program areas. In FY 2003, this activity was reduced by \$54,718 for SBIR/STTR and transferred to the Science Appropriation. <i>Participants: National Energy Technology Lab (NETL), other national laboratories and industry partners TBD.</i> | | | |
| Total, Emerging Technologies | 30,564 | 29,997 | 25,057 |

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Lighting R&D

Expand research on solid state lighting activities targeting a new technological paradigm of efficiency for general illumination, up to 90 percent more efficient than today's light sources +1,098

Space Conditioning and Refrigeration R&D

Reduce near term projects on heat pump water heaters and unitary air conditioners; Emphasize high risk longer term project at lower levels of effort in order to better align space conditioning R&D to residential and commercial integration activities..... -2,337

Appliances and Emerging Technologies R&D

Completed heat pump water heater field validations in FY 04 -225

Building Envelope R&D

Suspends thermal insulation research due to advanced state of technologies, which are being demonstrated in the Residential Integration sub-program..... -3,190

Analysis Tools and Design Strategies

Less funding is required due to the delaying of the incorporation of Zero Energy Buildings capability until required field validation is completed..... -286

Total Funding Change, Emerging Technologies **-4,940**

Equipment Standards and Analysis

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------------|---------|---------|---------|-----------|----------|
| Equipment Standards and Analysis | | | | | |
| Equipment Standards and Analysis..... | 9,635 | 10,387 | 7,800 | -2,587 | -24.9% |
| Total, Equipment Standards and Analysis | 9,635 | 10,387 | 7,800 | -2,587 | -24.9% |

Description

The goal of the Equipment Standards and Analysis subprogram is to develop minimum energy efficiency standards that are technologically feasible and economically justified. During FY 2005, the Equipment Standards and Analysis subprogram will focus on completing energy efficiency standards rulemakings for three priority products: electric distribution transformers; commercial central air conditioners and heat pumps; and residential furnaces.

Benefits

The table shows the progress of statutorily mandated Equipment Standards over the years, as well as anticipated future standards.

| Equipment | (original standard) | | (first update) | | (second update) | |
|---------------------------------|---------------------|----------------|----------------|----------------|-----------------|----------------|
| | Date | Effective Date | Final Rule | Effective Date | Final Rule | Effective Date |
| Residential Products | | | | | | |
| Refrigerators and Freezers..... | 1987 | 1990 | 1989 | 1993 | 1997 | 2001 |
| Room Air Conditioners..... | 1987 | 1990 | 1997 | 2000 | | |
| Central Air Conditioners..... | 1987 | 1992 | 2001 | 2005 | | |
| Clothes Dryers | 1987 | 1988 | 1991 | 1994 | | |
| Clothes Washers | 1987 | 1988 | 1991 | 1994 | 2001 | 2004 |
| Dishwashers | 1987 | 1988 | 1991 | 1994 | | |
| Water Heaters..... | 1987 | 1990 | 2001 | 2004 | | |
| Furnaces | 1987 | 1992 | In Process | | | |
| Electric Cooking Products..... | 1987 | 1990 | 1998 | 1998 | | |
| Pool Heaters | 1997 | | | | | |

| Equipment | (original standard) | | (first update) | | (second update) | |
|---------------------------------------------|---------------------|------------------------|----------------|----------------|-----------------|----------------|
| | Date | Effective Date | Final Rule | Effective Date | Final Rule | Effective Date |
| Commercial Products | | | | | | |
| Fluorescent Lamp Ballasts | 1988 | 1990 | 2000 | 2004 | | |
| ASHRAE Products | 2001 | 2003/2004 ^a | | | | |
| Unitary AC/HP | In Process | | | | | |
| Electric Distribution Transformers | In Process | | | | | |
| HID (Determination) | In Process | | | | | |
| Small Electric Motors (Determination) | In Process | | | | | |

Related indicators of progress include:

- In 2004, conduct Advance Notice of Proposed Rulemaking workshops for distribution transformers, residential furnaces and boilers and commercial unitary air conditioners and heat pumps.
- Complete analysis for HID determination.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Equipment Standards and Analysis **9,635** **10,387** **7,800**

In FY 2005, develop final rules regarding energy conservation standards for electric distribution transformers and commercial unitary air conditioners and heat pumps 65-135 and 135-240 kBtu/h and residential furnaces. Continue to develop test procedures and initiate standard rulemaking for torchieres, ceiling fans and commercial refrigerator products (reach-in refrigerators/freezers, vending machines/beverage merchandiser). Continue to implement a plan based on analyses that propose to add new products to the lighting and appliance standards program as well as other approaches such as tax incentives and ENERGY STAR labeling to improve and promote the efficiency of appliances and equipment.

Initiate standards rulemakings on products as identified in the prioritization process. Review existing test procedures to ensure that they remain current with advancing technology and measurement of standby power consumption. Ensure compliance to standards through follow-up inquiries, random audits, and investigations of noncompliance allegations. In FY 2003, this activity was reduced by 74,466 for SBIR/STTR and transferred to the Science Appropriation. *Participants will include:*

^a Central Water Cooled AC, Water Source HP, Evaporatively Cooled AC

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

LBNL, NIST, NREL, PNNL, and others TBD.

| | | | |
|------------------------------------------------------|--------------|---------------|--------------|
| Total, Equipment Standards and Analysis | 9,635 | 10,387 | 7,800 |
|------------------------------------------------------|--------------|---------------|--------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Equipment Standards and Analysis

| | |
|-------------------------------------------------------------------------------------------------------------------------------|--------|
| Resources commensurate with current needs to achieve energy efficiency improvements associated with various rulemakings | -2,587 |
|-------------------------------------------------------------------------------------------------------------------------------|--------|

| | |
|---------------------------------------------------------------------|---------------|
| Total Funding Change, Equipment Standards and Analysis | -2,587 |
|---------------------------------------------------------------------|---------------|

Oil Heat Research for Residential Buildings

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|----------------------------------------------------------|---------|---------|---------|-----------|----------|
| Oil Heat Research for Residential Buildings | | | | | |
| Oil Heat Research for Residential Buildings..... | 0 | 494 | 0 | -494 | -100.0% |
| Total, Oil Heat Research for Residential Buildings | 0 | 494 | 0 | -494 | -100.0% |

Description

The goal of the Oil Heat Research for Residential Buildings subprogram is to develop ultra-low emissions combustion technologies for oil-based fuels that could be used in residential building applications.

Benefits

Based on the completion of research to improve the environmental performance of oil combustion systems in FY 2004, no further activities will be performed in the Oil Heat Research for Residential Buildings subprogram in FY 2005.

Detailed Program Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Oil Heat Research for Residential Buildings

In FY 2003, \$745,000 was appropriated for the Oil Heat Research for Residential Buildings subprogram as part of the Fuel Flexibility subprogram under the Distributed Energy and Electric Reliability Program. No funds are requested in FY 2005 as projects are completed. *Participants include: None.*

| | | | |
|---------------------------------------------------------|---|-----|---|
| Total, Oil Heat Research for Residential Buildings..... | 0 | 494 | 0 |
|---------------------------------------------------------|---|-----|---|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Oil Heat Research for Residential Buildings

| | |
|--------------------------------------------------------------------------------|-------------|
| Oil heat research will be completed in FY 2004 | -494 |
| Total Funding Change, Oil Heat Research for Residential Buildings | -494 |

Technical/Program Management Support

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------------------------|---------|---------|---------|-----------|----------|
| Technical/Program Management Support | | | | | |
| Technical/Program Management Support | 1,609 | 1,481 | 1,500 | +19 | +1.3% |
| Total, Technical/Program Management Support | 1,609 | 1,481 | 1,500 | +19 | +1.3% |

Description

The Technical/Program Management Support subprogram provides analytic support to aid the Program to achieve its net Zero Energy Building goals.

Benefits

This is accomplished by identifying research priorities through R&D feasibility studies and trade-off analyses. During FY 2005, the Technical/Program Management Support subprogram will focus on developing a ranking process for trading-off component research with building system research.

Detailed Program Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Technical/Program Management Support **1,609** **1,481** **1,500**

In FY 2005, provide critical technical and program management support services including support for multi-year planning; strategic planning; feasibility studies and trade-off analyses; data collection to assess program and project performance; peer reviews of projects and program portfolio and management; evaluation of the impact and conducting analyses for new legislation on R&D programs such as tax credits; and analysis and assessments of past program impacts and performance.

Participants include: PNNL, and others TBD.

Technical/Program Management Support **1,609** **1,481** **1,500**

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Technical/Program Management Support

| | |
|-----------------------------|-----|
| No significant changes..... | +19 |
|-----------------------------|-----|

| | |
|-------------------------------------------------------------------------|------------|
| Total Funding Change, Technical/Program Management Support | +19 |
|-------------------------------------------------------------------------|------------|

Biomass and Biorefinery Systems R&D

Funding Profile by Subprogram^a

| | FY 2003 Comparable Appropriation | FY 2004 Comparable Appropriation ^b | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
|--------------------------------------------------------|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|----------------------------|----------|
| | | | | | \$ Change | % Change |
| Biomass and Biorefinery Systems R&D | | | | | | |
| Utilization of Platform Outputs | 8,960 | 7,110 | 7,110 | 8,280 | +1,170 | +16.5% |
| Industrial Gasification | 14,279 | 0 ^c | 0 | 0 | 0 | 0% |
| Technical Program Management Support | 811 | 396 | 396 | 400 | +4 | +1.0% |
| Total, Biomass and Biorefinery Systems R&D | 24,050 | 7,506 | 7,506 | 8,680 | +1,174 | +15.6% |

Public Law Authorizations:

P.L. 93-577, "Federal Non-nuclear Energy Research and Development Act" (1974)
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" (1978)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplants and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Conservation Act" (1987)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 101-549, "Clean Air Act Amendments of 1990"
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act" (1990)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 106-224, "Biomass Research and Development Act" (2000)

^a SBIR/STTR funding in the amount of \$545,000 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are \$189,153 and \$220,248 respectively.

^b Programs in the Energy Conservation appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

^c \$4,939 for Industrial Gasification was appropriated for the Industrial Technologies Program whereas the Biomass Program continues to be responsible for the management of this activity.

Mission

The mission of the Biomass and Biorefinery Systems R&D Program (“Biomass Program”) is to partner with U.S. industry to foster research and development on advanced technologies that will transform our nation’s biomass resources into affordable, and domestically-produced biofuels, biopower, and high-value bioproducts, which will diversify our domestic liquid energy resource and increase our economic and energy security.

The Program receives funds from both the Energy Supply and the Energy Conservation appropriations. Energy Supply-funded activities focus primarily on developing advanced technologies for producing transportation fuels and power from biomass feedstocks. Energy Conservation-funded activities focus on developing advanced technologies for more energy efficient industrial processes and co-production of high-value industrial products.

Benefits

The Program’s research focus will provide benefits in three areas^a: Feedstock Infrastructure, for reducing the cost of collecting and preparing raw biomass^b; Platforms R&D, for reducing the cost of outputs and byproducts from biochemical and thermochemical processes; and Utilization of Platform Outputs, for developing technologies and processes that co-produce liquid and gaseous fuels, chemicals and materials, and heat and power, and on integrating those technologies and processes in biorefinery configurations.

The next generation of biorefinery^c, being developed by the program and U.S. industry, will produce value-added chemicals and materials together with fuels and/or power from non-conventional, lower cost feedstock such as agricultural and forest residues and other biomass materials. Using our diverse biomass resources in future biorefineries will accelerate economic development and increase energy supply options and energy security.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

^a The Benefits discussion covers the entire Program, including both Energy Conservation-funded and Energy Supply-funded activities. Energy Supply funds Platforms Research and Development and Feedstock Infrastructure. Energy Supply also funds Utilization of Platform Outputs activities that are complementary to Utilization of Platform Outputs work funded by Energy Conservation.

^b Biomass includes agricultural crops and trees, wood and wood wastes and residues, plants, grasses, residues, fibers, and animal wastes, municipal solid wastes, and other waste materials.

^c Biorefineries are processing facilities that extract carbohydrates, oils, lignin, and other materials from biomass, convert them into multiple products such as transportation fuel, chemicals, and materials. Corn wet and dry mills, and pulp and paper mills are examples of existing biorefinery facilities that produce some combination of food, feed, power, and industrial and consumer products.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Biomass Program supports the following goals:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Biomass Program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.08.02.00: Biomass. Develop biorefinery-related technologies to the point that they are cost- and performance-competitive and are used by the Nation's transportation, energy, chemical and power industries to meet their market objectives. This helps the Nation by reducing fossil energy consumption, our dependence on foreign oil, and greenhouse gas emissions, while also expanding domestic energy supplies and improving the Nation's energy infrastructure.

Contribution to Program Goal 04.08.02.00 (Biomass)

The Program directly supports General Goal 4, Energy Security; the goals and recommendations of the President's National Energy Policy, the Biomass R&D Act of 2000 and the Farm Security and Rural Investment Act of 2002.

The Biomass Program will contribute to General Goal 4 by establishing the technical and market potential of at least three new commodity-scale chemicals and/or materials by 2010. The Energy and Water Development activities will provide synergy to the Interior activities as a result of their focus on platforms for sugars, synthesis gas and pyrolysis oils.

Indicators of progress toward achieving those benefits include:

- By 2005, establish the technical and market potential of a new biobased product.
- Through 2010, establish the technical and market potential of at least three new commodity-scale chemicals and/or materials.

Annual Performance Results and Targets

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|

Program Goal 04.08.02.00 (Biomass)

Utilization of Platform Outputs R&D: Products Development

| | | | | | |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| When this activity was part of OIT, OIT did not break out bio-based products in FY 2000. | Demonstrated advanced electro-deionization separation technology for product purification at a pilot scale in trials at a Tate & Lyle's high fructose corn syrup plant. | Cargill Dow LLC started up the first full-scale PLA plastic manufacturing facility (300 million lbs./yr.) based on corn sugar as the feedstock. | In partnership with industry, complete pilot scale demonstration of two new biobased product technologies for economic, technical, and product performance. | Complete validation of one new biobased product technology, with long-term potential of greater than 2 billion lbs./yr. sales, at the pilot scale for economic, technical, and product viability in partnership with industry. | Establish the technical and market potential of a new biobased products. |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|

A 2-cycle engine oil derived from soy oil is commercialized for the emerging bioproducts industry. (DOE terminated the support because the contractor did not perform on a timely basis.)

With industry partners, a new biobased product technology advances to scale-up with partners' intention to commercialize in a new industrial biorefinery by FY 2008. The biorefinery will be at pilot scale.

Management of Funds

Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.

Means and Strategies

The Biomass Program will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

America's diverse biomass resources, and favorable climates offer many opportunities for using domestic, sustainable biomass to meet our needs for fuel, power and products made from plants and plant-derived resources. The program focuses on industrial biorefineries that co-produce fuels and/or power along with high-value chemicals and materials by forming R&D partnerships to advance processing and conversion technologies, improve the efficiency and effectiveness of harvesting, storage and handling of biomass feedstock, and condition markets by increasing consumer awareness of, and acceptance for bio-based products, fuels and power.

The strategy consists of improving the cost-competitiveness of biomass technologies (including feedstock collection and storage subsystems) through research, development, and partnerships with industry, USDA, farmers, states and local communities. The program uses competitive solicitations to attract innovation and ensure investment value for industry’s and universities’ contracts; manages National Laboratory research to overcome technical barriers, and coordinates biomass activities at a local level through the State and Regional Partnership Activity. Funding for public-private collaborative R&D is made on a cost shared basis; managed by a series of objectives and milestones; and reviewed under the industrially developed “stage gate” process for moving each project through an independent review “gate”, from a less costly stage (such as preliminary paper studies) to a more costly stage (such as bench scale experiments). Technical oversight of the R&D portfolio and planning and analysis for the program is based at DOE Headquarters, and individual project management is provided by field office staff. Finally, the Program conducts analysis and performance assessments in order to direct effective strategic planning.

These means and strategies will result in improving energy security by increasing the generation of reliable, affordable and environmentally sound biobased energy, adding to the diversity and economic security of the Nation’s energy supply --- thus putting the taxpayers’ dollars to more productive use.

In carrying out the program’s mission, the Biomass Program collaborates with several groups on its key activities including:

- Partnerships with industry, USDA, farmers, states and local communities.
- Program decisions about research directions and priorities are guided by the Biomass Technical Advisory Committee and the Biomass R&D Board established under the Biomass R&D Act of 2000.
- The Program also relies on input from peer reviews, several of which have been completed in the last three years.

External factors affecting performance include availability of conventional fossil resources, consumer acceptance, and the cost of competing technologies. The market penetration rate of bio-based technologies is a function of technical breakthrough, price trends of coal, oil and natural gas, and policy factors.

Validation and Verification

To validate and verify program performance, the Biomass Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. The table below summarizes validation and verification activities.

| | |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Sources: | The Renewable Fuels Association's production statistics; the National Renewable Energy Laboratory's Renewable Electric Plant Information System (REPIS); the Energy Information Administration's (EIA) Annual Energy Review, Renewable Energy Annual and Annual Energy Outlook; the Gas Technology Institute Survey of Distributed Resources; EIA Form 860 data analyzed by the Resource Dynamics Corporation. Individual projects develop production cost and quantity estimates for sugar, syngas, ethanol, and other fuels and chemicals. |
| Baselines: | The following is the Energy Conservation-related key baseline now used in the Biomass Program: one newly developed, industrially viable biobased product (2003) |
| Frequency: | GPRA Benefits are estimated annually. Independent evaluation of R&D projects are performed according to schedule per the "stage gate" process for moving each project through an independent review "gate", from a less costly stage (such as preliminary paper studies) to a more costly stage (such as bench scale experiments). Program Peer Reviews are conducted annually. |
| Data Storage: | EE Strategic Management System, and other computer-based data systems. |
| Verification: | <p>Various trade associations review the data and the modeling processes (e.g. REPIS renewable and Distributed Energy Resources), and the EIA verifies the REPIS database. Stage-Gate, peer and program reviews of technology development and economic modeling efforts are independently conducted by personnel from industry, academia and governmental agencies other than the U.S. Department of Energy. These efforts help to focus the program's investments on activities that are within the Federal government's role and that address top priority needs.</p> <p>The National Laboratories receive direct funds for technology research and development, based on their capabilities and performance. Advisory panels consisting non-Federal and industry experts review each laboratory and industry project at scheduled Stage-gate Reviews and Peer Evaluation of R&D. Projects are evaluated based on the following criteria: 1) Relevance to overall DOE objectives; 2) Approach to performing the research and development; 3)</p> |

Technical accomplishments and progress toward project and DOE goals; 4) Technology transfer/collaborations with industry/universities/laboratories; and 5) Approach and relevance of proposed future research. OMB's R&D investment criteria have been incorporated into this evaluation. The panels also evaluate the strengths and weaknesses of each project, and recommend additions to or deletions from the scope of work. The program organization facilitates relationships to ensure that Federal R&D results are transferred to industry.

Funding by General and Program Goal

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-------------------------------------------------------------------------------------------------------------|---------------|--------------|--------------|---------------|---------------|
| General Goal 4, Energy Security | | | | | |
| Program Goal 04.08.02.00, Biomass and Biorefinery Systems R&D | | | | | |
| Utilization of Platform Outputs R&D | 7,967 | 7,110 | 8,280 | +1,170 | +16.5% |
| Industrial Gasification | 14,279 | 0 | 0 | 0 | 0.0% |
| Technical Program Management Support..... | 811 | 396 | 400 | +4 | +1.0% |
| Total, Program Goal 04.08.02.00, Biomass and Biorefinery Systems R&D | 23,057 | 7,506 | 8,680 | +1,174 | +15.6% |
| All Other | | | | | |
| Congressionally Directed, Utilization of Platform Outputs R&D/ Regional Bio-based Products Consortium | 993 | 0 | 0 | 0 | 0.0% |
| Total, All Other | 993 | 0 | 0 | 0 | 0.0% |
| Total, General Goal 4 (Biomass and Biorefinery Systems R&D) | 24,050 | 7,506 | 8,680 | +1,174 | +15.6% |

Expected Program Outcomes

The Biomass Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources and contribute towards improved energy productivity of our economy. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce several EPA-criteria pollutants and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these "EERE business-as-usual" benefits, realizing the Biomass Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, oil savings, and natural gas savings that result from the realization of Biomass Program goals are shown in the table below through 2050. The level of cellulosic ethanol production expected as a result of realizing the program goals is also reported through 2025.

These estimates are a conservative initial effort at assessing the benefits of the Biomass Program activities and likely significantly underestimate the benefits from integrated biorefinery production options that are yet to be modeled. In addition, these estimates do not yet address some of the more fundamental technologies being developed in the Integrated Biorefinery and Bioproducts processes.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. Final documentation is estimated to be completed and posted by March 15, 2004. Uncertainties are larger for longer term estimates. The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of growing national benefits over time.

FY 2005 GPRA Benefits Estimates for Biomass Program^a

Mid-Term Benefits^b

| | 2010 | 2015 | 2020 | 2025 |
|----------------------------------------------------------------|-------|-------|-------|-------|
| Cellulosic Ethanol Production (Million Gallons per year) | 90 | 300 | 710 | 1,410 |
| Primary Non-Renewable Energy Savings (quads) | 0.04 | 0.06 | 0.09 | 0.15 |
| Carbon Emission Reductions (mmtce) | 1 | 1 | 1 | 3 |
| Energy Expenditure Savings (Billion 2001\$) | ns | ns | 1 | 2 |
| Oil Savings (MBPD) | 0.012 | 0.015 | 0.019 | 0.027 |
| Natural Gas Savings (quads) | 0.01 | 0.02 | 0.02 | 0.04 |

^a Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. These estimates are a conservative initial effort at assessing the benefits of the Biomass Program activities and likely significantly underestimate the benefits from integrated biorefinery production options that are yet to be modeled. In addition, these estimates do not yet address some of the more fundamental technologies being developed in the Integrated Biorefinery and Bioproducts processes.

^b Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case. The cellulosic ethanol production estimates were derived from the Ethanol Long Range Systems Analysis Spreadsheet (ELSAS) model. "ns" stands for "not significant."

Long-Term Benefits^a

| | 2030 | 2040 | 2050 |
|---------------------------------------------------|------|------|------|
| Primary Non-Renewable Energy Savings (Quads)..... | 0.4 | 0.7 | 1.2 |
| Energy System Cost Savings (Billion 2001\$) | 3 | 2 | 0 |
| Carbon Emission Reductions (MMTCE)..... | 4 | 11 | 23 |
| Oil Savings (MBPD)..... | 0.03 | 0.18 | 0.36 |
| Natural Gas Savings (Quads)..... | 0.3 | 0.3 | 0.4 |

^a Long-term benefits were estimated utilizing the GPRA05 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Utilization of Platform Outputs

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------------------------------------------|---------|---------|---------|-----------|----------|
| Utilization of Platform Outputs | | | | | |
| Utilization of Platform Outputs..... | 7,967 | 7,110 | 8,280 | +1,170 | +16.5% |
| Congressionally Directed Activity, Regional Bio-based Products Consortium..... | 993 | 0 | 0 | 0 | 0.0% |
| Total, Utilization of Platform Outputs | 8,960 | 7,110 | 8,280 | +1,170 | +16.5% |

Description

The Utilization of Platform Outputs R&D subprogram consisted of the following activity in the FY 2004 budget request: Advanced Biomass Technology R&D - Products Development. Utilization of Platform Outputs R&D is one of three major subprograms of the biomass program. The other two subprograms (funded by Energy and Water Development) are Feedstock Infrastructure, and Platforms Research and Development, i.e., development of technologies for producing low cost sugar, syngas and pyrolysis oils. As R&D proceeds in collaboration with industry, the program will continue to leverage and coordinate with efforts in other EERE and DOE programs, USDA, and other agencies.

Benefits

Bio-based products with high market value will increase the profitability of future industrial biorefineries whose other major products may be fuels for the transportation sector and/or other sectors, including hydrogen. Producing a slate of bio-based chemicals would also add a dimension of seasonal flexibility to the biorefineries in view of the seasonal nature of biomass harvesting.

Indicators of progress toward achieving those benefits include:

| | 2003 | 2005 | 2010 | 2015 |
|-----------------------------------------------------------------------------------------------------------|------|------|------|------|
| Cumulative number of bio-based products for which the technical and market potential is established | 1 | 2 | 4 | 6 |

- By 2005, establish the technical and market potential of a new biobased products (the cumulative number will be two in FY 2005, including the bio-based product shown in the FY 2003 column).
- Through 2010, establish the technical and market potential of at least three new commodity-scale chemicals and/or materials (the cumulative number will be four in FY 2010, including the bio-based

Energy Conservation

Biomass and Biorefinery Systems R&D/

Utilization of Platform Outputs

FY 2005 Congressional Budget

product shown in the FY 2003 column).

Detailed Justification

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|
| Utilization of Platform Outputs..... | 8,960 | 7,110 | 8,280 |
| ▪ Utilization of Platform Outputs R&D | 7,967 | 7,110 | 8,280 |
| <p>In FY 2005, Utilization of Platform Outputs R&D will continue to focus on projects to develop processes for the production of chemicals and materials that can be integrated into biorefineries. Projects with industrial partners will focus on novel separations technologies, bio-based plastics, novel products from oils, and lower cost and energy use in biomass harvesting, pre-processing and storage. Additional work with industry, universities and the national laboratories will focus on improvements to increase the efficiency of individual process steps, e.g., catalysis, separations, etc. The Program will continue collaborative efforts with stakeholders in validating the sustainability of biobased products. In FY 2003, \$239,000 for SBIR/STTR was transferred to the Science Appropriation. Participants include: <i>National Corn Growers Association, Iowa Corn Promotion Board, American Soybean Association / United Soybean Board, American Forest and Paper Association, National Association of Land-Grant Colleges, Cargill, ADM, Dow Chemical Co., Dupont, Cargill Dow LLC, Metabolix, B/MAP, Vertec Biosolvents, Amalgamated Research Inc., Ashland Chemical, Arkenol, CNH, Castor Oil Inc., USDA Western Regional Laboratory, PNNL, INEEL, ANL, NREL, and a wide array of colleges and universities.</i></p> | | | |
| ▪ Congressionally Directed Activity, Regional Bio-based Products Consortium | 993 | 0 | 0 |
| Bio-Based Products Consortia. | | | |
| Total, Utilization of Platform Outputs..... | 8,960 | 7,110 | 8,280 |

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 Request |
|-----------------------------------|

Utilization of Platform Outputs

| | |
|-------------------------------------------------------------------------------|--------|
| Funding level is commensurate with achieving bio-based products targets | +1,170 |
|-------------------------------------------------------------------------------|--------|

Congressionally Directed Activity, Regional Bio-based Products Consortium

| | |
|---------------------------------------------------------------------------------------------------------------------------------|---|
| No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal. | 0 |
|---------------------------------------------------------------------------------------------------------------------------------|---|

| | |
|--------------------------------------------------------------------|---------------|
| Total Funding Change, Utilization of Platform Outputs | +1,170 |
|--------------------------------------------------------------------|---------------|

Industrial Gasification

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------|---------|---------|---------|-----------|----------|
| Industrial Gasification | | | | | |
| Industrial Gasification | 14,279 | 0 | 0 | 0 | 0 |
| Total, Industrial Gasification | 14,279 | 0 | 0 | 0 | 0 |

Description

In FY 2003, Utilization of Platform Outputs R&D also included Industrial Gasification, i.e., new technologies for the integrated production of power from solid wood waste and black liquors from the pulping processes.

Benefits

Successful technology development would enable paper mills to reduce their net energy requirements while decreasing waste discharges through increased power generation from the waste streams.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Industrial Gasification **14,279** **0** **0**

In FY 2004, \$4,939,000 for Industrial Gasification was appropriated for the Industrial Technologies Program whereas the Biomass Program continues to be responsible for the management of this activity. In FY 2003 this activity was reduced by \$306,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Industrial Gasification **14,279** **0** **0**

Technical/Program Management Support

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------------|---------|---------|---------|-----------|----------|
| Technical/Program Management Support..... | 811 | 396 | 400 | +4 | +1.0% |
| Total, Technical/Program Management Support..... | 811 | 396 | 400 | +4 | +1.0% |

Description

Technical/Program Management Support focuses on strategic and operating plans, feasibility studies, trade-off analyses, and evaluation of program performance. As information related to new R&D data, new governmental policies and industry initiatives are available, this needs to be incorporated into ongoing analytic, planning and evaluation activities.

Benefits

These efforts support EERE management's overall objectives of increasing program efficiency and targeting future resources to the most productive program efforts.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|---------------------------------------------------|------------|------------|------------|
| Technical/Program Management Support | 811 | 396 | 400 |
|---------------------------------------------------|------------|------------|------------|

In FY 2005, update strategic and operating plans, feasibility studies, trade-off analyses, and evaluation of program performance. Perform analysis of environmental emissions and energy use for each step of the production and utilization cycle for bio-based products. Document efficiency and sustainability benefits of products derived from biomass. *Participants include National Renewable Energy Laboratory, Oak Ridge National Laboratory and various universities.*

| | | | |
|----------------------------------------------------------|------------|------------|------------|
| Total, Technical/Program Management Support | 811 | 396 | 400 |
|----------------------------------------------------------|------------|------------|------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 Request |
|-----------------------------------|

Technical/Program Management Support

+4

No significant changes.....

Total Funding Change, Technical/Program Management Support.....

+4

Federal Energy Management Program

Funding Profile by Subprogram

(dollars in thousands)

| | FY 2003 Comparable Appropriation | FY 2004 Comparable Appropriation ^a | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
|---------------------------------------------------|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|----------------------------|----------|
| | | | | | \$ Change | % Change |
| Federal Energy Management Program | | | | | | |
| Project Financing | 7,839 | 8,126 | 8,126 | 7,450 | -676 | -8.3% |
| Technical Guidance and Assistance | 7,825 | 8,140 | 8,140 | 7,900 | -240 | -2.9% |
| Planning, Reporting and Evaluation | 2,751 | 2,571 | 2,571 | 2,550 | -21 | -0.8% |
| Technical Program Management Support | 884 | 879 | 879 | 0 | -879 | -100.0% |
| Total, Federal Energy Management Program | 19,299 | 19,716 | 19,716 | 17,900 | -1,816 | -9.2% |

Public Law 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, "DOE Organization Act" (1977)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act" (1992)

Mission

The mission of the Federal Energy Management Program (FEMP) is to promote energy security, environmental stewardship and cost reduction through energy efficiency and water conservation, the use of distributed and renewable energy, and sound utility management decisions at Federal sites.

^a Programs in the Energy Conservation appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

Benefits

FEMP supports the mission of the Office of Energy Efficiency and Renewable Energy by improving the energy efficiency and productivity of Federal Government buildings and by bringing clean, renewable technologies to Federal facilities. FEMP supports DOE's goals of protecting our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy to Federal facilities. These activities fulfill the statutory requirements of the National Energy Conservation Policy Act (NECPA); provisions under the Energy Policy Act of 1992 (EPACT); and Executive Order 13123 (Efficient Energy Management). Accomplishing this mission contributes to several national energy and environmental priorities. The President's National Energy Policy calls for America to modernize conservation efforts, increase energy supplies, "accelerate the protection and improvement of the environment, and increase our Nation's energy security." It directs heads of executive departments and agencies to "take appropriate actions to conserve energy use at their facilities to the maximum extent consistent with the effective discharge of public responsibilities."

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission plus seven general goals that tie to the strategic goals. The FEMP program supports the following goals:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options and improving energy efficiency.

The FEMP program has one program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.13.02.00: FEMP. The Federal Energy Management goal is to provide technical and financial assistance to Federal agencies and thereby lead the Nation by example in use of energy efficiency and renewable energy. Through the Federal Government's own actions, FEMP's target is to increase Federal renewable energy use to 2.5% of total Federal electrical energy use by 2005, and reduce energy intensity in Federal buildings by 30 percent by 2005 (relative to the 1985 statutory baseline level of 138,610 Btus per gross square foot). By 2010, the target is to further reduce energy intensity in federal buildings by 35 percent (relative to the 1985 statutory baseline level).

Annual Performance Results and Targets

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Goal 04.13.02.00 (Federal Energy Management Program) | | | | | |
| Project Financing | | | | | |
| Completed one nationwide Solar technology Super-Energy Savings Performance Contract (Super ESPC) for use by all agencies, bringing the total number of technology Super-ESPCs to four. | Achieved \$121 million in private sector investment through Super ESPCs. | Achieved \$97 million in private sector investment through Super ESPCs. | Achieved \$252 million in private sector investment through Super ESPCs, contributing to national energy security. | Will achieve between \$35 and \$55 million in private sector investment through Super ESPCs, contributing to national energy security. | Will achieve between \$60 and \$100 million in private sector investment through Super ESPCs which will result in about a 0.2 percent annual reduction in energy intensity. These projects are cost-effective, resulting in a positive net present value gain for the tax payer. |
| Technical Guidance and Assistance | | | | | |
| Provided technical and design assistance for 43 energy efficiency and renewable energy projects. | Provided technical and design assistance for 106 energy efficiency and renewable projects including distributed energy resources projects. | Provided technical and design assistance for 90 energy efficiency, renewable energy, and water conservation projects; four were large-scale distributed energy resources and and/or combined heat and power projects. | Provided technical and design assistance for 53 energy efficiency, renewable energy, and water conservation projects; 10 were large-scale distributed energy resources and combined heat and power projects. Reported the resulting impacts achieved through the end of FY 2001. | Will provide technical and design assistance for 60 energy efficiency, renewable energy, O&M, DER/CHP, and water conservation projects. | Will provide technical and design assistance for 60 federal projects which include energy efficiency, renewable energy, O&M, Distributed Energy Resources, Combined Heat and Power, SAVEnergy Audits, ALERTS and water conservation projects. These projects are cost-effective, because the technologies applied in these projects have been shown to be cost-effective by the supporting EREE programs. |

| FY 2000 Results | FY 2001 Results | FY 2002 Results | FY 2003 Results | FY 2004 Targets | FY 2005 Targets |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Provided 28 SAVEnergy Audits. | <p>Provided 40 SAVEnergy Audits and industrial facilities assessments. Completed 25 Assessment of Load and Energy Reduction Techniques (ALERT) assessments to shave anticipated peak demand and general energy consumption by 10 percent.</p> <p>Trained 5500 Federal energy personnel in best practices.</p> | <p>Provided at least 60 energy assessments including ALERTS, SAVEnergy Audits, industrial facility assessments, and operation and maintenance assessments that identified energy and cost saving opportunities</p> <p>Trained 6200 Federal energy personnel in best practices supporting National Energy Policy education goals.</p> <p>Published initial listing of products that use minimal standby power by December 31, 2001, in accordance with E.O. 13221.</p> | <p>Provided 56 energy assessments including ALERTS, SAVEnergy Audits, industrial facility assessments and operation and maintenance assessments to identify energy and cost saving opportunities.</p> <p>Trained 6700 Federal energy personnel in best practices supporting National Energy Policy education goals.</p> <p>Integrated information on standby power into Defense Logistics Agency and General Services Administration's product schedules in accordance with E.O. 13221.</p> | <p>Will train 4,000 Federal energy attendees in energy management best practices supporting National Energy Policy education goals.</p> <p>Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing annual program uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.</p> | <p>Will train 4,000 Federal energy attendees in energy management best practices supporting National Energy Policy education goals.</p> <p>Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing annual program uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.</p> |
| Management of Funds | | | | | |

Means and Strategies

The FEMP Program will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

FEMP helps Federal agencies take advantage of energy management opportunities in building construction, renovation, retrofit, operations and maintenance; energy consuming product and equipment procurement; and utility service acquisition and utility load management.

FEMP employs a variety of means and strategies to assist agencies in realizing energy, environmental and cost savings potentials, including:

- interagency coordination committees,
- direct technical assistance,
- education and training,
- information and outreach programs, and
- assistance in accessing alternative private sector funding.

These means and strategies will result in significant cost savings and a significant reduction in energy use at Federal facilities -- thus putting the taxpayers’ dollars to more productive use.

The following external factor could affect FEMP’s ability to achieve its strategic goal:

- The legal authority for implementing energy savings performance contracts expired in September 2003. The timing of reinstatement will significantly impact FEMP’s work on alternative financing.

The following collaborations help FEMP achieve its goals:

- FEMP hosts a number of working groups with its Federal agency partners to ensure that agencies are focused on the Congressionally mandated energy efficiency and renewable energy goals, that they develop strategies for obtaining the resources required to achieve these goals and that they share information on best energy management practices.

Validation and Verification

To validate and verify program performance, the FEMP Program will conduct internal and external reviews. These programmatic activities are subject to continuing review by, for example, the Congress, and the Department’s Inspector General. The table below summarizes validation and verification activities.

| | |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Sources: | Agencies submit annual reports documenting energy use, cost, gross square footage, and exempt facilities. The reports are supplemented by FEMP's tracking and reporting and are submitted each year to Congress. |
| Baselines: | Federal energy management goals are measured from the 1985 baseline for standard buildings (138,610 Btu/square foot) and the 1990 levels for energy intensive buildings (The 1990 levels vary for each federal agency). Goals are expressed in BTU per gross square foot and are not normalized for other factors. |
| Frequency: | Annual. |
| Data Storage: | FEMP maintains a database of reported information. Agencies maintain their own, more detailed data. |
| Verification: | External audits are conducted each year. Reporting anomalies are identified and resolved during the annual reporting cycle. |

Funding by General and Program Goal

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------|---------|---------|-----------|----------|
|---------|---------|---------|-----------|----------|

General Goal 4, Energy Security

Program Goal 04.13.02.00, FEMP

| | | | | | |
|--------------------------------------------|--------|--------|--------|--------|---------|
| Project Financing | 7,839 | 8,126 | 7,450 | -676 | -8.3% |
| Technical Guidance and Assistance..... | 7,825 | 8,140 | 7,900 | -240 | -2.9% |
| Planning Reporting and Evaluation | 2,751 | 2,571 | 2,550 | -21 | -0.8% |
| Technical/Program Management Support..... | 884 | 879 | 0 | -879 | -100.0% |
| Total, Program Goal 04.13.02.00, FEMP..... | 19,299 | 19,716 | 17,900 | -1,816 | -9.2% |
| Total, FEMP | 19,299 | 19,716 | 17,900 | -1,816 | -9.2% |

Expected Program Outputs

FEMP pursues its mission through integrated activities designed to improve the energy efficiency of, and renewable energy usage by, the Federal government. We expect these improvements to reduce susceptibility of federal agencies to energy price fluctuations and to lower their energy bills; reduce EPA criteria and other pollutants in the cities where agency operations are located; and enhance energy security by increasing the flexibility of local energy demand.

Estimates of annual non-renewable energy savings, energy expenditure savings, and carbon emission reductions that result from the realization of FEMP's goals are shown in the table below through 2025. In addition to these "EERE business-as-usual" benefits, realizing the FEMP goals would provide the technical potential to reduce conventional energy use by the federal government even further if warranted by future energy needs.

The assumptions and methods underlying the modeling efforts affect the estimated benefits, and results could vary if external factors, such as future energy prices, differ from the baseline case assumed for this analysis. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html Final documentation estimated to be completed and posted by March 15, 2004.

FY 2005 GPRA Benefits Estimates for FEMP^a

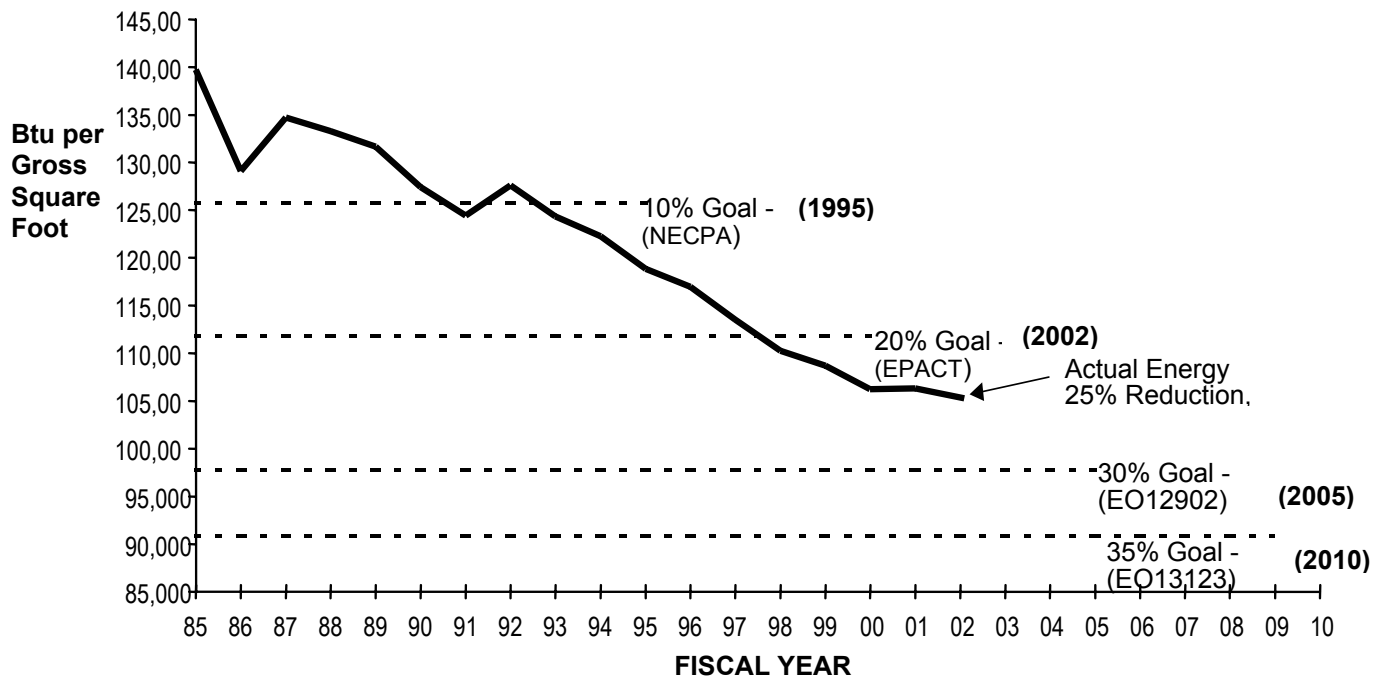
Mid-term benefits

| | 2010 | 2015 | 2020 | 2025 |
|---------------------------------------------------|------|------|------|------|
| Primary Non-Renewable Energy Savings (Quads)..... | 0.03 | 0.04 | 0.05 | 0.07 |
| Energy Expenditure Savings (Billion 2001\$)..... | 0.2 | 0.3 | 0.5 | 0.6 |
| Carbon Emission Reductions (MMTCE)..... | 1 | 1 | 1 | 1 |

Various factors can account for the reduction in energy intensity. These include FEMP activities, Federal Appliance Standard, efficiency improvements independent of Federal programs, changes in Federal building stock, and the type of fuel used in Federal Buildings. In addition to the benefits quantified here, improved Federal energy management increases the ability of the Federal Government to manage its energy loads during emergencies and facilitates coordination of Federal energy use with local authorities in the event of local energy supply constraints or emergencies. By helping large Federal facilities quickly reduce their peak demand, FEMP benefited California and other western States during past electricity shortages. The specific impacts of the FEMP program are illustrated in the graphic below entitled “Building Energy Reduction,” the Federal Government reduced its site energy intensity (Btu per gross square foot) at Federal facilities by 25.0 percent in 2002 compared to 1985 levels.

^a Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

Building Energy Reduction



Project Financing

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------|---------|---------|---------|-----------|----------|
| Project Financing | | | | | |
| Energy Savings Performance Contracts | 6,059 | 6,367 | 5,950 | -417 | -6.5% |
| Utilities Program..... | 1,780 | 1,759 | 1,500 | -259 | -14.7% |
| Total, Project Financing | 7,839 | 8,126 | 7,450 | -676 | -8.3% |

Description

FEMP developed its alternative financing programs to help agencies access private sector financing to fund needed energy improvements. FEMP helps Federal agencies use Energy Savings Performance Contracts (ESPC) and Utility Energy Service Contracts (UESC) to finance energy saving improvements at no net cost to taxpayers. These funds pay for energy improvements at federal facilities that are in need of significant energy system retrofits. Projects include all types of energy improvements including lighting upgrades, new heating and ventilation systems, and improved control systems.

Benefits

These alternative financing mechanisms for energy efficiency and renewable energy projects have and will continue to vastly improve the energy efficiency of Federal facilities. These projects save on the energy bills of Federal facilities and are implemented at no net cost to the taxpayer. By providing a means for Federal agencies to implement renewable energy and energy efficiency technologies, these financing mechanisms help reduce the emissions associated with power usage at Federal facilities and promote the use of clean alternatives to conventional technologies. The investment of millions of dollars through alternative financing vehicles helps develop the energy efficiency and renewable technology industries, and supporting industries are buttressed by this economic activity.

FEMP facilitated over \$250 million in Energy Savings Performance Contract (ESPC) investment in FY 2003, in part due the fact that the legislative authority for ESPCs was expected to, and did, expire at the end of FY 2003. Given this push to finish projects in FY 2003, as well as the fact that the ESPC authority is not expected to be reinstated until mid-FY 2004, FEMP reduced its investment targets for FY 2004 to between \$35 and \$55 million in private sector investment. After the authority is reinstated, FEMP expects agency interest and involvement in ESPCs to slowly ramp back up its level of activity to pre-FY2003 levels.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Energy Savings Performance Contracts (ESPCs) 6,059 6,367 5,950

Deliver FEMP services to award Super ESPC delivery orders, which will include communications and outreach, identifying and screening projects, preparing delivery orders, reviewing and evaluating proposals, reviewing and documenting projects. Will conduct workshops to help prepare agency technical, contracting, budget, legal, administrative, and management personnel to use the Super ESPC contracting vehicle. Will assist agencies to implement Super ESPC delivery orders with estimated value between \$60 and \$100 million. Because the legislative authority for ESPCs expired at the end of FY 2003, FEMP reduced its investment targets for FY 2004 to between \$35 and \$55 million in private sector investment. FEMP estimates other Federal agency reimbursements at \$600,000 in FY 2005.

Participants include: Lawrence Berkley National Lab (LBNL), National Renewable Energy Lab (NREL), Pacific Northwest National Lab (PNNL), Oakridge National Lab (ORNL), National Energy Technology Lab (NETL), McNeil Technologies, and Aspen Systems.

Utilities Program 1,780 1,759 1500

Lead the Federal Utility Partnership Working Group (FUPWG) and establish strategic partnerships with targeted utilities which have both a large concentration of Federal customers and a commitment to assist those customers. Use these partnerships to leverage private sector resources and expertise to assist in the early adoption of EERE technologies at Federal sites. Track Federal Utility Energy Services Contracting (UESC) projects and provide support through: workshops for Federal agencies, development and distribution of guidance documents, and direct assistance for projects. Enable Federal decision-makers to make well informed decisions regarding energy project implementation and commodity purchases; provide information, communications, outreach, training, and technical assistance on the impacts of utility restructuring, including energy cost, security, and reliability.

Participants will include: LBNL, NETL, NREL, PNNL, ORNL.

Total, Project Financing 7,839 8,126 7,450

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2004 vs. FY 2005 (\$000) |
|-----------------------------------|

Energy Savings Performance Contracts

Because this program is becoming more efficient, we are able to streamline our efforts but still meet our program goal. For example, FEMP has determined that it is not necessary at this time, because of activity consolidation, to create any new Technology Specific Energy Savings Performance Contracts. We have found that we can achieve similar benefits through a fuller utilization of our baseline Super ESPC in a way that continues to meet our agency customers' needs -417

Utilities Program

Because this program is mature, we are able to find areas to streamline our efforts..... -259

Total Funding Change, Project Financing **-676**

Technical Guidance and Assistance

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|----------------------------------------|---------|---------|---------|-----------|----------|
| Technical Guidance and Assistance | | | | | |
| Direct Technical Assistance..... | 5,800 | 6,165 | 6,000 | -165 | -2.7% |
| Training and Information | 2,025 | 1,975 | 1,900 | -75 | -3.8% |
| Technical Guidance and Assistance..... | 7,825 | 8,140 | 7,900 | -240 | -2.9% |

Description

Technical assistance helps agencies to take advantage of innovative technologies and training opportunities. FEMP assists Federal energy managers identify, design, and implement new construction and facility improvement projects. FEMP provides unbiased, expert technical assistance in areas such as energy and water audits for buildings and industrial facilities, peak load management; and new technology deployment, including combined heat and power and distributed energy technologies. FEMP also provides analytic software tools to help agencies choose the most effective energy and water project investments. To learn from the experts first-hand, Federal employees and others can enroll in FEMP's training programs in such areas as project financing, life-cycle costing, O&M, and sustainable design. In addition, FEMP helps agencies acquire the most energy efficient and water conserving products through procurement training, product efficiency recommendations, communications and outreach, and assisting agencies in amending their guide specifications to incorporate requirements for energy efficient products.

Benefits

Technical Guidance and Assistance supports FEMP's mission by helping agencies implement projects and practices that reduce energy costs, improve air quality, and promote the use of water conservation, energy efficiency and renewable energy. FEMP's direct project assistance allows agencies to consider cost-saving and energy-saving practices as they design new buildings and renovate existing ones. FEMP's technical information guides federal agencies as they make purchasing decisions, utility management decisions, and other choices that affect their energy use.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Direct Technical Assistance **5,800** **6,165** **6,000**

In FY 2005, FEMP will provide support for at least 40 agency projects to identify energy and cost saving opportunities in the design, review, and implementation of energy efficiency, water conservation, operations and maintenance, Distributed Energy Resources/Combined Heat and Power (DER/CHP), and renewable projects, including facility construction and renovation. FEMP will provide agencies 20 energy assessments including SAVEnergy Audits, ALERTS and industrial facility assessments that identify energy and cost saving opportunities.

FEMP will continue to develop technical information and assistance to help agencies deploy these technologies on a broader basis and conduct communications and outreach activities. These projects demonstrate leading-edge technologies with energy and cost savings. FEMP will assist agencies in identifying low-cost/no-cost improvements to their operation and maintenance of energy systems, and FEMP will continue to provide training and technology assessments. *Participants include: LBNL, NREL, PNNL, ORNL, Sandia National Laboratories (SNL), McNeil Technologies.*

Training and Information **2,025** **1,975** **1,900**

FEMP will provide technical information and tools and train over 4,000 attendees to enable agency action on a greater number of projects than FEMP can assist directly to meet statutory Federal energy and water savings goals. FEMP develops and publishes technical information products. FEMP will help agencies acquire the most energy efficient and water conserving products through procurement training, communications and outreach, and assisting agencies in amending their guide specifications to incorporate requirements for energy efficient products. FEMP will publish revised or new product energy efficiency recommendations, and coordinate energy efficiency criteria with the EPA/DOE Energy Star program, Consortium for Energy Efficiency (CEE) and others. FEMP will maintain essential software such as the Building Life Cycle Cost tool that implements requirements for Life Cycle Costing project analysis. *Participants will include: LBNL, NETL, NREL, PNNL, ORNL, SNL, McNeil Technologies.*

Total, Technical Guidance and Assistance **7,825** **8,140** **7,900**

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2004 vs. FY 2005 (\$000) |
|-----------------------------------|

Direct Technical Assistance

| | |
|------------------------------------------------------------------------------------------------------------------------------------|------|
| Request will fund direct technical assistance projects and comprehensive energy assessment commensurate with current targets | -165 |
|------------------------------------------------------------------------------------------------------------------------------------|------|

Training and Information

| | |
|----------------------------------------------------------------------------------------------------------------------|-----|
| Reduced need for funding for training because of collection of registration fees from private sector attendees | -75 |
|----------------------------------------------------------------------------------------------------------------------|-----|

| | |
|----------------------------------------------------------------------|-------------|
| Total Funding Change, Technical Guidance and Assistance | -240 |
|----------------------------------------------------------------------|-------------|

Planning, Reporting, and Evaluation

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------------|---------|---------|---------|-----------|----------|
| Planning, Reporting, and Evaluation | | | | | |
| Planning, Reporting, and Evaluation | 2,751 | 2,571 | 2,550 | -21 | -0.8% |
| Total, Planning, Reporting, and Evaluation | 2,751 | 2,571 | 2,550 | -21 | -0.8% |

Description

FEMP will continue targeting services at key emerging opportunities in the Federal sector. FEMP will promote building energy security through the whole building design approach in the Federal community. FEMP will facilitate one or two meetings with senior Federal energy officials and provide support for the Federal Energy Management Advisory Committee. FEMP will collect and publish data for the Annual Report to Congress, respond to inquiries and provide support to ensure accuracy in reporting and analysis of trends. FEMP will conduct awareness campaigns and Federal awards program.

Benefits

Through planning, reporting and evaluation, FEMP evaluates the effectiveness of its programs in the past and plans the design of its programs for the future in a way that provides the most benefit for the taxpayer's dollar. By making FEMP's programs more effective, these activities help ensure that FEMP's investments lead to the greatest possible reductions in energy costs, improvements in air quality, and promotion of water conservation, energy efficiency and renewable energy technologies.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|-------------------------------------------------|--------------|--------------|--------------|
| Planning, Reporting and Evaluation | 2,751 | 2,571 | 2,550 |
|-------------------------------------------------|--------------|--------------|--------------|

Following up on EERE's implementation of its strategic plan, FEMP will continue targeting services at key emerging opportunities in the Federal sector. FEMP will promote building energy security through the whole building design approach in the Federal community. FEMP will facilitate one or two meetings with senior Federal energy officials and provide support for the Federal Energy Management Advisory Committee. It will collect and publish data for the Annual Report to Congress, respond to inquiries and provide support to ensure accuracy in reporting and analysis of trends. FEMP will conduct awareness campaigns and Federal awards program. *Participants will include: LBNL, NETL, NREL, PNNL, ORNL, SNL, McNeil Technologies.*

| | | | |
|--------------------------------------------------------|--------------|--------------|--------------|
| Total, Planning, Reporting and Evaluation | 2,751 | 2,571 | 2,550 |
|--------------------------------------------------------|--------------|--------------|--------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2004 vs. FY 2005 (\$000) |
|-----------------------------------|

Planning, Reporting and Evaluation

| | |
|----------------------------|-----|
| No significant change..... | -21 |
|----------------------------|-----|

| | |
|-----------------------------------------------------------------------|------------|
| Total Funding Change, Planning, Reporting and Evaluation | -21 |
|-----------------------------------------------------------------------|------------|

Technical/Program Management Support

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------------------------|---------|---------|---------|-----------|----------|
| Technical/Program Management Support | | | | | |
| Technical/Program Management Support..... | 884 | 879 | 0 | -879 | -100.0% |
| Total, Technical/Program Management Support | 884 | 879 | 0 | -879 | -100.0% |

Description

Technical/Program Management has been used in support of activities relating to annual awards, technical analysis, information management, outreach publications, and legislative/executive branch reporting. These activities will be discontinued under this subprogram and absorbed by other subprograms as appropriate.

Detailed Justification

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|
| Technical/Program Management Support | 884 | 879 | 0 |
| As FEMP's core activities have matured, the efficiencies in those activities have increased, enabling FEMP to streamline its support activities. The support activities under this subprogram will be discontinued and will be absorbed by other subprograms as appropriate. | | | |
| Total, Technical/Program Management Support | 884 | 879 | 0 |

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2004 vs. FY 2005 (\$000) |
|-----------------------------------|

Technical/Program Management Support

As FEMP's core activities have matured, the efficiencies in those activities have increased, enabling FEMP to streamline its support activities. Activities will continue to be undertaken in other subprograms as appropriate

-879

Total Funding Change, Technical/Program Management Support

-879

Program Management

Funding Profile by Subprogram

(dollars in thousands)

| | FY 2003 Comparable Appropriation | FY 2004 Comparable Appropriation ^a | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
|-------------------------------------------------------|----------------------------------------|-----------------------------------------------------|-----------------|--------------------|----------------------------|----------|
| | | | | | \$ Change | % Change |
| Program Management | | | | | | |
| Program Direction | 69,941 | 70,132 | 73,078 | 75,109 | +2,031 | +2.8% |
| Planning, Evaluation, and Analysis | 4,972 | 4,944 | 4,944 | 5,005 | +61 | +1.2% |
| Information, Communications, and Outreach | 1,540 | 1,531 | 1,531 | 1,550 | +19 | +1.2% |
| Cooperative Program with States... | 0 ^b | 4,939 | 4,939 | 0 | -4,939 | -100.0% |
| Congressionally- Directed Activities..... | 497 | 3,458 | 3,458 | 0 | -3,458 | -100.0% |
| Total, Program Management | 76,950 | 85,004 | 87,950 | 81,664 | -6,286 | -7.1% |

Public Law 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. 96-294, "Energy Security Act" (1980)
P.L. 102-486, "Energy Policy Act of 1992"

Mission

The Energy Conservation Program Management budget provides executive and technical direction, public information, planning, analysis, evaluation, and oversight required for efficient and productive implementation of Energy Conservation programs in the Office of Energy Efficiency and Renewable Energy (EERE). Program Management supports Headquarters functions, six Regional Offices, and the

^a Programs in the Energy Conservation appropriation were reduced by the Interior appropriation's 0.646 percent across-the-board reduction and the 0.59 percent rescission in the Omnibus Appropriation Bill.

^b Total FY 2003 funding was \$2,928,000. Those funds are shown under the State Energy Activities subprogram within the Weatherization and Intergovernmental Program, which was how FY 2003 was presented in the FY 2004 DOE Congressional Request.

Golden (Colorado) Field Office in planning and implementing EERE activities, as well as facilitating delivery of applied R&D and grant programs to Federal, regional, State, and local customers. Program Management also contains several Congressionally-directed activities in FY 2004.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major programs in the Department but with additional effort from offices which support the programs in carrying out the mission. Through its Program Management activities, EERE performs critical functions which directly support the mission of the Department. These functions include managing information technology, ensuring sound legal and policy advice and fiscal stewardship, developing and implementing uniform program policy and procedures, performing cross-cutting economic and market analyses, estimating GPRA and other benefits of EERE's programs, maintaining and supporting our workforce, providing security at our Golden Field Office and Regional Offices, and providing Congressional and public liaison and information.

Benefits

Each of the major subprograms of Program Management serves to make possible, enhance, or quantify the benefits of all the other programs in Energy Conservation.

The Program Direction subprogram is essential to the performance of all Energy Conservation programs and the achievement of their missions, because it provides for their staff, management, and program execution (contracting and financial awards.) It also provides the cross-cutting functions necessary for a successful program, including preparation of budget requests, communication with Congress and the Office of Management and Budget, and oversight to ensure that program activities are consistent with the Department's mission, the National Energy Policy, and the President's Management Agenda. The Golden Field Office provides much of EERE's project management capability, and the Regional Offices provide EERE with a support mechanism to understand and address regional variations in energy resources, markets, and demand patterns.

Through the implementation of the August 26, 2003 EERE Management Action Plan (summary information on the web at: www.eere.energy.gov), EERE will increase its corporate costing of work by 5 percent (a weighted composite of 2 -10 percent increases for each program) in FY05 vs. FY04.

The Communications and Outreach subprogram coordinates and manages efforts to make all of the other programs' work – and their results – known to the public. This contributes both to the Energy Conservation account's deployment goals and to Administration E-government initiatives to make government more transparent and accessible to the public.

The Planning, Evaluation, and Analysis subprogram funds analysis contracts that support the integration of performance measurement and benefits estimation with program planning, support the development of consistent multi-year planning methods, provide energy-market foresight, and calculate the GPRA benefits estimates for all other DOE Energy Conservation programs. Each of these activities is central to the goals of the President's Management Agenda, and each is also key to effective management of the Energy Conservation programs and to deciding on the optimal allocation of resources among the programs.

Program Direction

Funding Profile by Category

(dollars in thousands, whole FTEs)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------|---------------|--------------------|---------------|---------------|---------------|
| Headquarters | | | | | |
| Salaries and Benefits | 31,300 | 31,902 | 33,458 | +1,556 | +4.9% |
| Travel | 1,770 | 1,975 | 1,975 | 0 | 0% |
| Support Services | 9,113 | 8,316 ^a | 8,512 | +196 | +2.4% |
| Other Related Expenses | 3,802 | 5,131 | 5,023 | -108 | -2.1% |
| Total, Headquarters | 45,985 | 47,324 | 48,968 | +1,644 | +3.5% |
| Full Time Equivalents | 274 | 270 | 262 | -8 | -3.0% |
| Golden Field Office | | | | | |
| Salaries and Benefits | 3,838 | 5,202 | 6,770 | +1,568 | +30.1% |
| Travel | 160 | 191 | 220 | +29 | +15.2% |
| Support Services | 1,158 | 1,108 | 1,158 | +50 | +4.5% |
| Other Related Expenses | 846 | 825 | 1,304 | +479 | +58.1% |
| Total, Golden Field Office | 6,002 | 7,326 | 9,452 | +2,126 | +29.0% |
| Full Time Equivalents | 37 | 50 | 60 | +10 | +20.0% |
| Operations Offices | | | | | |
| Salaries and Benefits | 1,415 | 0 | 0 | 0 | 0.0% |
| Travel | 0 | 0 | 0 | 0 | 0.0% |
| Support Services | 0 | 0 | 0 | 0 | 0.0% |
| Other Related Expenses | 0 | 0 | 0 | 0 | 0.0% |
| Total, Operations Offices | 1,415 | 0 | 0 | 0 | 0.0% |
| Full Time Equivalents | 13 | 0 | 0 | 0 | 0.0% |
| Regional Offices | | | | | |
| Salaries and Benefits | 10,914 | 11,196 | 11,879 | +683 | 6.1% |
| Travel | 834 | 830 | 830 | 0 | 0.0% |
| Support Services | 1,460 | 687 | 887 | +200 | +29.1% |
| Other Related Expenses | 3,331 | 2,769 | 3,093 | +324 | +11.7% |
| Total, Regional Offices | 16,539 | 15,482 | 16,689 | +1,207 | +7.8% |
| Full Time Equivalents | 119 | 119 | 119 | 0 | 0.0% |

^a \$894K was added by Congress to be used at the National Energy Technology Laboratory (NETL) to provide project management services to EERE's Distributed Energy Program in FY 2004. The support services funding available to EERE for Headquarters use in FY 2004 is \$7,422K.

(dollars in thousands, whole FTEs)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|------------------------------------|---------|---------|---------|-----------|----------|
| Total Program Direction | | | | | |
| Salaries and Benefits | 47,467 | 48,300 | 52,107 | +3,807 | +7.9% |
| Travel | 2,764 | 2,996 | 3,025 | +29 | +1.0% |
| Support Services | 11,731 | 10,111 | 10,557 | +446 | +4.4% |
| Other Related Expenses | 7,979 | 8,725 | 9,420 | +695 | +8.0% |
| Total, Program Direction | 69,941 | 70,132 | 75,109 | +4,977 | +7.1% |
| Total, Full Time Equivalents | 443 | 439 | 441 | +2 | +0.5% |

Mission

Program direction activities are performed in three office groups:

- Headquarters, where technical and budget planning and policy development are centered, and where the first stages of program execution occur;
- Golden Field Office, which provides field management of the National Renewable Energy Laboratory and where EERE is developing its centralized Project Management Office to handle the later stages of program execution; and
- Six Regional Offices, which provide regionalized support for EERE's deployment and State Grant programs, along with other local coordination activities requested by the 11 technology programs.

Headquarters

EERE faces four major institutional management challenges:

1. EERE's programs are numerous and diverse, addressing multiple national goals and providing multiple types of public benefits, making management and integration at the corporate level very complex;
2. EERE complies with multiple external requirements, such as the Government Performance Results Act (GPRA), that require a broad spectrum of information to be delivered at different times of the year, and has been at the forefront (often a "pilot" program) of efforts to improve benefits analysis and R&D performance measurement;
3. EERE's customer base is very diverse and therefore information preparation and delivery must address a greater range of intended audiences than many programs face; and
4. EERE's research, development and deployment (RD&D) programs have, in the past, depended heavily on contractors managing subcontractors.

In response to outside recommendations (e.g. the National Academy of Public Administration - NAPA) and its own continuing self assessments, EERE has established an Action Plan for FY 2004-2005 to guide reforms that will address identified shortcomings, including:

- Continuing to implement our streamlined and integrated program and business model, which consolidated our work into eleven technology development and deployment programs and centralized our business administration functions into a single EERE organization. Our work will focus on culture change and consolidating the improvements already made.
- Continuing a formal Program Management Initiative begun in FY 2003, focused on training for all program managers. As a result, EERE intends to have a fully certified and trained program management corps.
- Integrating the Strategic Management System (SMS) with the best features of the existing EERE project management systems and with the evolving DOE I-Manage initiative, in order to provide a unified corporate approach toward planning and budgeting, program execution, and performance measurement across EERE. A unified interim program planning and performance management software platform will be implemented in FY 2004 and 2005, with data migrated to I-Manage as soon as the Department-wide R&D management modules are ready.
- Developing new standard operating procedures intended to reduce end-of-year unclosed balances.
- Implementing advance procurement planning and improved "work packaging" to reduce procurement and financial assistance "churning" due to administrative change orders and numerous very small funding actions.
- Concluding a Workforce Analysis in FY 2004 to assess the most effective distribution of FTEs across EERE's programs, and implementing a workforce restructuring in FY 2004-2006 in order to provide effective oversight and to manage towards performance goals.
- Developing stronger management oversight on the use of support service contracts, and combining that with the workforce analysis to develop a strategy for optimally deploying support service resources for maximum benefit.
- Working with the DOE Chief Financial Officer (CFO), the White House Office of Management and Budget (OMB), and Congress to better convey and account for expenditure of program direction and policy analysis costs.

The Headquarters program direction budget supports staff, facilities, and contracted services in four functional areas that are essential for productive operation of the EERE enterprise:

1. Program and Project Management. Supplies the critical expertise needed to organize, plan, direct and monitor RD&D activities associated with energy efficiency programs at Headquarters and in the field.
2. Program Execution Support. Provides a full spectrum of program execution business activities for EERE managers from a single integrated organization. These services include all actions associated with program execution; funding allocation, acquisition, reporting and analysis steps that make appropriation intentions reality. They also encompass human resources, travel, training, space, and security activities (except cyber security).
3. Planning, Budget Formulation and Analysis (PBFA). Provides relevant and timely budget, planning, evaluation, and analysis support for budget formulation, performance measurement, and technology assessment. PBFA manages development of EERE's annual Government Performance and Results Act (GPRA) metrics and EERE's performance planning and accountability report. It coordinates development of EERE's budget requests, including integration of performance measures and updates of the EERE Strategic Plan. PBFA also coordinates the planning, evaluation, and analysis required by the President's Management Agenda (PMA) and EERE's reporting of PMA progress through the Program Assessment Rating Tool (PART) and R&D Investment Criteria. PBFA also provides analysis for the statutorily-required biennial National Energy Policy report and similar government-wide policy efforts.
4. Information and Business Management Systems. Develops and manages corporate level information and business management systems to insure consistent, efficient and effective business policies and practices for EERE's Headquarters and field organizations. These information systems serve all of the business activities associated with planning and budget formulation, budget execution, analyses and evaluation. This function also addresses other headquarters and field business systems; information technology and associated cyber security; environmental, safety and health; the coordination of audit activities and national laboratory evaluations as well as identifying field facility needs.

Golden Field Office

The Golden Field Office (GO), with 60 FTEs budgeted for FY 2005 (up from 50 in FY 2004), supports EERE energy conservation efforts through field project management of R&D partnerships, laboratory contract administration, and a variety of professional, technical, and administrative functions. Federal staff expenditures are funded by both of EERE's Energy Supply and Energy Conservation appropriations. GO provides management support for approximately 450 agreements and some 300 active projects in nearly every State and in several other nations to support the following programs:

- Weatherization & Intergovernmental Program;
- Federal Energy Management Program;
- Distributed Energy Resources;
- Building Technologies;
- Industrial Technologies;
- FreedomCAR & Vehicle Technologies.

Key activities include:

- Administering the management and operating contract for the National Renewable Energy Laboratory (NREL).
- Managing the Federal Energy Management Program (FEMP) Super Energy Savings Performance Contracts ("Super-ESPCs") and serving as the focal point for FEMP finance and procurement activities.
- Providing procurement, legal, business management, information resource management, and technical support to the six EERE Regional Offices.
- Supporting the Inventions and Innovations Program.
- Partnering with industry and academia in joint R&D projects to further develop and facilitate delivery of applied R&D.

Regional Offices

EERE's 6 Regional Offices (ROs), located in Atlanta, Boston, Chicago, Denver, Philadelphia, and Seattle, catalyze the implementation of energy efficient and renewable energy strategies at the State and local level by working with States and communities to promote EERE programs; identifying and engaging community and State partners; and integrating EERE programs with public and private sector activities. The ROs, with 119 FTEs budgeted for FY 2005, represent over a quarter of EERE's Federal workforce, and administer nearly \$0.4 billion in program funding to States, localities, and regional organizations. They play a key role in implementing EERE's mission in administering grants, managing projects, and delivering programs that accelerate market penetration of energy efficiency and renewable energy technologies, plays a key role in implementing EERE's mission. Key activities include:

- Administering EERE's principal technology deployment grant programs, including the Weatherization Assistance Program and the State Energy Program;
- Delivering EERE's principal technical assistance programs, including Clean Cities, Rebuild America, and the Federal Energy Management Program;
- Serving as EERE's liaison to State Energy Offices, other State agencies, regional organizations of the National Governors' Association, and other stakeholders involved in energy and environmental quality issues;
- Organizing over 150 meetings, workshops and conferences per year across all EERE technologies, and providing logistical support and briefing materials for high-profile/VIP events and visits for senior EERE and DOE management.
- Implementing Memoranda of Understanding between DOE and other Federal agencies, such as the Environmental Protection Agency, General Services Administration, Federal Emergency Management Agency (FEMA), and the Department of the Interior (DOI), to implement joint projects where the whole portfolio of EERE technologies is relevant;
- Providing EERE's national program managers at Headquarters with customer feedback on how to make their programs more effective and efficient;
- Supporting and helping deliver special initiatives of the President, Secretary, and Assistant Secretary;

- Creating local, State, and regional partnerships and leveraging local, State, and regional resources to maximize the impact of EERE's technologies and programs; and
- Helping EERE's end use sectors deliver their programs to State and local stakeholders.

The following is a crosscut of FY 2005 Regional Office budget estimates by EERE's major Energy Conservation programs: Federal Energy Management Program; Weatherization & Intergovernmental Program; Industrial Technologies Program; Distributed Energy Resources; as well as support activities:

FY 2005 Regional Office Budget Estimates

| (dollars in thousands) | | | | | | | |
|------------------------|-------|-------|----------|-------|--------------|--------------|--------|
| | FEMP | WIP | Industry | DER | Crosscutting | Mgmt & Admin | Totals |
| Atlanta..... | 360 | 1,081 | 300 | 360 | 421 | 482 | 3,004 |
| Boston..... | 195 | 958 | 149 | 304 | 244 | 632 | 2,482 |
| Chicago..... | 250 | 1,026 | 115 | 686 | 58 | 150 | 2,285 |
| Denver | 367 | 1,362 | 190 | 300 | 567 | 766 | 3,552 |
| Philadelphia | 324 | 1,071 | 242 | 267 | 0 | 779 | 2,683 |
| Seattle..... | 315 | 1,083 | 130 | 285 | 360 | 510 | 2,683 |
| Totals | 1,811 | 6,581 | 1,126 | 2,202 | 1,650 | 3,319 | 16,689 |

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Salaries and Benefits **47,467** **48,300** **52,107**

Funds a total of 441 full time equivalent employees in FY 2005, two more than the FY 2004 request. Staff funded in this decision unit provide the executive management, program oversight, analysis, and information required for the effective implementation of the EERE programs funded in the Energy Conservation appropriation. The two additional FTEs will support the Fuel Cell Program in the Golden Field Office (GO).

The past several budgets have underestimated the total per-FTE cost, which has required internal redirection of program direction funding and vacancies to be left unfilled longer than planned. The increase requested for FY 2005 addresses that issue and reflects appropriate personnel costs and expected escalation.

The DOE Headquarters component, consisting of 262 FTEs in FY 2005 (a reduction of 8 from FY 2004), is responsible for the development of policies, strategic plans and related guidance to program offices; the evaluation of program performance; the formulation, defense and execution of energy conservation budgets; program planning and execution; and communications with the public and

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

stakeholders regarding policies, funding, program performance, and related issues.

Program Direction supports a GO personnel level of 60 FTEs in FY 2005. This represents an increase of 10 from the FY 2004 request. Eight of these FTE represent a shift in FTE balance from Headquarters to Golden, and the remaining two represent a net increase in FTE. This shift and increase is intended to support the development of a centralized EERE Project Management Office at Golden. In order to have dedicated support at the NNSA Service Center in Albuquerque, GO will station one or two people there who will work on EERE programs full-time, but they will continue to be treated as GO employees.

In FY 2004, 13 FTEs previously supporting EERE at 3 operations offices were consolidated at GO. This consolidation of expertise dedicated to EERE field management is expected to increase productivity and effectiveness, because of focus on a single DOE program and adoption of unified business practices.

Program Direction also supports 119 FTEs located in EERE's six Regional Offices, the same level as requested in FY 2004.

Staff performance is measured by responsiveness to National Energy Policy goals and objectives; implementation of the President's R&D criteria for priority decision making; continued improvement in the utilization of Federal personnel, travel, and support service activities; increases in competitive and cost-sharing procurement awards; extending the use of more efficient electronic government information systems, improving financial performance; and further integration of program metrics into resource allocation processes.

| | | | |
|---------------------|--------------|--------------|--------------|
| Travel | 2,764 | 2,996 | 3,025 |
|---------------------|--------------|--------------|--------------|

The FY 2005 request provides adequate travel funds for 441 FTE, including an enhanced staff of project managers at the GO.

| | | | |
|------------------------------|---------------|---------------|---------------|
| Support Services..... | 11,731 | 10,111 | 10,557 |
|------------------------------|---------------|---------------|---------------|

Continue implementing management improvements guided by the President's Management Agenda. Peer review EERE program performance, providing feedback to research staff. Continue to provide program management support at Headquarters, Golden, and the Regional Offices for information technology, outreach, communication, procurement, financial and human resources management. Provide a small amount of staff training and provide funds for DCCA audits, not included in FY 2004. The FY 2004 figure also includes \$894,000 Congressionally directed to be used at the National Energy Technology Laboratory (NETL) for project-management services for EERE's Distributed Energy program. *Participants will include: TMS, Inc., NETL, TBD.*

| | | | |
|------------------------------------|--------------|--------------|--------------|
| Other Related Expenses..... | 7,979 | 8,725 | 9,420 |
|------------------------------------|--------------|--------------|--------------|

The FY 2005 request will support:

- \$4,994,000 for Headquarters Working Capital Fund (WCF) activities such as administrative services, rent, automated office support, contract close out, telephone services, postage,

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

printing, graphics, and similar services;

- \$2,700,000 for rent at the GO and the six Regional Offices; and
- \$1,726,000 for Other Related Expenses, including computer equipment and support, utilities, postage, printing, graphics, administrative expenses, and security at Golden and the Regional Offices, plus Worker's Compensation, software licenses, publications, and conferences.

| | | | |
|---------------------------------------|---------------|---------------|---------------|
| Total, Program Direction | 69,941 | 70,132 | 75,109 |
|---------------------------------------|---------------|---------------|---------------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Salaries and Benefits

| | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| More accurate pricing of on-board FTE and an increase of 2 FTE at Golden for the Fuel Cell Technology program; reflect pay increases enacted by Congress. | +3,807 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|

Travel

| | |
|-----------------------------------|-----|
| Small increase in GO travel. | +29 |
|-----------------------------------|-----|

Support Services

| | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Provide funding for DCAA audits and staff training, provide support for increased staff at Golden Field Office, partially restore historical support levels at Regional Offices, stretch out time-frame for development of unified program management and information systems to help cover the costs of the previous items. Expand project management funding at NETL..... | +446 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|

Other Related Expenses

| | |
|------------------------------------------------------------------------------------------------------------------------|------|
| Begin putting desktop PCs and EERE servers on a 3-year replacement rotation; cover anticipated increases in rent. | +695 |
|------------------------------------------------------------------------------------------------------------------------|------|

| | |
|-----------------------------------------------------|---------------|
| Total Funding Change, Program Direction..... | +4,977 |
|-----------------------------------------------------|---------------|

Support Services by Category

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------|---------|---------|---------|-----------|----------|
| Management Support | | | | | |
| Management Support | 11,731 | 9,217 | 8,657 | -560 | -6.1% |
| NETL Project Management | 0 | 894 | 1,900 | +1,006 | +112.5% |
| Total, Management Support | 11,731 | 10,111 | 10,557 | +446 | +4.4% |

Other Related Expenses

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------|---------|---------|---------|-----------|----------|
| Other Related Expenses | | | | | |
| Equipment transport | 75 | 75 | 75 | 0 | 0.0% |
| Rent to GSA..... | 2,400 | 2,255 | 2,594 | +339 | +15.0% |
| Rent to Others | 100 | 103 | 106 | +3 | +2.9% |
| Communications, Utilities, Misc..... | 1,087 | 701 | 1,102 | +401 | +57.2% |
| Printing and Reproduction | 160 | 150 | 160 | +10 | +6.7% |
| Other Services | 0 | 0 | 29 | +29 | |
| Supplies and Materials | 180 | 160 | 180 | +20 | +12.5% |
| Equipment..... | 175 | 150 | 180 | +30 | +20.0% |
| Working Capital Fund | 3,802 | 5,131 | 4,994 | -137 | -2.7% |
| Total, Other Related Expenses | 7,979 | 8,725 | 9,420 | +695 | +8.0% |

Planning, Evaluation, and Analysis

Funding Schedule by Activity

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|-----------------------------------------------|---------|---------|---------|-----------|----------|
| Planning, Evaluation, and Analysis | | | | | |
| Planning, Evaluation, and Analysis ... | 4,972 | 4,944 | 5,005 | +61 | +1.2% |
| Total, Planning, Evaluation and Analysis..... | 4,972 | 4,944 | 5,005 | +61 | +1.2% |

Description

Planning, Evaluation and Analysis collects economic, market, and technology characterization data and develops analytical tools and models for forecasting future energy and technology markets, the impact that energy-efficiency technologies might have, and the potential energy, economic environmental and social benefits of those impacts.

These analyses are essential for program planning, prioritization, and management of robust program pathways that lead to the achievement of EERE goals in the most cost effective manner. A solid analytical foundation is basic to understanding the potential for increasing the penetration of energy efficient and renewable energy technologies, and for achieving the correct balance and direction of programmatic activities. In addition, analysis and evaluation activities are required to ensure continued program alignment with the goals of the National Energy Policy (NEP) and the President's Management Agenda, and to properly explain the budgets and benefits of EERE's programs.

EERE 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 supporting databases 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.

Benefits

The Planning, Evaluation, and Analysis subprogram funds analysis contracts that support the integration of performance measurement and benefits estimation with program planning, support the development of consistent multi-year planning methods, provide energy-market foresight, and calculate the GPRA benefits estimates for all other DOE Energy Conservation programs. Each of these activities is central to the goals of the President's Management Agenda, and each is also key to effective management of the Energy Conservation programs and to deciding on the optimal allocation of resources among the programs.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

| | | | |
|-------------------------------------------------|-------|-------|-------|
| Planning, Evaluation, and Analysis | 4,972 | 4,944 | 5,005 |
|-------------------------------------------------|-------|-------|-------|

The FY 2005 funding for this activity represents level funding, the same as the FY 2004 request, although the funds will be more focused on crosscutting analyses in order to provide adequate support for numerous new and expanded analytical requirements. The funds have been consolidated under the EERE reorganization in order distribute them among all Energy Conservation programs in a manner consistent with EERE's annual corporate analytical agenda.

The Office of Planning, Budget Formulation, and Analysis (PBFA) conducts program evaluations and supports program planning by developing, interpreting and disseminating the basic data required to implement energy policy and manage and evaluate energy efficiency programs. PBFA will continue its collaboration with Energy Information Administration on energy use data.

PBFA is also responsible for execution of the analysis elements of the National Academy of Public Administration Implementation Plan; tracks program objectives and goals as required under the Government Performance and Results Act (GPRA); and analyzes new starts and technology commercialization to document program performance metrics. In developing EERE's strategic plans, PBFA must maintain the analytical capability to estimate the best pathways to making the U.S. transportation, buildings and industry sectors sustainable with respect to domestic fuels used and greenhouse gases emitted.

Recent emphasis on GPRA and the President's Management Agenda, including the Office of Management and Budget's "Program Assessment Rating Tool" and "Research and Development Investment Criteria" assessments, requires a greater effort to project benefits, assess past performance and benefits, anticipate future markets, and provide a more solid integration of analysis tools and products across the EERE program portfolio.

Participants are expected to include: NREL, LBNL, ORNL, PNNL, and TBD.

| | | | |
|--------------------------------------------------------|-------|-------|-------|
| Total, Planning, Evaluation, and Analysis | 4,972 | 4,944 | 5,005 |
|--------------------------------------------------------|-------|-------|-------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Planning, Evaluation, and Analysis

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Provide the same level of analysis as supported by the FY 2004 request. The increase restores across-the-board reductions applied during the FY 2004 appropriation process .. | +61 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

| | |
|-----------------------------------------------------------------------|-----|
| Total Funding Change, Planning, Evaluation, and Analysis | +61 |
|-----------------------------------------------------------------------|-----|

Information, Communications, and Outreach

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|--------------------------------------------------------|---------|---------|---------|-----------|----------|
| Information, Communications, and Outreach | | | | | |
| Information, Communications, and Outreach | 1,540 | 1,531 | 1,550 | +19 | +1.2% |
| Total, Information, Communications, and Outreach | 1,540 | 1,531 | 1,550 | +19 | +1.2% |

Description

Information, Communications, and Outreach activities in EERE are carried out by the Office of Communication & Outreach (OCO). OCO communicates the EERE mission, program plans, accomplishments, and technology capabilities to a variety of stakeholder audiences including Congress, the public, educational institutions, industry, and other government and non-government organizations. In addition, OCO writes testimony and prepares briefing books; coordinates answers to congressional questions (between 600 and 1,000 per year); prepares speeches and presentations by the Assistant Secretary and others when requested; manages the EERE public website and EERE's centralized public information clearinghouse; manages official correspondence; and coordinates reviews of EERE related statements by other DOE offices and Federal agencies.

Many of OCO's functions are inherently Federal, and are performed by EERE staff, whose salaries, benefits, and all related funding (like all EERE staff) are covered in the Program Direction subprogram. The funding requested in this subprogram is focused on two EERE public information activities: the EERE public website and a central information clearinghouse, which provides a toll-free information "hotline."

The objectives of the EERE public website and the central information clearinghouse activities are: (1) to provide accurate information on energy efficiency and renewable energy technologies to the public so EERE's customers can make informed decisions in the marketplace, resulting in an increase in the adoption of EERE efficiency technologies and efficient energy practices; and (2) to raise the general awareness of state-of-the-art energy efficiency technologies and practices.

Benefits

The Communications and Outreach subprogram coordinates and manages efforts to make the all of the other programs' work – and their results – known to the public. This contributes both to the Energy Conservation account's deployment goals and to Administration E-government initiatives to make government more transparent and accessible to the public.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

Information, Communications, and Outreach 1,540 1,531 1,550

From March 2002 through February 2003, the number of web pages called up by users doubled to 4.8 million. The increased demand for information in this medium will require us to devote a larger share of the ICO budget to web-server operations and maintenance and to content creation and updates. We will identify (in FY 2004) and implement (in FY 2005) ways to improve website content management and content timeliness in response to this increased consumer and stakeholder usage. We are continuing to update the website to reflect the recent reorganization and to incorporate a consistent "EERE corporate" look and feel across its many components.

The toll-free information clearinghouse provides a more personalized service than the website, and is available to consumers and businesses who do not have Internet access. The clearinghouse fielded 34,000 inquiries and delivered 425,000 publications to consumers, businesses, and schools in 2002.

As more individuals and businesses use the Internet as their first-choice resource for information, we are re-evaluating the clearinghouse's focus and operations in order to find efficiencies that will allow more resources to be applied to our Web-based information offerings. OCO is also examining ways to consolidate three existing program-specific and program-funded clearinghouses with the central EERE clearinghouse, in order to address the needs of all of EERE's programs and stakeholders with the most economical infrastructure.

Participants will include: NREL, LBNL, ORNL, PNNL, RS Information Systems, and TBD.

| | | | |
|---------------------------------------------------------------|-------|-------|-------|
| Total, Information, Communications, and Outreach | 1,540 | 1,531 | 1,550 |
|---------------------------------------------------------------|-------|-------|-------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Information, Communications, and Outreach

| | |
|------------------------------------------------------------------------------|------------|
| Restore general reductions applied to FY 2004 appropriation. | +19 |
| Total Funding Change, Information, Communications, and Outreach | +19 |

Cooperative Program with States

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------------------|----------------|---------|---------|-----------|----------|
| Cooperative Program with States | | | | | |
| Cooperative Program with States | 0 ^a | 4,939 | 0 | -4,939 | -100.0% |
| Total, Cooperative Program with States..... | 0 | 4,939 | 0 | -4,939 | -100.0% |

Description

The Cooperative Program with States is a Congressionally-directed activity that funds cooperative agreements with States, which in turn support technology development, field testing, and deployment activities that promote the commercialization of energy-efficiency technologies. The technologies and applications supported can address any sector of the nation's economy.

Detailed Justification

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------|---------|
| Cooperative Program with States | 0 ^a | 4,939 | 0 |
| FY 2004 will be distributed through cooperative agreements with States to support technology development, field testing, and deployment activities that promote the commercialization of energy-efficiency technologies. | | | |
| <i>Participants will include: TBD.</i> | | | |
| Total, Cooperative Program with States..... | 0 ^a | 4,939 | 0 |

^a Total FY 2003 funding was \$2,928,000. Those funds are shown under the State Energy Activities subprogram within the Weatherization and Intergovernmental Program, which was how FY 2003 was presented in the FY 2004 DOE Congressional Request.

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Cooperative Program with States

| | |
|-------------------------------------------------------------------------|--------|
| No funds are requested for this Congressionally-directed activity | -4,939 |
|-------------------------------------------------------------------------|--------|

| | |
|--------------------------------------------------------------------|---------------|
| Total Funding Change, Cooperative Program with States | -4,939 |
|--------------------------------------------------------------------|---------------|

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|----------------------------------------------------------------|------------|--------------|----------|---------------|----------------|
| Congressionally Directed Activities | | | | | |
| National Academy of Sciences Program Review | 497 | 495 | 0 | -495 | -100.0% |
| Energy & Research Consortium of the Western Carolinas | 0 | 2,963 | 0 | -2,963 | -100.0% |
| Total, Congressionally Directed Activities | 497 | 3,458 | 0 | -3,458 | -100.0% |

Description

These activities have been added at the direction of Congress. The National Academy of Sciences review of selected R&D activities is a continuation of an activity directed in FY 2003. The activities at the Energy & Research Consortium of the Western Carolinas represent new direction in FY 2004.

Detailed Justification

(dollars in thousands)

| FY 2003 | FY 2004 | FY 2005 |
|---------|---------|---------|
|---------|---------|---------|

National Academy of Sciences (NAS) Program

| | | | |
|---------------------|------------|------------|----------|
| Review | 497 | 495 | 0 |
|---------------------|------------|------------|----------|

The National Academy of Sciences is funded to study the prospective (predicted) benefits of Energy Conservation programs, and the possible methodologies for such predictions.

Participants will include: NAS.

Energy & Research Consortium of the Western

| | | | |
|------------------------|----------|--------------|----------|
| Carolinas | 0 | 2,963 | 0 |
|------------------------|----------|--------------|----------|

This activity will be executed in accordance with Congressional direction. EERE will endeavor to obtain benefits to the Department's goals and EERE's programs in negotiating the work to be performed by the earmark recipient.

Participants will include: Energy & Research Consortium of the Western Carolinas.

| | | | |
|--------------------------------------------------------|------------|--------------|----------|
| Total, Congressionally Directed Activities..... | 497 | 3,458 | 0 |
|--------------------------------------------------------|------------|--------------|----------|

Explanation of Funding Changes

| |
|-----------------------------------|
| FY 2005 vs. FY 2004 (\$000) |
|-----------------------------------|

Congressionally Directed Activities

No funds are requested to continue either of these Congressionally-directed activities
in FY 2005.

- 3,458

Total Funding Change, Congressionally Directed Activities

- 3,458

Energy Efficiency Science Initiative (EESI)

Funding Profile by Subprogram^a

| (dollars in thousands) | | | | | | |
|---------------------------------------------------------------|-----------------------------------------------------|----------------------------------------|-----------------|--------------------|----------------------------|----------|
| | FY 2003 ^b Comparable Appropriation | FY 2004 Comparable Appropriation | FY 2005 Base | FY 2005 Request | FY 2005 Request vs Base | |
| | | | | | \$ Change | % Change |
| Energy Efficiency Science Initiative | | | | | | |
| Energy Efficiency Science Initiative..... | 2,440 | 0 | 0 | 0 | 0 | 0.0% |
| Total, Total, Energy Efficiency Science Initiative..... | 2,440 | 0 | 0 | 0 | 0 | 0.0% |

Public Law Authorizations:

P.L. 93-275, "Federal Energy Administration Act of 1974"
P.L. 93-577, "Federal Non-nuclear Energy Research and Development Act of 1974"
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"

Mission

In collaboration with the DOE Office of Fossil Energy and the Office of Science, address technology gaps between exploratory science and pre-commercial applied R&D.

Benefits

By bridging the gap between exploratory science and pre-commercial R&D, this program helped accelerate applied research thereby facilitating the movement of basic science into the market.

^a SBIR/STTR funding in the amount of \$87,762 was transferred to the Science appropriation in FY 2003.

^b The office of Fossil Energy received, through transfer, \$1,220,000, or half of these funds.

Funding Schedule by Activity

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 | \$ Change | % Change |
|---------------------------------------------------|---------|---------|---------|-----------|----------|
| Energy Efficiency Science Initiative | | | | | |
| Energy Efficiency Science Initiative | 2,440 | 0 | 0 | 0 | 0.0% |
| Total, Energy Efficiency Science Initiative | 2,440 | 0 | 0 | 0 | 0.0% |

Description

This program expanded upon existing cooperative efforts with the Office of Fossil Energy in areas such as natural gas-fueled turbine and fuel cell technologies; combined heat, power and cooling applications; hydrogen production, and carbon emission sequestration. It also coordinated with the Office of Science in pursuing follow-on research in the areas of energy efficiency and clean energy development, including basic biosciences, plant genetics, photo emission, heat transfer, new materials, catalysts, and computational science to bridge gaps between fundamental exploratory science and pre-commercial applied R&D.

Detailed Justification

(dollars in thousands)

| | FY 2003 | FY 2004 | FY 2005 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|----------|
| Energy Efficiency Science Initiative | 2,440 | 0 | 0 |
| No funds requested for FY 2004 or 2005. In FY 2003, this activity was reduced by \$87,762 for SBIR/STTR and transferred to the Science Appropriation. | | | |
| Total, Energy Efficiency Science Initiative | 2,440 | 0 | 0 |

Explanation of Funding Changes

| | FY 2005 vs. FY 2004 (\$000) |
|-------------------------------------------------------------------------|-----------------------------------|
| Energy Efficiency Science Initiative | 0 |
| Total Funding Change, Energy Efficiency Science Initiative | 0 |