Proposed Appropriation Language
DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

Energy Conservation

For necessary expenses in carrying out energy conservation activities, **[**$611,723,000**]**, *$808,500,000* to remain available until expended, including, notwithstanding any other provision of law, the excess amount for fiscal year **[**1998**]** *1999* determined under the provisions of section 3003(d) of Public Law 99-509 (15 U.S.C. 4502): *Provided*, That **[**$155,095,000**]** *$191,100,000* shall be for use in energy conservation programs as defined in section 3008(3) of Public Law 99-509 (15 U.S.C. 4507) and shall not be available until excess amounts are determined under the provisions of section 3003(d) of Public Law 99-509 (15 U.S.C. 4502): *Provided further*, That notwithstanding section 3003(d)(2) of Public Law 99-509 such sums shall be allocated to the eligible programs as follows: **[**$124,845,000**]** *$154,100,000* for weatherization assistance grants and **[**$30,250,000**]** *$37,000,000* for State energy conservation grants. *(Department of the Interior and Related Agencies Appropriations Act, 1998.)*

EXPLANATION OF CHANGE

Deletes funding amounts which had specific application to FY 1998 and includes the appropriate funding amounts for FY 1999.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
Energy Efficiency and Renewable Energy
Energy Conservation
(Tabular dollars in thousands, Narrative in whole dollars)

Energy Efficiency Programs

EXECUTIVE SUMMARY

Introduction

The programs of the Office of Energy Efficiency and Renewable Energy (EERE) funded by the Interior and Related Agencies Appropriations Subcommittee are designed to improve the fuel economy of automobiles and other vehicles, increase the productivity of the nation's most energy-intensive and polluting industries, and improve the energy efficiency of buildings and appliances. EERE's programs work in voluntary cost-shared partnerships with the nation's utilities, industries, states, and the public to advance the development and deployment of clean and efficient energy technologies. By developing the means to manage energy use, EERE provides tools for the nation, its industries, and its citizens to be smart about energy -- to use energy more efficiently, with fewer financial and environmental costs. By promoting energy efficiency, EERE's programs help to strengthen the economy, improve the environment, and ensure a more secure future.

In its 1997 review of the national energy R&D portfolio, the President's Committee of Advisors on Science and Technology recommended expansion of a number of national energy R&D programs, and targeted energy efficiency programs for the greatest increases in funding. The Committee noted that energy efficiency technologies produce near-term and rapidly expanding public benefits, including air emissions reductions, reduced dependence on imported oil, and lower costs to households and firms. According to the Committee's analysis, R&D investments in energy efficiency have contributed to efficiency improvements that save U.S. consumers approximately $170 billion per year. The Committee called for significant expansion of energy efficiency programs in order to meet the energy challenges and opportunities of the 21st century.

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

EERE's programs target Federal resources in key areas that provide critical national benefits; stimulate complementary private investments; leverage market forces; and respond to five significant drivers:

- National Security;
- Economic Competitiveness;
- Environmental Quality;
- Climate Change; and,
- Electric Utility Restructuring.

National Security
During the past 23 years, three major disruptions in the world oil market have shaken the global economy. In 1996, U.S. net oil imports accounted for approximately 45 percent of domestic petroleum consumption. By 2020, U.S. net oil imports are expected to grow to over 65 percent of domestic petroleum consumption, with Persian Gulf nations accounting for over 65 percent of the world's oil exports. In 2020, U.S. net annual expenditures for imported crude oil and products are projected to exceed $130 billion in current dollars. Given historical precedents and future oil market trends, the United States has a critical interest in diminishing the nation's reliance on foreign oil through improved efficiency and use of indigenous renewable energy sources. EERE's efforts to implement a smart energy policy recognize this security concern and work to reduce U.S. dependence on foreign oil. As a related benefit, EERE's work on efficiency and renewable energy reduces the U.S. trade deficit by reducing costly energy imports.

Economic Competitiveness
In addition to reducing the nation's vulnerability to disruptions in energy supplies, EERE's research and development efforts advance U.S. economic interests. Carried out in partnership with industry, national laboratories, and universities, EERE's research and development programs are designed to maintain America's technological expertise and competitive advantage in the global market. A smart energy policy, as promoted by EERE's programs, strengthens the nation's economic power. EERE's investments not only lay the foundation for a more sustainable energy future but also open markets for manufacturers of advanced U.S. technology. EERE sponsors international programs to promote U.S. energy efficiency goods and services in international markets. EERE also participates in the Department's Science Education programs to cultivate the next generation of science and technology leaders and ensure the nation's continued economic competitiveness.

EERE's work with the nation's most energy-intensive and polluting industries results in productivity enhancements and savings in energy and environmental compliance costs. By cultivating clean and energy efficient industries, EERE is helping to assure the long-

term competitiveness of U.S. industry. EERE technologies also lead to greater worker productivity through lighting and other work space improvements.

Environmental Quality
Air pollution, particularly in urban centers, ranks high among the nation's most pressing environmental concerns. In advancing a smart energy policy, EERE programs work to mitigate and minimize the environmental costs associated with energy use. By developing technologies that improve energy efficiency in industry and buildings, EERE's programs are concurrently identifying ways to reduce energy-related air pollutants. Furthermore, EERE's work on vehicle technologies will lead to greater fuel-efficiency as well as use of alternative fuels -- both offering impressive reductions in emissions.

Climate Change
The President's FY 1999 budget request for EERE programs is a major element of his proposal to invest $5 billion over five years to reduce greenhouse gas emissions to below 1990 levels by 2008 - 2012 through energy technology research and development and tax incentives. In 1997, a major study conducted by five national laboratories documented the critical role that development and deployment of energy efficiency and renewable energy technologies can play in reducing greenhouse gases. Given the cost savings associated with these technologies, the study noted that aggressive investment in energy R&D and deployment could lead to significant emissions reductions without raising the nation's energy bill.

Electric Utility Restructuring
EERE is working with utilities, industry, states, and consumers to ensure that utility restructuring results in a competitive and effective electricity generation industry. Utility restructuring presents an opportunity to reduce energy costs, advance the use of energy efficient and renewable energy technologies, and provide affordable services with reduced environmental impacts.

Long-Term Priorities
EERE oversees a wide range of research, development, and deployment activities that lead to energy savings, enhanced industrial productivity and competitiveness, environmental benefits, and carbon emissions reductions. The following goals reflect some of EERE's most important priorities under the Interior and Related Agencies Appropriations Subcommittee and will help to direct its work in FY 1999:

- Advance the Partnership for a New Generation of Vehicles goal of developing by 2004 prototype mid-sized cars, capable of 80 miles per gallon and two-third reductions in nitrogen oxides (NO_x) and carbon dioxide (CO_2) emissions, without compromising safety, comfort, performance, and cost.

- Develop advanced turbines that can reduce annual industrial energy costs by $500 million and carbon emissions by nearly 1.7 million metric tons in 2010.

- By 2010, improve efficiency of the nation's most energy intensive industries and reduce energy-related releases of carbon dioxide, sulfur oxides, nitrogen oxides, particulates, and other wastes by as much as 5 percent relative to projected emissions.

- By 2010, improve the energy efficiency of the nation's new homes by 50 percent; commercial buildings by 30 to 50 percent; and existing buildings by 20 percent.

- By 2005, improve energy efficiency in Federal buildings by 30 percent over 1985 levels.

Using Federal Resources Wisely: Maximizing Public Benefit

EERE has developed expertise in setting program goals, measuring performance, and defining budget priorities based on projected benefits. EERE also works closely with industry to set research goals and leverage private sector resources. In an effort to build on these practices, EERE is pursuing the following management principles to ensure that its research, development, and deployment programs invest resources effectively and efficiently and achieve the greatest public benefit.

- *Increasing the Use of Competitive Solicitations:* EERE is increasing the amount of its program funds that will be awarded competitively. By issuing competitive solicitations, EERE will be able to evaluate and compare proposals and fund the most promising technologies. A number of EERE programs will issue broad solicitations in order to select among a wide range of technologies, rather than narrowly investing in each industry. This type of competitive process will lead to more effective use of R&D funds.

- *Measuring Performance:* As noted above, EERE assesses the progress of its programs against defined criteria. In particular, EERE projects the energy displaced, cost savings, and carbon reductions associated with its programs. EERE will continue to measure performance of its programs and quantify associated benefits. As a related effort, EERE will continue to use peer review to help evaluate programs and set priorities.

- *Terminating Activities:* As part of EERE's commitment to investing resources efficiently, EERE will discontinue activities that do not meet pre-determined goals. Completed and discontinued projects are highlighted in the sector descriptions of this executive summary.

- *Coordinating Cross-Cutting Activities:* EERE's sector programs work on a number of related projects that serve the interests of multiple customers. Furthermore, EERE represents only one part of public and private investment in energy technologies. The Department of Energy's Offices of Fossil Energy, Nuclear Energy, and Energy Research, along with other Federal agencies, are involved in complementary research. EERE is committed to working closely with its public and private sector partners to avoid redundancy and direct R&D to achieve the greatest public benefit.

- *Improving Deployment through Support Offices:* EERE's sector programs rely on six regional support offices (RSOs) to implement a number of important activities. RSOs collaborate with regional interests and ensure that EERE programs and technologies are deployed at the state and local level. This executive summary includes a section on RSOs with functions, funding, and staff levels.

- *Clarifying the Budget:* As the FY 1999 budget illustrates, EERE is working to clarify how funds are used across sectors and in the regional support offices. In particular, EERE is requesting specific increases in the program direction account for cross-cutting activities that were formerly funded through directed funding from sector program accounts.

- *Reducing Uncosted Balances:* Since the beginning of FY 1996, EERE has reduced its uncosted balances by over 40 percent. EERE is committed to managing and investing its resources wisely, and will continue to work to lower remaining balances.

- *Collaborating with Customers:* EERE works closely with Congress, industry, states, interest groups, national laboratories, utilities, universities, and others to set research and development priorities, identify program opportunities, deploy technologies, and disseminate information more effectively. EERE involves its customers and partners in all stages of research and development, including concept development, market and technical feasibility studies, system and component design, research plans, prototype construction and testing, demonstrations, and deployment. In many cases, EERE activities are jointly funded with private sector or other public sector players.

FY 1999 CONGRESSIONAL BUDGET REQUEST

In support of its priorities, EERE submits the following FY 1999 budget request to the Interior and Related Agencies Appropriations Subcommittee:

Office of Energy Efficiency and Renewable Energy Energy Efficiency Programs FY 1999 Congressional Budget Request (in millions of dollars)				
	FY 1997	FY 1998	FY 1999 Request	Program Change
Industrial Technologies	115.4	136.2	166.6	+30.4
Transportation Technologies	172.5	193.3	246.1	+52.8
Building Technology, State and Community Programs	229.9	233.9	317.5	+83.6
Federal Energy Management Program	19.8	19.8	33.9	+14.1
Policy and Management	26.4	28.5	44.4	+15.9
Total Program Funding	564.0	611.7	808.5	+196.8
PODRA and Prior Year Balances	-30.5	-20.6	-35.0	-14.4
Total Budget Authority[1]	533.5	591.1	773.5	+182.4

[1]Total Budget Authority figures take into account prior year balances and projected receipts associated with the Petroleum Overcharge Distribution and Restitution Act (PODRA).

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

The following overview summarizes the program's projected benefits, sector activities, cross-cutting programs, and regional support office responsibilities. Each sector description provides information on new activities for FY 1999, projects to be discontinued or completed in FY 1998 and FY 1999, and ongoing programs.

EERE PROGRAM BENEFITS

EERE's research, development and deployment of energy technologies have led to billions of dollars in energy cost savings over the past decade. Over the next 25 years, there will be significant additional benefits associated with each sector's programs, including increased energy efficiency, and associated cost savings and emissions reductions.

Projected energy, economic, and environmental savings are presented in the following table. *Total Primary Energy Displaced* refers to the amount of conventional, fossil, or electric energy directly displaced through energy efficiency improvements. One quadrillion BTUs has the energy equivalent of 172 million barrels of oil. *Energy Cost Savings* represents the annual dollar savings that consumers will realize through reduced energy consumption. Finally, the carbon figures represent the amount of carbon equivalent emissions that will be avoided due to reduced energy consumption. EERE uses carbon reductions because in many applications they serve as a useful measure and surrogate for a wide variety of energy-related pollutants, including carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), particulates, and in some cases, heavy metals.

Office of Energy Efficiency and Renewable Energy
Energy Efficiency Programs Projected Annual Benefits by Sector through the Year 2020

	Total Primary Energy Displaced (Quadrillion BTUs)			Energy Cost Savings ($ billions)			Carbon Reductions (million metric tons)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Transportation Sector *(oil savings in quads)*	0-.01 *(.07-.13)*	.93-1.23 *(1.33-2.40)*	2.49-2.74 *(3.05-4.17)*	0-.49	7.57-9.68	15.5-20.54	.3-.64	17.9-26.66	47-55.17

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

	Total Primary Energy Displaced (Quadrillion BTUs)			Energy Cost Savings ($ billions)			Carbon Reductions (million metric tons)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Industry Sector	.15-0.27	.95-1.46	1.52-2.47	.58-1.03	3.06-4.65	4.79-7.72	2.3-5.39	16.5-30.74	31.8-51.63
Building Technology, State & Community Sector	.07-.07	1.41-2.04	2.8-5.46	0.50-0.50	9.77-14.13	18.63-36.34	1.1-1.45	22.4-44.86	47.2-120.1
Federal Energy Management Program	.06	.24	.31	.42	1.41	1.92	1.16	4.4	5.63

Note: The program benefit ranges are developed through an impact analysis process undertaken annually by the Office of Energy Efficiency and Renewable Energy (EERE). The upper point of each range is based on analysis conducted by EERE's sectors and externally reviewed by Arthur D. Little. The sectors analyze the impacts their programs will have on energy savings, cost savings, and carbon reductions if all program goals are met. The lower point of each range for energy displaced and carbon reductions is derived from an integrated analysis model run by external contractors that controls for interaction effects. The integrated analysis model accounts for inter- and intra-sector double-counting as well as market trends, including reductions in new electricity generation. The lower point of the energy cost savings range is calculated by multiplying the total primary energy displaced, derived from the integrated analysis, by the sector's energy cost savings/total primary energy displaced ratio for that year.

OFFICE OF INDUSTRIAL TECHNOLOGIES

Resource Efficiency for Industry

Industry consumes over a third of the energy delivered in the United States and spends tens of billions of dollars annually for pollution abatement and control. Seven industries account for 82 percent of the energy used in manufacturing: pulp and paper; steel; aluminum; metal-casting; chemicals; petroleum refining; and stone, clay and glass. These industries also account for over 80 percent of air emissions and over 90 percent of waste produced by U.S. manufacturing. The Office of Industrial Technologies focuses on developing innovative technologies to assist major industry sectors in becoming more resource efficient, and thereby more productive and competitive and less polluting.

Industrial Technologies Program Funding
(in millions of dollars)

	FY 1997	FY 1998	FY 1999 Request	Program Change
Industries of the Future (Specific)	$45.3	$53.1	$76.0	$+22.9
Industries of the Future (Crosscutting)	38.4	49.1	49.4	+0.3
Technology Access (e.g.; Motor Challenge; National Industrial Competitiveness through Energy, Environment, and Economics; and Industrial Assessment Centers)	24.8	26.3	32.0	+5.7
Program Direction	6.9	7.7	9.2	+1.5
Total	$115.4	$136.2	$166.6	$+30.4

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

NEW ACTIVITIES IN FY 1999

As a corollary to its work with the steel and aluminum industries, OIT will initiate work with the mining industry in developing a technology road map and beginning directed research. In addition, OIT will significantly expand its research in bio-based renewable feedstocks to support an agriculture industry vision. OIT will initiate a deployment program aimed at increasing the efficiency of steam and compressed air systems in industry, modeled after the Motor Challenge program.

OIT will also focus on developing technologies specifically aimed at reducing greenhouse gases of all types. A competitive solicitation will be conducted and be open to all industries, with emphasis on those industries that have developed industry-wide visions and associated road maps. OIT will select proposals that offer the greatest impact on greenhouse gases and have widespread applicability to industry.

ACTIVITIES TO BE TERMINATED IN FY 1998

In the Industries of the Future program, OIT is concluding its current work with the petroleum refining industry due to the lack of progress in developing a vision and technology road map to direct future work. OIT is also terminating its Climate Wise program which received no appropriations in FY 1998, and is not included in the FY 1999 request.

PROGRAM IN BRIEF

The Office of Industrial Technologies (OIT) works with the nation's most energy-intensive industries to focus cooperative research on increasing energy efficiency and improving the environment. These industries could save over $10 billion in industry energy costs by 2010, and reduce carbon dioxide emissions by millions of tons per year.

OIT has developed visions and signed partnership agreements with the metal-casting, glass, aluminum, forest products, steel, and chemical industries. In addition, OIT is helping to facilitate the creation of industry visions with other trades, including forging, heat treating, mining, and agriculture.

The program will build on advances and opportunities in a number of industries including:

- **Forest Products:** With over 50 projects underway, OIT's partnership is developing technologies to reduce energy use in the drying of paper as well as emissions and effluents from paper mills.

Visions for Industries of the Future

Two key elements of the Industries of the Future strategy are each industry's "vision of the future" and "technology road map." Before initiating new research, each industry develops a vision and then a road map which outlines how to achieve the vision. The vision and road map guide industry- and government-funded research to advance U.S. industrial technology and create significant economic and environmental benefits.

- **Steel:** OIT will conduct research to reduce nitrogen oxide and other emissions from combustion processes in steel production, and to improve recycling of iron units from current production processes.

- **Aluminum:** OIT will continue research and development on the technology priorities identified in the Aluminum Industry Technology Road Map. With the goal of reducing energy consumption and emissions by about 30 percent, OIT is developing an advanced production cell that will result in a more efficient and cost-effective aluminum manufacturing process. By using non-carbon anodes that do not emit carbon, these advanced cells result in carbon reductions from both an improved design as well as a more energy efficient process. OIT is also developing a spray forming technology for continuous production of aluminum sheet using molten aluminum metal. This forming technology will result in fewer process steps, reduced energy and processing costs, as well as a metallurgically superior product, compared to alternative forming technologies.

- **Metal-Casting:** OIT will perform computer modeling of several casting processes and develop tools and new sensors to improve die-cavity filling. New efforts will focus on waste characterization, reduction, reuse, and alternative uses of foundry wastes.

- **Glass:** OIT will continue work initiated in FY 1998 on projects in process modeling, furnace refractory materials, and sensors for measurement and control of production and fabrication processes. OIT will also issue a competitive solicitation to target high priority research needs identified in the glass industry technology road map in the areas of production and energy efficiency, environmental protection and recycling, and innovative uses of glass.

- **Chemicals:** OIT will continue research and development in computational fluid dynamics, catalysis, separations, and bio-processes and complete a number of projects with national laboratories. In addition, research in bio-based renewable feedstocks will support the chemical industry's linkages to new agricultural industry.

- **Advanced Turbines and Materials:** OIT's efforts to develop advanced turbine systems for all sectors, including industry, utilities, federal installations, and large private buildings, will improve the efficiency of gas turbines by 15 percent and reduce their emissions by 80 percent. OIT is developing a number of materials geared at enhancing industrial productivity, including nickel aluminides for steel mills and ceramic materials that resist corrosion and high temperatures.

- **Technology Access:** OIT will continue to assist U.S. manufacturers in all sectors with immediate and near-term technical assistance through a variety of programs, including the National Industrial Competitiveness through Energy, Environment and Economics (NICE^3) program, Motor Challenge, and the Industrial Assessment Centers. In addition to providing technical assistance to a wide range of industries, these programs provide education and training; industry networking; waste, energy, and productivity assessments; showcase demonstrations; and software tools that assist manufacturers in evaluating and improving energy efficiency. OIT is working to ensure that all of the Technology Access programs provide integrated and efficient service to industrial customers, with a particular emphasis on small and medium manufacturers. As part of its new operating approach, OIT undertook a critical review of its Inventions and Innovation program. As a result, OIT is working to significantly reduce the processing time for grants issued to inventors and small technology based companies. A competitive solicitation to invest in promising energy efficient technologies will be issued in FY 1998; competitive awards will be granted in FY 1999.

OFFICE OF TRANSPORTATION TECHNOLOGIES

Cleaner Transportation and Energy Security

The U.S. transportation sector accounts for two-thirds of the nation's annual oil consumption and depends on oil for 97 percent of its fuel. The Office of Transportation Technologies (OTT) funds research, development and deployment of technologies that can significantly alter current trends in energy demand, particularly for oil. Commercialization of innovative transportation technologies and alternative fuels is the nation's best strategy for reducing reliance on oil. These advanced technologies can also result in dramatic reductions in criteria pollutants and greenhouse gas emissions from the transportation sector. The development and market acceptance of advanced transportation technologies (advanced clean diesel engines, hybrid vehicles, electric vehicles, fuel cell vehicles) and alternative fuels (ethanol from biomass, natural gas, electricity and others) have the potential to reduce oil consumption by 1 million barrels per day in 2010 and 2 million barrels per day in 2020; and reduce greenhouse gas emissions by 25 to 30 million metric tons in 2010 and by 50 to 60 million metric tons in 2020.

Transportation Technologies Program Funding (in millions of dollars)				
	FY 1997	FY 1998	FY 1999 Request	Program Change
Technology Deployment	$10.6	$11.8	$16.3	$+4.5
Advanced Automotive Technologies	102.7	113.3	144.6	+31.3
Advanced Heavy Vehicle Technologies	19.1	25.6	44.2	+18.6
Transportation Materials Technologies	32.3	35.0	31.8	-3.2
Implementation and Program Management	7.7	7.6	9.2	+1.6
Total	$172.5	$193.3	$246.1	$+52.8

NEW ACTIVITIES IN FY 1999

OTT's expanded R&D on diesel engines for light trucks will support three development teams, with a 50 percent minimum cost share, over five years. This effort reflects planned funding levels and the program's goal of deploying clean diesels in the light truck market by 2004. OTT will integrate this effort with other diesel R&D being conducted by DOE and EPA as part of PNGV.

In a joint program with the Department of Transportation, DOE will support electric and hybrid electric vehicle development for medium and heavy duty trucks, through regional consortia of industry, academia, state, and local governments. Previously funded and managed under the Defense Advanced Research Projects Agency program (DARPA), this R&D effort will now focus on developing applications targeted at medium and heavy duty trucks and buses. DOE and DOT will continue to work with the Advanced Transportation Technology Consortia to set priorities and direct R&D.

In addition to promoting the deployment of alternative fuel technologies, OTT will begin promoting advanced technology vehicles that car manufacturers and DOE recently exhibited. OTT will expand the scope of Clean Cities to include advanced technology vehicles, and expand grants to states and Clean Cities to demonstrate these vehicles, support innovative refueling infrastructure, and promote greenhouse gas emissions reductions. OTT will enhance the congressionally mandated Fuel Economy Guide and other information products to encourage broader use of fuel efficient and advanced technology vehicles. OTT will test and evaluate "state of the art" electric and hybrid vehicles. OTT will also focus on regulatory activities -- especially regarding Federal fleets -- in order to continue the promotion of existing alternative fuel vehicles.

The Partnership for a New Generation of Vehicles (PNGV) will support development of enabling technologies needed for an 80 mpg automobile (e.g., power electronic building block technology and high power energy storage devices.) For fuel cell vehicle systems, OTT will develop and test an advanced, high-efficiency, 50 kilowatt fuel-flexible fuel processor with 70 percent efficiency and a start-up time of less than three minutes. In compression ignition direct injection (CIDI) technology, OTT will expand its catalyst and plasma-assisted catalytic systems to full scale prototypes; apply closed loop controls to direct aftertreatment devices and combustion processes; and, benchmark prototypes in current CIDI multi-cylinder engines.

ACTIVITIES TO BE TERMINATED IN FY 1998

Given its focus on the most promising technologies, OTT is ending its research on gas turbines for vehicles, which has failed to progress sufficiently toward meeting design requirements. This project, conducted in collaboration with three major turbine manufacturers, was funded through FY 1997 and completed in FY 1998 with no additional funds. In addition, OTT will discontinue research and development on a number of PNGV enabling technologies including the Stirling engine, flywheels, and ultracapacitors. Each of these

technologies was found to be unable to attain one or more of the PNGV performance, cost, and manufacturing criteria. OTT has made these decisions in collaboration with its automotive partners.

PROGRAM IN BRIEF

Advanced Automotive Technologies

The Advanced Automotive Technologies program serves as the technological cornerstone for the Partnership for a New Generation of Vehicles (PNGV) -- our nation's partnership with the U.S. automobile manufacturing industry. With OTT's support, PNGV focuses on significantly improving the energy efficiency of automobiles and reducing associated emissions. Research and development activities in support of PNGV will emphasize four key system areas: hybrid-electric vehicle drive, direct-injection engines, fuel cells, and lightweight materials. The auto industry provides a significant share of the funding for PNGV research, which is aimed at a production prototype car with fuel efficiency of up to 80 miles per gallon by 2004. Announcements in 1997-1998 by the auto industry suggest that the PNGV goal is within reach and the government-industry partnership is working as envisioned.

In partnership with the U.S. Advanced Battery Consortium (USABC), which includes the major U.S. automobile manufacturers and the Electric Power Research Institute (EPRI), OTT supports research to improve the range, performance and cost of electric and hybrid vehicles and to evaluate new electric vehicles. Through this partnership, OTT has begun extensive in-vehicle testing of lithium polymer batteries, which could offer 3 to 4 times the range, and significantly greater performance and life, compared to conventional lead acid batteries.

Advanced Heavy Vehicle Technologies

The Office of Transportation Technologies has requested funding to work with industry partners to develop technology to increase the fuel efficiency of light trucks by improving the efficiency of diesel engines. Light trucks, including vans, pickups, and sport utility vehicles, represent the most rapidly growing segment of today's vehicle market. Improving their fuel economy while simultaneously reducing their emissions would have a dramatic impact on the nation's transportation energy consumption. OTT will undertake preliminary design, cycle analysis, and testing of the diesel engine for sport utility vehicles and pickup trucks in FY 1999. The program is developing technologies in support of significantly reduced emissions for medium sized trucks. The development of light truck diesel

engines will be closely coordinated with development of compression ignition direct injection engines in the PNGV, since most of the emissions control technologies envisioned for PNGV are also applicable to light duty trucks.

In FY 1999, program efforts to improve efficiency in large diesel engines will be coordinated with alternative fuels research and development efforts. Alternative fuels R&D activities will focus on developing advanced enabling technologies for the diesel engine to be fuel flexible. These engines will perform optimally on high cetane quality alternative fuels and blends (e.g., dimethyl ether) as well as on natural gas and renewable fuels such as bio-diesel and ethanol-derived diethyl ether. OTT will apply research tools developed for diesel fuel combustion R&D to study energy conversion efficiency and emissions from alternative fuel use. Fuel formulation strategies will focus on minimum exhaust emissions.

Transportation Materials Technology

New materials and material technologies are critical to the development and engineering of advanced transportation vehicles. The Office of Transportation Technologies supports materials research and development for both automobiles and trucks. These efforts focus on the development of lightweight vehicle materials that can reduce the weight of vehicles and decrease fuel consumption without compromising safety.

The High Temperature Materials Laboratory serves as a modern research facility with six user centers and a unique collection of advanced instruments for characterizing materials. By providing access to state-of-the-art equipment that few individual companies and institutions can afford, the laboratory enables scientists and engineers to solve materials problems that limit the efficiency and reliability of advanced energy conversion systems.

Technology Deployment

The Technology Deployment program promotes the acquisition of newly developed transportation technologies for both government and private fleets, to encourage their widespread penetration into domestic and foreign markets. The program focuses on commitments to alternative fuel vehicles through the Clean Cities program, public education, field testing and evaluation, and fleet programs established by the Energy Policy Act of 1992.

Technology Highlight
Compression Ignition Direct Injection (CIDI) Automotive Engines

The Partnership for a New Generation of Vehicles selected Compression Ignition Direct Injection (CIDI) technology for the heat engine component of its year 2004 concept vehicle. OTT's research resulted in the demonstration of crucial breakthrough technologies for nitrous oxide reduction. The success of on-going PNGV Cooperative Research and Development Agreements (CRADAs) is essential for developing an integrated CIDI automotive powerplant and fuel that will meet 2004 gaseous emissions standards as well as automotive industry criteria for cost and durability. OTT plans to continue assessing the performance and emissions of advanced CIDI engines fueled with reformulated or alternative fuels through FY 1999. These efforts will result in a cost effective emission control technique ($5/kW) that demonstrates sufficient durability (>3500 hours) to satisfy automotive industry partners.

Through the Clean Cities program, OTT encourages local governments and organizations to form public/private partnerships for developing alternative fuel vehicle markets. Over 60 Clean Cities now have a combined fleet of 165,000 alternative fuel vehicles, saving over 11 million gallons a year in oil consumption. Several of these local programs are linking across regional and state boundaries to strengthen efforts, expand purchasing power, and establish refueling infrastructure along Clean Corridors to enable inter-city travel of alternative fuel vehicles.

OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS

Energy Efficiency at Home and at Work

America's buildings—our homes and offices—consume roughly $220 billion worth of energy each year. Furthermore, heating and cooling, lighting, appliances, and equipment in buildings together account for over one-third of U.S. carbon emissions and a substantial amount of other pollutants.

The Office of Building Technology, State and Community Programs (BTS) is working with its partners in the private sector and in state and local government to make the nation's building stock more energy-efficient, comfortable, and affordable. To help achieve greater results in energy cost savings and associated emissions reductions, BTS is changing the way it does business. Based on its new strategic plan, BTS will refocus its research, development, and deployment on priorities set in collaboration with industry. Peer review and competitive solicitations will strengthen BTS' ability to achieve ambitious results. FY 1999 represents an important transition year as BTS takes its first step toward a refocused and improved program.

Building Technology, State, and Community Programs Funding
(in millions of dollars)

	FY 1997	FY 1998	FY 1999 Request	Program Change
Building System Design	$23.3	$23.0	$36.3	$+13.3
Building Equipment and Materials	26.1	26.9	46.2	+19.3
Codes and Standards	11.8	14.4	22.6	+8.2
State and Local Partnership Programs	151.4	156.7	197.7	+41.0
Management & Planning	17.3	12.9	14.7	+1.8
Total	$229.9	$233.9	$317.5	$ +83.6

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

NEW ACTIVITIES IN FY 1999

In collaboration with its industry partners, BTS will develop technology road maps to direct its research, development, and deployment in a number of key areas, including lighting, heating and cooling, windows, other materials, and construction. As part of its new way of doing business, BTS plans to issue a competitive procurement to fund new cost-shared R&D projects on a wide range of building technologies, including lighting, heating and cooling, and materials. BTS will evaluate proposals and select those technologies that offer the greatest energy savings and environmental benefits. By putting the emphasis on outcomes (highest energy saving-to-dollar ratio, greatest consumer impact, time needed for success, greatest environmental benefit, etc.) and working closely with industry, BTS will accelerate the development of energy efficient technologies for buildings.

As part of the State and Local Partnership Programs, BTS will expand its Competitive Energy Partnerships with a solicitation directed at a wide range of public and private entities, including states, business improvement districts, homebuilders, retailers, public institutions, and non-profits. Through this competitive process, BTS will fund projects to establish more efficient and comfortable buildings and highly productive and affordable communities. BTS will evaluate projects based on short and medium term goals, including energy and dollar savings, job creation, and environmental benefits. With an emphasis on locally-driven priorities and partnerships with local businesses, these projects will encourage innovation in building design and energy technologies, lower the cost of housing, and strengthen the local economy by becoming more energy efficient and less reliant on nonrenewable energy sources.

ACTIVITIES TO BE TERMINATED IN FY 1998

BTS will complete the following activities in FY 1998:

- Complete performance measurement of exemplary buildings constructed in FY 1995 and FY 1996 and publish findings.
- Issue final version of DOE-2, a highly successful software tool to assist in incorporating energy efficiency in building design and construction.
- Complete assessment of non-fluorocarbon refrigerant alternatives.
- Issue final rule to incorporate legislated standards and test procedures for plumbing equipment and large electric motors.

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

- Complete industrialized housing research, conducted by University of Oregon and Florida Solar Energy Center. (As a follow-up to this work, BTS plans to grant awards for research on industrialized housing based on a competitive solicitation issued in FY 1998.)

ACTIVITIES TO BE TERMINATED IN FY 1999

In FY 1999, BTS will complete the following projects:

- Provide final funding for Home Energy Rating Systems pilot states and for overcoming barriers to implementation of Home Energy Rating Systems.

- Complete successful seven-year jointly funded, industry-led program of materials compatibility and lubricant research that paved the way for a new generation of chlorine-free refrigerants.

- Complete laboratory support to CRADA partner Frigidaire to develop a pre-production refrigerator/freezer using 50 percent less energy than current designs.

- Complete the lighting controls project in a large Federal office building and report results to the General Services Administration for application at other Federal facilities.

- Issue final rule regarding energy conservation standards for lamp ballasts and water heaters.

PROGRAM IN BRIEF

Buildings for the 21st Century: Progress with Whole Buildings

Launched in FY 1997, Buildings for the 21st Century uses a "whole buildings" or systems engineering approach to achieve significant energy and carbon emissions savings. "Whole buildings" seeks to increase energy efficiency in the process of siting, design, construction, material and equipment selection, and financing of the nation's building stock. BTS will incorporate the whole buildings concept into vision statements and technology road maps designed with its industrial partners. BTS will continue to work with the Office of Utility Technologies and Federal Energy Management Program to integrate energy efficiency and solar technologies into new and existing buildings. BTS will also work cooperatively with other agencies to incorporate energy efficiency in ongoing activities such as school construction and the proposed Partnership in Advancing Technology for Housing (PATH).

Building Equipment and Materials R&D

Lighting and appliances account for a major portion of energy consumption in buildings. BTS will support research and development of a full range of technologies, including efforts to improve efficiency for "miscellaneous" uses of electricity, in appliances such as ceiling and furnace fans, dehumidifiers, controls, and electronic and communications devices.

BTS will also accelerate the development of proton exchange membrane (PEM) fuel cells for commercial buildings. PEM fuel cells for buildings differ from fuel cells for transportation because they are not as limited in size, can operate at high temperatures, and do not require quick startup. BTS expects these technologies to be available as a low-carbon option by 2004, with a potential to cut building energy requirements in half. In addition, BTS will advance desiccants, environmentally-friendly and energy efficient refrigerants, insulation and materials, and natural gas technologies for buildings, including natural gas heating and cooling equipment.

State and Local Partnership Programs

The Weatherization Assistance Program works with states and local agencies to increase the energy efficiency of homes occupied by low-income citizens -- particularly the elderly, those with disabilities, and families with children. Over 78,000 homes will be weatherized by the program in FY 1999. The State Energy Program provides support for states to undertake projects that will increase energy efficiency in transportation, buildings, and industry sectors and reduce greenhouse gas emissions. Other state projects focus on the use of renewable energy such as photovoltaics, solar thermal, geothermal and hydrogen technologies. These programs provide a means for deploying energy technologies at the state and local level. State and local organizations bring knowledge of regional needs to these partnerships and provide practical feedback loops to BTS' R&D efforts.

Building Codes and Appliance Standards

BTS provides assistance to states to update and implement building energy codes. BTS also issues standards and test procedures for a variety of appliances and equipment. According to guidelines defined in the 1996 process rule, BTS is working closely with industry and interest groups to set priorities, incorporate their input early in the development of standards, and expedite the process. With the likely introduction of an International Energy Code for new construction, BTS is working to strengthen its understanding of the marketplace and providing appropriate support to states and industry to advance energy efficiency in new construction.

FEDERAL ENERGY MANAGEMENT PROGRAM

Saving Energy and Dollars at Federal Facilities

As the nation's largest single energy user, the Federal government spends roughly $8 billion each year on energy required to operate its facilities, vehicles, and industrial equipment. The Federal Energy Management Program (FEMP) achieves significant Federal cost savings and associated environmental benefits by assisting Federal agencies in identifying, financing, and implementing energy efficiency and renewable projects in Federal facilities across the nation and at overseas missions. FEMP works to ensure that the Federal government serves as a leader in increasing energy productivity, reducing the nation's energy costs, and protecting the environment. FEMP saves additional taxpayer dollars by leveraging private resources through the use of Energy Savings Performance Contracts (ESPCs) and utility incentive programs.

Federal Energy Management Program Funding
(in millions of dollars)

	FY 1997	FY 1998	FY 1999 Request	Program Change
Federal Energy Management Program	$19.8	$19.8	$33.9	$+14.1

NEW ACTIVITIES IN FY 1999

The Federal Energy Management Program's FY 1999 budget request calls for expansion of the program's scope and is designed to accomplish the federal energy management goals set forth in the Energy Policy Act of 1992 and Executive Order 12902, including a 30 percent improvement in energy efficiency in Federal buildings by 2005, compared to 1985 levels. The budget request significantly accelerates FEMP's efforts to deliver energy savings through Energy Savings Performance Contracts (ESPCs), utility financing, and procurement of energy efficient products.

FEMP's efforts on ESPCs through FY 1998 concentrate on implementing conventional energy efficiency technologies through regional ESPCs. The FY 1999 request supports expansion of the types of products and services covered by ESPCs. For example, in FY 1999,

FEMP will finalize the awards of currently planned technology-specific Super ESPCs. These contracts require the use of advanced technologies in order to achieve energy cost savings and thereby provide an important vehicle for deploying recently developed EERE technologies, including solar, wind, and biomass technologies. Technology-specific ESPCs will increase the total contract value of all FEMP contracts to over five billion dollars. Together, the regional ESPCs and technology- specific ESPCs are projected to cut Federal energy costs by over 11 billion dollars over the life of the projects. A portion of these savings will be used to pay contractors for their initial private investment in implementing the technologies.

In FY 1999, contingent upon additional legislative authority, FEMP also plans to initiate ESPCs for mobile equipment including aircraft, ships, and heavy duty vehicles as a new component of its technical and financial assistance programs. In addition, FEMP plans to expand its ESPC assistance to support energy improvements in Federal leased space.

As a corollary to its ESPC efforts, the Department is instituting administrative mechanisms and contractual arrangements needed to recover funds from other agencies in the future. Under Public Law 105-83, the Department of Energy can accept funds from Federal agencies that realize energy cost savings as a result of FEMP's assistance with energy savings performance contracts and other private financing mechanisms. Appropriations in FY 1998 and 1999 provide the principal source of funds for the start-up of FEMP's assistance to other agencies. In the initial years of the process, revenues are expected to be small relative to appropriations, but will build in later years as assisted agency savings are realized.

In FY 1999, FEMP will also identify cost-effective opportunities for combined heat and power technology, and co-firing of biomass in boilers at Federal sites. FEMP plans to expand its work on the procurement of energy efficient equipment, and will streamline energy efficient and renewable energy purchases associated with the Million Solar Roofs Initiative and other cost-effective site-based projects. FEMP will continue its work to support the Million Solar Roofs Initiative by helping the Federal government realize its goal of installing 20,000 cost-saving, solar energy systems on Federal facilities by the end of 2010. In addition, FEMP will support the Interagency Energy Management Task Force's new efforts to develop effective approaches to procurement of bulk electricity, including "green power," in the emerging restructured utility environment.

PROGRAM IN BRIEF

The Federal Energy Management Program has achieved impressive gains, exceeding its interim goal of reducing energy consumption in Federal buildings by 10 percent per square foot between 1985 and 1995. FEMP provides energy management assistance to Federal customers, particularly in the area of alternative finance. The six Energy Efficiency and Renewable Energy Regional Support Offices implement the FEMP Program in the field, along with utility partners and state energy offices. By the end of FY 1998, as part of its assistance with alternative financing mechanisms, FEMP will have initiated six regional Super Energy Savings Performance Contracts (ESPCs) and additional technology-specific super ESPCs to assist Federal agencies across the country in purchasing energy efficiency and renewable energy services. These streamlined regional contracts use private capital to provide energy efficiency services to Federal facilities across all six regions, and allow Federal agencies to pay for these services through energy cost savings.

Private Financing for Federal Savings

The Federal Energy Management Program has developed broad, streamlined Super Energy Savings Performance Contracts (ESPCs) that allow Federal agencies to quickly reap large benefits from energy efficiency and renewable energy improvements. With these contracts, private firms incur the costs of installing energy retrofits at Federal facilities in exchange for a share of the resulting cost savings.

In addition to its assistance on financing options, FEMP provides technical assistance through SAVEnergy audits, evaluates proposals in response to solicitations, provides up front engineering and design support, and assists in the measurement and verification of energy savings from these projects. FEMP also develops analytical tools and information to assist Federal agencies in choosing cost-effective energy projects and products suited to ESPCs or other leveraged financing mechanisms.

FEMP's training and outreach programs promote understanding and acceptance of ESPCs and other innovative financing tools among Federal energy managers, procurement specialists, and facility managers. Training programs, which trained over 2300 Federal energy managers in FY 1997, provide up-to-date information on technical tools, techniques, and financial mechanisms for encouraging energy efficiency and use of renewable energy sources. Outreach helps raise awareness of FEMP's assistance on alternative financing, and provides opportunities for Federal agencies to share success stories and lessons learned.

FEMP maintains active communication with its customers through the Interagency Energy Management Task Force and the Interagency Energy Policy "656" Committee. As part of its involvement in these policy forums, FEMP identifies and resolves barriers to the use of ESPCs and other energy efficiency mechanisms, obtains feedback, and reports progress to Congress. FEMP continues to strengthen its program through integrated planning, analysis of emerging policy issues, exploration of new initiatives, and targeted program evaluation.

CROSS-CUTTING ACTIVITIES

A number of EERE's activities are mutually supportive and provide cross-cutting benefits to multiple sectors and customers. Many of EERE's activities and research initiatives also complement other public and private sector efforts. EERE participates in inter-agency and inter-sector committees to review and coordinate work on a number of cross-cutting issues. EERE also works closely with industry, universities, and interest groups to identify research priorities and critical gaps in research and development. Through these collaborative efforts, EERE is working to ensure that Federal investments in R&D complement private sector efforts and are directed at areas that offer the greatest public benefit.

The following list highlights some collaborative efforts among EERE sectors as well as with other Federal programs.

- *Fuel Cells* (OTT, BTS, OUT, FE)

  Proton-Exchange-Membrane (PEM) fuel cell technology, being developed by EERE's Office of Transportation Technologies (OTT), Office of Building Technology, State, and Community Programs (BTS), and Office of Utility Technologies' Hydrogen Program, can be used effectively for power generation in vehicles, buildings, and distributed power applications. In addition to coordinating fuel cell efforts across sector programs, EERE is working closely with industry to identify technical and cost requirements as well as cross-cutting R&D needs for different types of applications. Recent major developments in the transportation sector are contributing to earlier introduction of the technology in stationary applications for the buildings and utilities sector, which in turn, will accelerate commercialization and infrastructure development. In addition to providing an alternative and efficient energy source, application of fuel cells in small commercial buildings can lead to cost savings and reliability improvements for both transportation and building uses.

  DOE's Office of Fossil Energy (FE) is also working on developing fuel cell technologies (other than PEM) primarily for large utility applications. EERE has collaborated with FE to identify applications of these different types of fuel cells (high temperature) to the transportation sector, particularly for large vehicles such as buses.

- *Advanced Turbines* (OIT, FEMP, FE, ER, NASA, NIST, DOD, California Energy Commission, EPRI, GRI, EPA)

  EERE's Office of Industrial Technology (OIT) is working to develop energy efficient, advanced turbines that will be broadly

applicable to industry, Federal installations, and private buildings. These turbines will reduce energy use by 15 percent compared to conventional gas combustion turbines and associated emissions by 80 percent. Advanced turbines will also enhance customer flexibility by allowing facilities to produce energy efficiently off-grid with the use of individual generators. This technology offers great opportunities for application to Federal and other facilities. As a corollary effort, OIT and DOE's Office of Energy Research (ER) conduct research and development on materials that can be used in manufacturing the turbines. A number of other entities, noted above, are conducting complementary research and demonstration efforts.

- *Whole Buildings* (BTS, FEMP)

  With its whole buildings approach, EERE's Office of Building Technology, State, and Community Programs (BTS) identifies appropriate use of energy efficient technologies and renewable energy options in the design and construction of buildings. The Federal Energy Management Program (FEMP) works with Federal agencies to apply the whole buildings approach to the Federal government's existing and future building stock.

- *Million Solar Roofs Initiative* (BTS, FEMP, OUT)

  EERE's Office of Utility Technologies (OUT) funds research and development of solar technologies, including multiple types of panels and solar shingles. With many of these technologies already in the market, OUT is working to develop improved products that offer greater conversion efficiency and are more cost-effective. The Million Solar Roofs Initiative provides an opportunity for BTS and FEMP to help expand the use of solar energy in Federal and other buildings. FEMP will help meet the President's goal of placing a minimum of 20,000 solar roofs on Federal buildings by the year 2010. A number of BTS programs, including Rebuild America, Building America, and the Affordable Housing Programs will integrate solar technologies into their portfolio of assistance to building partners.

- *The Partnership for a New Generation of Vehicles*
  (DOC, DOE [OTT, OIT, OUT, ER], EPA, DOT, NASA, DOD, NSF)

  The Partnership for a New Generation of Vehicles (PNGV) is a cooperative research and development program between the Federal government and the United States Council for Automotive Research (USCAR). The three major domestic automakers are working with seven federal government agencies, labor, suppliers, and universities, to develop efficient, low-emission vehicles for the 21st Century. Research and technology development efforts are focused in four key system areas: hybrid-electric

vehicle drive, direct-injection engines, fuel cells, and lightweight materials. Technical teams, comprised of Federal, laboratory, and industry members, identify technical objectives, milestones, and priorities for research and development. While OTT provides over 80 percent of the federal resources for R&D activities relevant to the PNGV and coordinated with the technical teams, valuable contributions are made by OIT's work on low-cost methods for producing aluminum, OUT's development of enabling technologies for the use of hydrogen in fuel cells, and ER's basic research in materials and electrochemical compounds for consumer electronic applications.

- *Natural Gas* (OIT, BTS, OTT)

  Natural gas serves as a fuel source in industrial, building, and transportation applications. Because a number of EERE's developing technologies use natural gas as a fuel source, EERE sector programs are coordinating their efforts, both within EERE and with the natural gas industry, to ensure that public and private R&D investments are directed most effectively. Fuel cells, advanced turbine systems, and combustion systems, such as boilers and process heaters, rely on natural gas as a premier fuel source for both efficiency and environmental reasons. Furthermore, OTT is working on the development and deployment of natural gas vehicles. BTS is developing advanced heat pumps and chillers which use natural gas to heat and cool buildings to increase heating efficiency and reduce electric peak loads.

- *Combined Heat and Power* (OIT, FEMP, BTS, EPA)

  EERE's Office of Industrial Technology's work in developing combined heat and power systems and improving their efficiency has broad application to buildings, and industrial and Federal facilities. Combined heat and power systems generate multiple types of power, including electricity, steam, and mechanized energy by using the same fuel source. These systems can provide significant energy savings as well as environmental benefits. The Environmental Protection Agency's involvement focuses on streamlining the permitting process for these systems and offering one-stop permitting opportunities. In addition, the BTS work on fuel cells is specifically targeted to producing both heat and electricity for buildings.

Regional Support Offices

Implementing EERE's Programs in the Field

EERE's Regional Support Offices (RSOs) facilitate deployment of EERE's grant and technology programs to federal, regional, state and local customers. Along with state energy and weatherization offices and EERE's sector programs, the RSO's are critical to implementing EERE programs in the field.

In FY 1997, EERE began to integrate RSO operations more effectively into EERE program planning. Each RSO is responsible for developing an annual operating plan that includes proposals to support various sector programs. In turn, the sector programs use these plans to identify opportunities for innovative program delivery methods in the regions, and to determine how to allocate program funds among RSOs.

NEW ACTIVITIES IN FY 1999

In FY 1999, RSOs will play a key role in the implementation of the Million Solar Roofs Initiative. Each RSO will develop an outreach and technical assistance approach best suited to the needs of its region. In FY 1999, EERE is also requesting funds specifically to support Centers of Excellence in the Denver and Atlanta RSOs to address cross-cutting efficiency and renewable issues related to sustainable development and disaster remediation respectively.

RSOs will continue work begun in FY 1997 and FY 1998 to develop a more efficient, community-based approach to implement EERE programs. Finally, the RSOs will continue to develop best-practice methods for administering state formula grant programs, with a focus on increasing inter-and intra-regional transfer of programs and technologies developed through the state energy and weatherization programs.

THE MISSION OF THE REGIONAL SUPPORT OFFICES

The RSOs perform four key functions:

- Support the deployment of EERE programs and technologies by working to understand regional markets; preparing and implementing integrated regional outreach and deployment plans; providing technical assistance, information and training; and, executing and administering financial assistance.

EXECUTIVE SUMMARY: Energy Efficiency Programs (Cont'd)

RSOs support programs including FEMP, Rebuild America, Building Standards and Guidelines, Motor Challenge, Clean Cities, NICE3, Affordable Housing, and Geothermal Heat Pumps, among others. Each RSO emphasizes different program areas, depending upon staff skills and regional customers' interests. RSOs are working to package existing EERE programs and services into portfolios that respond more effectively to the expressed needs of states and communities.

- Provide headquarters program offices with information and feedback regarding regional needs; effectiveness of existing outreach activities; options for enhancing program effectiveness; and, opportunities for regional, state, and local partnerships.

- Provide liaison between headquarters and regional customers by serving as the principal EERE point of contact for these stakeholders; and, where possible, acting as a point of contact for stakeholders seeking assistance from other DOE and federal offices as well as DOE laboratories.

  Each RSO periodically holds meetings with state energy and weatherization offices to collect feedback on RSO and sector program administration. In FY 1997 and FY 1998, each RSO sponsored meetings involving the states, the RSO, the sector programs, and EERE management, as part of an ongoing effort to improve communication and coordination among all parties.

- Operate specialized outreach activities. Several RSOs are developing methods of bundling EERE programs and services to improve service delivery, and serving as lead offices for national components of the Clean Cities Program.

RSO FUNDING AND FTE LEVELS

The following chart illustrates operational funding levels for the six RSOs for FY 1997, FY 1998, and FY 1999. RSO funding levels are determined through an extensive planning process which involves both the RSOs and EERE's sector programs and results in an annual operating plan for each RSO.

The chart also provides information on FTEs for each RSO. The FTE figures represent planned FTE levels rather than actual FTEs in each office.

Regional Support Offices: Operational Funds and Planned FTE Levels (in millions of dollars)								
	FY 1997		FY 1998		FY 1999 Request		Program Change	
	$	FTE	$	FTE	$	FTE	$	FTE
Atlanta Support Office	$1.4	18	$1.7	23	$2.1	24	$0.3	1
Boston Support Office	1.5	13	1.7	15	2.1	15	0.4	0
Chicago Support Office	1.8	15	2.1	18	2.5	19	0.4	1
Denver Support Office	1.9	20	2.5	25	3.0	26	0.5	1
Philadelphia Support Office	1.8	17	2.1	17	2.5	18	0.4	1
Seattle Support Office	2.0	22	2.3	19	2.9	19	0.6	0
Total Budget Authority	10.4	105	12.4	117	15.0	121	2.6	4
Unobligated Carryover	1.3	--	--	--	--	--	--	--
Total Obligational Authority	$11.7	105	$12.4	117	$15.0	121	$2.6	4

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
I. Transportation Sector, Total	**$172,457**	**$193,271**	**$246,096**
A. Technology Deployment	10,618	11,775	16,250
B. Advanced Automotive Technologies	102,717	113,296	144,646
C. Advanced Heavy Vehicle Technologies	19,129	25,600	44,200
D. Transportation Materials Technologies	32,256	35,000	31,800
E. Implementation and Program Management	7,737	7,600	9,200
II. Industry Sector, Total	**115,424**	**136,197**	**166,559**
A. Industries of the Future (Specific)	45,332	53,078	76,000
B. Industries of the Future (Crosscutting)	38,378	49,120	49,400
C. Technology Access	24,827	26,299	32,000
D. Management & Planning	$6,887	$7,700	$9,159
III. Building Technology, State, and Community Sector, Total	**229,899**	**233,875**	**317,545**
A. Building Systems Design	23,255	22,986	36,373
B. Building Equipment and Materials	26,080	26,921	46,181
C. Codes & Standards	11,810	14,423	22,573
D. State and Local Partnership Programs	151,421	156,695	197,700
E. Management and Planning	17,333	12,850	14,718
IV. Federal Energy Management Program, Total	**$19,800**	**$19,800**	**$33,868**

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(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
V. Policy and Management, Total	**$26,403**	**$28,580**	**$44,432**
R&D	414,138	456,628	617,400
ENERGY CONSERVATION GRANTS	149,845	155,095	191,100
SUBTOTAL ENERGY CONSERVATION			
PROGRAM LEVEL	**563,983**	**611,723**	**808,500**
Financing: Use of Prior Year Balances	-480	0	0
Subtotal	563,503	611,723	808,500
Financing: PODRA	-29,997	-20,611	-35,000
TOTAL ENERGY CONSERVATION BA	**$533,506**	**$591,112**	**$773,500**
Total FTEs	432	430	427

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Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
I. Transportation Sector, Total	**$172,457**	**$193,271**	**$246,096**
A. Technology Deployment	10,618	11,775	16,250
1. Clean Cities Voluntary Deployment	2,606	2,850	6,000
2. Infrastructure, Systems, and Safety	1,605	2,175	2,000
3. EPACT Replacement Fuels Program	1,475	1,400	1,300
4. Vehicle Field Test/Evaluation	2,432	2,850	3,450
5. Technical Information Development	2,500	2,500	3,500
B. Advanced Automotive Technologies	102,717	113,296	144,646
1. Automotive Alternative Fuels R&D	3,160	5,550	7,000
2. Electric Vehicle R&D	17,497	18,386	11,000
3. Vehicle Systems R&D	53,840	58,200	58,000
4. Fuel Cell R&D	20,760	23,560	44,646
5. Advanced Combustion Engine R&D	7,460	7,600	18,000
6. Cooperative Automotive Research for Advanced Technology	0	0	6,000
C. Advanced Heavy Vehicle Technologies	19,129	25,600	44,200
1. Heavy Vehicle Systems R&D	6,970	12,900	33,200
2. Heavy Vehicle Alternative Fuels R&D	$12,159	$12,700	$11,000

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Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
D. Transportation Materials Technologies	$32,256	$35,000	$31,800
1. Automotive Materials Technology	19,997	21,750	19,000
2. Heavy Vehicle Materials Technology	7,702	8,050	7,300
3. High Temperature Materials Laboratory	4,557	5,200	5,500
E. Implementation and Program Management	7,737	7,600	9,200
1. Evaluation, Planning and Analysis	1,700	1,700	2,500
2. Program Direction	$6,037	$5,900	$6,700
Staffing Transportation Sector (FTEs):			
Oak Ridge Operations Office	1	1	1
Headquarters	67	60	57
Total FTEs	68	61	58

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ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
II. Industry Sector, Total	**$115,424**	**$136,197**	**$166,559**
A. Industries of the Future (Specific)	45,332	53,078	76,000
1. Forest & Paper Products Vision	10,843	12,040	12,076
2. Steel Vision	8,905	9,726	10,627
3. Aluminum Vision	5,503	7,335	9,178
4. Metal Casting Vision	3,399	5,480	5,797
5. Glass Vision	2,917	3,883	4,830
6. Chemicals Vision	9,983	11,614	14,492
7. Petroleum Refining Vision	3,782	3,000	0
8. Environmental Solicitations	0	0	19,000
B. Industries of the Future (Crosscutting)	38,378	49,120	49,400
1. Cogeneration	24,157	34,650	33,000
2. Advanced Materials & CFCCs	14,221	14,470	14,400
3. Combustion Technologies	0	0	2,000
C. Municipal Solid Waste	0	0	0
D. Technology Access	24,827	26,299	32,000
1. IACs/Technology Transfer	8,125	9,109	8,700
2. Motor Challenge	5,138	6,230	11,000
3. NICE-3	$5,800	$6,000	$7,500

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Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
4. Climate Wise	$1,000	$0	$0
5. Inventions & Innovation	4,764	4,960	4,800
E. Management & Planning	6,887	7,700	9,159
1. Evaluation and Planning	500	800	1,000
2. Program Direction	6,387	6,900	8,159
3. Capital Equipment	$0	$0	$0
Staffing Industry Sector (FTEs):			
Chicago Operations Office	5	6	6
Idaho Operations Office	4	5	5
Headquarters	61	61	61
Total FTEs	70	72	72

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ENERGY CONSERVATION
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Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
III. Building Technology, State, and Community Sector, Total	**$229,899**	**$233,875**	**$317,545**
A. Building Systems Design	23,255	22,986	36,373
1. Residential Buildings	10,157	9,697	15,292
2. Commercial Buildings	13,098	13,289	21,081
B. Building Equipment and Materials	26,080	26,921	46,181
1. Technology Roadmaps and Competitive R&D	0	0	8,000
2. Space Conditioning and Cogeneration	11,440	12,430	15,380
3. Lighting and Appliance	6,798	5,342	11,080
4. Building Envelope R&D	7,842	9,149	11,721
C. Codes & Standards	11,810	14,423	22,573
1. Building Standards & Guidelines	6,808	8,423	12,953
2. Lighting and Appliance Standards	5,002	6,000	9,620
D. State and Local Partnership Programs	151,421	156,695	197,700
1. Weatherization Assistance Program	120,845	124,845	154,100
2. State Energy Program	29,000	30,250	37,000
3. Municipal Energy Management	$1,576	$1,600	$6,600

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ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
E. Management and Planning	$17,333	$12,850	$14,718
1. Evaluation and Planning	10,409	5,500	7,268
2. Program Direction	6,924	7,350	7,450
3. Capital Equipment	$0	$0	$0
Staffing Building Technology, State, &			
Community Sector (FTEs):			
Headquarters	81	74	75
Total FTEs	81	74	75

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
IV. Federal Energy Management Program, Total	**$19,800**	**$19,800**	**$33,868**
A. Project Financing	7,000	7,900	13,864
B. Technical Guidance & Assistance	6,800	6,300	10,704
C. Planning, Reporting, & Evaluation	4,200	3,800	6,400
D. Capital Equipment	0	0	0
E. Program Direction	1,800	1,800	2,900
Staffing Federal Energy Management			
Program (FTEs):			
Headquarters	23	20	20
Total FTEs	23	20	20
V. Policy and Management, Total	**26,403**	**28,580**	**44,432**
A. Headquarters	7,398	7,494	15,252
1. Salaries and Related Expenses	4,398	3,425	3,990
2. Contractual Services	3,000	4,069	11,262
B. Golden Field Office	4,505	4,546	4,790
1. Salaries and Related Expenses	2,655	3,896	4,018
2. Contractual Services	$1,850	$650	$772

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
C. Regional Support Offices	$10,400	$12,390	$14,990
1. Salaries and Related Expenses	7,421	8,101	8,741
2. Contractual Services	2,979	4,289	6,249
D. Centers of Excellence	0	0	2,000
E. International Market Development Program	2,600	2,600	2,900
F. Information and Communications Program	1,500	1,550	2,000
G. Policy Initiatives	0	0	2,500
Staffing Policy Management (FTEs):			
Golden Field Office	25	35	36
Regional Support Offices	105	117	121
Headquarters	60	51	45
Total FTEs	190	203	202
R&D	414,138	456,628	617,400
ENERGY CONSERVATION GRANTS	149,845	155,095	191,100
SUBTOTAL ENERGY CONSERVATION			
PROGRAM LEVEL	**563,983**	**611,723**	**808,500**
Financing: Use of Prior Year Balances	-480	0	0
Subtotal	$563,503	$611,723	$808,500

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

Energy Efficiency
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request
Financing: PODRA	-$29,997	-$20,611	-$35,000
TOTAL ENERGY CONSERVATION BA	**$533,506**	**$591,112**	**$773,500**
Total FTEs	432	430	427

Energy Conservation
Small Business Innovation Research (SBIR)
Small Business Technology Transfer (STTR)
(Dollars in thousands)

	FY 1997 Actual			FY 1998 Estimate			FY 1999 Estimate		
	SBIR	STTR	Total	SBIR	STTR	Total	SBIR	STTR	Total
	1	2	3	4	5	6	7	8	9
Transportation Sector	$2,858	$226	$3,084	$3,112	$187	$3,299	$3,845	$231	$4,076
Building Technology, State, and Community Sector	1,060	84	1,144	1,107	66	1,173	1,786	105	1,891
Federal Energy Management Program	0	0	0	0	0	0	0	0	0
Industry Sector	1,881	148	2,029	2,156	130	2,286	2,518	153	2,671
Policy and Management	0	0	0	0	0	0	0	0	0
Total Energy Conservation Appropriation	$5,799	$458	$6,257	$6,375	$383	$6,758	$8,149	$489	$8,638

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY EFFICIENCY AND RENEWABLE ENERGY
ENERGY CONSERVATION
(Tabular dollars in thousands. Narrative in whole dollars)

TRANSPORTATION SECTOR

PROGRAM MISSION

Transportation Energy Situation

Activities funded by the FY 1999 budget for the transportation sector will continue to build the foundation for substantial gains in transportation vehicle fuel economy and use of alternative fuels. The following table provides historical and baseline projection data which illustrate the growing need for action and results in transportation:

	1973	1995	2000	2010	2020
Share of U.S. Oil Imported (%)	36.1	50.4	57.1	65.8	69.2
Ratio of Transportation Oil Use to Domestic Oil Production	0.91	1.69	1.69	2.69	3.16
Number of U.S. Light Vehicles (millions)	120	181.1	184.7	210.1	228.6
Transportation Oil Use (million barrels per day)	8.77	10.96	12.39	14.76	16.13
Net Oil Imports (million barrels per day)	5.99	7.88	10.31	13.74	15.53
Direct Cost of Imported Oil (billions of 1994 dollars)	22	48.1	71.7	104.9	126.6
Transportation Carbon Emissions (million metric tons per year)	N/A	457	518.1	627.5	691.6
New Car Fuel Economy (miles per gallon)	14.2	28.6	28.0	30.3	30.7
New Light Truck Fuel Economy (mpg)	13.7*	20.5	19.3	20.1	21.67

*1975 Estimate

PROGRAM MISSION - TRANSPORTATION SECTOR (Cont'd)

Program Emphasis

The program emphasis is on the development and commercialization of technologies which have the potential to radically alter current trends of United States and world demand for energy, particularly oil. Seventy-six percent of total transportation sector energy consumption is used by on-highway vehicles—cars and trucks. Working in partnership with industry and others, the mission of the Office of Transportation Technologies (OTT) program is to provide consumers with vehicle choices which result in significant oil demand and greenhouse gas emission reductions. Specific strategic objectives are to: (1) improve the fuel economy of transportation vehicles; and (2) increase the production and use of cost-effective alternative transportation fuels.

Industry often organizes for design, production, and marketing of cars and trucks around the idea of vehicle "platforms." "Class" is another term used to describe vehicles having distinctively different characteristics and capabilities. **In DOE's transportation sector program, every activity contributes to fuel economy improvement and/or alternative fuel capability for one or more of the following vehicle "platforms."**

1. Automobiles.

2. Light Trucks, including mini-vans and sport utility vehicles. (Classes 1 and 2)

3. Medium Trucks, such as delivery vans. (Classes 3 through 6)

4. Heavy Trucks, such as inter-city "18-wheelers." (Classes 7 and 8)

The diagram below illustrates how activities funded in the automotive and heavy vehicle portions of the budget are related to these basic vehicle platforms.

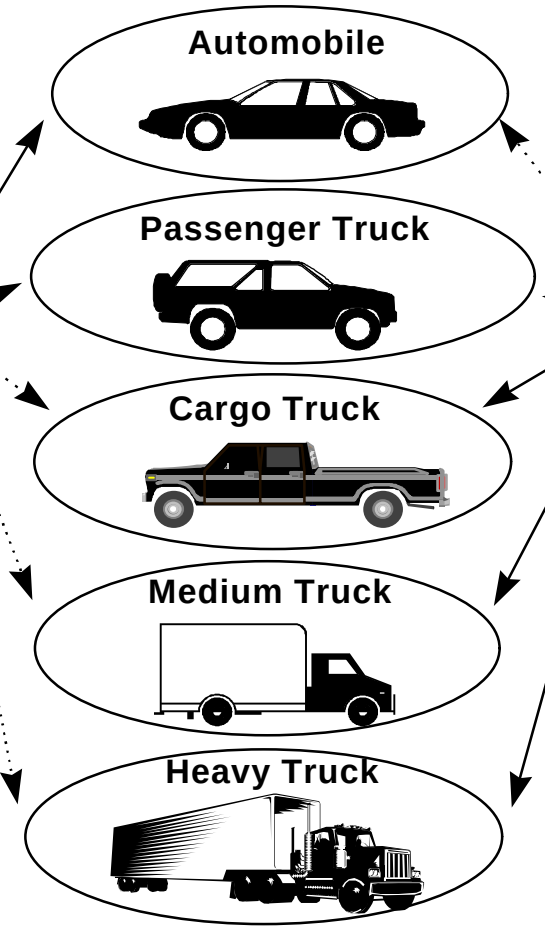
In every portion of the budget which supports technology research and development, each activity is directed primarily at a particular vehicle platform. However, as the diagram indicates, each R&D activity also has potential "spin-off" benefits for other platforms. For example, fuel cell development activities are focused specifically on achieving characteristics required for successful use in automobiles; but advances made could well result in truck and bus applications. The solid lines identify primary targets; dotted lines identify vehicle types which could also be changed based on results from each respective program.

FY 99 Budget Supports Multiple Platforms with Advanced Technologies

Automotive Program

- Alternative Fuels R&D
  - System Optimization
  - Advanced Fuels (DME, DMM)
  - Fuel Dispensing Technologies
  - Fuel Storage
  - Fuel Injection Technologies
- Electric Vehicle R&D
  - Nickel-Metal Hydride Battery
  - Lithium-Based Battery
- Vehicle Systems R&D-Exploratory R&D
  - Systems R&D
  - CIDI, SIDI
  - High Power Storage
  - Advanced Power Electronics
- Fuel Cell R&D
  - Stack Technology
  - Reformer & Storage R&D
  - Fuel Cell Systems R&D
  - Auxiliary Technology R&D
- Advanced Combustion R&D
  - Combustion
  - Emission Controls
  - Engine Technology Integration
- CARAT
  - Innovative R&D on Automotive Technologies (small business & Univ..)
- Advanced Materials
  - Lightweight Metals
  - Composites
  - Carbon Fiber

Platform



Heavy Vehicle Program

- Diesel Engine R&D
  - Diesel Combustion
  - Exhaust Aftertreatment
- Systems Technologies
  - Aerodynamics
  - Auxiliary Systems
- Advanced Transportation Technology Consortia
- Alternative Fuels R&D
  - Engine Efficiency
  - Combustion
  - Atmospheric Reactions
  - Storage Technologies
- Advanced Materials
  - High Temperature Materials Laboratory

PROGRAM MISSION - TRANSPORTATION SECTOR (Cont'd)

In the Technology Deployment portion of the budget, activities support multiple platforms. In most Clean Cities, for example, individuals and organizations involved include purchasers and users of all vehicle types.

Program Benefits

The following benefits are projected from sustained multi-year funding of the transportation program.

Improvements Due to Transportation Programs:	**2000**	**2010**	**2020**
New Car MPG	29.0	39.7	42.9
New Light Truck MPG	20.3	24.6	27.1
Carbon Emission Reductions:			
Million Metric Tons (MMTons)	0.64	26.7	55.2
% Carbon Reduced	0	4.2	9.8
Direct Oil Savings:			
Million Barrels per Day (MBPD)	0.06	1.13	1.97
% Oil Use Reduced	0.5	7.7	12.2
Increased Use of Renewables:			
MBPD Oil Equivalent	0	0.32	0.47

Studies estimate that developing countries will be major markets for technologies supported by this budget. While U.S. and European vehicle sales will grow modestly, sales in developing countries are expected to increase by over five percent annually. This provides a large export market opportunity for America's transportation industry, potentially also leading to the creation of jobs in the U.S.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Transportation Sector

Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Base	FY 1999 Request	Program Change Request vs. Base Dollar	Program Change Request vs. Base Percent
Advanced Automotive Technologies Operating Expenses	$102,717	$113,296	$113,296	$144,646	$ 31,350	28%
Advanced Heavy Vehicle Technologies Operating Expenses	$ 19,129	$ 25,600	$ 25,600	$ 44,200	$ 18,600	73%
Transportation Materials Technologies Operating Expenses	$ 32,256	$ 35,000	$ 35,000	$ 31,800	$ -3,200	-9%
Technology Deployment Operating Expenses	$ 10,618	$ 11,775	$ 11,775	$ 16,250	$ 4,475	38%
Implementation and Program Management Operating Expenses	$ 7,737	$ 7,600	$ 7,600	$ 9,200	$ 1,600	21%
TOTAL	$172,457 a/ b/	$193,271	$193,271	$246,096	$ 52,825	27%
Summary						
Operating Expenses	$172,457	$193,271	$193,271	$246,096	$ 52,825	27%
Total Program	$172,457	$193,271	$193,271	$246,096	$ 52,825	27%
Staffing (FTE's)						
HQ FTEs	67	60	60	57		
Field FTEs	1	1	1	1		
Total FTEs	68	61	61	58		

PROGRAM FUNDING PROFILE: Transportation Sector (Cont'd)

a/ Reflects adjustment for approved reprogramming 97-R-12 of $-2,857.8 thousand for the Small Business Innovative Research (SBIR) program and $-225.6 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities.

b/ Reflects adjustment of $+337.0 thousand for approved reprogramming 97-R-15b for Program Direction activities utilizing $-224.0 thousand in prior year balances and $-113.0 thousand from the Industry Sector Program Direction.

Authorizations:

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

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Transportation Sector

FY 1998 Enacted	$ 193,271
FY 1999 Base	0
	$ 193,271

Advanced Automotive Technologies

- Automotive Alternative Fuels R&D - The increase reflects the development of alternative and reformulated fuels for compression ignition direct injection (CIDI) engines. In addition, compressed natural gas fueling station cost reduction efforts will be accelerated	1,450
- Electric Vehicle R&D - The decrease is consistent with the overall strategic plan to complete all U.S. Advanced Battery Consortium (USABC) mid-term battery technologies and concentrate efforts on one or more long-term battery technologies	-7,386
- Vehicle Systems R&D - The decrease reflects the completion of the first phase (50 mpg) of the hybrid propulsion system development effort and the start-up of the next phase (80 mpg) of the vehicle systems development which initially consists of modeling, trade-off studies, and conceptual design studies. It also reflects the downselection process which reduces the number of candidate technologies for the next phase of technology development	-200

SUMMARY OF CHANGES: Transportation Sector (Cont'd)

Advanced Automotive Technologies (Cont'd)

- Fuel Cell R&D - The increase reflects critical needs for further component development related to technical barriers such as cold start-up and transient response, power management, thermal management, durability, and reliability. Processes for low-cost, high-volume manufacture of fuel cells and components will be developed . .	21,086
- Advanced Combustion Engine R&D - The increase reflects the characterization of the performance and emissions of advanced CIDI engines fueled with reformulated or alternative fuels	10,400
- Cooperative Automotive Research for Advanced Technologies - The increase will allow DOE to provide opportunities to small businesses and universities for development of advanced components and processes suitable for cost-effective automotive production	6,000

Advanced Heavy Vehicle Technologies

- Heavy Vehicle Systems R&D - The increase supports a joint Government/industry program for the development of clean diesel engine technologies for light trucks, and for transitioning the Advanced Transportation Technology Consortia program from the Defense Advanced Research Projects Agency to a combined DOE/DOT program, with DOE focusing on trucks	20,300
- Heavy Vehicle Alternative Fuels R&D - The decrease reflects a temporary reduction for program restructuring, that includes initiation of new projects	-1,700

Transportation Materials Technologies

- Automotive Materials Technology - The decrease for propulsion system materials reflects the termination of work on ceramics for gas turbines	-2,750
- Heavy Vehicle Materials Technology - The decrease reflects reduced work in two major projects, i.e., carbon products for heavy vehicle applications and casting of ultra large heavy vehicle components	-750
- High Temperature Materials Laboratory - The increase supports investment in improved technological capability for the characterization of advanced materials	300

SUMMARY OF CHANGES: Transportation Sector (Cont'd)

Technology Deployment	
- Clean Cities Voluntary Deployment - The increase reflects an expanded Clean Cities program and expanded State grants, that will both feature advanced fuel efficient vehicles.	3,150
- Infrastructure, Systems, and Safety - The decrease reflects reduced funding as a result of completion of selected electric vehicle infrastructure products	-175
- EPACT Replacement Fuels Program - The decrease reflects reduced funding due to the completion of Energy Policy Act reports	-100
- Vehicle Field Test/Evaluation - The increase reflects the addition of hybrid vehicle field testing, and the integration of electric vehicle and alternative fuel vehicle testing programs	600
- Technical Information Development - The increase reflects expanded and enhanced information products to encourage the use of fuel efficient vehicles	1,000
Implementation and Program Management	
- Evaluation, Planning and Analysis - The increase reflects an expanded quality metrics methodology, to include international impacts	800
- Program Direction - The increase provides for pay raise adjustments in salaries and benefits, and for training and other services, while supporting the Department's Strategic Alignment Initiative to streamline the management of research, development, demonstration and deployment programs within the Office of Transportation Technologies	800
FY 1999 Congressional Budget Request	$ 246,096

TRANSPORTATION TECHNOLOGIES

TRANSPORTATION SECTOR
(dollar in thousands)

ADVANCED AUTOMOTIVE TECHNOLOGIES

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

The Advanced Automotive Technologies program is the technological cornerstone for the nation's initiative to significantly improve the energy efficiency of, and reduce emissions from, our light duty vehicles, with a direct emphasis on automobile applications. An updated R&D Plan for the Office of Advanced Automotive Technologies defines the scope, focus, and content of the Advanced Automotive Technologies program. This R&D Plan has been developed through an intensive activity involving experienced teams of DOE and national laboratory personnel, working in a collaborative process to structure and focus the Department's effort. Plan development has included participation of stakeholders such as the auto industry and its supplier companies, energy companies, State and other Federal agencies, and other DOE organizations.

This Advanced Automotive Technologies program provides the primary support for research and development required to achieve the 80 miles per gallon (mpg) fuel economy goal of the Partnership for a New Generation of Vehicles (PNGV). This work is important because automobiles are 97 percent dependent upon petroleum-based fuels and consume about 33 percent of the total petroleum used in the United States, of which 50 percent is imported. Furthermore, the automobile is a major contributor to emissions of global climate change gases and criteria air pollutants, including volatile organic compounds, nitrogen oxides, carbon monoxide, and particulate matter. The current status of technology allows many opportunities, but also tremendous challenges, for improvement. For example: current baseline engine efficiencies are about 23 percent--program targets would more than double this efficiency; current energy storage technologies limit advanced vehicle driving ranges--the program seeks to develop electric vehicle batteries and other technologies that would enable ranges equal to those of conventional vehicles.

Through this program, the Department engages the technical and financial resources of the government and its laboratories, the automobile and fuels industries, their suppliers, and universities in a customer-focused national program to research and develop advanced automobile technologies, and to support their integration into affordable vehicles. Through partnering with industry, critical components and vehicle system technologies are identified and developed that will enable successful commercialization of electric and hybrid vehicles in the mid term, and fuel cell-powered vehicles in the longer term. With program success, pre-production prototype vehicles that provide up to 100 percent greater fuel economy will be available by the year 2001; in the longer term (2005-2010), automobiles that have three times the fuel economy of today's conventional automobiles will be developed. Successful development

of these technologies will also result in vehicles with near-zero emissions and enhanced fuel flexibility, and which are otherwise competitive in all respects with conventional products in the global marketplace.

The key elements of the program include: Automotive Alternative Fuels R&D, aimed at reducing dependence on petroleum through the use of alternative transportation fuels; Electric Vehicle R&D, focused on development of advanced batteries that meet stringent technical and cost goals, and would enable U.S. industry to market electric vehicles which compete directly with conventional vehicles, and which can expand its market share in response to agreements with the States on zero-emission vehicles; Vehicle Systems R&D, which sets targets for and develops advanced propulsion subsystems and critical components to achieve fuel economy objectives; Fuel Cell R&D, which will continue component development, testing and cost reduction for a propulsion technology with the potential for even higher energy conversion efficiency and near-zero total fuel cycle emissions; and Advanced Combustion Engine R&D, aimed at significantly improving the energy conversion efficiency of traditional combustion engines (including those using alternative fuels) and simultaneously reducing emissions, while advancing the technology base. In many cases, programs are closely coordinated with related efforts of other organizations. For example, compression ignition direct injection technology development for the PNGV is tightly coordinated with activities funded by the Advanced Heavy Vehicle Technologies program; several projects that address technologies applicable to both automobiles and trucks are jointly funded by the two Office of Transportation Technologies (OTT) organizations.

I. B. Program Benefits

Metric*	2000	2010	2020
Primary Energy Displaced (Quads)	0	0.23	1.08
Primary Oil Displaced (million barrels per day)	0.01	0.246	0.72
Energy Cost Savings ($ billion)	0.8	3.99	12.72
Carbon Reductions (million metric tons)	0	3.62	19.08

*Includes benefits for automotive materials.

Research and development activities funded by the alternative fuels program will help the private sector complete the development of commercially attractive ethanol fueled passenger cars. In addition, work on lower cost, higher capacity natural gas on-board storage systems will help promote the use of that alternative fuel.

As a result of Electric Vehicle R&D activities, it is expected that electric vehicles with advanced mid-term batteries, which will double the approximately 70-mile vehicle range obtained by using conventional lead-acid batteries, will begin to enter the market in 1999-

I. **Mission Supporting Goals and Objectives**: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

2000. Introduction of long-term advanced batteries, which could power electric vehicles with a range comparable to conventional vehicles by the year 2001, will result in oil savings of 5,000 barrels per day (bpd) in 2002, growing to 150,000 bpd in 2010 as market penetration increases to 2.7 percent.

As a result of Vehicle Systems R&D activities, it is expected that hybrid vehicles will begin to enter the market in large volumes between 2003 and 2010. Continued market penetration will result in oil savings of 369,000 bpd in 2020.

As a result of R&D funded by the fuel cell program, it is expected that vehicle fuel cell technology will begin to enter the market in 2008. This will result in small savings in 2010. However, by 2020 it is estimated that the benefits of the program will be 103,000 barrels per day of oil reduction, $2.0 billion in energy cost savings, and 4.1 million metric tons of carbon-equivalent emissions reduction.

The primary benefits of Advanced Combustion Engine R&D activities will accrue through the application of compression ignition direct injection (CIDI) engine technology to hybrid propulsion automobiles. Additional benefits will result from the application of CIDI engine technology in conventional vehicles, which are estimated to reach 62,000 barrels per day of oil reduction annually, and over $1.3 billion of energy cost savings, by 2010.

I. C. Performance Goals

Strategy/Goal: By 2010, in collaboration with U.S. auto industry partners, produce technologies that lead to vehicles in production which are up to three times more fuel efficient than today's vehicles, and which will reduce nitrogen oxides and carbon dioxide emissions by two-thirds compared to today's new car average without compromising safety, comfort, and cost. Also, these technologies will make the battery-powered electric vehicle an attractive and preferred option for many vehicle users.

Interim Goal: By the year 2000, complete development of production feasible hybrid propulsion systems that can double the fuel economy of passenger vehicles, compared to 1995 models, by all three of the United States' major auto manufacturers. Continuing work on propulsion systems and energy storage will be combined with advanced lighter weight vehicle structures to meet the PNGV goal of 80 miles per gallon, for a production prototype, in 2004. The United States Advanced Battery Consortium (USABC) will have demonstrated long-term battery technology in electric vehicles that are competitive with conventional vehicles in all respects.

FY 1997 Accomplishments

-- Completed the fabrication and field evaluation of dedicated propane and ethanol fueled sedans which meet ultra low emission vehicle (ULEV) standards.

-- Achieved the mid-term goal of 80 watt-hours/kilogram (Wh/kg) specific energy for nickel metal hydride batteries.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

-- Completed the first round of laboratory tests on long-term lithium polymer battery modules, to enable the industry to evaluate in-vehicle operation.

-- Completed fabrication of a Stirling powered test-bed vehicle with advanced hybrid propulsion systems for testing and technology validation.

-- Made selection of the engine and energy storage technologies to be integrated into deliverable hybrid vehicles.

-- Evaluated test-bed vehicles using an off the shelf compression ignition direct injection (CIDI) engine to refine the system operating strategy and optimize driveability; finalized the hybrid propulsion package design, and completed development of balance of drivetrain components.

-- Completed testing of four baseline prototype high power battery cells, and selected two baseline technologies for development of 50-volt prototype modules aimed at satisfying high power battery requirements of hybrid vehicles.

-- Completed development of an aqueous tape-casting process for components of a planar oxygen sensor for automobile exhaust gas measurement.

-- Completed laboratory validation tests on a methanol-fueled 30 kW proton exchange membrane fuel cell propulsion system.

-- Demonstrated 40 miles per gallon (combined city-highway cycle) on a mid-size vehicle in the FutureCar Challenge.

-- Completed the second series of improved power electronic building block (PEBB) modules using pre-production inverter/converter products, to achieve a 50 percent reduction in cost, weight, and volume.

<u>FY 1998 Planned Accomplishments</u>

-- Complete the lower cost, lighter weight natural gas cylinder project for on-board storage. Complete determination of requirements for reduced cost and increased reliability of alternative fuels refueling (dispensing) hardware.

-- Begin extensive laboratory testing of long-term electric vehicle lithium polymer batteries which would provide 3 to 4 times the range, and significantly greater performance and life, compared to conventional lead acid batteries.

-- Complete the development of a production feasible hybrid propulsion system which can double vehicle fuel economy, and integrate the propulsion system into two vehicles for independent testing; with the second and third industry hybrid teams, complete testing of final deliverable components and assemble propulsion systems for testing in test-bed vehicles.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

-- Fabricate 50-volt nickel metal hydride high power modules and initiate life cycle testing.

-- Scale up high power energy storage lithium-ion technology from one to 12 ampere-hour size cells.

-- Develop abuse test requirements and protocols, and complete assessment of high power energy storage lithium-ion safety performance envelope.

-- Complete PEBB technology laboratory tests that demonstrate the potential for 75 percent reduction in cost, weight, and volume relative to 1995 baseline.

-- Initiate Phase II of the hybrid vehicle systems program: development of enabling technologies capable of achieving an 80 mile per gallon (mpg) passenger vehicle.

-- Complete laboratory validation tests on hydrogen-fueled 50 kW (full-scale) proton exchange membrane fuel cell propulsion systems that can be tested under automotive drive cycle requirements.

-- Demonstrate 45 mpg (combined city-highway cycle) in the FutureCar Challenge.

-- Introduce a new Ethanol Challenge and demonstrate improved cold start capability of dedicated E-85 vehicles.

-- Commence prototype testing at the compression ignition direct injection (CIDI) engine benchmarking facility.

-- Complete data correlation from single cylinder, optical access and non-optical access CIDI engine tests.

<u>FY 1999 Planned Accomplishments</u>

-- Complete development of an optimized prototype dimethyl ether (DME) injection system for CIDI engine.

-- Initiate life cycle testing of advanced electric vehicle lithium polymer batteries and assess performance against USABC long-term battery goal of 1,000 cycles.

-- Complete international cooperative development of lithium battery safety abuse test and procedures manual.

-- Define vehicle design concepts capable of achieving 80 mpg. Focus will be on systems analyses, trade-off studies, and data gathering to determine optimum design for achieving program goals. Initiate a hardware design and integration effort.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

-- Complete 50-volt high power energy storage lithium-ion module development; initiate performance characterization and life cycle testing at the DOE laboratories; and compare results to PNGV technical targets of 25 watts per watt-hour (W/Wh) power-to-energy ratio, 60 watt-hours per liter (Wh/l) energy density, and 125,000 cycles.

-- Integrate power electronic building block (PEBB) technology into pre-production vehicles; demonstrate achievement of PEBB technical targets of $7/kW cost, 12 kilowatts per kilogram (kW/kg) specific power, and 96 percent efficiency.

-- Demonstrate 80 mpg fuel efficiency on the combined driving cycle on mid-sized sedans in the advanced technology competitions programs.

-- Demonstrate improved energy efficiency and reduced emissions from dedicated E-85 vehicles in the second year of the Ethanol Challenge.

-- For fuel cell vehicles, develop and test an advanced, high-efficiency, 50 kW, fuel-flexible fuel processor demonstrating a system efficiency of 70 percent and a start-up time less than 3 minutes.

-- Validate, by engine dynamometer testing and simulation of vehicle systems, advanced piston engine technology that meets requirements for an 80 mpg, low emissions automobile.

-- Test and evaluate nonthermal plasma-activated catalyst prototype for CIDI engines, with the potential to significantly reduce emissions.

-- Validate CIDI catalytic nitrogen oxides reduction prototype for year 2000 concept vehicle.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Complete lower cost alternative fuel refueling technology development.

-- Conduct extended testing of USABC long-term lithium polymer batteries for life and safety under accident conditions.

-- Validate advanced powertrain components for 80 mpg vehicles through performance testing and simulation.

-- Complete testing of baseline, prototype, 50-volt high power lithium-ion modules. Select one or two of the baseline technologies for development of 400-volt battery aimed at satisfying the PNGV high power energy storage requirements of hybrid vehicles.

-- Validate integrated PEBB technology having cost, specific power, and efficiency, necessary to achieve PNGV 80 mpg vehicle goals.

I. Mission Supporting Goals and Objectives: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

-- Develop an integrated, 50 kW (vehicle-size) fuel cell propulsion system that includes a fuel-flexible on-board fuel processor, compressors/expanders, heat exchangers, controls, and sensors, and demonstrates a stack system efficiency of 55 percent at 25 percent of peak power.

-- Complete selection of CIDI fuel injection system (<$8/kW) and fuel for year 2004 production prototype vehicles.

-- Validate CIDI engine system achievement of Tier II emission levels.

II. A. Funding Table: ADVANCED AUTOMOTIVE TECHNOLOGIES

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Automotive Alternative Fuels R&D	$ 3,160	$ 5,550	$ 7,000	$ 1,450	26%
Electric Vehicle R&D	17,497	18,386	11,000	-7,386	-40%
Vehicle Systems R&D	53,840	58,200	58,000	-200	0%
Fuel Cell R&D	20,760	23,560	44,646	21,086	89%
Advanced Combustion Engine R&D	7,460	7,600	18,000	10,400	137%
Cooperative Automotive Research for Advanced Technologies	0	0	6,000	6,000	>999%
Total, Advanced Automotive Technologies	$ 102,717	$ 113,296	$ 144,646	$ 31,350	28%

II. B. <u>Laboratory and Facility Funding Table</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES

	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Argonne National Lab (East)	$ 7,187	$ 8,349	$ 10,349	$ 2,000	24%
Brookhaven National Lab	500	336	500	164	49%
Idaho National Engineering and Environmental Lab	1,175	926	2,000	1,074	116%
Lawrence Berkeley National Lab	3,242	3,400	3,800	400	12%
Lawrence Livermore National Lab	1,303	1,165	2,180	1,015	87%
Los Alamos National Laboratory	4,212	3,837	8,837	5,000	130%
National Renewable Energy Lab	36,776	36,776	43,526	6,750	0%
Oak Ridge National Lab	3,740	6,360	8,050	1,690	27%
Pacific Northwest National Lab	1,285	1,350	1,550	200	15%
Sandia National Laboratories	4,765	4,095	5,000	905	22%
All Other	38,532	46,702	58,854	12,152	26%
Total, Advanced Automotive Technologies	$ 102,717	$ 113,296	$ 144,646	$ 31,350	38%

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES

Activity	FY 1997	FY 1998	FY 1999
Automotive Alternative Fuels R&D	SYSTEMS OPTIMIZATION: Completed the fabrication and field evaluation of two light duty vehicles which incorporate the use of ethanol and propane and meet ultra low emission vehicle (ULEV) standards.	SYSTEMS OPTIMIZATION: Complete evaluation of data and disseminate results of ethanol and propane vehicle test program. Conduct alternative fuel vehicle R&D to increase vehicle performance while lowering costs.	SYSTEMS OPTIMIZATION: Conduct R&D for alternative fuel vehicles that will reduce cost, increase range and fuel efficiency while meeting emission standards. Typically cost share projects at 80% government and 20% industry.
	Compressed Natural Gas (CNG): Completed Phase I (storage) and II (engine) of the advanced natural gas vehicle project. Continued to develop low cost, lightweight storage for natural gas.	Compressed Natural Gas (CNG): Complete the Phase III fabrication and field evaluation of a second generation advanced natural gas vehicle. Complete a lower cost and lighter weight natural gas cylinder project using conventional materials for type 2 tanks which have metal liners reinforced with hoop-wrapped continuous filaments (usually fiberglass) in a resin matrix. Formulate a program to develop low cost storage for natural gas vehicles with new lightweight materials, improved manufacturing techniques, fuel storage integration research, and a test method for on-vehicle tank inspection for natural gas cylinders.	Compressed Natural Gas (CNG): Continue development of lower cost tank material, and cost-effective tank manufacturing techniques, for storage of compressed natural gas for type 4 tanks. These tanks are made with plastic liners with full-wrapped continuous fiberglass and/or carbon fibers in a resin matrix. Begin work on advanced CNG storage concepts. Direct the work toward reaching the targets of $3,000/vehicle for incremental cost and 300 mile range by the year 2000. Focus CNG fueling infrastructure program on reduced cost and increased reliability of compressors and auxiliary equipment, with the goal of reaching cost reduction of 50% from today's costs by 2003. Continue development of high efficiency components for use in

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Alternative Fuels R&D (Cont'd)			natural gas vehicles. Develop improved fuel injectors and ignition systems to reach efficiency gains of at least 5% over current levels by the year 2000. Coordinate with the Advanced Heavy Vehicle Technologies program.
	Ethanol: Complete development of cold-start technology project for ethanol vehicles.	Ethanol: Evaluate and integrate additional cold-start techniques for alcohol fueled engines. Conduct a study to determine the best approach for a high efficiency ethanol vehicle powered by lean-burn spark ignition or four stroke direct injection, and formulate plan to develop a high efficiency ethanol vehicle.	Ethanol: Continue to integrate and evaluate previously developed cold-start devices for alcohol fueled engines, to meet the goal of operation at -20 degrees Celsius. Develop high efficiency components for use in ethanol fueled engines to increase efficiency by 8% in the year 2000.
	Fuels for Advanced Engines: Continued assessment of alternative fuels for four stroke direct injected engines. (NREL, Southwest Research Institute (SwRI)) ($2,310)	Fuels for Advanced Engines: Evaluate potential dimethyl ether (DME) fuel storage systems and develop a DME fuel injection system for use in an automotive diesel cycle engine. Initiate development of a second pump design concept for a DME fuel injection (FI) system. Evaluate commercially available lubricants to determine their adequacy for the DME FI system. Initiate	Fuels for Advanced Engines: Complete development of an optimized prototype DME fuel injection system to be used in an automotive CIDI engine. Perform comprehensive analysis of DME fuel production, distribution, and dispensing requirements, and develop a prototype refueling system. Continue to optimize fuels for use in CIDI engines, and other advanced automotive power

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Alternative Fuels R&D (Cont'd)		testing of advanced fuels on advanced compression ignition, direct injection (CIDI) engines. (Johns Hopkins Univ., SwRI, NREL, TBD) (PNGV: $4,700) ($4,700)	plants. Coordinate with the Advanced Heavy Vehicle Technologies program. (Johns Hopkins Univ., NREL, ANL, ORNL, and TBD) (PNGV: $6,000) ($6,000)
	STUDENT COMPETITIONS: Sponsored and conducted two major competitions, and provided support to one other. Conducted the second year of the FutureCar Challenge, in partnership with Ford, GM, and Chrysler. FutureCar provided universities the opportunity to contribute to the PNGV technology development path and to demonstrate selected systems and technologies in actual on-road vehicles. Also conducted the second year of the Propane Vehicle Challenge in conjunction with the Texas Railroad Commission, Texas State Energy Conservation office, and Chrysler. Added twelve new schools to convert pickup trucks donated by Chrysler. Continued to collect and analyze performance data on various hybrid and alternative fuel	STUDENT COMPETITIONS: Offer new universities the opportunity to participate in the FutureCar Challenge. Provide the opportunity for two FutureCar universities to build fuel cell vehicles. Transition from the Propane Challenge to the Ethanol Vehicle Challenge, co-sponsored by GM. (ANL, ASEE, universities) (PNGV: $850) ($850)	TECHNOLOGY COMPETITIONS: Continue the FutureCar Challenge with enhanced performance targets. Provide limited advanced technologies (e.g., fuel cells) to those universities which demonstrate the greatest potential. Offer opportunities to new universities to participate in the Ethanol Challenge with particular emphasis on hot/cold start capabilities. DOE funding will continue to be matched at least three to one by other contributors. (ASEE, ANL, universities) (PNGV: $1,000) ($1,000)

III. Performance Summary: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Alternative Fuels R&D (Cont'd)	configurations for fuel efficiency, emissions, and performance. Each Federal dollar was matched at least three to one by outside sponsors. In addition, provided support to the American Tour de Sol, conducted by the Northeast Sustainable Energy Association. (American Society for Engineering Education (ASEE), universities, ANL) ($850)		
	$ 3,160	$ 5,550	$ 7,000
Electric Vehicle R&D	ADVANCED BATTERY DEVELOPMENT: Development of advanced batteries that satisfy the long-term performance and cost goals established by the United States Advanced Battery Consortium (USABC) is considered by the automotive industry to be a critical step toward broad consumer acceptance of zero emission vehicles. Continued support for R&D on advanced batteries for electric vehicles through a cost-shared cooperative agreement with the USABC, with industry cost share of 55% in FY 1997.	ADVANCED BATTERY DEVELOPMENT: Continue support for R&D on advanced batteries for electric vehicles with the USABC, with an average industry cost share for Phase II of 55% in FY 1998.	ADVANCED BATTERY DEVELOPMENT: Continue support for R&D on long-term advanced batteries for electric vehicles with the USABC, with an average industry cost share of 55% in FY 1999.

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Electric Vehicle R&D (Cont'd)	Mid-term Battery R&D: Completed R&D efforts to reduce the cost of the mid-term nickel metal hydride battery. Continued test and evaluation program for nickel metal hydride pilot line modules.	Mid-term Battery R&D: Continue test and evaluation program for nickel metal hydride pilot line modules and nickel metal hydride cost-reduction technology programs.	Mid-term Battery R&D: Complete test and evaluation program for nickel metal hydride pilot line modules and nickel metal hydride cost-reduction technology programs.
	Conducted supporting R&D, and performance and life testing of prototype cells, modules, and battery packs, at DOE laboratories under Cooperative Research and Development Agreements (CRADAs) with the USABC. Delivered laboratory test results to the USABC and DOE for detailed evaluation, to establish that progress is being made toward achieving the program goals.	Continue to conduct performance and life testing, with industry and DOE laboratories, under suitable subcontracts or CRADAs. Continue to deliver latest laboratory test results to USABC and DOE for detailed evaluation, to establish that progress is being made toward the program goals.	Continue to conduct performance and life testing and evaluation with industrial developers and DOE laboratories. Complete delivery of laboratory test results to USABC and DOE.
	Continued environmental, safety, and health (ES&H) work on the long-term battery technology selected for development by the USABC, to ensure that these new battery systems will be in full compliance with regulatory requirements when commercialized.	Continue ES&H work on the USABC's selected battery technology, to ensure that these new battery systems will be in compliance with regulatory requirements when commercialized.	Continue ES&H assessment activities on selected advanced battery technology issues through the Advanced Battery Readiness Working Groups, to ensure compliance with regulatory requirements when commercialized.

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Electric Vehicle R&D (Cont'd)	Long-term Battery R&D: Selected a single lithium-based technology with one major developer, for continued R&D to meet USABC long-term goals. Finalized the battery design and fabricated prototype battery systems for evaluation by DOE laboratories and the automotive industry in its prototype electric vehicles. (ANL, INEEL, NREL, USABC) ($15,021)	Long-term Battery R&D: Through the USABC, continue to support work on the long-term advanced lithium-based battery with one major development team. Evaluate first generation prototype batteries in DOE laboratories and by the automotive industry in prototype electric vehicles. Focus technology development on design and manufacturing improvements to reduce costs and improve battery performance and life. (ANL, INEEL, LBNL, NREL, SNL, USABC) ($15,150)	Long-term Battery R&D: Through the USABC, using USABC long-term battery goals, evaluate second and third generation battery packs in automotive industry prototype vehicles. Evaluate option of developing ambient-temperature, lithium-based, long-term battery technologies and compare results to the advanced USABC lithium polymer baseline technology. Focus technology development on manufacturing and enhanced processing to improve battery performance and life and reduce costs. ANL, INEEL, LBNL, NREL, SNL, USABC) ($7,000)
	EXPLORATORY TECHNOLOGY RESEARCH: Continued close cooperation with the USABC and the battery developers within the Exploratory Technology Research (ETR) program. Continued to fund fundamental and applied research on critical areas of advanced battery technology. Selected research areas and coordinated with the USABC and DOE's	EXPLORATORY TECHNOLOGY RESEARCH: Continue research that strives to solve the most difficult problems facing the various vehicle electrochemical powersource systems under development by USABC and Partnership for a New Generation of Vehicles (PNGV) contractors. Focus on clear technical challenges requiring the development of new	EXPLORATORY TECHNOLOGY RESEARCH: Continue to focus exploratory technology research on developing low cost components and processes amenable to mass production of battery technology that can meet USABC and PNGV performance and cost targets. This effort will take advantage of expertise at DOE laboratories, universities, and industries to

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Electric Vehicle R&D (Cont'd)	Basic Energy Sciences (BES) program to maximize the impact on emerging battery technology for electric and other advanced vehicles. Focused on technologies to improve the performance of lithium and lithium carbon electrodes for both high energy and high power batteries. Shared research results with developers working for the USABC and automotive industry. (LBNL, LANL, LLNL, USABC) ($2,476)	processes and components for advanced batteries. Identify new electrochemical power sources for electric and hybrid vehicles that can meet long-term electric vehicle performance and/or cost goals, and can meet the power and lifetime requirements for high power applications. Improve each power source system by better defining the life-limiting processes that are poorly understood; developing significantly better models and analytic tools and applying them to solve critical problems; using advanced analytic techniques on corrosion processes; and developing and optimizing high performance electrochemical components, such as electrodes, electrolytes, and current collectors. (ANL, LANL, LLNL) ($3,236)	solve critical problems via a multi-disciplinary approach. Develop new electrodes, separators, components, and analytical techniques for investigating phenomenological processes. Develop improved understanding of life-limiting and performance-limiting processes. Develop refined user-friendly models and analytic tools to guide the development of lithium-based battery systems. Develop lithium batteries with greater stability and aqueous batteries with the optimal performance-durability/cost ratios. Investigate and characterize thin-film electrodes to understand the relationships of rate controlling mechanisms for the production of power and energy. Characterize and assess thermal behavior of lithium-based systems under dynamic loads--especially high power pulse charges and discharges. Measure transport properties of non-aqueous electrolytes by Nuclear Magnetic Resonance (NMR) techniques to facilitate the development of highly conductive electrolytes. Increase the

III. Performance Summary: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Electric Vehicle R&D (Cont'd)			conductivity of polymer electrolytes by a factor of ten while doubling the energy and power densities of the lithium-based system. (ANL, LANL, LLNL, LBNL) ($4,000)
	$ 17,497	$ 18,386	$ 11,000
Vehicle Systems R&D	Vehicle systems R&D utilizes results of research conducted under all Advanced Automotive Technologies (AAT) budget elements (Hybrid Propulsion Systems, High Power Energy Storage, Heat Engines, Advanced Power Electronics, Advanced Combustion Engine R&D, Lightweight Materials, Alternative Fuels R&D, and Fuel Cell R&D) to resolve integration issues and improve technology to meet program performance targets.	Vehicle systems R&D utilizes results of research conducted under all AAT budget elements to resolve integration issues and improve technology to meet program performance targets.	Vehicle Systems R&D: Vehicle systems R&D utilizes results of research conducted under all AAT budget elements to resolve integration issues and improve technology to meet program performance targets.
	HYBRID PROPULSION SYSTEMS: Continued the development of production feasible hybrid technologies and systems including batteries, power units, controls, and complete electric drive systems	HYBRID PROPULSION SYSTEMS: Continue final development stages of production feasible automotive hybrid propulsion technologies. Fabricate next generation hybrid components and integrate into	HYBRID PROPULSION SYSTEMS: Continue development and further advanced component integration for achieving triple fuel economy.

III. Performance Summary: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	aimed at achieving 50 miles per gallon (mpg) when used in production vehicles. Efforts focused on integrating hybrid technologies into test-bed vehicles for functionality, packaging efficiency, and reliability. Developed control strategies for optimal hybrid propulsion system efficiency and performance under all types of operating conditions. Completed initial testing of components in the laboratory and in the test-bed vehicles. Retained under the prime contracts only those subcontractors which could reasonably support volume production of the most promising technologies. Eliminated technologies for which technical risk and level of maturity did not meet the reliability, cost, and manufacturability targets for the 50 mpg program. For the technologies that were retained, evaluated design improvements to reduce costs and manufacturability, and incorporated the most promising into next generation hardware designs for testing.	test-bed vehicles to assess propulsion system configurations, design approaches, control strategies, and performance under various operational conditions and test cycles. These test-bed vehicles resemble the final deliverable vehicles under the program in form, fit, and function. Focus efforts to refine and improve propulsion system integration, control strategies, and reliability on the development activity. Use propulsion system test data to validate models of predicted performance. Transition the hybrid propulsion R&D activities from a propulsion system development focus, to encompass vehicle development which will be systems driven and barrier focused to achieve the 80 mpg goal. Through systems modeling, begin evaluating the spectrum of technology options including lightweight materials, improved accessories, lower aerodynamics and rolling resistance losses, advanced power electronics, electric motors, transmissions, advanced compression ignition direct	Continue developing and refining the vehicle systems modeling activity to include cost, vehicle handling, and reliability models. Perform trade-off studies to determine the candidate technologies, configurations, and control strategies required to achieve the PNGV 80 mpg fuel efficiency, emission, and cost goals. Improve understanding of performance targets and system requirements for technologies being developed in the program. Develop concept designs that can achieve the goals of the program.

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	(NREL, GM, Ford, ANL, INEEL, Chrysler, Stirling Thermal Motors, AlliedSignal, Detroit Diesel Corp., and others) (PNGV: $38,007) ($38,007)	injection engines, and fuel cells to determine the best possible candidate technologies that have the potential for meeting the performance and cost goals of the program. Initiate a vehicle systems integration effort which will design and fabricate test-beds to evaluate advanced technologies in the context of a lightweight, PNGV-type vehicle. Initiate focused R&D projects aimed at overcoming the critical barriers to commercialization of high efficiency hybrid technologies. Continue systems analysis work with the PNGV partnership under a cooperative agreement with USCAR. (ANL, NREL, INEEL, GM, Ford, Chrysler, subcontractors TBD) (PNGV: $44,700) ($44,700)	Initiate complete hardware designs and begin development and fabrication of the most promising designs through the systems integration effort. Further refine and improve efficiency, cost, weight and volume of the most promising propulsion system technologies for the 80 mpg target. Simultaneously harvest, as appropriate, advanced enabling technologies in other Advanced Automotive Technologies program elements for development in the context of the vehicle systems program. (NREL, INEEL, GM, Ford, Chrysler, subcontractors TBD) (PNGV: $25,000) ($25,000)
	HEAT ENGINE R&D: Continued to focus the gas turbine hybrid power unit and technology support program on four critical turbine engine technologies: structural ceramic component reliability and durability; low emission combustion concepts and control; low cost heat	HEAT ENGINE R&D: Complete the hybrid vehicle gas turbine engine-technology support and ceramic turbine engine demonstration projects. As a result of program restructuring started in FY 1996, conclude both projects when prior year (FY 1997) funding expires. Based on	HEAT ENGINE R&D: Focus the heat engine program on component technology for direct injection engines, including lean-burn gasoline direct injection (GDI), to achieve stringent emissions requirements (.2g/mile nitrogen oxides, .01g/mile particulates) in an advanced, high

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	recovery systems; and hot flow path thermal management and insulation. Continued the ceramic turbine engine demonstration project to demonstrate reliability and durability of ceramic components in modified existing hybrid power units, and demonstrate ceramic component manufacturing processes in the production environment. (Allison, AlliedSignal, ANL) (PNGV: $4,833) ($4,833)	PNGV technology selection decision, no additional turbine-related hybrid power unit R&D will be funded. ($0)	efficiency engine. Develop fuel delivery systems (pumps, injectors) for high compression ratio GDI engines utilizing low sulfur fuel. Develop advanced variable timing technology for direct injection. Apply optical engine measurements to benchmark and compare existing GDI engines to determine characteristics and necessary design features for an optimized GDI engine. Investigate basic fundamentals of GDI stratified charge combustion, determining the importance of in-cylinder mixing, flame quench and propagation as contributions to nitrogen oxides and carbon formation. Conduct single cylinder testing using technology developed under Advanced Combustion Engine R&D program activities. (TBD Consortium: engine manufacturer(s) and suppliers, with ORNL, ANL, TBD universities, TBD other, and USCAR) (PNGV: $13,000) ($13,000)
	HIGH POWER ENERGY STORAGE: High power energy	HIGH POWER ENERGY STORAGE: Under the	HIGH POWER ENERGY STORAGE: Under the

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	storage devices are one of the performance-limiting subsystems in the hybrid vehicle program. Selected the most promising high power battery technologies for further development under the 50% cost-shared cooperative agreement with the U.S. Advanced Battery Consortium (USABC). Focused research and development activity on improving the power density, cycle life, and charge acceptance of the candidate technologies, to achieve capability of high power performance with high cycle life. Initiated basic modeling studies. Delivered battery prototype cells to the USABC for performance evaluation and verification testing in DOE laboratories.	cooperative agreement with the USABC, continue development of the most promising advanced battery technologies--nickel metal hydride and lithium-ion—moving from laboratory cells to 50-volt demonstration modules. Provide results from the tests on prototype modules for industry application in PNGV concept vehicle(s). Refine energy storage/vehicle system requirements, using the test data to validate energy storage models.	cooperative agreement with the USABC, continue the development of high-power nickel metal hydride and lithium-ion technologies. Fabricate a 400-volt high power energy storage nickel metal hydride battery; start life verification testing at a DOE laboratory to characterize the performance against PNGV energy storage requirements for a 400-volt subsystem battery pack. Complete 50-volt high power energy storage lithium-ion module development, initiate performance characterization and life cycle testing at DOE laboratories, and compare results to PNGV technical targets for a 50-volt module. Based on the lithium-ion test results, select one or two of the competing lithium-based technologies for scale-up development to a 400-volt subsystem battery pack for application in the PNGV concept vehicle(s).
	Conducted applied research and developed advanced electrochemical components to address the specific life limiting	Reassess longer term technologies that promise further performance, life, and/or cost benefits to determine their priority for	Initiate a national laboratory effort to focus on the research and development of low cost electrolyte salts and separators for

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	phenomena of high power batteries and ultracapacitors.	application to future energy storage systems. Acquire high voltage test equipment to assess performance characteristics of high power battery systems.	high power batteries, and in situ overcharge protection for lithium-based battery systems.
	Continued the flywheel safety and containment program with the Defense Advanced Research Projects Agency (DARPA), by conducting failure modes and effects analysis, followed by the development of analytical failure prediction models. Proceeded with testing of composite rotor specimens in an effort to gain a better understanding of the physics of rotor failure.	Complete flywheel safety and containment efforts by demonstrating the safe containment of a flywheel during a burst test.	Complete close out of the flywheel program. (USABC, LBNL, LLNL, ORNL, INEEL) (PNGV: $15,000) ($15,000)
	Transitioned nanostructure ultracapacitor technology from high-power propulsion applications to power electronics. Completed testing of bipolar capacitors. (USABC, LBNL, LLNL, INEEL) (PNGV: $8,000) ($8,000)	Complete close-out of the ultra capacitor program. (USABC, LBNL, LLNL, ORNL, INEEL) (PNGV: $9,000) ($9,000)	
	ADVANCED POWER ELECTRONICS: Transitioned the power electronic building	ADVANCED POWER ELECTRONICS: Continue PEBB semiconductor module	ADVANCED POWER ELECTRONICS: Continue the core PEBB program, developing

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	block (PEBB) semiconductor module development activities from series one (PEBB-1) to series two (PEBB-2) designs, incorporating single-side cooled, single and multiple chips. Made samples of these prototypes available to automotive manufacturers for test, evaluation, and determination of conformance to automotive specifications.	technology improvements leading to fabrication of small quantities of PEBB-1 technology that meet automotive functional requirements and are 50% lower in cost, weight, and volume compared to the 1995 baseline. Demonstrate further technology improvements in the laboratory to increase power density and degree of integration. Determine the feasibility of 75% reductions below the 1995 baseline for cost, weight, and volume for the PEBB-2 design. Transition integrated cooling from single-sided to two-sided cooling, and reduce the multi-chip count. Distribute pre-production samples of improved PEBB technology to the automotive industry partners for evaluation.	semiconductor modules for automotive applications. Incorporate technology improvements into limited quantities of prototype PEBB-2 devices aimed at meeting not only the "form" but also the functional specifications developed in conjunction with the automobile manufacturers for traction drive power electronics. Demonstrate improvements by increasing the power density and lowering production cost and assess final results. Initiate demonstration of PEBB-3 modules that have two-sided cooled power electronics integrated with control and communication chips. Evaluate laboratory PEBB-3 modules in advanced vehicle systems. Use the results of the evaluation to measure progress against FY 2000 power electronics technical targets.
	Initiated a power electronics materials needs assessment study.	Complete the power electronics materials needs assessment study.	Based on the results of the materials needs assessment study, develop a research plan for materials technologies to support power electronics and electric machines.

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Systems R&D (Cont'd)	Continued development of nanostructure ultracapacitors transitioned from high power battery development. (GM, Ford, Chrysler, AlliedSignal, Allison, USABC, Navy, Harris Semiconductor, ORNL, SNL, NREL) (PNGV: $3,000) ($3,000)	Develop novel capacitors that permit integration of capacitor functions with power modules. (General Motors, Ford, Chrysler, AlliedSignal, Harris Semiconductor, ORNL, SNL, Navy, TBD) (PNGV: $4,500) ($4,500)	Continue advanced nanostructure and metal oxide chemical vapor deposition (MOCVD) capacitor R&D for power electronics. Integrate nanostructure or MOCVD capacitors into a power electronic module and assess performance against technical targets. (General Motors, Ford, Chrysler, AlliedSignal, Harris, Northrup-Grumman, ORNL, SNL, Navy, DoD, TBD) (PNGV: $5,000) ($5,000)
	$ 53,840	$ 58,200	$ 58,000
Fuel Cell R&D	SYSTEMS DEVELOPMENT: Realigned the fuel cell program into a single effort consisting of projects coordinated through the Fuel Cell Alliance, a joint industry/government alliance that included domestic original equipment manufacturers, fuel cell developers, subsystem and component suppliers, and the fuels industry. The cooperative government/industry management structure directed and guided the	SYSTEMS DEVELOPMENT: Focus systems development activities on validation of fuel cell technologies meeting automotive requirements. Building on the success of the fuel reformer/storage and stack component R&D, fabricate integrated 30-50 kilowatt (kW) fuel cell laboratory systems which operate directly on hydrogen, other alternative fuels and conventional fuels. Demonstrate	SYSTEMS DEVELOPMENT: Integrate fuel cell stack, fuel processor, and balance-of-plant components into a fuel-flexible fuel cell power system that is vehicle ready; capable of operating on natural gas, methanol, ethanol, and gasoline; and demonstrates a system efficiency of 55% at 25% of peak power. Test and evaluate fuel cell power systems under simulated driving cycles for integration into

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)	research and development efforts. Industry collaboratively set the generic fuel cell vehicle system requirements and performance specifications, and jointly established R&D priorities with DOE. The industry alliance focused on the sharing of component development results among the members.	stack efficiencies of 60% and fuel processor efficiencies of 75%. Test and evaluate these propulsion systems under simulated driving cycles.	available test bed vehicles.
	Awarded contracts to fuel cell suppliers and developers for fuel cell propulsion system development. Built a 30 kilowatt (kW) methanol-fueled and a 50 kW hydrogen-fueled proton exchange membrane (PEM) system. Achieved a two-fold increase in power density over 1995 levels in a fuel cell stack, meeting automotive industry mid-term performance and cost goals for light duty vehicles. Achievement of this milestone verified feasibility of a critical component, provided the path to system development, and could lead to fuel cell-powered vehicles which can achieve three times greater fuel economy than today's vehicles with near-zero tailpipe emissions.	Identify critical needs for continued, more focused component development needed to address technical barriers, such as start-up and transient response, power management, thermal management, and reliability. Use propulsion system test results to update system models so that trade-offs among subsystems can be evaluated and component R&D can be prioritized. (International Fuel Cells, Plug Power, ANL) (PNGV: $4,142) ($4,142)	Integrate components to identify vehicle system technical barriers such as cold start-up and transient response, power management, thermal management, durability, and reliability. Use test results to update system models, to facilitate subsystem design analysis, and to prioritize component R&D. (International Fuel Cells, Plug Power, ANL) (PNGV: $7,546) ($7,546)

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)	(GM, Ford, Chrysler/Pentastar, International Fuel Cells, Mechanical Technology, Inc., Energy Partners, Delphi, AlliedSignal, and others) (PNGV: $11,760) ($11,760)		
	COMPONENT R&D: Continued work on supporting ongoing PEM technology development efforts and identifying promising new concepts, with oversight by the Fuel Cell Alliance. Developed bipolar plates that are highly conductive and corrosion resistant at a small scale (50 sq. cm), and membrane electrode assemblies with improved tolerance to carbon monoxide (10 parts per million). Developed and tested high efficiency compressors and expanders for fuel cell applications.	COMPONENT R&D: Fuel cell propulsion system components must meet technical challenges such as size and weight reduction, manufacturing cost reduction, quick start-up and transient response, and durability. Focus development on low cost, high performance components for proton exchange membrane (PEM) fuel cells. Produce improved fuel cell catalysts which are able to tolerate 50 parts per million (ppm) carbon monoxide from the hydrogen-rich fuel processing stream without performance degradation. Develop membrane-electrode assemblies employing low platinum loadings or non-noble catalyst formulations for reformatted systems. Investigate alternative bipolar plates that are low cost and lightweight, such as conductive plastics separator plates.	COMPONENT R&D: Continue to focus R&D activities on low cost, high performance components for proton exchange membrane fuel cells. Develop improved fuel cell catalysts which are able to tolerate 100 ppm carbon monoxide from the hydrogen-rich fuel processing stream without performance degradation. Establish stability and durability of catalysts through long-term testing. Build and test fuel cell stack systems operating on reformated, which incorporates new, low cost, lightweight bipolar plates and high carbon monoxide-tolerant catalysts. Complete development of advanced compressors and expanders demonstrating 80 and 90% efficiency, respectively.

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)		Investigate low cost, high volume manufacturing processes to produce advanced bipolar plates, membrane electrode assemblies, and other fuel cell components having reproducible performance and leading to a fuel cell stack having a power density of 850 watts/liter (W/l).	Increase emphasis on development of low cost, high volume manufacturing processes of fuel cell components leading to a fuel cell stack system (including air, heat and water management devices) having an automotive power density of 350 W/l.
	Continued direct methanol fuel cell development, with the demonstration of 1,000 hours of stable performance on a single test cell.	Produce a new methanol impermeable membrane to facilitate the development of direct methanol fuel cells, eliminating the need for a reformer.	If previous R&D activities are successful, begin scale-up of direct methanol fuel cell to 5 kilowatt (kW) level.
	(ANL, LANL, Energy Partners, Texas A&M, International Fuel Cells, AlliedSignal, Vairex) (PNGV: $4,500) ($4,500)	Conduct independent testing and evaluation of new components and systems, to identify and assess promising new technologies and/or technical approaches.	Continue independent testing and evaluation of new components and stack systems.
		Coordinate with the other fuel cell activities to facilitate the integration of advanced components into the total system.	Coordinate with systems development efforts to facilitate integration of advanced components into the total system.
		(AlliedSignal, Foster-Miller, Energy Partners, Spectracorp, Electrochem, IGT, 3M, A.D. Little, Vairex, Meruit, LANL,	(TBD, ANL, LANL) (PNGV: $18,100) ($18,100)

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)		ANL, LBNL, NREL) (PNGV: $11,078) ($11,078)	
	REFORMER AND STORAGE R&D: Continued to build on the R&D breakthroughs and lessons learned from the 50 kW fuel flexible reformer. Focused the fuel flexible reformer program on unique issues associated with gasoline, and demonstrated technical feasibility of producing electricity from gasoline.	REFORMER AND STORAGE R&D: In cooperation with the DOE Hydrogen Program, focus R&D on development and testing of low cost, lightweight hydrogen storage systems for on-board vehicle use. Due to the lack of a hydrogen infrastructure, develop hydrogen producing fuel processors. Building on previous R&D breakthroughs, develop a 50 kW fuel-flexible processor capable of rapid start-up (less than 3 minutes) and fast response processing of natural gas, methanol, ethanol, and gasoline. This fully integrated system will include all components (reactors, heat exchangers, fuel purification system, controls and sensors) and be sufficiently compact and lightweight for test-bed vehicle installation.	FUEL PROCESSOR AND STORAGE R&D: Complete fabrication and safety testing of hydrogen storage tanks, for on-board vehicle use, having an available energy density of 700 watt-hours per liter (Wh/l). Complete development of a compact, lightweight, 50 kW fuel-flexible fuel processor capable of rapid start-up (less than 3 minutes), and fast response processing of natural gas, methanol, ethanol and gasoline. This fuel processing system will be fully automated and ready for integration with the fuel cell stack system. Address development of a low pressure, low temperature fuel-flexible fuel processor with automotive controls, eliminating the need for a compressor when integrated with a low pressure fuel cell, while improving start-up time and overall system efficiency. Build advanced CO clean-up prototypes to lower CO to less

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)	Worked on developing improved fuel processing catalysts and carbon monoxide (CO) clean-up catalysts. Validated other innovative concepts (e.g., CO adsorption) to increase energy efficiency and fuel stream purity.	Address remaining key barriers: removal of carbon monoxide (CO) from the fuel stream (critical because even small levels of CO (50 ppm) can poison the fuel cell stack catalyst); system thermal integration; and cost reduction. Evaluate preferential oxidation, hydrogen filters, and adsorption/desorption techniques to lower CO levels to less than 10 ppm.	than 10 ppm. Down select from advanced preferential oxidizers, hydrogen filters, and adsorption/desorption devices, and integrate into fuel processor.
		Using microtechnology, develop compact, efficient heat exchangers and fuel pre-heaters to provide integrated thermal management, maximizing system efficiency and power density.	Optimize and scale up compact, efficient heat exchangers and fuel pre-heaters which utilize microtechnology.
	Made awards to fuel processing developers and national laboratories. This activity will lead to a 50 kW compact, lightweight, low cost fuel processor system which meets automotive requirements for steady state operations, and which can process natural gas, ethanol, methanol and gasoline. (ANL, LANL, A.D. Little, Hydrogen Burner) (PNGV:	Coordinate with system development efforts to facilitate integration of the fuel processor into the total system. Acquire fuel cell test stand apparatus and a gas stream analyzer. (LANL, ANL, PNNL, LBNL, Hydrogen Burner, A.D. Little, Thiokol, Thermo Power) (PNGV: $8,340) ($8,340)	Coordinate with systems development efforts to facilitate integration of the fuel processor into the total system. (Hydrogen Burner, A.D. Little, Thiokol, Thermo Power, ANL, LANL) (PNGV: $19,000) ($19,000)

III. Performance Summary: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuel Cell R&D (Cont'd)	$4,500) ($4,500) $ 20,760	$ 23,560	$ 44,646
Advanced Combustion Engine R&D	Increased support for advanced automotive piston engine technologies which have the potential for achieving a threefold improvement in vehicle fuel efficiency, as well as nearer term conventional vehicle improvements.	Continue support for advanced automotive piston engine technologies required to achieve a threefold improvement in vehicle fuel efficiency as well as nearer term conventional vehicle improvements.	Conduct R&D which will enable fuel efficient compression ignition direct injection (CIDI) engines to meet stringent Federal and State emission requirements.
	Combustion: Continued optical access measurement and numerical modeling of fluid flow and chemistry, analysis of fuel-air mixture formation and combustion in production engines. Upgraded models to include lean-burn fuel injection simulation and validate against experimental data.	Combustion: Continue optical access measurement and numerical modeling of fluid flow and chemistry, analysis of fuel-air mixture formation and combustion in production engines. Continue refinement of models which include lean-burn fuel injection simulation. Validate against experimental data.	Combustion: Continue optical access, single-cylinder combustion research to directly measure injection spray patterns and combustion processes using laser visualization. Characterize inlet and in-cylinder flows and effects of wall heat transfer and exhaust gas recirculation. Correlate optical measurements with numerical models to validate and refine model for optimization of fuel injection, sensor, and exhaust gas recirculation (EGR) systems.
	Emission Controls: Initiated development of a diagnostic tool to identify sources of unburned	Emission Controls: Continue development of diagnostic tool to identify sources of unburned	Emission Controls: Develop cost effective ($5/kilowatt (kW) versus current $15/kW) control and

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Combustion Engine R&D (Cont'd)	hydrocarbons in engine exhaust.	hydrocarbons in engine exhaust. Continue development of lean-NOx catalyst and other exhaust after treatments.	aftertreatment system to reduce gaseous and particulate emissions. Scale up NOx catalyst and plasma-assisted catalyst systems to 50 kW-engine capacity and test performance/durability (goal greater than 3,500 hours). Continue non-combustible gas sensor development for closed-loop control. Initiate development of accurate, low density particulate sensors and develop initial control system design.
	Engine Integration: Continued development of fuel injection, alternative fuel capability and other enabling technology elements. Conducted projects in partnership with DOE laboratories, universities, industry. Coordinated with the Advanced Heavy Vehicle Technologies program.	Engine Integration: Continue development of CIDI technology, fuel injection, alternative fuel capability and other enabling technology elements. Continue projects in partnership with DOE laboratories, universities, industry. Coordinate with the Advanced Heavy Vehicle Technologies program.	Engine Integration: Benchmark prototype components and control strategies, and compare to state-of-the-art, multi-cylinder engines. Continue projects in partnership with DOE laboratories, universities, and industry. Coordinate with the Advanced Heavy Vehicle Technologies program.
	(ANL, ORNL, PNNL, INEEL, SNL, Ford, GM, Chrysler, Princeton, Penn State University, Wayne State University, University of Wisconsin, University of Illinois, MIT, Drexel, Florida, A&M) (PNGV:	(ANL, ORNL, PNNL, SNL, Ford, GM, Chrysler, Princeton, Penn State University, Wayne State University, University of Wisconsin, University of Illinois, MIT, Drexel, Florida A&M, TBD) (PNGV: $7,600) ($7,600)	(ANL, ORNL, PNNL, SNL, Ford, GM, Chrysler, Wayne State University, University of Wisconsin, TBD) (PNGV: $18,000) ($18,000)

III. <u>Performance Summary</u>: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Combustion Engine R&D (Cont'd)	$7,460) ($7,460) $ 7,460	$ 7,600	$ 18,000
Cooperative Automotive Research for Advanced Technologies	No Activities. ($0)	No Activities. ($0)	Under the Partnership for a New Generation of Vehicles, support a Cooperative Automotive Research for Advanced Technologies (CARAT) program which provides an opportunity for small businesses and universities to help accelerate progress on inventions needed for advanced vehicle technologies. Issue a solicitation inviting proposals that describe how specific technical targets might be met in the areas of, but not limited to: fuel cells, compression ignition direct injection engines, spark ignition engines, alternative fuels, energy storage, and lightweight materials. Award multiple, cost-shared cooperative agreements to conduct research and development under a three-stage program, from bench modeling and preliminary development plans in Phase 1 through validation of production feasibility in Phase 3. (PNGV:

III. Performance Summary: ADVANCED AUTOMOTIVE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cooperative Automotive Research for Advanced Technologies (Cont'd)	$ 0	$ 0	$6,000) ($6,000) $ 6,000
Advanced Automotive Technologies Total	$ 102,717	$ 113,296	$ 144,646

TRANSPORTATION TECHNOLOGIES
TRANSPORTATION SECTOR
(dollars in thousands)

TECHNOLOGY DEPLOYMENT

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

This program's mission is to reduce oil consumption, as well as environmental emissions, through promoting the introduction and commercialization of alternative fuel vehicles (AFVs) and advanced technology vehicles with significantly improved fuel economy.

During and following successful technology development by industry and government, and in coordination with partners, stakeholders, and customers, this program provides the catalyst needed to establish an improved public understanding about, and resulting market demand for, alternative fuel vehicles, advanced technology vehicles, and advanced fuels; and establish a strong and far-reaching fuel and service infrastructure. The program is designed to provide support at critical periods in the transition of advanced transportation technologies from the laboratory to the marketplace, and then reduce government support as market penetration improves for vehicles which reduce petroleum consumption.

The Energy Policy Act of 1992 (EPACT) establishes multiple goals for alternative fuel technology development and utilization. Fuels of interest include biodiesel, electricity, ethanol, hydrogen, methanol, natural gas, and propane. Relative to petroleum fuel substitution, the basic EPACT goal is to promote the development and use of domestic replacement fuels to substitute for imported petroleum motor fuels to the maximum extent practicable. Within the context of the basic program goal, DOE focuses its program on those replacement fuels which will have the greatest impact on: reducing oil imports, improving the nation's economy, and reducing criteria pollutants and greenhouse gas emissions.

Achieving these goals will require the establishment of sustainable alternative fuel and vehicle production industries, and extensive private sector investment in supporting infrastructure. Markets for the products of these industries will be based on the confidence of consumers in the performance, reliability, cost-effectiveness, and other characteristics of those products. This program is about building that confidence by weaving together a variety of activities in response to customer needs. The program will:

- ✓ Forge partnerships with fleet owners, fuel providers, vehicle manufacturers, and State and local governments to expand the use of alternative fuel vehicles and the development of refueling infrastructure.
- ✓ Provide current, accurate, reliable information on all types of alternative fuels and vehicles.
- ✓ Perform rigorous, structured programs to test and evaluate cars and trucks that use alternative fuels.

I. **Mission Supporting Goals and Objectives**: TECHNOLOGY DEPLOYMENT (Cont'd)

- ✓ Implement the requirements of the Energy Policy Act.
- ✓ Promote consumer acceptance of advanced technology cars and trucks with significantly improved fuel economy.

With fleets paving the way for higher volume, lower cost vehicle production, and the installation of refueling capability, the objective is to make alternative fuel vehicles the choice of many individual private vehicle purchasers by the year 2000. Local, voluntary initiatives and agreements can be the mechanism by which all parties with a stake in alternative fuels can develop their plans together. With this premise, DOE has created and nurtured the Clean Cities program. Clean Cities is a voluntary Federal program designed to accelerate and expand the use of alternative fuel vehicles (AFVs) in communities throughout the country, and to provide refueling and maintenance facilities for their operation. As of January 1998, sixty communities have joined the Clean Cities program. Clean Cities encourages local governments and organizations to form public/private partnerships in developing markets for AFVs. Many of these local programs have links across regional and State boundaries to establish Clean Corridors with refueling infrastructure to allow inter-city travel with alternative fuel vehicles.

Under provisions of the Alternative Motor Fuels Act of 1988 and EPACT, a large number of vehicles are included in the Department of Energy's data acquisition activities. These vehicles represent a comprehensive cross section of our national commercial fleet. Projects are cost shared with many industry, State, and Federal groups. These activities place state-of-the-art AFV technology "on the road" for real-world fleet test evaluation. Over 1,000 Federal and commercial sedans, pickup trucks, vans, minivans, snowplows, garbage trucks, long-haul trucks, school buses, and urban mass transit buses have been tracked continuously, with performance, fuel economy, emissions, and maintenance data provided to the DOE-sponsored Alternative Fuels Data Center for compilation, analysis and dissemination.

To assist with utilization activities and provide information, fact sheets and reports designed to describe the various projects currently underway within the Office of Transportation Technologies (OTT) are developed. The distribution of the Congressionally-mandated Fuel Economy Guide, a pamphlet developed to help consumers compare the fuel economy of similarly sized new cars and light trucks, is made available to all new vehicle dealerships and to persons and organizations which request copies.

I. B. Program Benefits

	2000	2010	2020
Primary Energy Displaced (Quads)	0	0	0
Primary Oil Displaced (million barrels per day)	0.05	0.40	0.45
Energy Cost Savings ($ billion)	0.34	2.49	1.80
Carbon Reductions (million metric tons)	0.46	3.98	4.47

Using the quality metrics modeling methodology, it is estimated that 500,000 AFVs will be in operation nationally by the year 2000, thereby displacing 50,000 barrels per day of petroleum, reducing carbon emissions by 0.46 million metric tons per year, and reducing annual energy costs (i.e., oil costs) by approximately $340 million per year.

I. **Mission Supporting Goals and Objectives**: TECHNOLOGY DEPLOYMENT (Cont'd)

I. C. Performance Goals

Strategy/Goal: In concert with regional and local authorities, partnerships will be created among fuel suppliers, vehicle manufacturers, and fleet operators to displace 50,000 barrels per day of petroleum by the year 2000. This represents an annual savings of approximately $340 million in energy (oil) costs, and will lay the groundwork for further expansion of the alternative fuels industry and continued reduction in imported petroleum products.

FY 1997 Accomplishments

-- Expanded the Clean Cities program to 57 participating communities, and expanded efforts to help communities develop local market development plans for alternative fuels.

-- Initiated field test/evaluation of electric vehicles using the first generation of advanced batteries developed under the Department of Energy's (DOE) cooperative agreement with the U.S. Advanced Battery Consortium.

-- Completed Phase I of public/private development of an alternative fuel clean corridor linking California, Nevada, and Utah. Initiated Phase I of a similar program for the New York-Philadelphia-Baltimore-Washington, D.C., corridor.

-- Reviewed public comments on Energy Policy Act fleet programs, and incorporated them into a technical and policy analysis of the Act's replacement fuel goals, for submission to Congress.

FY 1998 Planned Accomplishments

-- Expand Clean Cities program to 60 participating communities and focus efforts on assisting implementation of local plans for alternative fuel market development.

-- Strengthen infrastructure corridor program, through the States and Clean Cities, that will encourage refueling development and alternative fuel use.

-- Complete field test/evaluation of electric vehicles using first generation advanced batteries developed with support from the DOE/U.S. Advanced Battery Consortium.

-- Add electric and hybrid vehicle data and information products to the Alternative Fuels Data Center and disseminate through Clean Cities.

I. <u>Mission Supporting Goals and Objectives</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

-- Through the Clean Cities program, continue to attract alternatively fueled medium and heavy duty urban delivery vehicle fleets as key urban stakeholders.

-- Initiate efforts to promote technologies to reduce greenhouse gases through Clean Cities grants.

-- Close out certification of training program and transition to private sector.

-- Continue implementation of EPACT fleet requirements, with emphasis on adding 10,000 AFVs to the Federal fleet and undertaking a rulemaking to consider expanding requirements to private and local fleets.

<u>FY 1999 Planned Accomplishments</u>

-- Expand Clean Cities scope to include emphasis on greenhouse gas reductions, significantly expanding grants to States and Clean Cities to demonstrate vehicles with significantly improved fuel economy.

-- Improve the value of the Fuel Economy Guide and other information products, as a means to encourage the use of fuel efficient vehicles.

-- Demonstrate state-of-the-art, fuel-efficient vehicle technologies for cars and trucks, including hybrid vehicles.

-- Link and solidify Clean Cities infrastructure and corridor investments launched in 1996 through 1998, creating continuous corridors of alternative fuel infrastructure linking 10 major urban centers.

-- Determine, through public comment and rulemaking, how to modify the Energy Policy Act replacement fuel goals, and design a program to promote the maximum practicable use of alternative fuels.

-- Continue EPACT fleet programs, adding 15,000 AFVs to the Federal fleet and completing the rulemaking on private and local fleets.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Support a national Clean Cities Foundation to support and coordinate the network of local coalitions.

-- Implement focused projects that reduce greenhouse gases through the use of advanced technologies and low greenhouse gas fuels.

-- Increase utilization of advanced hybrid and electric vehicles.

-- Facilitate the use of 500,000 alternatively fueled vehicles operating in the Clean Cities and corridors.

II. A. Funding Table: TECHNOLOGY DEPLOYMENT

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Clean Cities Voluntary Deployment	$ 2,606	$ 2,850	$ 6,000	$ 3,150	111%
Infrastructure, Systems, and Safety	1,605	2,175	2,000	-175	-8%
EPACT Replacement Fuels Program	1,475	1,400	1,300	-100	-7%
Vehicle Field Test/Evaluation	2,432	2,850	3,450	600	21%
Technical Information Development	2,500	2,500	3,500	1,000	40%
Total, Technology Deployment	$ 10,618	$ 11,775	$ 16,250	$ 4,475	38%

II. B. Laboratory and Facility Funding Table: TECHNOLOGY DEPLOYMENT

Argonne National Lab (East)	$ 1,055	$ 950	$ 950	$ 0	0%
Idaho National Engineering and Environmental Lab	482	660	1,460	800	121%
National Renewable Energy Lab	3,332	2,410	2,410	0	0%
Oak Ridge National Lab	375	200	200	0	0%
All Other	5,374	7,555	11,230	3,675	49%
Total, Technology Deployment	$ 10,618	$ 11,775	$ 16,250	$ 4,475	38%

III. **Performance Summary**: TECHNOLOGY DEPLOYMENT

Activity	FY 1997	FY 1998	FY 1999
Clean Cities Voluntary Deployment	Supported voluntary programs for State and local governments and private industry to acquire alternative fuel vehicles in 57 participating Clean Cities through developing and using expanded networks and agency-to-agency communications. Expanded coordinated efforts with the electric utility industry to introduce electric vehicles in selected Clean Cities, catalyzed infrastructure development and encouraged consumer acceptance. (EPACT Section 505) (NREL)	Expand the Clean Cities program to at least 60 participating communities, focusing efforts to leverage specific private capital investments for greater alternative fuel market development. Continue efforts to measure the success of each city in carrying out its plan. Voluntary private sector efforts complement existing rules for government fleets and help to meet energy, environmental, and economic goals. Strengthen and expand electric vehicle programs started in Clean Cities during the EV Market Launch. (EPACT Section 505) (NREL)	Strengthen the Clean Cities program through focus on infrastructure and corridor efforts, supported by increased funding for projects to address market barriers. Expand Clean Cities scope to encompass reductions in greenhouse gases as well as other emissions of concern. Develop tools and training to promote use of fuel efficient and advanced technology vehicles. (EPACT Section 505) (NREL)
	Linked grants to State governments for accelerated use of alternative fuel vehicles with the Clean Cities Program. (EPACT Section 409)	Continue State grants work from previous year with an emphasis on infrastructure development. (EPACT Section 409)	Increase State grants work from previous year. Expand projects that deliver reductions in air emissions, including greenhouse gases. (EPACT Section 409)
	Continued demonstration and evaluation of alternative fuel cars and trucks, working with selected States and Clean Cities. (EPACT Section 302) (INEEL, States) $2,606)	Cost share demonstration and evaluation of light and heavy duty alternative fuel vehicles with industry, focusing on new applications in selected Clean	Expand cost-shared demonstrations from previous year, adding advanced technology, fuel-efficient vehicle demonstrations, such as hybrid vehicles, in Clean Cities.

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Clean Cities Voluntary Deployment (Cont'd)	$ 2,606	Cities. (EPACT Section 302) (INEEL, States) ($2,850) $ 2,850	(EPACT Section 302) (INEEL, States) ($6,000) $ 6,000
Infrastructure, Systems, and Safety	Completed Phase I of the public/private development of an alternative fuel clean corridor linking California, Nevada, and Utah, as part of the Clean Cities program. (EPACT Section 505)	Commence Phase II of a nationwide infrastructure corridor development program, through the Clean Cities and States, to encourage private investment in refueling development along key transportation corridors. (EPACT Sections 505 and 502)	Continue work from previous year, with an additional focus on deployment projects that reduce greenhouse gases and other air emissions through the use of advanced technology and low carbon fuels. Use some grant funds to begin a National Parks initiative. (EPACT Sections 505 and 502)
	Continued certification of training programs for alternative fuel technicians to provide broad coverage of all alternative fuels. (EPACT Section 411) (NATEF)	Close out certification of training program and transfer to private sector. (EPACT Section 411) (NATEF)	
	Continued work with electric utilities and the Infrastructure Working Council on coordinated development of electric vehicle infrastructure. (EPACT Sections 505 and 601) (INEEL)	Continue work with electric utilities from previous year. (EPACT Sections 505 and 601) (INEEL)	Continue work with electric utilities on electric vehicle infrastructure. (EPACT Sections 505 and 601) (INEEL)
	Expanded systems and safety analysis of refueling, transport, and delivery infrastructure for	In coordination with industry, further refine systems and safety analysis of refueling, transport,	Continue infrastructure systems and safety analysis from previous years, with focus on compressed

III. <u>Performance Summary</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Infrastructure, Systems, and Safety (Cont'd)	alternative fuels. (EPACT Section 502) (INEEL) ($1,605) $ 1,605	and delivery infrastructure for alternative fuels, and implement findings as appropriate. (EPACT Section 502) (INEEL) ($2,175) $ 2,175	and liquified natural gas. (EPACT Section 502) (INEEL) ($2,000) $ 2,000
EPACT Replacement Fuels Program	Utilized analytical tools to assess the EPACT replacement fuel goals and solicited public comment on programs to reach the goals. Added modeling capability for analysis of transition pathways for alternative fuels. (EPACT Section 502) (ANL, ORNL)	Using transition modeling and other analytical tools, assess progress of EPACT fleet programs in helping to reach the Act's replacement fuel goals. Develop utilization scenarios for advanced transportation technologies, such as hybrid and fuel cell vehicles, that draw upon Clean Cities experience and industry expertise. (EPACT Section 502) (ANL, ORNL, TBD)	Continue analytical and modeling work to support EPACT rulemakings. Expand scenarios to include the Partnership for a New Generation of Vehicles (PNGV) and new heavy vehicle technologies. (EPACT Section 502) (ANL, ORNL, TBD)
	Reviewed public comment on EPACT fleet programs and incorporated in a technical and policy analysis of the Act's replacement fuel goals. (EPACT Sections 506 and 507) (ORNL)	Obtain additional public comment on the potential for additional fleet programs, renewable fuels, replacement fuels, and incentive programs to meet the Act's goals and reduce vulnerability to oil price shocks. Use comments to initiate a second technical and policy analysis of the Act's goals. (EPACT Sections 506 and 507) (ORNL)	Obtain public comment on the second technical and policy analysis of the Act's replacement fuels goals and submit to the President and Congress. (EPACT Sections 506 and 507) (ORNL)

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
EPACT Replacement Fuels Program (Cont'd)	Continued implementation of the credit trading program for State and fuel provider compliance with EPACT mandates. (EPACT Sections 501, 507 and 508) (NREL, ANL, ORNL)	Continue EPACT regulatory work, initiating rulemaking on private and local fleets. (EPACT Sections 501, 507 and 508) (NREL, ANL, ORNL)	Continue regulatory work on alternative fuels and fleet programs including completion of rulemaking on private and local fleets. (EPACT Sections 501, 507, and 508) (NREL, ANL, ORNL) ($1,300)
	In cooperation with industry, developed and issued, as needed, guidance, standards, and regulations for alternative fuel composition. (EPACT Section 302) (ANL)	Complete standards work from previous year. (EPACT Section 302) (ANL)	
	Continued transportation demand management program in selected Clean Cities to develop tools and technologies to increase efficiency in the transportation sector in coordination with DOE and EPA. (EPACT Sections 502(a) and 504) ($1,475)	Transition demand management efforts to Clean Cities program. (EPACT Sections 502(a) and 504) ($1,400)	
	$ 1,475	$ 1,400	$ 1,300
Vehicle Field Test/Evaluation	Emissions testing program re-engineered to reduce emissions and performance testing on General Services Administration alternative fuel vehicles.	Focus light duty alternative fuel vehicle emissions and performance testing on small numbers of new original equipment manufacturer and qualified vehicle modifier	Continue fuel and vehicle emissions testing and coordinate with electric vehicle field test and evaluation efforts. (NREL, ANL)

III. <u>Performance Summary</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Field Test/Evaluation (Cont'd)	Expanded efforts to collect data from private fleets and developed case studies of fleet experience with alternative fuels. (NREL, ANL)	vehicles. Continue work from previous year. (NREL, ANL)	
	With modified program, initiated testing and evaluation of new electric vehicles to support commercialization in response to the requirements of EPACT. Initiated field test/evaluation of electric vehicles with first generation advanced batteries. (EPACT Sections 601 and 505) (INEEL) ($2,432)	Acquire, test, and evaluate new electric vehicles to support commercialization in response to the requirements of Executive Order 13031. Continue work from previous year. (EPACT Sections 601 and 505) (INEEL) ($2,850)	Start field testing hybrids developed under the Partnership for a New Generation of Vehicles (PNGV). Continue to acquire, test, and evaluate new electric vehicles to support commercialization in response to the requirements of Executive Order 13031. Continue work from previous year. (EPACT Sections 601 and 505) (INEEL) ($3,450)
	$ 2,432	$ 2,850	$ 3,450
Technical Information Development	Streamlined publication and distribution of the congressionally required Fuel Economy Guide. (GPO)	Continue publication of Fuel Economy Guide. (GPO)	Re-engineer the Fuel Economy Guide and develop other consumer products for Clean Cities and consumers to promote fuel efficiency, advanced technology vehicles and low greenhouse gas technologies.
	Working with stakeholders, continued to develop technical information on alternative fuels	Through EPACT information programs, provide targeted technical information products to	Continue technical information development, adding products related to near-term PNGV

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technical Information Development (Cont'd)	for various audiences. Expanded the delivery mechanisms for these products to ensure that affected audiences have access to the information. Continued to use DOE regional support offices to disseminate documents and publications. (EPACT Sections 302 and 405) (ANL, NREL, ORNL) ($2,500)	fleets and other stakeholders. Provide information over the Internet, at conferences, and through publications. Continue work from previous year. (EPACT Section 405) (ANL, NREL, ORNL) ($2,500)	technologies, including fuel cells. (EPACT Section 405) (ANL, NREL, ORNL) ($3,500)
	$ 2,500	$ 2,500	$ 3,500
Technology Deployment Total	$ 10,618	$ 11,775	$ 16,250

TRANSPORTATION TECHNOLOGIES

TRANSPORTATION SECTOR
(dollars in thousands)

ADVANCED HEAVY VEHICLE TECHNOLOGIES

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

Since the 1973 Arab oil embargo, data from the Energy Information Agency indicates that essentially all of the increase in highway fuel consumption has been due to trucks. In 1996, trucks consumed as much fuel as automobiles due to the continued growth of freight transport provided by heavy trucks and the explosive growth in the popularity of relatively low miles per gallon (mpg) light trucks such as pickups, vans, and sport utility vehicles used for personal transport. The gross domestic product, and hence economic activity, depends on the movement of goods. Truck energy use is less discretionary; trucks are the mainstay for trade/commerce and economic growth and, thus, critical to the economy.

The goal of Advanced Heavy Vehicle Technologies R&D is to develop, by 2004, the enabling technologies needed to achieve fuel-flexibility, ultra-low emissions, and 10 miles per gallon (mpg) fuel economy in Class 7-8 trucks (currently the most efficient new trucks get 7 mpg, with a fleet average of 5.3 mpg), while simultaneously devolving these technologies to pickups and sport utility vehicles (Class 1-2 trucks). These technologies will enable pickup trucks to achieve at least a 35 percent efficiency improvement relative to current gasoline-fueled trucks. The strategy is to focus R&D efforts primarily on improving the efficiency, emissions characteristics, and alternative fuel capability of the diesel cycle engine. This strategy supports the DOE strategic goals of enhanced energy productivity (Goal 1), reduced vulnerability (Goal 2), reduced environmental impacts (Goal 3), and economic/regional equity (Goal 4), through the development of energy efficient/alternative fuel capable clean diesel engine technologies.

The diesel has the highest efficiency of the commercial engines used in highway vehicles today (44 percent efficient vs. 24 percent for production gasoline engines), and can be made even more efficient (at least 55 percent) with advanced technologies. The diesel engine is the engine of choice for heavy duty trucks used for commercial transport because it offers power, efficiency, reliability, and durability. It runs on alternative fuels, e.g., natural gas, dimethyl ether, ethanol, methanol, biodiesel, and can be made fuel flexible, i.e., use more than one kind of liquid fuel in the same engine. With successful research and development, diesel engine exhaust can be cleaned up to ultra low emissions through a combination of in-cylinder combustion control, exhaust aftertreatment, and fuel formulation. Because diesel engine manufacturers have the production and nationwide field service infrastructure in place, this technology constitutes an attractive potential technology for efficiency improvements by replacing gasoline engines with "clean diesels" in the fastest growing market segment of pickup trucks and sport utility vehicles.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Continual improvement of diesel engine efficiency and fuel flexibility is a real, achievable strategy for maintaining the energy and economic security of the trucking industry. Further reducing truck energy use is perhaps most readily achievable through devolution of energy efficient, fuel-flexible, ultra low emissions heavy duty diesel engine technologies through all truck classes. For instance, annual sales of Class 1-2 trucks, essentially all of which use less efficient gasoline-fueled engines, have increased dramatically in the past 12 years, from approximately 3 million vehicles in 1983 to over 6 million vehicles in 1995 (from 25 to 42 percent of the foreign and domestic highway vehicle sales in the U.S.). The vehicle production industry is shifting substantial manufacturing emphasis to light trucks in response to the growth in demand for pickups, sport utility vehicles, and vans. The diesel engine can provide power (especially needed for four-wheel drive, hauling, and towing--popular features of pickups and sport utility vehicles) and ruggedness, in addition to higher energy efficiency. Emissions control technologies to meet increasingly more stringent environmental standards are the key enablers for greater utilization of the inherently higher efficiency diesel engine. This is the critical requirement for market entry if potential energy savings are to be realized. Advanced Heavy Vehicle Technologies program activities will continue to focus on the diesel engine in both heavy vehicle systems R&D and heavy vehicle alternative fuels R&D.

Heavy Vehicle Systems R&D activities are primarily focused on two areas: a) high efficiency engine R&D, with a specific goal to achieve 55 percent efficient diesel engines for heavy duty trucks, and an adaption of this diesel engine technology for sports utility vehicles and light trucks; and b) heavy vehicle systems technologies R&D focused on the transfer of an electric and hybrid electric vehicle program from the Defense Advanced Research Projects Agency (DARPA) to a joint DOE/Department of Transportation program, with the intent of applying electric propulsion technologies to medium and heavy trucks and buses. A second part of the systems program will continue the evaluation of the reduction of parasitic energy losses from aerodynamics, rolling resistance, and accessories in conventional on-highway large trucks.

The high efficiency light truck engine R&D program is integrated with the Partnership for a New Generation of Vehicles (PNGV) compression ignition direct injection (CIDI) diesel engine technology program. Critical enabling technology will be developed cooperatively between the U.S. diesel engine manufacturers and the U.S. automakers. These engine concepts integrate major design advances such as higher peak cylinder and fuel injection pressures, increased sophistication in microprocessor control, improved turbocharger efficiency, and the introduction of turbo compounding, in addition to a substantial effort in cost and size reduction. Diesel engine performance will be optimized, while reducing emissions to or below EPA standards, by simultaneously addressing in-cylinder combustion control, exhaust aftertreatment technologies, and fuel formulation strategies. Modeling and validation of engine combustion will continue to enable more definitive understanding of the chemical species formed in the combustion process.

Electric and hybrid electric technologies developed with DARPA funding through the Advanced Transportation Technology Consortia (ATTC) have matured to a level that requires a focus on specific applications to complete the development cycle. Many urban service vehicles, such as delivery trucks and buses, can utilize electric propulsion to achieve much higher fuel efficiency and substantially reduced emissions of criteria pollutants and greenhouse gases. These vehicles are typically operated and managed as part of fleets, both government and private. Fleet applications with the highest potential for energy and carbon savings, as well as economic success, will be used to guide the next phase of development under DOE and DOT. Test vehicles are expected to be completed and placed in the fleets for evaluation as early as 2000. The diversity and typical low manufacturing volume of service type vehicles will require

that several different applications be identified to achieve a large impact. This is compatible with the structure of the ATTC, allowing each region to independently bring value to the program.

Heavy Vehicle Alternative Fuels R&D activities focus on developing advanced enabling technologies (e.g., fuel sensors, electronic valve timing coupled with closed-loop feedback electronic control systems, lubrication requirements, etc.) necessary for the diesel engine to operate on natural gas and be fuel flexible, and to operate optimally on other alternative fuels and blends (e.g., natural gas liquids and derivatives like dimethyl ether, and renewable fuels such as ethanol derived compression ignitable fuels (e.g., diethyl ether) and biodiesel). A complementary combustion research activity focuses on alternative fuels appropriate for heavy vehicle use. Research tools developed for diesel fuel combustion R&D are applied in the investigation of the energy conversion efficiency and emissions from alternative fuels. Fuel formulation strategies focus on obtaining minimum emissions.

Responding to customer input, the Heavy Vehicle Technologies program embarked in FY 1997 on a major effort to increase the efficiency of natural gas engines from their current 37 percent level to be more nearly coincident with the current 44 percent efficiency of heavy duty diesel engines. These efforts will be maintained in FY 1999 and will contribute significantly to the economical transition to and operation of heavy duty Class 7-8 trucks on liquefied natural gas (LNG). Also in FY 1999 another research emphasis will be maintained to enhance the on-board storage of natural gas to enable the transition to and operation of Class 3-6 (local delivery) trucks on compressed natural gas (CNG). Trucks operating on such a clean fuel as natural gas in downtown non-attainment areas will make a substantial contribution to reducing the vehicular pollution burden in these areas.

For FY 1999, program integration and collaborative research leveraging efforts begun in FY 1997 with the DOE Office of Energy Research (ER) and the Office of Fossil Energy (FE) will be expanded and solidified. The Heavy Vehicle Technologies program was awarded support by ER for two collaborative pilot projects focused on diesel engine emissions control research. Dubbed "DOE 2000," the ER initiative is funding the development and emplacement of the high speed information network to enable geographically distributed researchers to collaborate in the areas of diesel combustion and catalytic aftertreatment of diesel exhaust. The Heavy Vehicle Technologies program is supporting both scientific combustion studies and extensive diesel engine testing of compression ignitable clean diesel fuels coming from the research efforts of FE's Advanced Fuels Conversion and Liquefaction Programs. The Heavy Vehicle Technologies Program is supporting research at the High Temperature Materials Laboratory (HTML) to characterize catalysts needed by these programs to advance these fuels processing technologies to commercial reality. Characterization of carbon produced materials from coal will also be maintained in support of FE.

The Heavy Vehicle Systems R&D program efforts in the high efficiency large diesel engine projects will continue to be coordinated with the Heavy Vehicle Alternative Fuels R&D program, to accelerate the usage of alternative fuels in the largest truck classes. The track record of the high efficiency engine program for improving the state of the art is reflected in the improved efficiency of current production engines--a success story brought about through industry/government cooperation. The advancements in alternative fuel enabling technologies developed under the Heavy Vehicle Alternative Fuels R&D program have proven that fuels, such as natural gas, its derivatives and biodiesel are technically viable and have major benefits. The combination of the two programs will encourage the U.S. diesel industry to offer efficient natural gas and flexible fuel technologies in mainstream production engines.

I. **Mission Supporting Goals and Objectives**: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Program planning for the Advanced Heavy Vehicle Technologies program has been conducted in collaboration with stakeholders in the trucking industry diesel engine manufacturers, natural gas industry, automakers' truck divisions and fuels producers. The first of several industry/government workshops provided customer input from heavy duty diesel engine manufacturers, truck manufacturers and their association, and truck users. The workshop itself was co-sponsored by the Truck and Bus Division of the Society for Automotive Engineers. Other workshops have addressed other areas of opportunity for technical collaboration to achieve increased energy efficiency in the heavy vehicle portion of the transportation sector.

I. B. Program Benefits

Metric*	2000	2010	2020
Primary Energy Displaced (Quads)	0.01	0.32	0.61
Primary Oil Displaced (million barrels per day)	.005	0.15	0.29
Energy Cost Savings ($ billion)	.07	3.00	5.46
Carbon Reductions (million metric tons)	.18	5.89	11.34

*Includes benefits for heavy vehicle propulsion materials.

I. C. Performance Measures

Heavy Vehicle Systems R&D:
Strategy/Goal: Focus on the diesel engine. By 2004, in partnership with the diesel engine manufacturers, truck manufacturers, and their suppliers, develop technologies for enabling fuel flexibility and heavy duty truck fuel economy to increase to 10 mpg from the current average of 7 mpg, with simultaneous devolution of these technologies to the mid-range (Class 3-6) and Class 1-2 trucks, achieving at least 35 percent efficiency improvement over gasoline-fueled trucks.

FY 1997 Accomplishments

-- Demonstrated multi-cylinder engine concepts with teams led by engine manufacturers that achieve 50 percent efficiency while reducing emissions to 3.0 grams/brake horsepower-hour (g/bhp-hr) for nitrogen oxides ($NO_{x)}$ and 0.5 g/bhp-hr for particulates.

-- Achieved 60 percent NO_x and particulate reduction in diesel engine exhaust by using a non-thermal plasma device, with a 5 percent fuel penalty, in a collaborative program with California's South Coast Air Quality Management District.

-- Undertook testing of microwave regenerated particulate trap with 90 percent trapping efficiency of even small particulates (2.5 microns in diameter).

I. Mission Supporting Goals and Objectives: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

FY 1998 Planned Accomplishments

-- Conduct laboratory experiments to achieve a 69 percent efficiency in a turbocharger for diesel engines; integrate with multi-cylinder engine design.

-- Achieve a simultaneous 80 percent reduction in diesel engine NO_x and particulate emissions using a non-thermal plasma device, with less than 5 percent fuel penalty.

-- Complete initial performance specifications of critical enabling technologies, as well as cost goals, for the high efficiency diesel engine to replace the lower efficiency spark ignition gasoline engine for light truck applications (sport utility vehicles, vans, pickup trucks).

-- Undertake design and cycle analysis of the diesel engine concept for light trucks. Initiate single-cylinder engine fabrication.

-- Conduct a series of experiments to better understand the diesel engine combustion process. Investigate in-cylinder strategies that will yield improvements in engine efficiency. Determine the mechanisms which lead to the formation of NO_x and particulate emissions.

-- Establish joint EE/ER "collaboratory" R&D efforts in combustion, catalysis, and fuel chemistry to optimize the energy conversion efficiency of the diesel engine.

FY 1999 Planned Accomplishments

-- Demonstrate advanced concepts that lead to at least 40-45 percent thermal efficiency in multi-cylinder diesel engines for light trucks, while substantially reducing NO_x and particulates.

-- Complete development of a prototype non-thermal plasma device for simultaneous 80 percent reduction of NO_x and particulates. Initiate field test of prototype.

-- Within the EE/ER "collaboratory" efforts, complete establishment of a combustion component team of researchers needed to develop the knowledge base to achieve near-zero emission levels from a high efficiency diesel engine.

-- Validate with experimental data that the combustion computer model accurately simulates fuel injection, combustion, and emissions formation processes.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

<u>FY 2000-FY 2004 Planned Accomplishments</u>

-- Complete the development of enabling technologies for clean diesel engines to be used in light trucks.

-- Make available to the industry a predictive computer modeling tool that will drastically shorten the process of designing cleaner diesel engines.

Heavy Vehicle Alternative Fuels R&D:

Strategy/Goal: By 2004, in partnership with the diesel engine manufacturers, alternative fuel developers and producers, truck manufacturers, and their suppliers, develop the technologies for enabling clean and efficient natural gas utilization and liquid fuel flexibility using non-petroleum fuels in diesel engines, while maintaining the efficiency and emissions at levels comparable to, or better than, those achievable with petroleum-based diesel fuel.

<u>FY 1997 Accomplishments</u>

-- Achieved reliable compression ignition (i.e., without glow plugs) in a heavy duty, high efficiency, direct injected natural gas diesel engine.

-- Continued on-road development of liquefied natural gas (LNG) engine/vehicle systems utilizing the West Virginia University (WVU) chassis dynamometer for evaluation.

-- Completed evaluation of heavy vehicle contributions to urban airshed inventories.

-- Designed and burst tested, at 8,800 pounds/square inch, a carbon composite conformable shaped compressed natural gas tank with 40 percent more fuel volume than currently used cylindrical tanks.

-- Began development of next generation natural gas engine aimed at solving the part load and lean limit operation efficiency and emissions problems of current technology.

<u>FY 1998 Planned Accomplishments</u>

-- Conduct on-road testing of heavy duty engines using direct injected natural gas, pilot ignition natural gas, and dimethyl ether.

-- Continue development of next generation natural gas engine with the goal of achieving 55 percent efficiency.

-- Complete development of technical methods for assessing impacts of heavy vehicles on air quality.

I. <u>Mission Supporting Goals and Objectives</u>: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

-- Perform proof-of-concept burst tests on medium pressure liquefied natural gas conformable tanks and complete certification tests (based on the Department of Transportation's (DOT's) certification criteria) on high pressure compressed natural gas conformable tanks having cost and weight advantages over currently used tanks.

-- Evaluate the combustion initiation and propagation of low-cetane number fuels.

-- Initiate an EE/ER collaboratory on non-thermal/plasma assisted catalysts.

-- Undertake design of full-up heavy duty diesel engine concepts (e.g., variable valve timing technology) for liquid fuel-flexible operation (e.g., ethanol, methanol, dimethyl ether, biodiesel).

-- Evaluate the direct fuel injection characteristics of alternative fuels and their effects on combustion and emissions.

<u>FY 1999 Planned Accomplishments</u>

-- Complete build of single-cylinder proof-of-concept fuel-flexible low emission 55 percent efficient engine.

-- Complete input database files for air quality modeling of heavy vehicles using alternative fuels in urban centers.

-- Test proof-of-concept next generation natural gas engines to demonstrate optimum efficiency level.

-- Develop advanced liquefied natural gas storage systems for heavy vehicles that reduce life-cycle costs by 25 percent, achieve a ten-fold reduction in fuel boil-off rate, and conserve 5 percent of the fuel value.

-- Continue evaluation of direct fuel injection characteristics of alternative fuels and their effects on combustion and emissions.

-- Investigate the combustion characteristics of alternative fuels in an optically accessible diesel engine.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Publish a comprehensive report on the emissions, performance, and durability of alternative fuels, including natural gas, natural gas derivatives, alcohol, and biomass derived fuels in Class 3-8 trucks.

-- Devolve alternative fuel technologies developed for Class 3-8 trucks into light truck/sport utility vehicles.

II. A. Funding Table: ADVANCED HEAVY VEHICLE TECHNOLOGIES

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Heavy Vehicle Systems R&D	$ 6,970	$ 12,900	$ 33,200	$ 20,300	157%
Heavy Vehicle Alternative Fuels R&D	12,159	12,700	11,000	-1,700	-13%
Total, Advanced Heavy Vehicle Technologies	$ 19,129	$ 25,600	$ 44,200	$ 18,600	73%

II. B. Laboratory and Facility Funding Table: ADVANCED HEAVY VEHICLE TECHNOLOGIES

Argonne National Lab (East)	$ 609	$ 820	$ 1,500	$ 680	83%
Brookhaven National Lab	1,400	2,000	3,000	1,000	50%
Idaho National Engineering and Environmental Lab.	100	0	0	0	0%
Los Alamos National Laboratory	45	165	650	485	294%
National Renewable Energy Lab	5,082	6,070	12,000	5,930	98%
Oak Ridge National Lab	2,780	2,840	4,000	1,160	41%
Sandia National Laboratories	1,575	825	1,500	675	82%
All Other	7,538	12,880	21,550	8,670	67%
Total, Advanced Heavy Vehicle Technologies	$ 19,129	$ 25,600	$ 44,200	$ 18,600	73%

III. <u>Performance Summary</u>: ADVANCED HEAVY VEHICLE TECHNOLOGIES

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Systems R&D	HIGH EFFICIENCY ENGINE R&D: In order to enable major fuel use reductions in essential truck transportation, while also meeting more stringent emission standards, continued research and development of broadly applicable low emission (LE)-55 engine concepts with teams led by engine manufacturers. Tested LE-55 concepts in multi-cylinder engine configurations. Concepts included components and designs to increase engine mean effective pressure, reduce friction, and recover exhaust energy. Developed and integrated advanced control systems, 70% efficient turbochargers, ring/piston design, sensors, lubricants, turbo compounding, engine thermal management, and application of advanced materials. Continued evaluation and development of innovative exhaust energy recovery technologies. Continued investigating efficiency and emissions at ultra-high combustion pressures. Continued research and development (on heavy vehicles)	HIGH EFFICIENCY ENGINE R&D: Implement initial stages of a planned program to devolve the technologies under development in the LE-55 heavy duty engine program to diesel engines of the size and duty cycle appropriate for light trucks (100-275 horsepower). Complete the first phase of a 50% cost-shared program that will define the critical path to achieving a 35% fuel efficiency improvement in light trucks. The second phase will include development of critical technologies to increase engine mean effective pressure, reduce friction, and improve exhaust energy utilization. Identify technologies needed to meet the additional challenge of meeting more stringent performance and emissions standards for vehicles under 8,500 pounds gross vehicle weight rating.	HIGH EFFICIENCY ENGINE R&D: Continue program of diesel engine R&D for light trucks, pickups, vans, and sport utility vehicles. Using competitive industry teams led by domestic diesel engine manufacturers and U.S. auto manufacturers, the program goal is to achieve at least a 35% fuel efficiency improvement in light trucks, with very low emissions. Maintain at least a 50% cost share on the part of industry. Include technologies that will enable the high efficiency diesel engine to meet market and regulatory demands for performance, noise, cost, and emissions. Specific technologies may include: components to increase engine mean effective pressure, reduce friction, and improve exhaust energy utilization; advanced control systems; fuel injection equipment; high efficiency turbochargers; ring/piston designs; sensors; lubricants; engine thermal management; and utilization of advanced materials (including lightweight components).

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Systems R&D (Cont'd)	of the most promising emission reduction technologies. Carried out scale-up and prototype testing of catalytic exhaust converters for nitrogen oxides (NOx), advanced particulate trap concepts with microwave regeneration, and fuel modifications. Accelerated full system tests, integrating necessary sensors for control, and hydrocarbon injection systems for NOx and particulate matter reduction. Continued projects to reduce engine emissions through combustion optimization using modeling and engine validation. Developed integrated engine/ aftertreatment systems targeted toward Environmental Protection Agency (EPA)/California Air Resources Board (CARB) 2004 emissions standards. Continued iterative chemical reformulation of the Texaco NOx reduction fuel additive and its evaluation in an expanded set of engines. Coordinated with advanced automotive piston engine R&D activities.	Support an industry-wide cooperative effort between the major U.S. vehicle manufacturers and the U.S. diesel engine manufacturers. In partnership, investigate efficiency and emissions at ultra-high combustion pressures, using facilities at the national laboratories and universities. Perform fundamental combustion research by utilizing laser diagnostic and computer modeling techniques. Investigate the formation of oxides of nitrogen and particulates in the combustion chamber of diesel and alternative fuel engines, and how they are affected by such parameters as fuel injection, combustion chamber geometry, temperature and density.	Continue to support base technology research and development for the diesel engine with the U.S. diesel engine manufacturers, the U.S. vehicle manufacturers, the U.S. EPA, and the U.S. Army. Focus base technology R&D on combustion optimization and exhaust aftertreatment research. Perform combustion optimization research in an optically accessible diesel engine and an ultra high pressure combustion vessel, using laser diagnostics and high speed photography. Use experimental data in the development of computer models to simulate the diesel combustion process. The Office of Energy Research will enhance this research effort by funding the DOE 2000 Diesel Combustion Collaboratory Pilot Project. Focus exhaust aftertreatment projects on the treatment of nitrogen oxides and particulates that remain in the exhaust stream after the in-cylinder combustion event. In cooperation with the Advanced Automotive Technologies program, explore

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Systems R&D (Cont'd)			several options, including a catalyst, non-thermal plasma, and combinations of the two together with particulate and NOx traps.
	(ORNL, SNL, NREL, Caterpillar, Cummins, DDC, HiZ, Texaco, Univ. of Wisconsin) ($6,970)	(ORNL, SNL, Univ. of Wisconsin, LANL, diesel industry, Univ. of Illinois, other universities, Texaco, NOxTech) ($11,200)	(SNL, LANL, ORNL, diesel industry, auto industry, Univ. of Wisconsin, other universities) ($22,200)
	HEAVY VEHICLE SYSTEMS TECHNOLOGIES: Evaluated heavy vehicle systems to identify opportunities for improvement of vehicle efficiency in the areas of aerodynamics, rolling resistance, and accessory systems (e.g., air conditioning loads and braking systems).	HEAVY VEHICLE SYSTEMS TECHNOLOGIES: Delineate potential cost-effective methodologies to reduce parasitic energy losses endemic in the operation of heavy vehicles. Further evaluate the effects of proposed energy saving approaches in the areas of aerodynamics, rolling resistance, and auxiliary systems.	HEAVY VEHICLE SYSTEMS TECHNOLOGIES: Parasitic energy consumption arising from aerodynamic drag, rolling resistance, and auxiliary on-board systems accounts for 52%, 28%, and 20%, respectively, of the non-engine energy losses in heavy vehicle operations. Develop, with trucking industry participation, comprehensive multi-year program plans (MYPPs) that will address potentially effective methodologies to reduce parasitic energy losses, and will provide a prioritized, focused R&D agenda to develop cost effective, energy efficient heavy vehicle systems designs. Total near-term increases in energy efficiency of heavy vehicles is estimated to be
	Evaluated enhanced sensoring requirements, weight savings, safety needs and operational characteristics of advanced fuel handling and fuel storage systems for heavy commercial vehicles. Evaluated prototype/advanced/emerging technologies for transit, intercity,	Employing a fully integrated systems approach, further develop sensoring, weight reduction, safety and operational characteristics of fuel systems for heavy commercial and multi-purpose vehicles. Apply systems integration analysis to increase the energy efficiency, safety, and cost effectiveness of	

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Systems R&D (Cont'd)	and school bus vehicles. (In-house) ($0)	transit, intercity, and school bus vehicles. (ANL, MIT, WVU, AAR, TBD) ($1,700)	in excess of 10% across the fleet, with concomitant reduction in greenhouse gases and other emissions of concern. Assemble teams with the appropriate skill mixes to expand research and developmental efforts in the three top areas identified in the MYPPs. Assess this fully integrated systems engineering approach, developed for the analysis and amelioration of parasitic energy losses in heavy duty trucks, for broader application to transit, intercity, and school buses. (ANL, MIT, WVU, AAR, TBD) ($1,000)
	No Activities. ($0)	No Activities. ($0)	ADVANCED TRANSPORTATION TECHNOLOGY CONSORTIA: Transition the Advanced Transportation Technology Consortia (ATTC) program from the Defense Advanced Research Projects Agency (DARPA) to an equally funded, 50% industry cost shared, Department of Energy/Department of Transportation program focusing on truck applications. Through this combined program, complete the development of electric and

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Systems R&D (Cont'd)			hybrid propulsion technologies, directed at civilian applications such as trucks and buses, that was initiated by DARPA through seven regional consortia consisting of small and large businesses and State and local governments. Dedicated to the challenge of bringing electric-based propulsion, and other high efficiency technologies, to commercial and public transportation, the Consortia offer a means to team local manufacturers with vehicle users, such as transit districts, to seed a demand for the advanced technology in a highly segmented transportation sector. Focusing the program on applications identified in this manner will result in several parallel regional projects. This effort is closely integrated and coordinated with the Advanced Automotive Technologies program. ($10,000)
	$ 6,970	$ 12,900	$ 33,200

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Alternative Fuels R&D	Enabling Technology: Completed evaluation and demonstration of compressed natural gas (CNG) storage system in three prototype vehicles. Initiated development of three medium duty (urban delivery trucks, for example) engines for alternative fuel operation. Initiated fundamental combustion studies to explore the mechanisms of nitrogen oxides (NOx) formation in biodiesel and natural gas combustion. Demonstrated the operation of a heavy duty diesel engine using direct injected natural gas. Demonstrated the operation of a heavy duty diesel engine on dimethyl ether (DME). Developed liquefied natural gas (LNG) storage systems to be compatible with advanced engines. Applied modeling results to the database for environmental impacts of alternative fuels in non-attainment areas. Completed quantitative measurements of volatile organic compounds emitted from advanced alternative fueled vehicles. Completed cost-shared program with the Coordinating Research Council to co-fund	Enabling Technology: Continue fundamental combustion studies and expand the scope to include diesel/alternative fuel blends. Conduct combustion research on alternative fuel blends, including DME and Fisher Tropsch diesel from natural gas. Utilize the capabilities of the DOE 2000 supercomputer, developed by Defense Programs, to model and develop the relationships among fuel formulation, in-cylinder combustion, and exhaust after treatment. Design and begin development of a three-way catalyst for heavy duty natural gas engines. Evaluate advanced NOx control technologies to control emissions of diesel/alternative fuel blends. Identify heavy vehicle emissions inventory and composition of heavy vehicle volatile organic compound (VOC) emissions from alternative and conventional diesel fuels. Identify and conduct additional cost-shared research in cooperation with the Coordinating Research Council, to extend the previous light duty vehicle emissions impacts to heavy vehicles. Conduct preliminary	Enabling Technology: With industrial partners, continue fundamental combustion studies on alternative fuel/diesel fuel blends, to determine their effects on NOx and particulate emissions formation in a diesel engine. Perform experimental combustion research in an optically accessible engine with alternative fuel blends, including DME and Fisher Tropsch diesel provided by the Office of Fossil Energy; examine fuel injection spray characteristics and study formation of NOx and soot. Develop chemical kinetic models to simulate the combustion of alternative fuel/diesel fuel blends in a diesel engine. Continue development of a three-way catalyst to reduce NOx in the exhaust stream of natural gas fueled engines. Evaluate projected heavy vehicle emissions inventories for NOx, volatile organic compounds, toxics, and particulates. Using modeling and other techniques, examine the potential future atmospheric impacts on urban air quality and climate change from heavy vehicle emissions. Continue

III. <u>Performance Summary</u>: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Alternative Fuels R&D (Cont'd)	additional projects that match DOE goals of identifying relative alternative fuel impacts on air quality. Conducted research on health issues associated with new engine technologies.	urban airshed modeling emphasizing the relative impacts of heavy vehicles operating on alternative fuels and fuel blends compared to petroleum-based diesel. Conduct cooperative program with the Office of Energy Research to evaluate the health impacts of diesel engine particulates from alternative fuels and alternative fuel blends.	cost-shared research with the Coordinating Research Council, California Air Resources Board, and other organizations on studies of mutual interest. Continue a cooperative program with the Office of Energy Research to evaluate the health impacts of diesel engine particulates from alternative fuel blends. Examine the chemical interactions between ozone and particulates in urban atmospheres.
	Engine R&D: Initiated an effort in partnership with the Gas Research Institute, California's South Coast Air Quality Management District, and the Trucking Research Institute in support of a natural gas enhanced engine efficiency program. Evaluated three ignition assist concepts in support of direct injection diesel cycle operation on natural gas. Completed a proof-of-concept testing of common rail fuel injection system for DME fuel.	Engine R&D: Award contracts to kickoff the natural gas enhanced engine efficiency program. Continue development of advanced natural gas engines with the goal of raising efficiency levels to that of their petroleum-based diesel fueled counterparts. Integrate the flexible fuel engine concept with the low emission (LE)-55 engine family, incorporating its efficiency and emissions goals. Study the capability of advanced technologies, including variable valve timing, to expand the fuel tolerance of the diesel engine and enable greater fuel flexibility. Perform reliability assessment	Engine R&D: Continue the natural gas enhanced engine efficiency program with the goal of reaching the technology targets of the LE-55 engine. Continue development of LE-55 engine technology to enable this concept to be fuel flexible on liquid alternative fuels and blends. Conduct round robin emissions, performance, and durability testing of the best available engine technologies operating on alternative fuel/diesel fuel blends. Complete phase three, on-road test, of conformable natural gas tank. Conduct research activities aimed at developing natural gas tank technologies that fully

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Alternative Fuels R&D (Cont'd)		studies for heavy vehicles on the components comprising liquefied natural gas (LNG) storage. Continue development and testing of advanced LNG storage systems for heavy vehicles. Complete certification testing of conformable-shaped CNG tanks and burst test low pressure tanks, thus completing phase two and allowing on-road testing to begin.	integrate the fuel dispenser, the tank, and the engine system. Develop smart sensor technology to enable the monitoring of natural gas tank structural integrity on a continuous basis, utilizing technology developed for the Department of Defense in the DOE Defense Program. Continue development of advanced LNG storage and fuel delivery systems to support direct injected natural gas engine technology. Develop technology to support compressor development for adsorbent natural gas storage. Conduct research aimed at developing a high efficiency, small-scale natural gas compressor/fuel delivery system. Cost share effort with the Office of Fossil Energy to support the La Porte facility in tailoring fuel quality of DME and Fisher Tropsch diesel toward the LE-55 fuel requirements.
	Advanced Development: Tested 150 heavy duty trucks and buses with the West Virginia University (WVU) transportable chassis dynamometer. Used the capability of this equipment to	Advanced Development: Continue advanced development of alternative fueled engine/vehicle systems, with the goal of bringing newly developed natural gas and propane	Advanced Development: Continue activities with West Virginia University and the Trucking Research Institute to support the advanced development of heavy duty

III. Performance Summary: ADVANCED HEAVY VEHICLE TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Alternative Fuels R&D (Cont'd)	perform iterative testing and advanced development of vehicle engine systems operating on natural gas. Prepared case study on medium duty alternative fuel demonstration vehicles.	technologies to production-ready status. Continue the operation of the West Virginia University Transportable Chassis Dynamometer, utilizing its capabilities as a developmental tool.	alternative fuel technologies.
	(NREL, ORNL, ANL, BDM, WVU, SwRI) ($12,159)	(NREL, SNL, ORNL, BNL, ANL, Caterpillar, Detroit Diesel Corp., WVU, SwRI) ($12,700)	(NREL, PNNL, SNL, ORNL, BNL, ANL, Caterpillar, Detroit Diesel Corp., WVU, SwRI) ($11,000)
	$12,159	$ 12,700	$ 11,000
Advanced Heavy Vehicle Technologies Total	$ 19,129	$ 25,600	$ 44,200

TRANSPORTATION TECHNOLOGIES

TRANSPORTATION SECTOR
(dollars in thousands)

TRANSPORTATION MATERIALS TECHNOLOGIES

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

Timely availability of new materials and materials manufacturing technologies is critical for the development and engineering of advanced transportation vehicles. The materials R&D required for transportation vehicles falls into three categories: (1) Automotive Materials Technology, (2) Heavy Vehicle Materials Technology, and (3) the High Temperature Materials Laboratory. An important element of the Transportation Materials Technologies program is the partnership between Federal government laboratories and U.S. industry, which ensures that the R&D is relevant and that Federal research dollars are highly leveraged.

The Automotive Materials Technology program develops: (a) propulsion system materials to enable advanced propulsion systems for hybrid vehicles, and (b) lightweight vehicle materials to reduce weight and thereby decrease fuel consumption and carbon emissions. The program's objective is to develop advanced materials with the required properties, and the processes needed to produce them at the costs and volumes required by the automotive producers. Improved materials and processes for advanced engine, fuel cell, and electrical powertrain components are critical to attaining target efficiencies and automotive costs. Improved materials for body, chassis, and powertrain are critical to attaining the challenging performance and fuel economy goals for advanced automotive vehicles. By 2004, as part of the Partnership for a New Generation of Vehicles (PNGV) initiative, advanced automotive materials technology should be available which will ensure that the weight of light duty vehicles can be reduced by 40 percent compared to the 1994 PNGV baseline and that the powertrain can achieve energy conversion efficiencies sufficient to meet the 80 miles per gallon target.

The Heavy Vehicle Materials Technology program focuses on two areas: (a) heavy vehicle propulsion, and (b) high strength weight reduction materials. In collaboration with U.S. industry and universities, heavy vehicle propulsion system materials efforts focus on the materials technologies critical to the development of diesel engines for light trucks, vans, and sport utility vehicles, as well as the low emissions, 55 percent efficient (LE-55) heavy duty diesel engine for heavy trucks. These include thick thermal barrier coatings and insulating structural ceramics, advanced fuel system materials, materials for nitrogen oxides (NOx) and particulate reduction, advanced air handling materials, and smart materials (i.e., materials that can change their properties as a function of how they are used) for fuel injection systems. The design of advanced components for high efficiency diesel engines has, in some cases, pushed the performance envelope for materials of construction past the point of reliable operation. Higher mechanical and surface stresses and higher temperatures of advanced designs limit the engine designer; advanced materials allow the design of components that may operate reliably at higher stresses and temperatures, thus enabling more efficient engine designs. Advanced materials also offer the

opportunity to improve the emissions; noise, vibration, and harshness (NVH); and performance of diesel engines for pickup trucks, vans, and sport utility vehicles. In the area of high strength weight reduction materials, energy savings from commercial trucking is possible with high strength materials which can reduce the vehicle weight within the existing envelope, so as to increase payload capacity, and thereby reduce the number of trucks needed on the highways. Increased safety can be obtained from new brake materials and by incorporating high shock absorbent materials in truck structures for improved control and crashworthiness.

The High Temperature Materials Laboratory (HTML), at the Oak Ridge National Laboratory, is a modern research facility that houses in its six user centers a unique collection of instruments for characterizing materials. It supports a wide variety of high temperature ceramics and metals R&D. The HTML enables scientists and engineers to solve materials problems that limit the efficiency and reliability of advanced energy conversion systems by providing access to sophisticated state-of-the-art equipment which few individual companies and institutions can afford to purchase and maintain.

I. B. Program Benefits

Metric	2000	2010	2020
Primary Energy Displaced (Quads)			
Primary Oil Displaced (million barrels per day)	Benefits for Transportation Materials Technologies are included in the benefits for Advanced Automotive Technologies and Advanced Heavy Vehicle Technologies		
Energy Cost Savings ($ billion)			
Carbon Reductions (million metric tons)			

I. C. Performance Measures

Automotive Materials Technology:

Strategy/Goal: By 2004, in partnership with U.S. automotive manufacturers and suppliers, enhance the materials technology base available to ground transportation vehicle manufacturers to enable high efficiency advanced propulsion systems and a weight reduction of 40 percent in automobiles, compared to a 1995 baseline.

I. Mission Supporting Goals and Objectives: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

FY 1997 Accomplishments

-- Developed an aluminum alloy which requires no heat treatment, with cost equivalent to or less than currently used grades of aluminum sheet.

-- Improved reliability of small, lightweight metal castings by 10 percent and reduced the rejection rate by more than 25 percent.

-- Demonstrated scale-up production of ceramic gas turbine nozzles at 200 parts/month, with greater than 50 percent total process yield.

-- Demonstrated preform processing for rapid preforming of glass fiber reinforced composites.

-- Initiated R&D for improved, low cost, lightweight bipolar plate material, coordinating efforts with fuel cell components R&D under Advanced Automotive Technologies.

FY 1998 Planned Accomplishments

-- Perform prototype testing of lightweight vehicle components with a production cost of 1.1 times the cost of conventional materials.

-- Identify R&D for low cost production of lower weight magnesium components for chassis applications, thus increasing the amount of magnesium in cars by 50 percent.

-- Identify key material properties and processing improvements for advanced power electronic materials for hybrid vehicle applications, coordinating activities with Advanced Power Electronics program under Advanced Automotive Technologies.

-- Validate 50 percent lower cost aluminum sheet processing technology, as compared to cost of ingot-to-sheet technology.

-- Conclude R&D on automotive gas turbine ceramics, and transition program to support the remaining 80 mpg propulsion system candidates.

FY 1999 Planned Accomplishments

-- Produce prototype carbon fiber reinforced polymer composites for body panel applications using carbon fiber reduced in cost by 80 percent.

I. <u>Mission Supporting Goals and Objectives</u>: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

-- Initiate R&D on methods for low cost production of titanium, to increase its use in chassis and powertrain components by 50 percent.

-- Demonstrate low cost casting methods to produce structural light metal castings for automotive applications.

-- Validate, by manufacturing demonstrations and modeling, cost competitive processing of advanced compression ignition direct injection (CIDI) and fuel cell propulsion system materials and components, in conjunction with Advanced Automotive Technologies programs.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Develop low cost advanced materials and novel methods of processing to meet the design requirements of high efficiency advanced heat engines.

-- Fabricate a prototype large automotive structure using carbon fiber reinforced polymer composites, with realistic cycle times and realistic system costs, and perform barrier testing to assess its energy absorption characteristics.

Heavy Vehicle Materials Technology:

Strategy/Goal: Focus on the diesel engine. In partnership with the diesel engine manufacturers, truck manufacturers, and their material and component suppliers, develop cost effective material technologies for enabling fuel flexibility and heavy vehicle fuel economy.

<u>FY 1997 Accomplishments</u>

-- Demonstrated a ten-times reduction in cost, and improvement in quality, of diesel engine ceramic components such as valves, fuel injector plungers, and turbocharger rotors.

-- Sintered 1,000 silicon nitride engine valves in a continuous furnace, and finished five sets for in-service heavy duty engine testing.

-- Proceeded to optimize the forming process (e.g., casting and aggregate squeeze casting) for high strength lightweight materials for heavy vehicles.

I. <u>Mission Supporting Goals and Objectives</u>: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

<u>FY 1998 Planned Accomplishments</u>

-- Complete zirconia-ceramic materials and precision manufacturing development for high pressure/rate-shaping fuel injector components.

-- Complete 500-hour thermal fatigue rig durability testing of thick thermal barrier coatings for piston-crown insulation.

-- Reduce heavy vehicle weight by 1,250 lbs. through substitutions with high strength lightweight materials.

-- Develop a multi-year program plan for the development of lightweight rigid structures for pickups, vans, and sport utility vehicles, as well as the larger Class 7-8 over-the-road trucks, through the Northwest Alliance for Transportation Technologies (NATT).

<u>FY 1999 Planned Accomplishments</u>

-- Develop technologies to manufacture thick thermal barrier coated pistons for the 55 percent efficient (LE-55) engine with an incremental cost increase acceptable to the customer; demonstrate over 2,000 hours durability.

-- Demonstrate a reliable and commercially viable cylinder head insert for the advanced LE-55 engine, made from a suitable ceramic (zirconia toughened mullite) using innovative composite and sintering processes.

-- Develop new catalyst systems which include plasma assisted catalysis, and determine if microwave systems coupled with catalysts can reduce the activation energy required for NOx catalysts.

-- Develop material systems that increase turbocharger design flexibility and improve variable geometry turbocharging. Demonstrate cost effective and reliable shaft attachments for titanium aluminide (TiAl) rotors, as well as reliable and durable variable geometry actuation methods.

-- Complete system development of fuel injection systems actuated by "smart" material systems, including electro-hydro-mechanical modeling, combustion optimization, and materials selection.

-- Complete development of the process for casting ultra large vehicular components; cast prototypes for laboratory testing and evaluation by original equipment manufacturers (OEMs); field test qualified components under service conditions.

-- Extend the successful development of metal compression forming for solid solution and precipitation hardenable aluminum alloys to metal matrix composites and magnesium alloys. Produce prototype components for testing and evaluation by OEMs.

I. <u>Mission Supporting Goals and Objectives</u>: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

-- Complete the characterization of coal-derived carbon fibers for weight reduction applications in heavy vehicles.

-- Reduce heavy vehicle weight by an additional 750 lbs. through substitutions with high strength lightweight materials, for a total vehicular weight reduction of 2,000 lbs.

-- Implement a planned program through the Northwest Alliance for Transportation Technologies (NATT) to reduce the weight of heavy trucks and pickups, vans, and sport utility vehicles.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Complete the several cooperative agreements with the three major U.S. diesel engine manufacturers and their suppliers, to develop enabling materials technology for low emissions, higher efficiency diesel engines. Complete engine evaluations of components which have potential for introduction into diesel engines.

-- In conjunction with the heavy vehicle industry, define and test the design, methodological, materials, process, and forming approaches required to cost effectively achieve further total heavy vehicle weight reduction of 5,000 pounds; validate the maintenance of safety and vehicular performance requirements in all applicable truck classifications.

-- Optimize and implement the successful approaches, in discrete stages, to achieve the ultimate total vehicular weight reduction of 5,000 pounds in the Class 7-8 truck classifications, and of realistic appropriate weight reductions in the intermediate truck classifications.

High Temperature Materials Laboratory (HTML):

Strategy/Goal: Support industry, government, and university efforts in high temperature materials research through a state-of-art research facility and user centers.

<u>FY 1997 Accomplishments</u>

-- Increased from 3 to 10 the number of industrial users in the residual stress user center funded jointly between DOE's Offices of Energy Efficiency and Renewable Energy and Energy Research.

-- Implemented country-wide remote access to HTML equipment for users via the Internet.

I. Mission Supporting Goals and Objectives: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

FY 1998 Planned Accomplishments

-- Establish facilities for evaluating material performance under high thermal gradients, including thermal shock and cyclic oxidation of thermal barrier coatings.

-- Add radiography, tomography, and temperature measurement inside running engines to neutron-based characterization capabilities.

FY 1999 Planned Accomplishments

-- As part of DOE 2000, provide neutron instruments for user residual-stress measurements, at the High Flux Isotope Reactor, on the remote access network.

-- Expand capability for x-ray stress measurement on curved surfaces by use of parallel beam optics.

-- Demonstrate an intelligent grinding process for ceramic engine components, and demonstrate manufacturing of products such as engine valves and fuel injector components.

II. A. Funding Table: TRANSPORTATION MATERIALS TECHNOLOGIES

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Automotive Materials Technology	$ 19,997	$ 21,750	$ 19,000	$ -2,750	-13%
Heavy Vehicle Materials Technology	7,702	8,050	7,300	-750	-9%
High Temperature Materials Laboratory ...	4,557	5,200	5,500	300	6%
Total, Transportation Materials Technologies	$ 32,256	$ 35,000	$ 31,800	$ -3,200	-9%

II. B. <u>Laboratory and Facility Funding Table</u>: TRANSPORTATION MATERIALS TECHNOLOGIES

	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Ames Lab	$ 150	$ 65	$ 65	$ 0	0%
Argonne National Lab (East)	1131	380	744	364	96%
Idaho National Engineering and Environmental Lab	1,498	700	2,000	1,300	186%
Lawrence Livermore National Lab	886	1,000	1,000	0	0%
Los Alamos National Laboratory	665	1,005	805	-200	-20%
National Renewable Energy Lab	21	0	0	0	0%
Oak Ridge National Lab	18,625	22,683	21,743	-940	-4%
Pacific Northwest National Lab	3,750	2,205	1,205	-1,000	-45%
Sandia National Laboratories	1,205	650	650	0	0%
All Other	4,325	6,312	3,588	-2,724	-43%
Total, Transportation Materials Technologies	$ 32,256	$ 35,000	$ 31,800	$ -3,200	-9%

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES

Activity	FY 1997	FY 1998	FY 1999
Automotive Materials Technology	PROPULSION MATERIALS: Continued the development of advanced materials and analytical design tools, along with associated manufacturing technologies needed to enable achieving the goal of significantly increasing the fuel economy of propulsion systems for automobiles. Demonstrated scale-up production of ceramic vanes and blades for a commercial gas turbine auxiliary power unit. Initiated follow-on program to demonstrate low cost manufacturing of complex automotive ceramic gas turbine components in larger quantities. Improved ceramic-metal joining technologies for heat engine assemblies. Continued characterization of time-dependent high temperature deformation behavior of candidate heat engine materials. Investigated integration of engine design, materials, and coatings to reduce engine friction and improve noise, vibration and harshness characteristics while maintaining or improving durability and cost. (ORNL, NASA Lewis, AlliedSignal	PROPULSION MATERIALS: Conclude R&D on automotive gas turbine ceramic materials and processes. Effect an orderly and cost effective transition of these laboratory in-house and contracted ceramics projects to a broader advanced materials R&D program that supports targeted improvements in efficiency and automotive manufacturing cost for the remaining Partnership for a New Generation of Vehicles (PNGV) candidate propulsion systems: compression ignition direct injection (CIDI) engine, fuel cell, and complementary propulsion electronics and electric machines. Coordinate the transition with the Office of Heavy Vehicle Technologies (OHVT), and Office of Industrial Technologies (OIT) propulsion/turbine materials activities. Prepare, with OIT, for an orderly transfer of those automotive gas turbine ceramic technology projects needed for continued support of the industrial gas turbine program. Assume responsibility for and continue development of low cost bipolar plate material systems for	PROPULSION MATERIALS: Continue enabling R&D efforts on advanced materials in support of, and in close coordination with, PNGV candidate propulsion systems development. The propulsion systems include advanced energy conversion, power control and transmission, and emission control concepts and components for the remaining candidates: CIDI engines and fuel cells, with associated electro-mechanical power trains. Continue to develop and validate materials having characteristics, such as high strength, high temperature performance, low friction, highly magnetic, highly insulating or conducting (heat or electricity), and durability. These materials include advanced metals, plastics, ceramics, composites, and new concepts. Analyze automotive scale manufacturing processes to form low cost components using these materials. Evaluate specific new materials concepts. (ORNL, ANL, LANL, ONR, Universities, Contractors, TBD) (PNGV: $3,000) ($3,000)

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Materials Technology (Cont'd)	Ceramics, AlliedSignal Engines, Univ. of Dayton Research Institute, Univ. of Michigan, Kyocera Industrial Ceramics, ONR) (PNGV: $6,381) ($6,381)	fuel cells. Broaden non-gas turbine ceramics and other propulsion materials R&D efforts, such as ultra low friction coatings, microwave regenerated particulate trap matrices, and advanced material systems for power capacitors and electronic substrates. (ORNL, AlliedSignal Ceramics, Kyocera Industrial Ceramics, Univ. of Dayton Research Institute, Univ. of Michigan, NASA Lewis; ANL, LANL, Nixdorf, ONR, TBD) (PNGV: $6,500) ($6,500)	
	LIGHTWEIGHT MATERIALS: The goals of the lightweight vehicle materials program are to successfully design and prototype lighter automotive structural components. A cooperative industry-government management structure, involving the United States Automotive Materials Partnership (USAMP) and the PNGV Materials Technical Team, collaboratively set technical targets and jointly established R&D priorities with DOE.	LIGHTWEIGHT MATERIALS: Continue establishing priorities for R&D efforts in conjunction with USAMP and PNGV Materials Technical Team.	LIGHTWEIGHT MATERIALS: Continue establishing priorities for R&D efforts in conjunction with USAMP and PNGV Materials Technical Team.
	Metals: Continued R&D to develop and verify high volume,	Metals: Maintain efforts to develop and verify high volume	Metals: Develop low cost cast light metals for structural chassis

III. Performance Summary: **TRANSPORTATION MATERIALS TECHNOLOGIES** (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Materials Technology (Cont'd)	low cost aluminum sheet production methods for automotive body and structural applications. Developed improved processes such as semi-solid forming for thin-wall precision casting of magnesium and aluminum alloys, and reduced cost metal matrix composites.	low cost aluminum sheet production and joining methods for automotive body and structural applications. Maintain efforts to develop improved, recyclable aluminum alloys for weight reduction, with fewer processing steps at lower costs. Complete assessments to determine R&D for low cost magnesium and titanium components, for chassis and engine applications.	applications. Adapt innovative technologies for the production, forming, and recycling of low cost aluminum sheet for automotive body panels and structures. Initiate R&D on promising technologies to lower the cost of titanium and magnesium in automotive chassis and powertrain applications. Continue R&D to further develop low cost, light metal alloys and metal matrix composite processing technologies.
	Composites: Verified capability of meeting automotive requirements with carbon and carbon/glass fiber reinforced polymer composites. Assessed high volume production processes, weight, cost, crash worthiness, recyclability, durability, and repairability.	Composites: Continue efforts to develop low cost polymer composites for structural applications. Initiate, with USAMP, efforts to accelerate availability of low cost carbon fiber for high strength composite components by advancing processing improvements. To reduce current manufacturing costs, implement rapid prototyping approaches for lightweight automotive polymer components.	Composites: Continue R&D on low cost carbon fiber for polymer matrix composites. Identify techniques to integrate these new fibers into advanced resins using innovative composite processing methods.
	Developed and demonstrated reliable joining methods for dissimilar automotive materials,	Continue efforts on joining methods and NDT of joints.	Continue R&D on joining methods and NDT of joints.

III. Performance Summary: **TRANSPORTATION MATERIALS TECHNOLOGIES** (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Materials Technology (Cont'd)	to lower the cost of vehicular assembly and assure safety of joints. Included in-plant non-destructive testing (NDT) of mechanical, adhesive, and fusion joints.		
	In conjunction with fuel cell program, initiated R&D to develop lightweight bipolar plate materials for fuel cell applications.	Continue activity under Propulsion Materials.	
	Established the Northwest Alliance for Transportation Technologies. (ORNL, PNNL, Ames Lab, SNL, INEEL, LANL, LLNL, LBNL, Univ. of Texas-Austin, Alcoa, Commonwealth Aluminum, Ravenswood Aluminum, Ford, Chrysler, GM, Reynolds Aluminum, Textron, Rockville, Knight & Packer, Budd Corp., Amcast, Georgia Tech, Purdue Univ., Applicator System, Oakland Univ., Concurrent Tech., ARCO Aluminum, Thixomat) (PNGV: $13,616) ($13,616)	Identify efforts to be supported by the Northwest Alliance for Transportation Technologies. Issue request for proposals, select contractors, and initiate work. (ORNL, PNNL, Ames Lab, SNL, INEEL, LANL, LLNL, LBNL, Univ. of Texas-Austin, Alcoa, Chrysler, Ford, GM, Reynolds Aluminum, Commonwealth Aluminum, Ravenswood Aluminum, Textron, Rockwell, Knight & Packer, Budd Corp., Amcast, Georgia Tech, Purdue Univ. Applicator System, Oakland Univ., Concurrent Tech., ARCO Aluminum, Thixomat) (PNGV: $15,250) ($15,250)	Continue to support the Northwest Alliance for Transportation Technologies projects to develop advanced low-cost materials for transportation. (PNNL, ORNL, Ames Lab, SNL, INEEL, LANL, LLNL, LBNL, ALRC, University of Texas-Austin, ALCOA, Reynolds Metals, Chrysler, Ford, GM, Commonwealth Aluminum, Ravenswood Aluminum, Textron, Rockwell, Budd Company, Amcast, ARCO Aluminum, Thixomat, Georgia Tech, Oakland University, University of Michigan, Michigan Tech, Erie Press Systems, Troy Design,

III. Performance Summary: **TRANSPORTATION MATERIALS TECHNOLOGIES** (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Automotive Materials Technology (Cont'd)			Imageware, AutoDie International, Wyman Gordon, Universal Energy Systems, Eck Industries, CMI International, Thompson Aluminum Casting, Stackpole, EPRI, Inland Bar Steel, Republic Engineered Steel, North Star Steel Co., MacSteel Co., Aeroquip Corp., Stahl Speciality, Westmorland Mechanical Testing, Delphi Energy Systems, PACCAR) (PNGV: $16,000) ($16,000)
	$ 19,997	$ 21,750	$ 19,000
Heavy Vehicle Materials Technology	HEAVY VEHICLE PROPULSION SYSTEM MATERIALS: Expanded materials development to include both ceramics and other materials needed by the heavy vehicle propulsion system manufacturers and suppliers for low emissions, high efficiency diesel engine components. Initiated 50% cost-shared cooperative agreements with U.S. engine manufacturing companies, to research and develop materials for heavy duty and multi-purpose	HEAVY VEHICLE PROPULSION SYSTEM MATERIALS: Develop advanced materials technologies that contribute to the achievement of 55% efficiency in diesel engines (LE-55) for heavy vehicles, while simultaneously reducing emissions of environmental pollutants to meet increasingly stringent standards. Expand the application of the materials technologies under development to include diesel engines for multipurpose vehicles	HEAVY VEHICLE PROPULSION SYSTEM MATERIALS: Continue work in partnership with the diesel engine companies and suppliers to develop enabling materials technology for low emission, higher efficiency diesel engines. Verify 2,000 hour durability of thick thermal barrier coating using component thermal fatigue rig, and continue engine testing to verify the 10,000 hour durability required for highway truck application of LE-55 technology.

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Materials Technology (Cont'd)	diesel engines. Developed thick thermal barrier coatings and insulating structural ceramics, advanced fuel system materials, materials for nitrogen oxides (NOx) and particulate reduction, advanced air handling materials, and materials for high brake mean effective pressure (BMEP) engines. Completed the advanced ceramic manufacturing program by demonstrating ten times reduction in cost, with improved quality, for ceramic diesel engine components, including valves, fuel injector plungers, clevis pins, and turbocharger rotors. Sintered 1,000 silicon nitride engine valves in continuous furnaces. Demonstrated scalability of microwave processing of ceramic heat engine components to commercial heavy vehicle quantities. Developed low cost powder for fabricating low expansion ceramics. Certified new generation diamond grinding wheels for high speed grinding of ceramic components. Extended life prediction methodology to include failure mechanisms observed for piston engines. Completed transfer of information	(100-275 horsepower) that account for a rapidly growing market segment (pickups, vans, and sport utility vehicles). Continue R&D on cost effective, high toughness silicon nitride for diesel components; expand Cooperative Research and Development Agreement (CRADA) activity with industry. Develop alumina matrix, self-lubricating ceramics for low cost/low emission valve guides. Continue low expansion materials development and catalyst characterization using the High Temperature Materials Laboratory electron microscopes. Continue life prediction verification of engine valve materials. Complete the ceramic machining efforts. Continue support of low cost sintering, and CRADA-directed non-destructive testing. Continue diesel component manufacturing technology projects with industry that support efficient diesel engine objectives. These include development of titanium aluminide and other materials for more efficient turbocharger rotors, ceramic thermal barrier	Through 50% cost-shared agreements with the three leading U.S. diesel companies: (1) continue development of a zirconia toughened mullite cylinder head insert for advanced diesel engines, using composite fabrication and low cost processing; (2) continue projects on fuel system materials, materials for NOx and particulate reduction, advanced airhandling materials, and materials for higher cylinder-pressure engines; and (3) develop "smart materials" for fuel injection systems; this is a revolutionary approach using a piezoceramic actuator to allow greater speed and control for fuel injection rate shaping. Continue non-destructive evaluation (NDE) of diesel engine materials; high temperature tensile testing and life prediction of ceramic valves; ceramic materials testing standards activities, jointly with industry and standard setting organizations. Continue support to a Historically Black University's Center for Advanced Materials and Smart Structures. In partnership with the Office of Fossil Energy's liquefaction

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Materials Technology (Cont'd)	to the Internet. (ORNL, Saint-Gobain Norton, Kyocera, Cummins Engine, Caterpillar, Detroit Diesel, LoTEC, Eaton Corp. North Carolina AT&T, Univ. of Massachusetts, NIST, ANL) ($4,925)	piston and cylinder head coatings, ceramic exhaust port and intake port liners, wear resistant liner coatings, and smart material actuators. Initiate tribology (friction, wear and lubrication) applied research. (ORNL, Cummins Engine, Caterpillar, Detroit Diesel Corp., LoTEC, Southern Illinois Univ., Univ. of Massachusetts, ANL) ($4,950)	program, support characterization of fuel processing catalysts utilizing unique High Temperature Materials Laboratory (HTML) capabilities. Coordinate all activities with Automotive Materials Technology program. (ORNL, Caterpillar Inc., Cummins Engine Co., Detroit Diesel Corp., North Carolina A&T State Univ., ANL, NIST) ($6,300)
	HIGH STRENGTH WEIGHT REDUCTION MATERIALS: Developed high rate (greater than 1 per 5 minutes) process for casting large, lightweight, high strength, reliable, cost competitive vehicular components. Performed test casts on prototype to define casting parameters.	HIGH STRENGTH WEIGHT REDUCTION MATERIALS: Cast selected large, high strength, light weight vehicular components by a high rate process, to validate selection of casting parameters and prepare for industrial production run.	HIGH STRENGTH WEIGHT REDUCTION MATERIALS: Complete large component castings project. In conjunction with West Virginia University (WVU) and the Office of Fossil Energy, continue to develop, characterize, and test precursor fibers, and other forms of coal-derived carbon, for light weighting of heavy vehicle components, such as structural insulation, tires, and safety applications. In cooperation with the Northwest Alliance for Transportation Technologies, and DOE's Offices of Industrial Technologies and Energy Research, evaluate applications of new metal forming processes and
	Evaluated the potential use of carbon-based materials in commercial vehicular applications requiring improved stiffness, durability, and lighter weight, as a function of cost and process. (Alcoa, Thompson Aluminum Casting, Cummins Engine Co., Amoco, Detroit	Fabricate and test selected prototype components employing carbon-based materials for heavy vehicle applications, based on improved stiffness, durability and lighter weight. Complete development and characterization of advanced	

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Heavy Vehicle Materials Technology (Cont'd)	Diesel Corp., Caterpillar Tractor, ORNL, ANL, PNNL, WVU, MIT) ($2,777)	processing of high strength, lightweight materials for heavy vehicle engine and structural applications. Continue development and characterization of lightweight metallic components for application in advanced diesel engines. (American Trucking Associations, truck OEMs, ALCOA, Thompson Aluminum Casting, Cummins Engine Co., Amoco, Detroit Diesel Corp., Caterpillar Tractor, ORNL, PNNL, WVU, MIT) ($3,100)	lightweight alloys for producing heavy vehicle components, particularly structural and advanced diesel engine applications. Coordinate all activities with Automotive Materials Technologies program. (American Trucking Associations, truck OEMs, Alcoa, Thompson Aluminum Casting, Cummins Engine Co., Amoco, Detroit Diesel Corp., Caterpillar Inc., ORNL, ANL, PNNL, WVU, MIT) ($1,000)
	$ 7,702	$ 8,050	$ 7,300
High Temperature Materials Laboratory	HTML OPERATION: With the unique collection of instruments in six HTML user centers, provided a comprehensive set of tools for performing state-of-the-art determination of the structure and properties of materials at high temperatures. Provided funding to fully support 17 scientific staff for the user program, and increase collaborative activities with	HTML OPERATION: The HTML is a nationally-designated user facility comprising a building of about 64,500 square feet in which reside six user centers that are made available to American industries and universities to help solve materials problems. Each user center is focused on a suite of specialized instruments and techniques, with the staff to	HTML OPERATION: With the unique collection of instruments in the six HTML user centers, continue to provide a comprehensive set of tools for performing state-of-the-art determination of the structures and properties of materials at high temperature. Provide increasingly sophisticated instrumentation and techniques, including microstructure at higher

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
High Temperature Materials Laboratory (Cont'd)	industry in the joint EE/ER residual stress user center.	operate them. Continue to focus HTML support and assistance to automotive manufacturers, heavy vehicle manufacturers, diesel engine manufacturers, and the trucking industry. Provide funding to fully support 16 scientific staff for the user program.	resolution, IR (infra-red) imaging of processes at their sites, thermal barrier and other coating evaluation (hardness, modulus, thermal properties, wear, friction, residual stresses, adherence), ceramic component lifetime analysis, and higher speed/higher precision machining. Fully support 16 scientific staff for the user program.
	Demonstrated remote microscopy between an industrial user and ORNL, using software at the industrial site that operates an electron microscope. Developed unique capabilities to image, at high resolution, both electrostatic and magnetic fields in semiconductor materials, and in free space using electron holographic techniques. Established facilities for evaluating material performance under high thermal gradients, including thermal shock and cyclic oxidation of thermal barrier coatings. Added capabilities in the area of micro mechanical characterization of materials. Increased industrial user days to 3,900. (ORNL) ($4,557)	As part of the DOE 2000 initiative, increase applications of the remote operation technique, developed in prior years for the electron microscopes, by applying to other instruments. Increase efforts to provide users with friction and wear characterization capabilities. Demonstrate neutron radiography and tomography for large items such as engine blocks. Demonstrate remote capability (DOE 2000) via neutron resonance spectrometry, to accurately measure temperatures of components, such as pistons, in operating diesel or other internal combustion engines. (ORNL) ($5,200)	Continue participation in the DOE 2000 Materials Micro Characterization Collaboratory (MMC), an Office of Energy Research initiative with Heavy Vehicle Materials and HTML participation and funding. The MMC is designed to permit creative scientists, having varying yet complementary expertise, to operate in a new environment which allows convenient, rapid, and dynamic research interactions to flow unencumbered by the limits of time and distance. Purchase a high resolution Scanning Auger Microscope, which has 10 times the brightness, and 10 times the signal, of the current instrument.

III. Performance Summary: TRANSPORTATION MATERIALS TECHNOLOGIES (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
High Temperature Materials Laboratory (Cont'd)			Maintain existing equipment and upgrade the Differential Scanning Calorimeter. ($5,500)
			$ 5,500
	$ 4,557	$ 5,200	
Transportation Materials Technologies Total	$ 32,256	$ 35,000	$ 31,800

TRANSPORTATION TECHNOLOGIES
TRANSPORTATION SECTOR
(dollars in thousands)

TECHNOLOGY DEPLOYMENT

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

This program's mission is to reduce oil consumption, as well as environmental emissions, through promoting the introduction and commercialization of alternative fuel vehicles (AFVs) and advanced technology vehicles with significantly improved fuel economy.

During and following successful technology development by industry and government, and in coordination with partners, stakeholders, and customers, this program provides the catalyst needed to establish an improved public understanding about, and resulting market demand for, alternative fuel vehicles, advanced technology vehicles, and advanced fuels; and establish a strong and far-reaching fuel and service infrastructure. The program is designed to provide support at critical periods in the transition of advanced transportation technologies from the laboratory to the marketplace, and then reduce government support as market penetration improves for vehicles which reduce petroleum consumption.

The Energy Policy Act of 1992 (EPACT) establishes multiple goals for alternative fuel technology development and utilization. Fuels of interest include biodiesel, electricity, ethanol, hydrogen, methanol, natural gas, and propane. Relative to petroleum fuel substitution, the basic EPACT goal is to promote the development and use of domestic replacement fuels to substitute for imported petroleum motor fuels to the maximum extent practicable. Within the context of the basic program goal, DOE focuses its program on those replacement fuels which will have the greatest impact on: reducing oil imports, improving the nation's economy, and reducing criteria pollutants and greenhouse gas emissions.

Achieving these goals will require the establishment of sustainable alternative fuel and vehicle production industries, and extensive private sector investment in supporting infrastructure. Markets for the products of these industries will be based on the confidence of consumers in the performance, reliability, cost-effectiveness, and other characteristics of those products. This program is about building that confidence by weaving together a variety of activities in response to customer needs. The program will:

- ✓ Forge partnerships with fleet owners, fuel providers, vehicle manufacturers, and State and local governments to expand the use of alternative fuel vehicles and the development of refueling infrastructure.
- ✓ Provide current, accurate, reliable information on all types of alternative fuels and vehicles.
- ✓ Perform rigorous, structured programs to test and evaluate cars and trucks that use alternative fuels.

I. **Mission Supporting Goals and Objectives**: TECHNOLOGY DEPLOYMENT (Cont'd)

- ✓ Implement the requirements of the Energy Policy Act.
- ✓ Promote consumer acceptance of advanced technology cars and trucks with significantly improved fuel economy.

With fleets paving the way for higher volume, lower cost vehicle production, and the installation of refueling capability, the objective is to make alternative fuel vehicles the choice of many individual private vehicle purchasers by the year 2000. Local, voluntary initiatives and agreements can be the mechanism by which all parties with a stake in alternative fuels can develop their plans together. With this premise, DOE has created and nurtured the Clean Cities program. Clean Cities is a voluntary Federal program designed to accelerate and expand the use of alternative fuel vehicles (AFVs) in communities throughout the country, and to provide refueling and maintenance facilities for their operation. As of January 1998, sixty communities have joined the Clean Cities program. Clean Cities encourages local governments and organizations to form public/private partnerships in developing markets for AFVs. Many of these local programs have links across regional and State boundaries to establish Clean Corridors with refueling infrastructure to allow inter-city travel with alternative fuel vehicles.

Under provisions of the Alternative Motor Fuels Act of 1988 and EPACT, a large number of vehicles are included in the Department of Energy's data acquisition activities. These vehicles represent a comprehensive cross section of our national commercial fleet. Projects are cost shared with many industry, State, and Federal groups. These activities place state-of-the-art AFV technology "on the road" for real-world fleet test evaluation. Over 1,000 Federal and commercial sedans, pickup trucks, vans, minivans, snowplows, garbage trucks, long-haul trucks, school buses, and urban mass transit buses have been tracked continuously, with performance, fuel economy, emissions, and maintenance data provided to the DOE-sponsored Alternative Fuels Data Center for compilation, analysis and dissemination.

To assist with utilization activities and provide information, fact sheets and reports designed to describe the various projects currently underway within the Office of Transportation Technologies (OTT) are developed. The distribution of the Congressionally-mandated Fuel Economy Guide, a pamphlet developed to help consumers compare the fuel economy of similarly sized new cars and light trucks, is made available to all new vehicle dealerships and to persons and organizations which request copies.

I. B. Program Benefits

	2000	2010	2020
Primary Energy Displaced (Quads)	0	0	0
Primary Oil Displaced (million barrels per day)	0.05	0.40	0.45
Energy Cost Savings ($ billion)	0.34	2.49	1.80
Carbon Reductions (million metric tons)	0.46	3.98	4.47

Using the quality metrics modeling methodology, it is estimated that 500,000 AFVs will be in operation nationally by the year 2000, thereby displacing 50,000 barrels per day of petroleum, reducing carbon emissions by 0.46 million metric tons per year, and reducing annual energy costs (i.e., oil costs) by approximately $340 million per year.

I. **Mission Supporting Goals and Objectives**: TECHNOLOGY DEPLOYMENT (Cont'd)

I. C. Performance Goals

Strategy/Goal: In concert with regional and local authorities, partnerships will be created among fuel suppliers, vehicle manufacturers, and fleet operators to displace 50,000 barrels per day of petroleum by the year 2000. This represents an annual savings of approximately $340 million in energy (oil) costs, and will lay the groundwork for further expansion of the alternative fuels industry and continued reduction in imported petroleum products.

FY 1997 Accomplishments

-- Expanded the Clean Cities program to 57 participating communities, and expanded efforts to help communities develop local market development plans for alternative fuels.

-- Initiated field test/evaluation of electric vehicles using the first generation of advanced batteries developed under the Department of Energy's (DOE) cooperative agreement with the U.S. Advanced Battery Consortium.

-- Completed Phase I of public/private development of an alternative fuel clean corridor linking California, Nevada, and Utah. Initiated Phase I of a similar program for the New York-Philadelphia-Baltimore-Washington, D.C., corridor.

-- Reviewed public comments on Energy Policy Act fleet programs, and incorporated them into a technical and policy analysis of the Act's replacement fuel goals, for submission to Congress.

FY 1998 Planned Accomplishments

-- Expand Clean Cities program to 60 participating communities and focus efforts on assisting implementation of local plans for alternative fuel market development.

-- Strengthen infrastructure corridor program, through the States and Clean Cities, that will encourage refueling development and alternative fuel use.

-- Complete field test/evaluation of electric vehicles using first generation advanced batteries developed with support from the DOE/U.S. Advanced Battery Consortium.

-- Add electric and hybrid vehicle data and information products to the Alternative Fuels Data Center and disseminate through Clean Cities.

I. <u>Mission Supporting Goals and Objectives</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

-- Through the Clean Cities program, continue to attract alternatively fueled medium and heavy duty urban delivery vehicle fleets as key urban stakeholders.

-- Initiate efforts to promote technologies to reduce greenhouse gases through Clean Cities grants.

-- Close out certification of training program and transition to private sector.

-- Continue implementation of EPACT fleet requirements, with emphasis on adding 10,000 AFVs to the Federal fleet and undertaking a rulemaking to consider expanding requirements to private and local fleets.

<u>FY 1999 Planned Accomplishments</u>

-- Expand Clean Cities scope to include emphasis on greenhouse gas reductions, significantly expanding grants to States and Clean Cities to demonstrate vehicles with significantly improved fuel economy.

-- Improve the value of the Fuel Economy Guide and other information products, as a means to encourage the use of fuel efficient vehicles.

-- Demonstrate state-of-the-art, fuel-efficient vehicle technologies for cars and trucks, including hybrid vehicles.

-- Link and solidify Clean Cities infrastructure and corridor investments launched in 1996 through 1998, creating continuous corridors of alternative fuel infrastructure linking 10 major urban centers.

-- Determine, through public comment and rulemaking, how to modify the Energy Policy Act replacement fuel goals, and design a program to promote the maximum practicable use of alternative fuels.

-- Continue EPACT fleet programs, adding 15,000 AFVs to the Federal fleet and completing the rulemaking on private and local fleets.

<u>FY 2000 - FY 2004 Planned Accomplishments</u>

-- Support a national Clean Cities Foundation to support and coordinate the network of local coalitions.

-- Implement focused projects that reduce greenhouse gases through the use of advanced technologies and low greenhouse gas fuels.

-- Increase utilization of advanced hybrid and electric vehicles.

-- Facilitate the use of 500,000 alternatively fueled vehicles operating in the Clean Cities and corridors.

II. A. Funding Table: TECHNOLOGY DEPLOYMENT

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Clean Cities Voluntary Deployment	$ 2,606	$ 2,850	$ 6,000	$ 3,150	111%
Infrastructure, Systems, and Safety	1,605	2,175	2,000	-175	-8%
EPACT Replacement Fuels Program	1,475	1,400	1,300	-100	-7%
Vehicle Field Test/Evaluation	2,432	2,850	3,450	600	21%
Technical Information Development	2,500	2,500	3,500	1,000	40%
Total, Technology Deployment	$ 10,618	$ 11,775	$ 16,250	$ 4,475	38%

II. B. Laboratory and Facility Funding Table: TECHNOLOGY DEPLOYMENT

Argonne National Lab (East)	$ 1,055	$ 950	$ 950	$ 0	0%
Idaho National Engineering and Environmental Lab	482	660	1,460	800	121%
National Renewable Energy Lab	3,332	2,410	2,410	0	0%
Oak Ridge National Lab	375	200	200	0	0%
All Other	5,374	7,555	11,230	3,675	49%
Total, Technology Deployment	$ 10,618	$ 11,775	$ 16,250	$ 4,475	38%

III. **Performance Summary**: TECHNOLOGY DEPLOYMENT

Activity	FY 1997	FY 1998	FY 1999
Clean Cities Voluntary Deployment	Supported voluntary programs for State and local governments and private industry to acquire alternative fuel vehicles in 57 participating Clean Cities through developing and using expanded networks and agency-to-agency communications. Expanded coordinated efforts with the electric utility industry to introduce electric vehicles in selected Clean Cities, catalyzed infrastructure development and encouraged consumer acceptance. (EPACT Section 505) (NREL)	Expand the Clean Cities program to at least 60 participating communities, focusing efforts to leverage specific private capital investments for greater alternative fuel market development. Continue efforts to measure the success of each city in carrying out its plan. Voluntary private sector efforts complement existing rules for government fleets and help to meet energy, environmental, and economic goals. Strengthen and expand electric vehicle programs started in Clean Cities during the EV Market Launch. (EPACT Section 505) (NREL)	Strengthen the Clean Cities program through focus on infrastructure and corridor efforts, supported by increased funding for projects to address market barriers. Expand Clean Cities scope to encompass reductions in greenhouse gases as well as other emissions of concern. Develop tools and training to promote use of fuel efficient and advanced technology vehicles. (EPACT Section 505) (NREL)
	Linked grants to State governments for accelerated use of alternative fuel vehicles with the Clean Cities Program. (EPACT Section 409)	Continue State grants work from previous year with an emphasis on infrastructure development. (EPACT Section 409)	Increase State grants work from previous year. Expand projects that deliver reductions in air emissions, including greenhouse gases. (EPACT Section 409)
	Continued demonstration and evaluation of alternative fuel cars and trucks, working with selected States and Clean Cities. (EPACT Section 302) (INEEL, States) $2,606)	Cost share demonstration and evaluation of light and heavy duty alternative fuel vehicles with industry, focusing on new applications in selected Clean	Expand cost-shared demonstrations from previous year, adding advanced technology, fuel-efficient vehicle demonstrations, such as hybrid vehicles, in Clean Cities.

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Clean Cities Voluntary Deployment (Cont'd)		Cities. (EPACT Section 302) (INEEL, States) ($2,850)	(EPACT Section 302) (INEEL, States) ($6,000)
	$ 2,606	$ 2,850	$ 6,000
Infrastructure, Systems, and Safety	Completed Phase I of the public/private development of an alternative fuel clean corridor linking California, Nevada, and Utah, as part of the Clean Cities program. (EPACT Section 505)	Commence Phase II of a nationwide infrastructure corridor development program, through the Clean Cities and States, to encourage private investment in refueling development along key transportation corridors. (EPACT Sections 505 and 502)	Continue work from previous year, with an additional focus on deployment projects that reduce greenhouse gases and other air emissions through the use of advanced technology and low carbon fuels. Use some grant funds to begin a National Parks initiative. (EPACT Sections 505 and 502)
	Continued certification of training programs for alternative fuel technicians to provide broad coverage of all alternative fuels. (EPACT Section 411) (NATEF)	Close out certification of training program and transfer to private sector. (EPACT Section 411) (NATEF)	
	Continued work with electric utilities and the Infrastructure Working Council on coordinated development of electric vehicle infrastructure. (EPACT Sections 505 and 601) (INEEL)	Continue work with electric utilities from previous year. (EPACT Sections 505 and 601) (INEEL)	Continue work with electric utilities on electric vehicle infrastructure. (EPACT Sections 505 and 601) (INEEL)

III. <u>Performance Summary</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Infrastructure, Systems, and Safety (Cont'd)	Expanded systems and safety analysis of refueling, transport, and delivery infrastructure for alternative fuels. (EPACT Section 502) (INEEL) ($1,605)	In coordination with industry, further refine systems and safety analysis of refueling, transport, and delivery infrastructure for alternative fuels, and implement findings as appropriate. (EPACT Section 502) (INEEL) ($2,175)	Continue infrastructure systems and safety analysis from previous years, with focus on compressed and liquified natural gas. (EPACT Section 502) (INEEL) ($2,000)
	$ 1,605	$ 2,175	$ 2,000
EPACT Replacement Fuels Program	Utilized analytical tools to assess the EPACT replacement fuel goals and solicited public comment on programs to reach the goals. Added modeling capability for analysis of transition pathways for alternative fuels. (EPACT Section 502) (ANL, ORNL)	Using transition modeling and other analytical tools, assess progress of EPACT fleet programs in helping to reach the Act's replacement fuel goals. Develop utilization scenarios for advanced transportation technologies, such as hybrid and fuel cell vehicles, that draw upon Clean Cities experience and industry expertise. (EPACT Section 502) (ANL, ORNL, TBD)	Continue analytical and modeling work to support EPACT rulemakings. Expand scenarios to include the Partnership for a New Generation of Vehicles (PNGV) and new heavy vehicle technologies. (EPACT Section 502) (ANL, ORNL, TBD)
	Reviewed public comment on EPACT fleet programs and incorporated in a technical and policy analysis of the Act's replacement fuel goals. (EPACT Sections 506 and 507) (ORNL)	Obtain additional public comment on the potential for additional fleet programs, renewable fuels, replacement fuels, and incentive programs to meet the Act's goals and reduce vulnerability to oil price shocks. Use comments to	Obtain public comment on the second technical and policy analysis of the Act's replacement fuels goals and submit to the President and Congress. (EPACT Sections 506 and 507) (ORNL)

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
		initiate a second technical and policy analysis of the Act's goals. (EPACT Sections 506 and 507) (ORNL)	
EPACT Replacement Fuels Program (Cont'd)	Continued implementation of the credit trading program for State and fuel provider compliance with EPACT mandates. (EPACT Sections 501, 507 and 508) (NREL, ANL, ORNL)	Continue EPACT regulatory work, initiating rulemaking on private and local fleets. (EPACT Sections 501, 507 and 508) (NREL, ANL, ORNL)	Continue regulatory work on alternative fuels and fleet programs including completion of rulemaking on private and local fleets. (EPACT Sections 501, 507, and 508) (NREL, ANL, ORNL) ($1,300)
	In cooperation with industry, developed and issued, as needed, guidance, standards, and regulations for alternative fuel composition. (EPACT Section 302) (ANL)	Complete standards work from previous year. (EPACT Section 302) (ANL)	
	Continued transportation demand management program in selected Clean Cities to develop tools and technologies to increase efficiency in the transportation sector in coordination with DOE and EPA. (EPACT Sections 502(a) and 504) ($1,475)	Transition demand management efforts to Clean Cities program. (EPACT Sections 502(a) and 504) ($1,400)	
	$ 1,475	$ 1,400	$ 1,300

III. <u>Performance Summary</u>: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Vehicle Field Test/Evaluation Vehicle Field Test/Evaluation (Cont'd)	Emissions testing program re-engineered to reduce emissions and performance testing on General Services Administration alternative fuel vehicles. Expanded efforts to collect data from private fleets and developed case studies of fleet experience with alternative fuels. (NREL, ANL)	Focus light duty alternative fuel vehicle emissions and performance testing on small numbers of new original equipment manufacturer and qualified vehicle modifier vehicles. Continue work from previous year. (NREL, ANL)	Continue fuel and vehicle emissions testing and coordinate with electric vehicle field test and evaluation efforts. (NREL, ANL)
	With modified program, initiated testing and evaluation of new electric vehicles to support commercialization in response to the requirements of EPACT. Initiated field test/evaluation of electric vehicles with first generation advanced batteries. (EPACT Sections 601 and 505) (INEEL) ($2,432)	Acquire, test, and evaluate new electric vehicles to support commercialization in response to the requirements of Executive Order 13031. Continue work from previous year. (EPACT Sections 601 and 505) (INEEL) ($2,850)	Start field testing hybrids developed under the Partnership for a New Generation of Vehicles (PNGV). Continue to acquire, test, and evaluate new electric vehicles to support commercialization in response to the requirements of Executive Order 13031. Continue work from previous year. (EPACT Sections 601 and 505) (INEEL) ($3,450)
	$ 2,432	$ 2,850	$ 3,450
Technical Information Development	Streamlined publication and distribution of the congressionally required Fuel Economy Guide. (GPO)	Continue publication of Fuel Economy Guide. (GPO)	Re-engineer the Fuel Economy Guide and develop other consumer products for Clean Cities and consumers to promote fuel efficiency, advanced

III. Performance Summary: TECHNOLOGY DEPLOYMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technical Information Development (Cont'd)	Working with stakeholders, continued to develop technical information on alternative fuels for various audiences. Expanded the delivery mechanisms for these products to ensure that affected audiences have access to the information. Continued to use DOE regional support offices to disseminate documents and publications. (EPACT Sections 302 and 405) (ANL, NREL, ORNL) ($2,500)	Through EPACT information programs, provide targeted technical information products to fleets and other stakeholders. Provide information over the Internet, at conferences, and through publications. Continue work from previous year. (EPACT Section 405) (ANL, NREL, ORNL) ($2,500)	technology vehicles and low greenhouse gas technologies. Continue technical information development, adding products related to near-term PNGV technologies, including fuel cells. (EPACT Section 405) (ANL, NREL, ORNL) ($3,500)
	$ 2,500	$ 2,500	
			$ 3,500
Technology Deployment Total	$ 10,618	$ 11,775	$ 16,250

TRANSPORTATION TECHNOLOGIES
TRANSPORTATION SECTOR
(dollars in thousands)

IMPLEMENTATION AND PROGRAM MANAGEMENT

I. Mission Supporting Goals and Objectives:

I. A. Statement of Mission

Implementation and Program Management supports the human resource requirements as well as the Office-level analysis, assessment, evaluation, and planning functions for the Office of Transportation Technologies (OTT). The mission of the program is to provide the integrated program direction needed to plan, manage, and oversee the research, development, and technology deployment activities funded by the transportation sector program. The analytical and evaluation part of the mission is accomplished by collecting and analyzing technology and market data, using computer models to project technology potential and market share, and calculating program benefits.

The technology assessment activity estimates the impacts, benefits, and costs of advanced transportation vehicle and fuel technologies. A system of models has been created that: (1) estimates the market shares of new light duty vehicle sales for alternative advanced vehicle technologies; and (2) calculates the alternative fuel use, petroleum use reductions, and changes in ambient and global emissions. These models are continually being improved and updated to consider new technology developments, and to be consistent with projections prepared by the Energy Information Administration. The models are also being used to estimate the impacts of individual technology programs during budget formulation and program planning.

The analysis function produces the annual Transportation Energy Data Book; assembles the best past and current data to use in updating transportation sector plans; and supports preparation and updating of Energy Efficiency and Renewable Energy and Department of Energy plans.

I. B. Performance Goals

FY 1997 Planned Accomplishments

-- Began development of a light and heavy vehicle benefits model jointly with the Energy Information Administration.

-- Improved the accuracy of the vehicle choice models by taking capital constraints and model-turnover rates into account.

I. Mission Supporting Goals and Objectives: IMPLEMENTATION AND PROGRAM MANAGEMENT (Cont'd)

FY 1998 Planned Accomplishments

-- Continue to improve the quality metrics methodology to incorporate risk and uncertain future oil prices.

FY 1999 Planned Accomplishments

-- Expand the quality metrics methodology to include international impacts. This will include estimating the benefits for domestic manufacturers of selling advanced technologies abroad and the impact of foreign manufacturers introducing technology to the U.S.

- Undertake a major effort to estimate the cost of advanced vehicle technologies, with emphasis on the cost of vehicles capable of achieving 80 miles per gallon.

FY 2000 - FY 2004 Planned Accomplishments

-- Update all the computer model coefficients, especially the vehicle choice coefficients.

II. A. **Funding Table**: IMPLEMENTATION AND PROGRAM MANAGEMENT

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Evaluation, Planning and Analysis	$ 1,700	$ 1,700	$ 2,500	$ 800	47%
Program Direction	6,037	5,900	6,700	800	14%
Total, Implementation and Program Management	$ 7,737	$ 7,600	$ 9,200	$ 1,600	21%

II. B. **Laboratory and Facility Funding Table**: IMPLEMENTATION AND PROGRAM MANAGEMENT

Argonne National Lab (East)	$ 1,100	$ 1,000	$ 1,200	$ 200	20%
National Renewable Energy Lab	250	240	200	-40	-17%
Oak Ridge National Lab	300	340	300	-40	-12%
All Other	6,087	6,020	7,500	1,480	25%
Total, Implementation and Program Management	$ 7,737	$ 7,600	$ 9,200	$ 1,600	21%

III. Performance Summary: IMPLEMENTATION AND PROGRAM MANAGEMENT

Activity	FY 1997	FY 1998	FY 1999
Evaluation, Planning and Analysis	Maintained a comprehensive and accurate set of transportation data, including energy use by transportation mode and fuel type. Prepared baseline projections of future transportation demands and energy use, and estimated the petroleum savings and substitution potential of transportation programs. Published and distributed Edition 17 of the Transportation Energy Data Book; expanded information to include alternative vehicle registration and fuel use. Assessed the energy, environmental, and economic impacts of introducing new vehicles and fuels. Estimated the oil substitution and energy saving impacts of all the technology programs for alternative funding levels, fuel price scenarios, and economic growth scenarios. Estimated technology market penetration by operating improved vehicle and fuel choice models. Developed detailed technology characterization of alternative vehicle technologies as input to the choice models. Completed total energy cycle analysis for hybrid vehicles, addressing several battery types, propulsion engine and fuel types. Initiated a comparative total energy cycle analysis that deals with all the alternative vehicle and fuel	Continue to maintain a comprehensive and accurate set of transportation data, including energy use by transportation mode and fuel type. Assemble baseline projections of future transportation demands and energy use, and estimate the petroleum savings and substitution potential of transportation programs, as well as the pollution and economic impacts. Publish and distribute Edition 18 of the Transportation Energy Data Book; expand to include detailed information on the growth of light truck use. Assess the energy, environmental, and economic impacts of introducing new vehicles and fuels. Estimate the oil substitution and energy saving impacts of all the technology programs for alternative funding levels, and scenarios for fuel price and economic growth. Estimate technology market penetration by operating the vehicle and fuel choice models that have been improved. Develop detailed technology characterization of alternative vehicle technologies as input to the choice models. Complete the total energy cycle analysis for all alternative vehicles and fuels. Initiate a comparative total energy cycle analysis for fuel cell vehicles. (ANL, ORNL, NREL, TBD) ($1,700)	Continue to maintain a comprehensive and accurate set of transportation data, including energy use by transportation mode and fuel type. Assemble baseline projections of future transportation demands and energy use. Estimate the petroleum savings, oil substitution potential, emissions reduction and economic impacts of transportation programs. Publish and distribute Edition 19 of the Transportation Energy Data Book. Continue to assess the energy, environmental, and economic impacts of introducing new vehicles and fuels. Estimate the oil substitution, energy saving impacts, and emissions reduction of all the technology programs for alternative funding levels, fuel price scenarios, and economic growth scenarios. Estimate technology market penetration by operating the vehicle and fuel choice models. Develop detailed technology characterization of alternative vehicle technologies as input to the choice models. Complete the comparative total energy cycle analysis for fuel cell vehicles. Analyze the international impacts of exporting and/or importing advanced vehicle technologies. Improve methods for estimating greenhouse gas reductions from travel

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

Activity	FY 1997	FY 1998	FY 1999
Evaluation, Planning and Analysis (Cont'd)	technologies. (ANL, ORNL, NREL) ($1,700)		demand reductions, land use planning, and telecommunications. Analyze the market for greenhouse gas reducing technologies. The level of these efforts also increase commensurate with the base program level. (ANL, ORNL, NREL, TBD) ($2500)
	$ 1,700	$ 1,700	$ 2,500
Program Direction	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $4,702 12.1 Civilian personnel benefits $ 931 21.0 Travel and transportation of person $ 251 25.2 Other services $ 153 Provided funds for salaries, benefits, and travel (including normal increases in both salaries and benefits) to support the 68 FTEs needed to conduct and monitor research, development, and other activities associated with various transportation technologies, at Headquarters (67) and in the field (1). ($6,037)	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $4,382 12.1 Civilian personnel benefits $898 21.0 Travel and transportation of persons $ 450 25.2 Other services $ 170 Provide funds for salaries, benefits, and travel (including normal increases in both salaries and benefits) to support the 61 FTEs needed to conduct and monitor research, development, and other activities associated with various transportation technologies, at Headquarters (60) and in the field (1). A 3% contingency is provided under Other Services. ($5,900)	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $4,264 12.1 Civilian personnel benefits $ 936 21.0 Travel and transportation of persons $ 450 25.2 Other services $1,050 Provide funds for salaries, benefits, and travel (including normal increases in both salaries and benefits) to support 58 FTEs needed to conduct and monitor research, development, and other activities associated with various transportation technologies, at Headquarters (57) and in the field (1). A total of $1,050 under Other Services includes activities such as permanent change of station moves, employee training, and a 5% contingency. ($6,700)

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

Activity	FY 1997	FY 1998	FY 1999
Program Direction (Cont'd)	$ 6,037	$ 5,900	$ 6,700
Implementation and Program Management Total	$ 7,737	$ 7,600	$ 9,200

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Tabular dollars in thousands, Narrative in whole dollars)

INDUSTRY SECTOR

PROGRAM MISSION

Industry's efficient use of energy is critical to the U.S. energy economy. Industry consumed almost 31 quads of primary energy in 1994--about 38% of all energy used in the U.S. Of this amount, about 25 quads were used in manufacturing. Within manufacturing, energy use is concentrated in a relatively small number of industries. Based on the 1994 Manufacturing Energy Consumption Survey (MECS), pulp and paper, primary metals, chemicals, petroleum refining, and stone, clay and glass accounted for 82% of all energy used in manufacturing in 1994.

Efficient energy use and waste disposal are important to industry. Industry spent about $104 billion on energy in 1993 and about $29 billion for pollution abatement and control. While for all industry this represents less than 5% of total costs of operation, for material and process industries, the percentage of costs attributable to energy and waste ranges from about 7% to over 30%. In the last ten years, energy has become less important as a driver of U.S. industry investment decisions because natural gas, electricity, and imported oil have been readily available at attractive prices, and energy costs have been declining as a percent of product selling price. However, because of their intensive energy use, energy is still an important driver of investment and operating decisions for materials and process industries.

Concerns about generation of pollution and the levels and types of industrial wastes are increasing. Industry generated 14 billion tons of waste in 1994, including over 200 million tons of hazardous and toxic wastes. Manufacturing accounts for about 65% of all industrial wastes, and almost all of the hazardous and toxic wastes. Within manufacturing, materials and process industries account for about 80% of the hazardous and toxic wastes, and about 95% of non-hazardous waste. These wastes often impose expensive clean up and disposal costs, but offer the potential for recovering the "embedded" energy and materials value.

Manufacturing jobs are important to the economy. About 18 million people are employed in manufacturing. Also, many manufacturing jobs are higher paying, higher skilled jobs compared to many jobs in service industries. Manufacturing jobs are also a

PROGRAM MISSION - INDUSTRY SECTOR (Cont'd)

strong stimulus to the economy with a multiplier of 4 jobs in the economy being created for every manufacturing job created. Manufacturing jobs have declined from 19.6 million jobs in 1974 to 18 million today.

There are substantial opportunities for the Office of Industrial Technologies to help improve the competitive climate for U.S. industry. While many energy and waste intensive industries have been in decline over the last 20 years, new innovations in technology could reverse the decline. Overall, up to $10 billion per year or more in energy costs could be saved by industry. The Office of Industrial Technologies (OIT) has targeted six industries: steel, aluminum, metal casting, chemicals, forest products, and glass for an Industries of the Future strategy. A seventh industry, petroleum refining, has been dropped because of a lack of perceived need by industry for DOE assistance. Research is accomplished primarily through competitive solicitations, including in FY 1999 a broad industry solicitation, guided by industry-developed technology road maps to ensure focusing on key needs and best performers. This approach matches DOE's economic, environmental, and science and technology goals with the needs and expectations of technology users in the private sector, and targets Federal R&D investments to market requirements. OIT is establishing partnerships with industry and government to develop the advanced manufacturing and process technologies which have the best chance of strengthening U.S. materials and process industries. Many of the individual firms in these industries are small or medium sized and do not have the resources to pursue the often expensive and lengthy research needed to develop advanced technologies. These advanced technological options can preserve existing industry jobs as well as create new jobs, and can result in increased exports. They can also provide strong economic and environmental benefits without the market dislocations which regulatory approaches often embody.

The GOAL of Industry Sector programs is to significantly improve the resource efficiency and competitiveness of energy and waste intensive U.S. industries by rapidly developing and delivering advanced science and technology options which will have the OBJECTIVES of: 1) lowering raw material and depletable energy use per unit output; 2) improving labor and capital productivity; and 3) reducing generation of wastes and pollutants.

Analysis of OIT programs indicate that if OIT technologies are successfully developed it would lead to reductions of 1.5 quads in industrial energy demand by the year 2010 (depending on speed of market penetration of new technologies). This would also result in annual carbon reductions of over 30 million metric tons. The industrial technologies not only improve industrial productivity through reducing energy cost expenditures, but also through other process productivity enhancements and innovative solutions for environmental requirements. The non-energy productivity improvements are expected to lead to even greater savings than the energy cost savings. The OIT programs working with industry are also expected to preserve and increase industrial jobs by helping the international competitiveness of U.S. industry by energy productivity improvements and waste reduction.

PROGRAM MISSION - INDUSTRY SECTOR (Cont'd)

The Office of Industrial Technologies delivers its programs through three mechanisms: Industries of the Future (Specific), Industries of the Future (Crosscutting) and Technology Access. The Industries of the Future (Specific) mechanism cost-shares with industry and other organizations technology development identified in industry-wide developed visions and roadmaps. These technologies are chosen based on their ultimate impact on energy and waste reduction, high priority and high risk to meet roadmap targets, wide-spread industry applicability and precompetitive nature. They are technologies that are specific to an industry's processes. The Industries of the Future (Crosscutting) cost shares with industry and other organizations technology development beneficial to and of high priority for many industries. Power generation equipment, combustion equipment and sensors and controls are pursued. In addition, advanced materials that can address a multitude of wear and corrosion problems are explored. The Technology Access mechanism delivers information and tools to help plant managers make informed decisions on technology choices today that result in energy, waste and dollar savings. In addition, new ideas from inventors are supported and grants for demonstration of near-term viable technologies are funded. These mechanisms provide an integrated set of options responsive to the near, mid and long term goals and objectives of industry. They are also responsive to the National goals of improved energy efficiency, expanded adoption of pollution prevention, increased productivity, and more globally competitive industries.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Industry Sector

Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Base	FY 1999 Request	Program Change Request vs. Base Dollar	Program Change Request vs. Base Percent
Industries of the Future (Specific) Operating Expenses	$ 45,332	$ 53,078	$ 53,078	$ 76,000	$ 22,922	43%
Industries of the Future (Crosscutting) Operating Expenses	$ 38,378	$ 49,120	$ 49,120	$ 49,400	$ 280	1%
Technology Access Operating Expenses	$ 24,827	$ 26,299	$ 26,299	$ 32,000	$ 5,701	22%
Management and Planning Operating Expenses	$ 6,887 b/	$ 7,700	$ 7,700	$ 9,159	$ 1,459	19%
TOTAL	$ 115,424 a/	$ 136,197	$ 136,197	$ 166,559	$ 30,362	22%
Summary						
Operating Expenses	$ 115,424	$ 136,197	$ 136,197	$ 166,559	$ 30,362	22%
Total Program	$ 115,424	$ 136,197	$ 136,197	$ 166,559	$ 30,362	22%
Staffing (FTE's)						
HQ FTEs	59	61	61	61		
Field FTEs	11	11	11	11		
Total FTEs	70	72	72	72		

a/ Reflects adjustment for approved reprogrammings 97-R-12 of $-1,883.2 thousand for the Small Business Innovative Research (SBIR) program and $-148.7 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities.

PROGRAM FUNDING PROFILE: Industry Sector (Cont'd)

b/ Reflects adjustment of -$113.0 thousand for approved reprogramming 97-R-15b totaling $337.0 thousand to support Transportation Sector Program Direction activities.

Authorizations:
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act of 1978"
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplant and Industrial Fuel Use Act of 1978"
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Conservation Act of 1987"
P.L. 100-615, "Federal Energy Management Improvement Act of 1988"
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"
P.L. 101-549, "Clean Air Act Amendments of 1990"
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990"
P.L. 93-577, "Federal Nonnuclear Energy Research and Development Act of 1974"

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Industry Sector

FY 1998 Enacted	$ 136,197
FY 1999 Base	0
	$ 136,197

Industries of the Future (Specific)

- Forest and Paper Products Vision - The increase essentially maintains the FY 1998 level of effort and supports the implementation of Agenda 2020 to further the national goals of reduced energy consumption, environmental compatibility and resource efficiency in the Forest and Paper Industry.	36
- Steel Vision - The increase will fund new R&D responsive to industry-identified and prioritized needs related to material recycling and environmental improvements gained through efficiency and productivity increases.	901
- Aluminum Vision - The increase will be used to support the energy-efficiency R&D needs of the industry, as identified in the Aluminum Industry technology roadmap and the Mining Industry technology roadmap.	1,843
- Metal Casting Vision - The increase will support activities identified in the Metal Casting Vision and roadmap.	317
- Glass Vision - The increase will be used to fund a competitive solicitation in support of the glass industry technology roadmap to conduct R&D in the following areas: production efficiency, energy efficiency, environmental protection/recycling, and innovative uses of glass.	947
- Chemicals Vision - The increase will fund projects in support of biobased renewable feedstocks and additional projects in support of the chemical industry Vision 2020 solicitation.	2,878
- Petroleum Refining Vision - The decrease reflects the closeout of the Petroleum Refinery Vision activities.	-3,000

SUMMARY OF CHANGES: Industry Sector (Cont'd)

- Industry-Wide Solicitation - The increase will fund a competitive solicitation which will focus on reducing climate change gases, and increasing efficiency in the industrial sector. This will result in higher productivity at the plant level, increased or sustained jobs, and roughly 40 new technologies developed.	19,000
Industries of the Future (Crosscutting)	
- Cogeneration - The decrease will reduce the technology development in the Advanced Turbine Systems Program including advanced materials, such as coatings, ceramics, and alloys.	-1,650
- Advanced Materials and CFCCs - The decrease essentially maintains activities at the FY 1998 level of effort.	-70
- Combustion Technologies - The increase will initiate a cross-cutting program in combustion and sensor R&D in direct support of the vision industries.	2,000
Technology Access	
- IACs/Technology Transfer - The decrease will impact technology transfer and communications activities.	-409
- Motor Challenge - The increase will support expanded Motor Challenge activities, and the development of new partnerships that assist in the deployment of energy efficient compressed air system and steam system technologies within manufacturing plants.	4,770
- NICE-3 - The increase will fund additional worthy projects.	1,500
- Climate Wise - The net change of $0 reflects the phase out of the program.	0
- Inventions & Innovation - The decrease will slightly reduce the delivery of support to inventors.	-160
Management and Planning	
- Evaluation and Planning - The increase will support the development of quality metrics for the vision industries.	200
- Program Direction - The increase will support on-board FTEs and new activities with the Environmental Protection Agency.	1,259
FY 1999 Congressional Budget Request	$ 166,559

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

INDUSTRIES OF THE FUTURE (SPECIFIC)

I. **Mission Supporting Goals and Objectives**:

A. Statement of Mission: OIT's Industry Vision strategy aligns its resources with our principal customers--the energy-intensive material and process industries. These industries: steel, aluminum, glass, metalcasting, forest products, and chemicals account for over half of all manufacturing energy use and account for 75 to 90% of most manufacturing wastes for the various waste streams. This energy usage represents over 12 quadrillion Btu (quads) each year at a cost of about $50 billion. The vision strategy is based on the facilitation of industry developing their vision and the alignment of OIT resources to that vision. The Industries of the Future (IOF) strategy provides the catalyst for tapping into America's vast capabilities in R&D for the development and deployment of advanced energy and material efficient technologies, fosters synergism among different organizations in DOE and other government agencies, and focuses R&D on technologies that are responsive to the needs of each industry and provide benefits at a national level. Benefits in energy savings, improved productivity, use of renewable energy sources, and pollution prevention fulfill both the mission of OIT and industries' technological needs.

Each key activity directly relates to the strategic goals set in the IOF strategy. After the completion of the vision documents, a roadmapping process provides a list of critical prioritized research needs for each of the six industries. The roadmapping process allows the establishment of research teams to address each industry and each vision identified needs. The program areas addressed in the key activities identify opportunities to invest in research partnerships with industry that meet industry's needs and our mission.

B. Program Benefits: Aluminum, Chemicals, Forest Products, Glass, Metalcasting, and Steel Visions

The industries which are the target of the vision of the future strategy in OIT account for a value in shipments of three-quarters of a trillion dollars, total direct employment of 2.6 million, and expend over $30 billion in capital per year. The estimated benefits by year 2010 from the FY 1999 project portfolio, including those realized directly by the process industries and those from the commercialization of the developed technologies and products used in the end use sector, include:

	2000	2010	2020
Total Primary Energy Displaced (quads)	.02	.70	1.16
Energy Cost Savings ($ billions)	.06	1.90	3.31
Carbon Reductions (million metric tons)	.37	16.63	28.15

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Many promising fundamental improvements in these energy, waste, and capital-intensive industries that are OIT's principal customers are simply too expensive and too risky for individual private firms to pursue by themselves. OIT acts as a catalyst in drawing together many firms with national laboratories and other interested parties to pool risk, investment, and know-how in promising technologies that are too costly and high-risk for individual firms to develop on their own. The Industries of the Future strategy makes government more responsive and effective. The strategy facilitates integrated planning and implementation by all participants, fosters cooperative planning among different organizations in DOE and other government agencies, and results in R&D focused on technologies that are responsive to the unique challenges each industry faces. In addition, industry partners have emphasized that the Federal participation has acted as a catalyst in the process especially by lending an objective influence, adding credibility, and fostering cooperation between normally competing firms.

C. Performance Goals: Aluminum, Chemicals, Forest Products, Glass, Metalcasting, and Steel Visions.

Strategy/Goal for 2000

The Industries of the Future strategy has provided the framework for industry to complete strategic long range planning and coordination. The goals of this strategy for the year 2000 include:

-- All of the industry vision documents have been completed identifying the characteristics of the industry needed in the future to maintain global competitiveness with target values to be achieved in key areas.

-- The technology roadmaps for the industries are complete and identify the research priorities needed to achieve the vision targets. Suppliers, end use industries, and research providers have participated in the roadmapping process.

-- Implementation plans are being executed to focus available research funding with the roadmapping opportunities.

D. Management and Partnering Accomplishments:

FY 1995

Visions of the Future strategies were completed with the Forest Products Industry and Steel Industries. These partnerships between government and industry were signed by the Secretary of Energy and representatives of the industries.

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

FY 1996

The Metalcasting, Glass, and Aluminum Industries completed their vision strategies. Partnership compacts were signed between the Secretary of Energy and the Metalcasting and Glass industries. The compact signing for the Aluminum Industry was October 9, 1996. The development of technology roadmaps are being developed for each of the industries that have completed their vision strategy.

FY 1997

The Chemical Industry completed its vision and began work on several roadmaps. Funding of research that address needs in each of the vision industries and fulfills the mission of the OIT will continue. Significant redirection of research programs was initiated to focus resources on industry roadmaps as they developed. The outreach to other Federal, state, and regional agencies is a key driver for the success of the industries of the future strategy and where the OIT provides great value added to our industry partners. Efforts in communicating the needs and opportunities developed by industry in their visions as well as coordination of Federal funding for research with these industries is a major thrust of the IOF vision teams.

FY 1998

Initiate work on facilitating visions for the Mining and Agriculture Industries, and facilitating selected State-wide Industry of the Future strategies. Roadmaps will be completed for all six participating industries.

FY 1999

The IOF strategy will continue through the out years. As the market, government regulations, and technology advances drive the industry to reassess their position in the global economy and how their industry must change to be competitive in the future, the IOF strategy will continue to evolve. The Industry of the Future strategy is an ongoing effort which will be revisited in total or by the phases that industry feels need augmentation. The roadmaps phase of the IOF strategy will be updated as the implementation plan identifies new paths for fulfillment of an identified need or new opportunities that must be added to the vision. The vision teams will continue their role as facilitators of the processes, central contacts for industry on federal opportunities for partnering, and partners for the needed research that has the energy, environmental, and economic benefits that fulfill OIT's mission. Research will be conducted based heavily on industry-specific (as well as an industry-wide) competitions and the industry-developed roadmaps.

E. Technical Accomplishments of IOF (Specific) Industries:

Industries of the Future: In response to the Industries of the Future strategy and consistent with the Galvin Commission findings that the national laboratories and facilities must work as a team, a "Memorandum of Cooperation" was signed by DOE national laboratories and facilities. Sixteen national laboratories and facilities have formed a coordinating council to work cooperatively with

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

the IOF industries to determine in what areas the capabilities of the national laboratories and facilities can best be utilized to address the future technology needs of the industry.

Forest Products: The Black Clawson Company commercialized a breakthrough cleaning technology for paper recycling. This new technology enables papermakers to use even lower grades of recycled paper without compromising the quality of the paper produced. This technology will assist the U.S. forest products industry in meeting its 2000 goal of recovering for recycling 50% of all paper used. In addition, this improved cleaning technology achieves greater efficiency while using less energy. These accomplishments were realized with a 45% industrial cost share.

Steel: The first commercial Galvanneal Phase Measurement sensor was installed and is now operating at Stelco Inc. This is the first commercial installation of technology developed under the Advanced Process Control Program. Preliminary result of the sensor's real time output, reporting metal temperature and viscosity, indicate it functions as designed. During the next several months, work will continue on fine tuning and quantifying the benefits of this instrument. Additional commercial installations are anticipated next fiscal year. By the year 2005, the steel industry could save over $250 million in energy costs from the overall effort due to improved process control.

Aluminum: New technology cathode elements installed in conventional aluminum cells were shown to reduce energy consumption in the production of primary aluminum through a collaborative R&D project between Kaiser and Reynolds Metals Co. Although some of the cathode elements failed during testing in Kaiser full-scale pre-bake cells, test results showed an 8% energy savings compared to a standard cell. Also, there was no loss of aluminum production even with reduced element coverage of the anode due to the material failures. Retrofitting existing alumina reduction cells with wettable cathodes could reduce energy consumption and greenhouse gas emissions in the primary aluminum industry by 10%.

Metalcasting: Through a consortium of OIT, foundries, suppliers, and academia (University of Alabama-Birmingham), a number of significant achievements have been made to improve the lost foam casting process. Development of new coatings has helped to reduce scrap rates in some foundries from 5.5% to 0.25%. A non-destructive evaluation sensor was tested and brought to market, providing a method of dimensional analysis with a precision level of about 0.0005 inches. This significantly improves the ability of founders to increase the dimensional accuracy of castings. Also, a new device, a densitometer, was developed to measure vibration effects on densification around and in patterns during the compaction process. Also developed was a distortion strip to measure distortion amount and when it occurs during compaction. Using the distortion strip in one foundry alone has reduced distortion scrap from 17% to 1%, resulting in a savings of $60,000/month. The cost sharing percentage is 54%.

Glass: AccuTru International, in cooperation with Corning, Anchor, Owens-Corning, Libbey-Owens-Ford, **Idaho National Laboratory**, Clemson, and several other industrial partners, developed a temperature sensor able to withstand the thermal shock and corrosive atmosphere of molten glass to provide reliable, accurate information over the lifetime of a furnace. Its enhanced abilities will

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

improve the quality of glass products and reduce energy consumption and emissions by optimizing the melting temperatures needed to produce glass. The cost-sharing percentage is 25%.

Chemicals: Pilot plant tests of plastics separation from automobile shredder residue were conducted in partnership with the Vehicle Recycle Coalition and steel, metals, and plastic recycling industries. The technology, developed by **Argonne National Laboratory**, will be tested at a commercial automobile shredder site. Tests will determine commercial feasibility. The cost-sharing percentage is 65%.

II. A. **Funding Table**: INDUSTRIES OF THE FUTURE (SPECIFIC)

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Forest and Paper Products Vision	$ 10,843	$ 12,040	$ 12,076	$ 36	0%
Steel Vision	8,905	9,726	10,627	901	9%
Aluminum Vision	5,503	7,335	9,178	1,843	25%
Metal Casting Vision	3,399	5,480	5,797	317	6%
Glass Vision	2,917	3,883	4,830	947	24%
Chemicals Vision	9,983	11,614	14,492	2,878	25%
Petroleum Refining Vision	3,782	3,000	0	-3,000	-100%
Industry-Wide Solicitations	0	0	19,000	19,000	>999%
Total, Industries of the Future (Specific)	$ 45,332	$ 53,078	$ 76,000	$ 22,922	43%

II. B. <u>Laboratory and Facility Funding Table</u>: INDUSTRIES OF THE FUTURE (SPECIFIC)

	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Ames	$ 80	$ 196	$ 111	$ -85	-43%
Argonne National Lab (East)	5,342	4,899	1,318	-3,581	-73%
Brookhaven National Lab	145	148	0	-148	-100%
Idaho National Engineering Lab	612	400	0	-400	-100%
Lawrence Berkeley Lab	787	585	674	89	15%
Los Alamos National Laboratory	600	600	500	-100	-17%
National Renewable Energy Lab	2,644	2,490	252	-2,238	-90%
Oak Ridge National Lab	4,583	2,562	1,509	-1,053	-41%
Pacific Northwest Lab	1,074	1,358	0	-1,358	-100%
Sandia National Laboratories	833	810	800	-10	-1%
All Other	28,632	39,030	70,836	31,806	81%
Total, Industries of the Future (Specific)	$ 45,332	$ 53,078	$ 76,000	$ 22,922	43%

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision	The forest, wood and paper industry produces wood and paper products valued at more than $230 billion each year. It employs 1.6 million people directly and ranks as one of the top 10 manufacturing industries in 46 states. The pulp and paper industry includes 547 mills in 42 states, and produces 82 million tons of paper and paperboard and 10 million tons of market pulp. With only 17% of the world's pulp and paper mills, the U.S. produces 35% of the world's pulp. Pulp and paperboard are used to publish more than 2 billion books, 350 million magazines and 24 billion newspapers in the U.S. annually.		Benefits of the forest products vision activities to the nation by the year 2010 include increased energy efficiency resulting in energy savings, reduced waste generation, and production cost savings. Over 400 large, medium and small companies, are participating along with other government agencies, national laboratories, universities and states. Jobs saved or created by development of these advanced technologies exceed 12,600 person years in 2010.
	This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: ON-MACHINE ULTRASONIC SENSORS FOR PAPER	This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: COUPLED PHYSICAL/CHEMICAL AND	This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: ENERGY EFFICIENT KRAFT PULPING FOR HIGHLY

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	STIFFNESS - this technology provides increased data for process control, improved product uniformity; increases energy efficiency, increases use of recycled fibers, and reduces reprocessing; and POLYOXOMETALATE BLEACHING - development of a new bleaching technology that will save energy, allow mills to eliminate water discharge, and eliminate the need for chlorine use in bleaching.	BIOFILTRATION TECHNOLOGIES TO REDUCE AIR EMISSIONS FROM FOREST PRODUCTS INDUSTRIES - development of a cost-effective technology to eliminate air emissions of both VOCs and Hazardous Air Pollutants (HAPs) in the forest products industry; and RECYCLING OF BLEACH PLANT FILTRATES - development of a technology to remove inorganic non-process elements from bleach plant effluent using electrodialysis to enable closure of the pulp mill water stream.	BLEACHABLE, LOW LIGNIN CONTENT PULP - development of advanced control systems specifically targeted at producing low lignin pulps of greatly enhanced bleachability offering a route to integrated pulping and bleaching for an environmentally neutral mill of the future, and DESIGN AND DEMONSTRATION OF MULTIPORT CYLINDER DRYERS - demonstration of a technology to have steam flow through multiport passages that are in close proximity to the cylinder drying surface increasing the drying rate by 100% over conventional drying cylinders.
	R&D Activities: IMPROVED CAPITAL EFFECTIVENESS: Corrosivity Monitoring of Kraft Recovery Boilers; ($0.5M) ENVIRONMENTAL PERFORMANCE: Sulfur Free Pulping, Paper Mill Sludge Utilization, Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, CORRIM II Consortium, VOC Control in Kraft Mills, Highly Bleachable	R&D Activities: IMPROVED CAPITAL EFFECTIVENESS: Corrosivity Monitoring of Kraft Recovery Boilers; ($0.5 M) ENVIRONMENTAL PERFORMANCE: Paper Mill Sludge Utilization, Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, VOC Control in Kraft Mills, Highly Bleachable Low Lignin Content Pulp, Low-VOC Drying of	R&D Activities: IMPROVED CAPITAL EFFECTIVENESS: ($0.5M) ENVIRONMENTAL PERFORMANCE: Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, Volatile Organic Compound (VOC) Control in Kraft Mills, Highly Bleachable Low Lignin Content Pulp, Low-VOC Drying of Lumber and Wood Panel Products, Coupled

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	Low Lignin Content Pulp, Low Temperature Oxidation of Volatile Organic Compounds, Low-VOC Drying of Lumber and Wood Panel Products, Coupled Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, Recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, Photoactivated Ion Exchange Resins, High Efficiency ClO_2 Delignification, Understanding the Nature and Reactivity of Residual Lignin for Improved Pulping and Bleaching Efficiency ($3.2M) ENERGY PERFORMANCE: Black Liquor Electrolysis, Black Liquor Properties, High Solids Firing, Electrochemical and Integrated-Process Opportunities for On-Site/On-Demand Generation of ClO_2 at Reduced Cost ($2.9M)	Lumber and Wood Panel Products, Coupled Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, ($4.0M) ENERGY PERFORMANCE: Black Liquor Properties, High Solids Firing, Electrochemical and Integrated-Process Opportunities for On-Site/On-Demand Generation of ClO_2 at Reduced Cost ($4.0M) SENSORS AND CONTROL: Ultrasonic Sensors for Paper Stiffness, Automated Sorting of Recycled Raw Materials and On-Line Chip and Web Analysis ($1.8M) RECYCLING: Stickies Control in Recycle Operations, Infrared Detection of Contaminants ($0.5M) SUSTAINABLE FOREST MANAGEMENT: High-Yield	Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, Recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, Understanding the Nature and Reactivity of Residual Lignin for Improved Pulping and Bleaching Efficiency, Reducing the Emissions of Volatile Organic Compounds, Producing a True Depolymerase for Biobleaching Softwood Kraft Pulp, Electrically Switched Ion Exchange for the Separation of Potassium and Chloride Ions to Enhance Water Recycle, Low Odor, High Yield Kraft Pulping, Reducing VOC Press Emissions from Oriented Strand Board Manufacturing, A New Freeze Concentration Process for Minimum Effluent Processes in Bleached Pulp Mills, Improved Pulping Uniformity by measurement of Single Fiber KAPPA Numbers ($4M)

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	SENSORS AND CONTROL: Ultrasonic Sensors for Paper Stiffness, Fiber Optic Sensing System for Measurement of Paper Web Parameters, Refiner Disc Gap and Wear, CCD-Based Sensor Instrumentation for On-Line Measurement of Paper Web Properties, Rapid Chemical and Physical Characterization of Wood Chips and Paper, Automated Sorting of Recycled Raw Materials and On-Line Chip and Web Analysis ($2.4M) RECYCLING: Stickies Control in Recycling Operations, Infrared Detection of Contaminants ($0.5M) SUSTAINABLE FOREST MANAGEMENT: High-Yield Hardwood Species, High Intensity Forest Management, Marker Aided Selection Methods for Wood Property Traits, Molecular Analysis of Carbohydrate Regulation in Loblolly Pine, Model-Based Diagnosis of Soil Limitations to Productivity ($1.3M) ($10,843)	Hardwood Species, High Intensity Forest Management, Marker Aided Selection Methods for Wood Property Traits, Molecular Analysis of Carbohydrate Regulation in Loblolly Pine, Model-Based Diagnosis of Soil Limitations to Productivity ($1.1M) ($12,040)	ENERGY PERFORMANCE: Design and Demonstration of Multiport Cylinder Dryers, High-Speed Microwave Treatment for Rapid Wood Drying, Moisture Distribution and Flow During Drying of Wood and Fiber, Biological Augmentation of Kraft Recycle, Growth and Property Development of Convection Pass Deposits in Recovery Boilers ($3.2M) SENSORS AND CONTROL: Ultrasonic Sensors for Paper Stiffness, Refiner Disc Gap and Wear, Rapid Chemical and Physical Characterization of Wood Chips and Paper, Contactless Real Time Monitoring of Paper Mechanical Properties, Real Time Wood Chip Moisture Content and Cross Direction Measurement of Web Caliper and Basis Weight by Magnetics ($2.1M) RECYCLING: The Removal of Wax and Stickies from old corrugated containers, Acoustic Separation Technology ($0.6M) SUSTAINABLE FOREST MANAGEMENT: High-Yield Hardwood Species, Model-Based Diagnosis of Soil Limitations to

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)			Productivity, Dominant Negative Mutations of Floral Homeotic Genes for Sterility in Trees, Pine Gene Discovery Project, Molecular Physiology of Nitrogen Allocation in Poplar, Sustaining the Productivity and Function of Intensively Managed Forests, Assessing the Significance of Below Ground Carbon Allocation of Fast and Slow Growing Families of Loblolly Pine, What Causes the Density Effects in Young Forest Plantations, Trees Containing Built-in Pulping Catalysts ($1.7M) ($12,076)
	$ 10,843	$ 12,040	$ 12,076
Steel Vision	The U.S. steel industry employs 170 thousand Americans in jobs paying 50 percent more than the average for all manufacturing. Steel is the most widely used engineering material in manufacturing, and forms the backbone of the infrastructure that defines our society, from silos to skyscrapers, from railroads to highway bridges, and from pipelines to supertankers. Steel is the most recycled of all materials.	In FY 1998, R&D activities continue to be responsive to the three critical areas defined in the steel industry vision, and will be prioritized and guided by the steel industry's technology roadmap. Significant benefits to steelmaking casting, rolling, and coating operations will be achieved by incorporating previously developed advanced	In FY 1999, the collaborative R&D partnership between the steel industry and DOE continues. R&D activities responsive to the three critical areas of production efficiency, iron-unit recycling, and environmental engineering of the Steel Industry's Vision of the Future will continue. The R&D will be both guided and prioritized by the Steel Industry Technology Roadmap.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)	The steel industry recycles nearly 55 million tons of scrap annually producing more than 50 percent of all steel from recycled material. This program will focus its strategies and its R&D in concert with the steel industry's vision of its future as described in "Steel: A National Resource for the Future" which identifies four critical areas requiring continuous improvement to retain steel's position as the material of choice for the 21st century. In DOE's R&D Compact with the steel industry, signed on May 2, 1995, DOE committed itself to collaborate in three of those critical areas: production efficiency, recycling, and environmental engineering. Based upon the steel industry's strategic vision of its future as described in "Steel: A National Resource for the Future," the industry is producing a tactical plan which will provide the essential technology roadmap for future steel R&D activities both public and private.	process controls into those operations.	Significant benefits to steelmaking casting, rolling, and coating operations will be achieved by incorporating previously developed advanced results from Metals Initiative funded projects on process controls into those operations. Other significant benefits will accrue to the steel industry as it incorporates the results of projects funded from sources other than that of Metals Initiative. Projects previously incorporated under the Steel Vision from Advanced Industrial Materials, Combustion Program, NICE3, and the Environmental Technology Partnership (ETP) will have started commercialization activities and will begin to benefit the industry.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)	In FY 1997 R&D activities were initiated that focused on three critical areas as identified in DOE's R&D compact with the steel industry: production efficiency, recycling, and environmental engineering. PRODUCTION EFFICIENCY: R&D efforts included the application of nickel aluminides (developed under the Advanced Industrial Materials Program) to steel forming and finishing operations. R&D on advanced process controls will improve energy efficiency and productivity in the U.S. steel industry by developing, testing, and commercializing selected sensors, control devices, and software to support steelmaking casting, rolling, and coating operations. ($4,500)	PRODUCTION EFFICIENCY: Nickel aluminides will be tested in steel forming and finishing (rolling) operations at U.S. plant host sites. R&D will continue on advanced process controls to improve energy efficiency and productivity in the U.S. steel industry by developing, testing, and commercializing selected sensors, control devices, and software to improve the efficiency of such basic steel processes as the blast furnace, basic oxygen furnace, and the electric arc furnace. Various process control modifications will also be developed and assessed under operating conditions to improved productivity and efficiency of these operations. Most tasks in the Advanced Process Control program are scheduled for	PRODUCTION EFFICIENCY: Continue collaborative R&D with The American Iron and Steel Institute (AISI) to improve the efficiency of steel making, casting, and rolling processes. R&D initiated in late FY 97 will be continued on subjects such as processes and techniques to remove residual elements, advanced casting technologies, and improved material properties. Application of high-temperature nickel aluminides to critical areas of steel making and forming operations (beyond steel rolls) will be made on an accelerated basis. Efforts in collaboration with the National Laboratory System, AISI and Steel Manufacturers Association (SMA) to identify and adapt nuclear and weapon systems related technologies previously developed at the National Labs

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)		completion in FY 1998, which accounts for the decreases from FY 1996. ($3,704)	for industry use will continue. ($3,827)
	RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations. ($4,405)	RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on methods to lower nitrogen oxide (NOx) and other emissions from combustion processes associated with steel production will be conducted. R&D will continue on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations. Methods of increasing the rate of steel scrap recycling from currently marginally tapped waste streams will be assessed and implemented. ($6,022)	RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on methods to lower NOx and other emissions from combustion processes associated with steel production will continue. Other R&D projects are responsive to the R&D needs identified in the chapters "Iron Unit Recycling" and "Environment" of the Iron and Steel Industry Technology Roadmap. This new R&D will provide material recycling and environmental improvements gained through efficiency and productivity increases in the steel production process. R&D on end-of-pipe concepts are specifically excluded. In collaboration with AISI, R&D will continue on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations. Continue

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)			collaborative R&D with the Electric Power Research Institute (EPRI) to minimize electric arc furnace dust emissions. R&D on methods of increasing the rate of steel scrap recycling from currently marginally tapped waste streams will be continued. ($6,800)
	$ 8,905	$ 9,726	$ 10,627
Aluminum Vision	In 1990 the U.S. primary aluminum industry had shipments valued at $23 billion, and was composed of 11 companies with only 3 retaining some research capability. In recent years the major companies have made extensive off-shore investments to exploit lower cost resources and operating costs. Leapfrog retrofitable metal production technologies for existing facilities and advanced manufacturing processes were critical to maintaining a viable domestic aluminum production and manufacturing industry.	The U.S. aluminum industry operates 300 plants in 40 states, employing 128,000 people, with a total payroll of more than $4 billion. The U.S. aluminum industry consumes approximately 0.9 Quad of energy annually at a cost of over $2 billion. The largest concentration of domestic aluminum shipments is in transportation, containers and packaging, and building and construction. As of 1994, the transportation market (24% of total 1994 shipments) is the largest user of aluminum. Recycling is a critical component of the industry; over one-third of the total industry supply of	To sustain a competitive advantage in the global marketplace into the 21st Century, the U.S. aluminum industry must maintain its leadership in energy efficiency, manufacturing processes and technologies, ecological sustainability, enabling technologies, information technologies, computational materials science, and multidisciplinary integration. Industry-wide performance goals include: reduce production costs by 25%, achieve significant costs reductions in aluminum for automotive applications, recycle and treat all types of aluminum

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	Reduction of energy consumption and operating costs in the production of primary aluminum metal, retention of alloy purity in metal recycling and leapfrog process improvements are key elements in producing competitive aluminum products for increased use in downstream applications and attendant weight reduction benefits to U.S. industry: Aerospace, automotive, food and beverage packaging, electric transmission, consumer durables, machinery and equipment, building and construction. This program focused on the completion of the Aluminum Vision of the Future and the realignment of existing Aluminum production, recycling and fabrication programs to the technology needs and opportunities included in the Vision. Government R&D funds are synergistically leveraged with other federal and state agencies and industry to address the technology needs and	aluminum now comes from recycled aluminum.	wastes, achieve 80% wrought recycling of autos by 2004, eliminate emissions of carbon dioxide in the smelting process, decrease energy intensity from an average of 15 kilowatt hours per kilogram (kw-hr/kg) to 11 kw-hr/kg.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	opportunities identified in the Aluminum Industry Vision of the Future and Technology Roadmap to ensure a viable U.S. aluminum industry in the world market. Benefits for this program include energy savings in primary aluminum production. The cost savings in metal production and fabrication will enable full utilization of aluminum in the transportation sector. Significant annual reduction in greenhouse emissions from metal production and the full implementation of aluminum in light weight vehicles will be realized. An additional benefit will be the many jobs generated/saved through cost reductions in the aluminum production industry. Implementation of the stable cathode technology will enable existing smelters to expand production capacity to meet the U.S. needs in 2010 without new smelter capital investments. All states are impacted with aluminum production and related automotive manufacturing centered in WA, TN, IL, IA, TX, CA, NY, NC, MI, OH, IN and PA. A scientific base will be		

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	initiated to ensure future viability of U.S. aluminum industry. Partnerships will be formed with other government and state agencies, universities, national laboratories and industry to generate a synergism in government supported R&D to address the integration of upstream, process and downstream enabling technology needs and opportunities addressed in the Aluminum Technology Roadmap. Primary metal production R&D includes design of a full-scale low energy pilot cell, testing of an energy-efficient pressure calciner, and evaluation of industry commercialization of aluminum salt cake recovery process.		
	R&D Activities: R&D in semifabricated production includes completion of a pilot test facility for spray formed automotive sheet metals. (Partnership for a New Generation Vehicle PNGV=$1,000) R&D in the finished products area includes development and characterization	R&D Activities: Continue R&D partnerships to address technical challenges identified in the Aluminum Technology Roadmap. Research partnerships will address the needs of the primary, semifabricated, and finished product sectors of the Aluminum industry, as well as provide enabling technical support for the	R&D Activities: Continue support for R&D partnerships to address technical challenges identified in the Aluminum Technology Roadmap. Research partnerships will address the needs of the primary, semifabricated, and finished product sectors of the Aluminum industry, as well as provide

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	of an aluminum bridge deck system using multi-void extrusions joined together to make panel sections, for upgrading deficient bridges in the U.S. Aluminum partnerships will provide enabling technical support for the industry in arenas such as furnace design, modeling and control, and improvements in materials properties and processes. Advanced electrolysis process control sensors will provide 1-2% productivity gains in existing aluminum production cells and the improved bath composition control required for the commercial use of inert anodes in the advanced aluminum production cell capable of energy savings to 32% and production cost savings up to 30%. Innovative Concepts projects in aluminum are completed. ($5,503)	industry in areas such as furnace design, modeling and control, and improvements in materials properties and processes. Core R&D will include completion of plant testing of sensors, evaluation of inert/stable electrode materials for primary aluminum production, and commercialization of an aluminum salt cake recovery process. Complete sprayforming pilot unit and optimize alloy and processing parameters to increase use of recycled aluminum in auto sheet products with reduced material and energy costs. (PNGV=$1,000) ($7,335)	enabling technical support for the industry in areas such as process modeling, high-performance furnace designs, and improvements in materials properties and processes. Core R&D will include continued evaluation of inert/wettable electrode materials and advanced cell designs for primary aluminum production, development of semisolid forming techniques, and development of robust sensors and controls for harsh environments. Complete construction of the spray forming Advanced Development Unit and test the viability of the process to produce automotive aluminum sheet with reduced material, production, and energy costs. (PNGV=$1000) ($8,178) Execute research that aligns with the mining industry's technology roadmap. ($1,000)

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	$ 5,503	$ 7,335	$ 9,178
Metal Casting Vision	The research co-funded on an equal basis with industry has resulted in improvements in energy and raw material usage efficiency, process knowledge, and a reduction in environmental impacts. All of these impacts are dependent on the commercialization of the technologies developed and therefore increase into the future. The estimated results of this six year partnership with the metalcasting industry include. Energy: The metalcasting industry uses about 250 trillion Btu's of energy each year. Program research has resulted in an estimated yearly energy savings to the Nation of 5.3 Trillion Btu which relates to an annual cost savings in 1994 dollars of $203 million. Environment: The Metal Casting Industry is the largest recycler in North America saving 13.3 million tons of scrap metal from disposal in landfills and junk yards each year. Scrap iron and steel are a major source of raw	The program focuses its strategy and R&D on high priority technologies as defined by the Metal Casting Industry Vision of the Future, Beyond 2000. The program maintains its focus and relevance through the partnership with the Cast Metal Coalition, which is composed of industry experts from the American Foundrymen's Society, North American Die Casting Association, and Steel Founders' Society of America, directly serving over 1,400 metalcasting companies, and indirectly serving more than 2,000 metalcasters in the United States, and its oversight by industry. Each project proposed is reviewed by the OIT metal casting team to priorities those with the strongest match to our energy, environmental, and economics goals for the Nation.	Continue R&D partnerships with the Cast Metal Coalition (CMC) to address the technical challenges identified in the Metalcasting Technology Roadmap. Benefits of the metalcasting R&D activities to the nation by year 2010 include: 1) increase of energy efficiency resulting in energy savings, 2) reduction of waste generation, and 3) increase in productivity. Technology transfer will also be effectively accomplished through the CMC, which is composed of industry experts from the American Foundrymen's Society, North American Die Casting Association, and Steel Founders' Society of America, directly serving over 1,400 metalcasting companies, and indirectly serving more than 2,000 metalcasters in the United States.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	material for foundries. Program research has resulted in an estimated reduction of CO_2 emissions by almost 440,000 tons each year and SOx reduction of 2,000 tons each year. Industries Vision for Its Future The metal casting industry developed a comprehensive vision document called "Beyond 2000: A Vision for the American Metal casting Industry." As stated in Beyond 2000 "Metal casting will be the preferred supplier of net or near-net shape metal components beyond the year 2000. Its globally competitive products will be produced in an efficient, environmentally friendly manner." The key challenges for the metal casting industry as described in their vision include: the development of advanced manufacturing technologies to increase productivity 15%, reduce average lead times 50%, and reduce energy consumption 3-5%; Develop environmental technologies to achieve 100% pre- and post-consumer recycling; 75% beneficial re-use of foundry by-products, and the complete		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	elimination of waste streams. Beyond2000 allows for the focusing and leveraging of federal funds and resources toward technologies critical to the metal casting industry and which completely eliminates waste streams. The partnership between the metal casting industry and DOE will continue to be successful and was renewed by the signing of a compact between the Secretary of Energy and the Metal Casting Industry in October of 1995 and is destined for continued success. The program focuses its strategy and R&D on high priority technologies as defined by Beyond 2000 so that industry can transfer research results to the metal casting shop-floor; and to establish centers for conducting Metal casting Research. Research conducted under this program requires significant industry participation and an equal match for each Federal dollar invested. The program focuses its strategy and R&D on high priority technologies as defined by the Metal Casting Industry Vision,		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	Beyond 2000, so that industry can transfer research results to the metal casting shop-floor; and to establish centers for conducting Metal casting Research. Research conducted under this program requires significant industry participation and an equal match for each Federal dollar invested. This portfolio of near-, mid-, and long-term projects supports Beyond 2000 and furthers the national goals of reduced energy consumption, environmental responsibility, resource efficiency, and a strong national manufacturing base.		
	R&D Activities: Continue projects that demonstrate continued technical success. Continue research on the critical technology needs identified in Beyond 2000 and the metal casting technology roadmaps with guidance by the partnerships with the Cast Metals Coalition. Provide continued support for 8 of the 13 projects started in FY96 and co-fund about 10 projects that are focused on the key challenges identified in Beyond 2000. Planned project areas include "Unconventional Methods for	R&D Activities: Continue funding of 7 projects started in FY96 that demonstrate continued technical success. Continue balancing the research portfolio to provide results in the time frames identified by industry in the technology roadmaps for each sector of the metal casting industry. Continue the research development partnerships with the Cast Metals Coalition on the critical technology needs	R&D Activities: Continue to maintain a balanced portfolio of high priority projects in meeting the challenges identified in the MetalcastingTechnology Roadmap, which will benefit each sector of the metalcasting industry. The continued present-funded projects from previous years' solicitations include the following educational institutions: University of Alabama-Tuscaloosa, University of Alabama-Birmingham, Ohio State University, Worcester Polytechnic Institute, Case

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	Yield Improvement through Directional Solidification in Steel Castings," "Impurity Limits in Aluminum Bronzes," "Clean Machinable, Thin-Walled Gray & Ductile Iron," "High Speed Milling," "Yield Improvements," "Wear Analysis of Foundry Tooling Materials," "Clean Metal Casting," "Cupola Neural Network Model & Feedback Control" ($3,399)	identified in Beyond 2000. Planned project areas include: "Lost Foam Process Development," "Evaluation of Coatings for Die Resistance," "Sensors for Die Casting," and "Thin wall castings for light weight components." Technologies in thin wall casting also targets the automotive market with strong recyclable cast components which would offset the use of other more expensive metals. The benefits of this project include reduced energy consumption in the iron casting process, transportation fuel savings in automobile applications and 50% reduction in machining scraps. ($5,480)	Western Reserve University, Penn State University, University of Wisconsin-Milwaukee, University of Michigan, and University of Iowa. Manufacturing Technologies: Planned activities that will improve energy efficiency, casting productivity, and quality include: 1) Computer Modeling efforts, e.g. "Computer Modeling of Short Sleeves," 2) Advances in Semi-Solids Metal Processing technologies, e.g. "Semi-Solid Metal Processing" and "Properties of Squeeze and Semi-Solid Metal," 3) Advances in Metal Cleanliness, e.g. "Clean Metal Casting" and "Clean Cast Steel," and 4) Advances in Thin-Wall Casting, e.g. "Thin Section Steel Castings" and "Thin-Wall Iron Casting." Tools and new sensors will also be developed to improve die-cavity filling for higher quality castings, extend die life, and minimize part distortion for die-casting process used for aluminum, magnesium, and zinc alloys, e.g. "Sensors for Die Casting" and "Evaluation of Coatings for Die Wear Resistance." Examples of other

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)			process improvement activities include: "Advances in Lost Foam Process Development" and "Heat Transfer Permanent Mold Aluminum Alloys." Materials Technologies: Activities are focused on Advancing the Use of New and Improved Materials for Castings, e.g. "Cast Particulate Metal Matrix Components" and "Clean, Machinable, Thin-Wall Iron Casting Production." Environmental Technologies: Begin developments in new waste characterization, reduction, reuse, and alternate use of foundry waste. ($5,797)
	$ 3,399	$ 5,480	$ 5,797
Glass Vision	Glass is an important component of the U.S. economy, employing 150,000 people in skilled jobs, and generating more than 21 million tons of consumer products annually at a value of $22 billion in optical fibers to windshields to medicinal vessels. Manufacturing		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)	lines ranging from 650 ton/day float lines to hand glass day tanks feel increased competition from alternate materials and lower R&D resources at 1.75% of sales where capital intensity is 5.2% of annual sales with lifetimes of furnaces beyond 10 years. Energy cost is running an average of 12% across the sectors of container, flat, fiberglass, and specialty glass. This highly competitive, capital-intensive industry ($100 million to build a facility) requires a cultural transition to leveraging between members of its community, which this federal strategy solely provides. The focal points of the industry's vision, Glass: A Clear Vision for a Bright Future, are meeting targets by 2020 in the areas of: production efficiency, energy efficiency, environmental protections, recycling, and innovative uses. Projects shall be identified that are key priorities for the industry, such as development of refractory materials, oxygen fuel optimization, and modeling of		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)	furnace operation. These technologies shall be developed in partnership with industry to be commercialized by them to move the whole industry forward in improving the Nation's technology balance, reducing fuel consumption, and improving environmental compliance. Goals as stated by the industry include: production costs reduced at least 20% below 1995 levels; recycling 100% of all glass products in the manufacturing process; reducing process energy use from present levels resulting in major cost savings; reduction of air/water emissions by a minimum of 20% through environmentally sound practices; increased recycling of available post consumer glass; achieve six sigma quality through automation, process control, optimized glass composition, and computer simulation; create innovative products and broaden the marketplace; and increase supplier and customer partnerships in raw materials, equipment, and energy improvements in 2020.		

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)	R&D Activities Include: PRODUCTION EFFICIENCY: Continuation of Molybdenum Disilicide as a Coating and Structural Component in Glass Furnaces, Initiation of New Alloy Development, Initiation of Refractory Materials and Creep Assessment, Modeling Properties Assessment of Glass Characteristics; ENERGY EFFICIENCY/ CONSERVATION: Completion of Air Enriched Air Staging, Completion of Oxy-Fuel Problems Workshop, Continuation of Advanced Combustion Space Modeling; ENVIRONMENTAL PROTECTIONS: Continuation of High Heat Transfer/Low Emissions Gas Combustion System; RECYCLING: Continuation of Cullet/Batch Preheater, Cullet Preparation and Contaminant Removal; INNOVATIVE USES: Continuation of Chemical Vapor Deposition; DEPLOYMENT LOGISTICS: Completion of Benchmarking Assessment. ($2,917)	R&D Activities Include: PRODUCTION EFFICIENCY: Completion of Molybdenum Disilicide as a Coating and Structural Component in Glass Furnaces, Continuation of New Alloy Development, Continuation of Refractory Materials and Creep Assessment, Initiation of Advanced Sensor, Modeling, and Properties Development; ENERGY EFFICIENCY/ CONSERVATION: Completion of Advanced Combustion Space Modeling, Initiation of Optimized Electric Boost; ENVIRONMENTAL PROTECTIONS: Completion of High Heat Transfer/Low Emissions Gas Combustion System, Initiation of Non-Hazardous Waste Refractory Materials, Initiation of Solid Waste Reuse in Glass Manufacture; RECYCLING: Completion of Cullet/Batch Preheater, Continuation of Cullet Preparation and Contaminant Removal; INNOVATIVE USES: Completion of Chemical Vapor Deposition;	R&D Activities Include: PRODUCTION EFFICIENCY: Initiation and/or continuation of new projects started in FY 98 in the following areas: controls for process optimization for desired glass properties; contact and non-contact sensors for glass physical properties, heat flux, furnace refractory thickness and temperature, on-line stress measurements; and process simulation models that actually simulate the glass manufacturing process. Completion of new alloy development and creep assessment. ENERGY EFFICIENCY/ CONSERVATION: Initiation and/or continuation of new projects started in FY98 in the following areas: glass furnaces with lower net production cost; in-situ testing of furnace refractories; and combustion laboratory characterization of flames from different burner configurations. Continued development of optimized electric boost. ENVIRONMENTAL PROTECTIONS AND RECYCLING: Initiation and/or

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)		DEPLOYMENT LOGISTICS: Completion of Coating & Composition Workshop. ($3,883)	continuation of new projects started in FY98 in the following areas: improved oxy-fuel firing technology to reduce air emissions; alternate raw materials, batch preparation, and/or furnace designs with lower particulate and gaseous emissions; improved sorting and preparation of post-consumer waste. Completion of non-hazardous waste refractory materials and solid waste reuse. INNOVATIVE USES: Initiation and/or continuation of new projects started in FY98 in the following areas: innovative glass compositions and processes to enhance performance; new material-design models to improve properties; and enabling technologies that allow new and innovative uses of glass. DEPLOYMENT LOGISTICS: Conduct two (2) technical workshops. Conduct technology roadmap assessment. ($4,830)
	$ 2,917	$ 3,883	$ 4,830
Chemicals Vision	The chemical industry employs over one million people in the	Benefits of these activities will result in improved productivity,	

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	U.S. It has sales of over $313 billion, of which $45 billion represents exports. Over 91% of the 10,000 companies in this diverse industry have fewer than 100 employees. It is the second largest energy consumer and the largest generator of waste in the manufacturing sector. Downsizing and global market pressures have forced re-deployment of resources to address critical short term needs so the industry can no longer afford to fully assume the financial risk associated with long-term revolutionary R&D. The balanced OIT R&D portfolio is aligned with the Chemical Industry Technology Vision 2020 functional structure. Industry has identified four critical technical areas: New Chemical Science and Engineering Technology, Computer Utilization & Information Management, Manufacturing Operations, and Supply Chain and Logistics. Technologies developed in partnerships with industry will be commercialized by industry, improving the Nation's balance of	increased energy efficiency, and significant reduction in process wastes. The chemical program is aligned with large and small private companies, using the unique resource of the National Laboratory System and U.S. universities. Jobs saved or retained exceed 14,000 person years in 2010.	

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	payments, reducing oil imports, improving the environment and creating new high paying jobs.		
	R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement and computational technologies. Projects include commercialization of technologies for wood waste to adhesive and plant starch to plastics. ($8.8M) COMPUTER UTILIZATION & INFORMATION MANAGEMENT: e.g. Complete OIT's contribution to computer models of environmental effects of processing: ($0.183M) MANUFACTURING OPERATIONS: e.g. Initiate field testing of technology for membrane separation of	R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement and computational technologies. Projects include completion of polyphosphazene membrane test of pallet-sized membrane system at an industrial site to familiarize industry with technology. The bio-process for di-acid production will be scaled-up to an intermediate size to collect basic operating data and obtain process performance data prior to a full-scale pilot plant demonstration. ($10.614M) MANUFACTURING OPERATIONS: e.g. Support R&D identified in the Chemical Industry Technology Vision 2020	R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement. Support R&D identified in the chemical industry roadmaps including catalysis, bioprocesses, and separations. ($10.492M) Execute research in biobased renewable feedstocks which supports the Agriculture vision. ($2.0M) COMPUTER UTILIZATION AND INFORMATION MANAGEMENT: Support R&D identified in the chemical industry roadmap on computational fluid dynamics and chemistry. ($1.0 M) MANUFACTURING OPERATIONS: Support R&D

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	chlorinated wastes. ($1.0M) ($9,983)	with industrial partners such as the Center for Waste Reduction Technologies. ($1.0M) ($11,614)	identified in the Chemical Industry Technology Vision 2020 with industrial partners such as the Center for Waste Reduction Technologies. ($1.0 M) ($14,492)
	$ 9,983	$ 11,614	$ 14,492
Petroleum Refining Vision	The Petroleum Refining (SIC 2911) industry is critical to the economic stability and energy security of the United States. The annual value of all product shipments from the petroleum refining industry is about $136 billion. The industry supplies 97% of the transportation fuels for the nation. This industry is facing major restructuring in response to international competition and the requirements to meet the Clean Air Act Amendments of 1990. In response to these immediate needs, the industry is unable to maintain its financial commitment to high risk R&D. The industry consumes about 6 quads annually, and produces 180 million tons/yr. of wastes. There are 163 refineries situated in 35	Research activities with the Petroleum Refining industry were brought to an orderly close during FY98, due to the industry's reluctance to proceed with the development of an industry vision and technology roadmaps. ($3,000)	No Activities. ($0)

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Petroleum Refining Vision (Cont'd)	states, with California, Texas and Louisiana representing 80 refineries. The industry employment is 77,000. The Petroleum Refining program is a strategic response to the needs of this industry, as defined by multiple industry inputs including a Workshop report and a National Petroleum Council study. The program is conducted in partnership with industry and addresses these research priority areas: Environmental & Safety Performance; Process Improvement; Enabling Technologies; and Feedstock Flexibility and Product Characterization. R&D Activities include: ENVIRONMENTAL & SAFETY PERFORMANCE: Very Low Emission Burners; ($0.98M) PROCESS IMPROVEMENT: High Pressure Heat Exchanger for Ethylene Production; ($0.75M) ENABLING TECHNOLOGIES: Advanced Fluid Catalytic Cracker, Fouling Mitigation, Improved Refining Catalysts; ($1.052M)		

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Petroleum Refining Vision (Cont'd)	FEEDSTOCK FLEXIBILITY/PRODUCT CHARACTERIZATION: Removal of Sulfur from Petroleum Products. ($1.0M) A specific R&D example is Advanced Fluid Catalytic Cracker (FCC). The U.S. consumes annually about 22 quads of transportation fuels, with more than 40% of all gasoline produced by the FCCs. The FCC project targets a 7% improvement in yield in the processing of crude oil to produce these fuels. ($3,782)		
	$ 3,782	$ 3,000	$ 0
Industry-Wide Solicitation	No Activities. ($0)	No Activities. ($0)	INDUSTRY-WIDE SOLICITATION: A competitive solicitation will be conducted which will focus on reducing the generation of climate change gases, and increasing energy efficiency in the industrial sector. These items will, in turn, result in higher productivity at the plant level, and increased or sustained jobs. This solicitation will be open to all industries, with

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Industry-Wide Solicitation (Cont'd)			emphasis on those industries which have developed industry-wide visions and associated roadmaps to develop advanced technologies to improve their environmental and energy performance. Proposals will be selected which will have the most impact on climate change gases, especially including non-CO_2 greenhouse gases and energy efficiency and which will have widespread applicability in industry. The solicitation will be scheduled in order to make contract awards early in the fiscal year, in order to reduce uncosted obligations. At the proposed level of funding, research on roughly 40 new technologies might be initiated, which could eventually lead to a reduction of carbon emissions on the order of 10 million metric tons and several trillion Btus of energy. Productivity gains of 5% could be expected. ($19,000)
	$ 0	$ 0	$ 19,000
Industries of the Future (Specific) Total	$ 45,332	$ 53,078	$ 76,000

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

INDUSTRIES OF THE FUTURE (CROSSCUTTING)

I. **Mission Supporting Goals and Objectives**:

A. Statement of Mission:

Crosscutting Technologies address the problems common to all of the Vision Industries. The planning units include Cogeneration/Advanced Turbine Systems, Continuous Fiber Ceramic Composites/Advanced Industrial Materials, and Combustion/Sensors. An efficient use of R&D resources is gained by dealing with these common problems in specialized programs.

Cogeneration is the concurrent production of two forms of energy (e.g., electricity and steam) from the same fuel source, typically using the exhaust from one system as the input for the other. Cogeneration system efficiencies can reach as high as 80% and produce much less pollution than conventional systems.

The Advanced Turbine Systems (ATS) Program will develop and demonstrate the next generation of gas turbines for both utility and industrial applications, including cogeneration and combined heat and power. The goals of the ATS program are to improve the efficiency (15% increase) and environmental performance (80% reduction in emissions) of gas turbines while reducing the cost of electricity by 10%. These goals will be met through advancements in engine system and component design, including innovations in cooling, materials, and coatings. The environmental goals will require the use of new combustion techniques including ceramics and catalytic combustion.

U.S. industry has a critical need for high performance materials that improve productivity, product quality, and energy efficiency in industrial products and the major process industries. Ceramic materials offer superior performance in energy intensive processes, but are often too brittle for many operations. The goal of the Continuous Fiber Ceramic Composite (CFCC) Program is to overcome these limitations with new material systems. The Advanced Materials Program is focusing efforts on the development of materials with high temperature strength and fatigue resistance, improved corrosion resistance, and better wear resistance.

The CFCC Program operates as a collaborative effort between industry, national laboratories, universities and the government to develop advanced composite materials to a point at which industry will assume the full risk of further development. There are currently six industry teams comprising 51 members (led by AlliedSignal, Babcock & Wilcox, Dow Corning, DuPont Lanxide, General Electric, and Textron) developing more than 20 applications for continuous fiber ceramic composite materials. The National Laboratories, led by **Oak Ridge National Laboratory**, are developing supporting technologies (e.g., material design, processing methods, manufacturing techniques) and conducting performance evaluations.

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

The Advanced Materials Program supports the joint DOE/industry vision programs through several activities. Projects include: the development of nickel aluminides to make steel mill and foundry equipment last longer; molybdenum disilicide and other materials for longer glass melting furnaces; and polymer processing methods for better plastic products. Specific activities continue on intermetallic alloy development, including nickel, iron, and titanium aluminides. For example, a project was initiated to develop improved composite tubes for boilers used by most paper manufacturers. Other activities include development of ceramic processing methods, metal matrix composites by innovative methods, and improvement of properties of polymers.

The goal of Combustion activities is to maximize efficiency and minimize emissions at the lowest practical cost. The ongoing implementation of clean air regulations and relatively low fuel prices have shifted industrial concern, and consequently program emphasis, to low-cost approaches to reducing air pollution emissions from industrial combustion sources. Combustion activities at OIT are driven by the needs of industry and guided by end-user experts from industry, academia, and national laboratories. The program is designed to move superior combustion concepts from the laboratory through industry host site demonstration resulting in commercialization. All projects are cost-shared with industry partners. A distinct record of success and maximum results for the taxpayer dollar are hallmarks of OIT combustion activities. Oxy-fuel combustion, first demonstrated under OIT combustion sponsorship, is now operating on over 20 percent of U.S. glass production capacity. The combustion program concentrates on projects which span more than one industry need. All of the Industries of the Future rely on combustion of fuels to achieve process goals and must deal with the emissions which result from combustion. The program develops methods to improve boilers, furnaces, and burners for the target industries. The program also works to coordinate combustion with improved sensors and controls for optimization of operation and emissions controls.

B. Program Benefits

	2000	2010	2020
Total Primary Energy Displaced (quads)	.01	.30	.68
Energy Cost Savings ($billions)	.02	.92	1.96
Carbon Reductions (million metric tons)	.10	4.55	10.08

Productivity improvements could result in other cost savings equal to or greater than the energy cost savings.

C. Performance Goals

The Strategy/Goal for 2001 for the Advanced Turbine Systems program is for commercial introduction of gas turbines that will:

-- increase efficiency from 29% to 43%.

-- lower Nitrogen Oxide (NOx) emissions to less than 8 ppm.

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

-- lower Carbon Monoxide (CO) and unburned hydrocarbons to less than 20 ppm.

-- reduce the cost of electricity by 10%.

-- encourage the expanded use of cogeneration.

D. Accomplishment Summary:

FY 1997

-- Completed ATS subsystem engine design and testing.

-- Demonstrated representative components including high temperature filters, hot gas filters, and submerged aluminum melters.

-- Completed Phase II, feasibility testing activities of most applications, in the CFCC program.

-- Completed large-scale testing of nickel aluminide trays and fixtures for carburization of steel components.

-- Developed six new applications for nickel, iron, and titanium aluminide in the major process industries.

-- Completed development of new processes for production of metal matrix composites for high temperature applications.

-- Identified reasons for whirl burner low NOx.

-- Determined limiting heat transfer step in black liquor gasification process.

FY 1998

-- Complete Ceramic Stationary Gas Turbine field test (2000 hr) at 1850 degrees F.

-- Complete single crystal gas turbine blade castings development.

-- Initiate thermal barrier coating bench-scale testing.

-- Complete ATS full-scale engine tests.

-- Prepare for first field evaluation of ATS engines.

I. **Mission Supporting Goals and Objectives**: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

-- Deploy nickel aluminide to all segments of industry.

-- Minimize whirl burner CO levels.

-- Determine if black liquor fuel gas can be used in pulse combustor.

-- Reconcile differences between fuel gas recirculation modeling and experimental results.

FY 1999

-- Initiate Phase IV thermal barrier coatings development in ATS.

-- Complete ATS combustion testing.

-- Continue deployment of nickel aluminide to all segments of industry.

-- Develop new iron aluminide materials for die casting, and boiler tube applications.

-- Complete submerged aluminum melter tests of CFCC's.

-- Complete whirl burner scoping, prepare package for transfer of technology to industry.

-- Produce complete explanation of effectiveness of fuel injection recirculation.

-- Extend oscillating combustion to rotary hearth furnace.

II. A. **Funding Table**: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Cogeneration	$ 24,157	$ 34,650	$ 33,000	$ -1,650	-5%
Advanced Materials and CFCCs	14,221	14,470	14,400	-70	0%
Combustion Technologies	0	0	2,000	2,000	>999
Total, Industries of the Future (Crosscutting)	$ 38,378	$ 49,120	$ 49,400	$ 280	1%

II. B. **Laboratory and Facility Funding Table**: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Ames Lab	$ 50	$ 0	$ 0	$ 0	0%
Argonne National Lab (East)	205	275	275	0	0%
Los Alamos National Laboratory	1,400	1,100	1,100	0	0%
Oak Ridge National Lab	7,073	7,410	7,350	-60	-1%
Sandia National Laboratories	760	750	750	0	0%
All Other	28,890	39,585	39,925	340	1%
Total, Industries of the Future	$ 38,378	$ 49,120	$ 49,400	$ 280	1%

III. <u>Performance Summary</u>: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration	Continue the industrial and utility Advanced Turbine Systems (ATS) program activities including design, manufacture and testing of full-scale components and integrated subsystems. Preparations for 8000 hour field demonstrations commenced. Complete preliminary engine designs. ($16.5M) Complete retrofit of Gas Turbine Ceramic Retrofit field test engine. Commence 4000 hour field test at the cogeneration site in Bakersfield, CA. Pre- and post-testing component evaluation and characterization commenced. ($3.5M) Complete field evaluation of three turbines equipped with Ultra-Low NOx technology. ($0M) Continue enabling materials support program including scale-up of single crystal turbine castings and improved Thermal Barrier Coatings. ($4.0M) ($24,157)	Continue the industrial and utility Advanced Turbine Systems (ATS) program activities including design, manufacture and field testing of full-scale components and integrated subsystems. Complete engine detail designs. Continue turbine and compressor rig testing. Commence first engine builds. Evaluate the market of ATS for distributed generation applications. ($24.5M) Complete 2000 hour Gas Turbine Ceramic Retrofit field test at the cogeneration site in Bakersfield, CA. Continue pre-and post-testing component evaluation and characterization. ($4.0M) Continue enabling materials support program including scale-up of single crystal turbine casting and improved Thermal Barrier Coatings. Complete melt desulfurization technology development for turbine castings. Complete Phase III for Thermal Barrier Coatings projects. Continue development of catalytic combustion technologies for reduced emissions in	Continue the industrial Advanced Turbine Systems (ATS) program activities including manufacture and field testing of full-scale components. Commence first industrial scale engine builds and initiate full-scale testing. Continue ceramic insertion program for industrial turbines, including microturbines. ($23.0M) Complete post-testing component evaluation and characterization. ($4.0M) Continue enabling materials support program including scale-up of single crystal turbine casting and improved Thermal Barrier Coatings. Initiate Phase IV of thermal barriers coatings. Continue to identify defect tolerance limits and alternative casting technologies. ($4.0M) ($31,000)

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)		industrial gas turbines. ($6.0M) ($34,650)	
	No Activities. ($0)	No Activities. ($0)	Initiate combined heat and power (CHP) challenge program for improved deployment of CHP systems. ($2,000)
	$ 24,157	$ 34,650	$ 33,000
Advanced Materials and CFFCs	Continue Phase II activities to improve engineering and material processing methods and continue fabrication and testing activities. Most industrial participants will complete Phase II feasibility testing activities this fiscal year and begin demonstration of representative components. Demonstrated components will include diesel valve guides, submerged aluminum melters, burners and filters. Continue tests of materials and representative components in gas turbine, coal exhaust, electric motors, and combustion environments. ($6.1M) Continue to develop supporting technologies (such as interfaces, joining, fibers, standards), conducting performance evaluations, and developing design methods for CFCC	Continued long term field demonstration and testing of components, environmental exposure of components, material analysis, data collection and database establishment. Continued long term tests of representative components in gas turbine, coal exhaust, and combustion environments. Begin some pilot scale process development activities. Begin batch production of burners, diesel valve guides and filters. ($6.4M) Continue work on conducting performance evaluations, test methods, fiber interfaces, coatings, joining, design standards, and materials needs assessments. ($2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, DoD, NASA,	Continued long term field demonstration and testing of components, environmental exposure of CFCC components, material analysis, data collection and database establishment. Continued long term tests of representative components in gas turbine, coal exhaust, and combustion environments. Continue pilot scale process development activities. Continue batch production of burners, diesel valve guides, combustor linings, and filters. ($6.4M) Continue work on performance evaluations, test methods, fiber interfaces, coatings, joining, design standards, and materials needs assessments. ($2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, DoD, NASA, and others. ($8,400)

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Materials and CFFCs (Cont'd)	components. ($2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, Department of Defense (DOD), National Aeronautics and Space Administration (NASA), and others. ($8,160)	and others. ($8,400)	
	For FY97 and future years some mature projects were transferred to the industrial vision areas. This included two nickel aluminide projects for steel, a molybdenum disilicide project for glass, and a polymer processing project for chemicals. Work will continue on materials processing including composite tubes for Kraft boilers, ceramic process development, polymers for membranes, and commercialization of processes for magnetic field treatment of organic polymers. ($6,061)	Identification of new industrial applications for nickel, iron, and titanium aluminides will be made and applications engineering will be done to adapt these materials to those uses. Development of new iron-chromium alloys for contact with molten glass will be continued, as will development of new coatings for flat glass, and new chromium silicides will be tested in industrial applications. The process for polymerization of plastics in magnetic fields will be transferred to the Chemical Industry Vision for commercialization. Work to develop superior gas separation membranes using liquid crystal polymers will be continued. Development of composites by molten metal infiltration will be continued, with emphasis on intermetallic alloy matrices. Work will continue on uniform metal droplets, with emphasis on high	Following on successful identification of new industrial applications for, and demonstration of, nickel and iron aluminides in FY 1997, the effort will continue, at an accelerated pace, to deploy these materials in a wider range of applications over all the Vision Industries. Additional work will be done on titanium aluminides, which have superior specific strengths at high temperatures, in order to ready them for industrial trials. Development of chromium silicides, iron-chromium alloys, and iron-chromium-silicon alloys for molten glass contact applications and uses in corrosive atmospheres in the chemical and refinery industries will continue and new applications will be identified. CRADAs with Dow Chemical and Amoco, to develop superior organic and inorganic membranes for gas and liquid

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Materials and CFFCs (Cont'd)		temperature alloys, steel, and aluminum for the primary metals and powder metals industries. ($6,070)	separations and an electrochemical reaction cell for improvement of energy efficiency in the chloralkali process, will be completed. Development of metal matrix composites by reactive metal infiltration, under terms of a CRADA with Reynolds Metals and A.P. Green Industries, will be continued, with completion scheduled for FY 2000. Work will continue on uniform metal droplets and spray coatings, with emphasis on high temperature alloys, steel, and aluminum, for the primary, secondary, and powder metallurgy industries. Industrial trials will continue and new applications will be identified. ($6,000)
	$ 14,221	$ 14,470	$ 14,400
Combustion Technologies	In FY97 some combustion projects were concluded. Prior year funds were used to continue whirl burner scoping and benefits analysis of black liquor gasification process with technology transferred to manufacturer. Other projects continued in vision areas as requested by specific industries. ($0)	Prior year funds were used to continue whirl burner scoping, fuel gas recirculation investigation and benefits analysis of black liquor gasification process with technology transferred to manufacturer. Other projects continued in vision areas as requested by specific industries. ($0)	Complete whirl burner scoping with transfer of technology to industry. Continue pre-competitive fuel injection recirculation research to determine why this procedure is more effective than flue gas recirculation. In conjunction with glass, steel and metal casting activities demonstrate oscillating combustion in additional

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Combustion Technologies (Cont'd)			equipment types, continue development of efficient low cost heat exchanger system for power generation. For FY99 the combustion program will examine industrial boilers, process heaters and furnaces in the seven industries for cross-cutting impacts. Integration of combustion and sensors technologies will improve industrial performance and reduce emissions. Emphasis will be on low emissions, high efficiency, and remote sensing for high temperature, corrosive systems. Synergies between the vision industries will be examined to increase leveraging of projects. Participants include the Gas Research Institute (GRI), the Electric Power Research Institute (EPRI) and the seven vision industries. ($2,000)
	$ 0	$ 0	$ 2,000
Industries of the Future (Crosscutting) Total	$ 38,378	$ 49,120	$ 49,400

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

TECHNOLOGY ACCESS

I. Mission Supporting Goals and Objectives:

A. Statement of Mission: The Technology Access Program plays an important role in launching new industrial technologies from the research and development stage to the manufacturing plant where the technology can be used to boost the productivity and competitiveness of U.S. industry. The goal of the program is to facilitate and promote the introduction to industry of near-term and emerging energy efficiency, renewable energy and pollution prevention technologies.

The strategy of the Technology Access Program is to work closely and develop partnerships with key industrial firms, Federal, State and local governments, industry and trade associations, inventors, universities, and others with a stake in U.S. industrial competitiveness -- to jointly develop and implement innovative and effective ways to demonstrate, communicate and promote the benefits of energy savings, pollution prevention and cost savings possible through the adoption of energy-efficient industrial technologies. As a result of continuing dialogue with these partners, and based on feedback from industrial clients, an improved system for delivery of existing technical assistance services has been implemented. Under this new integrated delivery approach, near-term technical assistance services formerly available only through separate contacts with each of the individual programs, are now available on a single point-of-contact basis. By contacting staff from any of the technical assistance programs, industrial clients can get information and access to any of the services which might best fit their needs. Technical assistance can then be provided through the most effective combination of the individual Technology Access Programs.

As part of the Industries of the Future Program strategy, the Technology Access Program provides near-term technology implementation assistance to Vision Partners. Working closely with Vision Partners to bring successful R&D projects into the industrial marketplace allows the program to offer concrete evidence of the economic and productivity gains that are possible now through advanced, clean, and efficient technology. Successful partnerships developed with industry to speed the implementation of such technologies can significantly strengthen industry's commitment and resolve to work with the Office of Industrial Technologies on longer-term energy efficiency and pollution prevention solutions possible through the Industries of the Future Program.

I. <u>Mission Supporting Goals and Objectives</u>: TECHNOLOGY ACCESS (Cont'd)

The Technology Access Program is comprised of the following programs:

1) The Industrial Assessment Center (IAC)/Technology Transfer Program. The Industrial Assessment Center Program provides energy, waste, and productivity assessments to small- and medium-sized manufacturers in order to pinpoint and analyze opportunities for cost-effective energy, waste and productivity savings; and at the same time to provide hands-on training to engineering students in energy, waste and productivity management practices. It is also the only program which provides engineering students with both theoretical and practical plant experience in energy and waste management and productivity improvements. This university-based program serves parts of 43 states through 30 university engineering departments. IACs assist the Industries of the Future Partners and other manufacturers by providing assessments to vital industries, and by providing actual case study data on industry technologies with the greatest potential impact. The approximately $45 million dollars provided to participating universities (since the Program's inception 21 years ago) to conduct assessments has generated an estimated $375,000,000 in cost savings to manufacturers. This represents a ratio of $8.00 for every Federal dollar spent.

The Technology Transfer Program is designed to provide an integrated approach to promoting the introduction of advanced, energy efficiency, renewable energy and pollution prevention technologies to industry. Through the development and dissemination of cohesive and effective information illustrating the benefits of technology partnership activities, the Technology Transfer Program provides a critical link between technology development and market penetration. The program reaches and influences industrial firms through the use of printed materials, online technical information, conferences and workshops.

2) The main goal of the Motor Challenge Program is to work in partnership with industry to increase the market penetration of energy efficient motor-driven systems. A key element in the Motor Challenge strategy is to encourage a "systems approach" to how motors, drives and motor-driven equipment are engineered, specified, purchased, and maintained by industry. This represents a whole new way of looking at motor efficiency and the potential for energy and cost savings. The program works closely with industry to: develop and disseminate unbiased technical information, provide technical tools and training; publicize successful technology deployment case studies and corporate activities; and create awareness amongst end-users of motor system efficiency opportunities. A targeted approach is being used to provide special focus on Vision industries.

3) The National Industrial Competitiveness through Energy, Environment, and Economics (NICE3) Program seeks to advance the competitiveness of U.S. industry by demonstrating the advantages of energy efficient, cleaner production in industry. The Program provides funding to State and industry partnerships (on a competitive basis) for projects that demonstrate advances in near-term, energy efficient, clean production technologies that are emerging or ready for commercialization. To date NICE3 has cost-shared 77 projects in 29 States. The program supports Industries of the Futures by using a solicitation to State agencies and industry that is designed to encourage energy and waste intensive industry participation.

4) The Inventions and Innovation Program offers opportunities for inventors, innovators, and entrepreneurs to make their energy-related ideas a commercial reality. The goal of the program is to stimulate U.S. economic growth by supporting the

I. <u>Mission Supporting Goals and Objectives</u>: TECHNOLOGY ACCESS (Cont'd)

development, market penetration, and commercial success of energy-related inventions and innovations from independent inventors, very small companies and universities. The Program supports Industries of the Future by targeting Innovative Concept grants to Vision industries.

B. Program Benefits: The program benefits for the Office of Technology Access listed below reflect the total impact projected in the years 2000, 2010, and 2020 from all prior funding still having an effect in those years.

	2000	2010	2020
Total Primary Energy Displaced (quads)	.24	.46	.63
Energy Cost Savings ($billions)	.96	1.83	2.44
Carbon Reductions (million metric tons)	4.92	9.56	13.40

The dollar value of waste savings and productivity improvements have been estimated to be at least twice the energy cost savings.

C. Performance Goals: 1) Industrial Assessment Center (IAC)/Technology Transfer Program. IAC goals for the year 2000 include maintaining 30 primary partner level schools, with increased interaction with trade associations, State & local governments, and industry through the industry Vision process; establishing joint programs and inter-agency training with the National Institute of Standards and Technology's Manufacturing Extension Centers (as part of the Climate Change Technology Initiative); conducting 750 industrial assessments year; complete a cumulative 9,900 assessments; and train a cumulative total of 2,945 engineering professionals in energy and waste management. Goals for the Technology Transfer Program for the year 2000 include increased participation in outreach and communications events that impact adoption of energy efficiency and pollution prevention technologies, improving and increasing tools that effectively communicate the benefits of industrial efficiency and pollution prevention, and supporting the Industries of the Future and partnership programs by providing effective communications tools.
2) Motor Challenge goals: By the year 2000, have over 1,200 plants participating in the program, the combined energy consumption of these plants representing 6.5% of total current annual industrial electric motor energy consumption.

3) NICE3 goals: By the year 2000, at least 35 states will have participated in the program, building a stronger relationship between state energy offices and state departments of environmental protection. Also by 2000, NICE3 will have supported over 100 demonstrations of near-term innovative technologies that are ready for commercialization.

4) The Inventions and Innovations Program goal for the year 2000 is to have supported new inventions and innovations that result in over $1.2 billion in cumulative sales, with an increased emphasis on technologies for energy intensive industries.

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

The Climate Wise program was zeroed-out by Congress in FY98, giving direction that the Environmental Protection Agency should be the sole funding source.

II. A. Funding Table: TECHNOLOGY ACCESS

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
IACs/Technology Transfer	$ 8,125	$ 9,109	$ 8,700	$ -409	-4%
Motor Challenge	5,138	6,230	11,000	4,770	77%
NICE-3	5,800	6,000	7,500	1,500	25%
Climate Wise	1,000	0	0	0	0%
Inventions & Innovation	4,764	4,960	4,800	-160	-3%
Total, Technology Access	$ 24,827	$ 26,299	$ 32,000	$ 5,701	22%

II. B. Laboratory and Facility Funding Table: TECHNOLOGY ACCESS

	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Idaho National Engineering Lab	$ 0	$ 50	$ 50	$ 0	0%
Lawrence Berkeley Lab	500	700	900	200	29%
National Renewable Energy Lab	800	1,340	1,040	-300	-22%
Oak Ridge National Lab	1,335	1,230	1,630	400	33%
Pacific Northwest Lab	400	440	350	-90	-20%
All Other	21,792	22,539	28,030	5,491	24%
Total, Technology Access	$ 24,827	$ 26,299	$ 32,000	$ 5,701	22%

III. Performance Summary: TECHNOLOGY ACCESS

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer	The Industrial Assessment Center (IAC)/Technology Transfer Program is comprised of two separate activities: The Industrial Assessment Center Program and the Office of Industrial Technologies Technology Transfer Program.		
	Industrial Assessment Centers (IACs)	Industrial Assessment Centers (IACs)	Industrial Assessment Centers (IACs)
	The Industrial Assessment Center Program in its twenty-first year serves the dual purposes of: 1) providing energy, waste and productivity assessments to small-and medium-sized manufacturing facilities that typically do not have the staff or finances to evaluate their own operations; and 2) providing hands-on training to engineering professionals. These centers, located at 30 participating universities, conduct the assessments and provide manufacturers with recommendations on cost effective energy, waste and productivity savings.	Support for Industrial Assessment Centers operating at 30 participating universities continues. Approximately 750 combined energy, waste and productivity assessments are conducted.	Support for Industrial Assessment Centers continues. Approximately 750 combined energy, waste and productivity assessments are conducted.
		An annual IAC Director's meeting for the exchange of information and experience is held. The Program continues to make available to manufacturers and the public (through Rutgers University) a database of assessment results based on approximately 8,400 IAC audits and assessments.	An annual IAC Director's meeting for the exchange of information and experience is held. The Program continues to make available to manufacturers and the public (through Rutgers University) a database of assessment results based on approximately 9,150 IAC audits and assessments.
	In FY 1997 the IACs conducted 750 combined energy and waste	Top performing schools are given incentives to look at and evaluate innovative program approaches,	Top performing schools are given incentives to look at and evaluate innovative program approaches.

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	assessments and trained 225 engineering students. The program conducted an annual IAC Director's meeting to exchange information and experience; and continued to maintain (at Rutgers University) a database which provides public access to technical information on the results of approximately 7,650 audits and assessments. This data is available by SIC code. The IAC Program also makes available a best practices manual for manufacturers that don't meet program criteria for an assessment. The Program saves energy and money, helps reduce industrial pollution, and has the added benefit that students trained by the IACs are able to take practical energy and waste management skills to their employers after graduation. ($7,125)	such as pilot two-day assessments and assisting manufacturers in identifying and obtaining the financing and technical assistance necessary to implement assessment recommendations. Collaborative work with State agencies continues. Work that strengthens university and local industry cooperation continues. ($8,309)	Collaborative work with State agencies continues. Work that strengthens university and local industry cooperation continues. ($8,300)
	Technology Transfer Program The Technology Transfer Program answers a need common to all industry for credible technical information on potential applications and performance of	Technology Transfer Program	Technology Transfer Program

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	energy efficiency and pollution prevention technologies. The strategy of the Program is to partner with industry to develop and use technology demonstrations, publications, online technical information, clearinghouse services, conferences and workshops that get information into the hands of potential users. It searches for innovative and efficient methods of disseminating the message that energy efficiency and pollution prevention measures are good for business, good for the environment, and good for the U.S. economy.		
	The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the	The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the	The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. ($1,000)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. ($800)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. ($400)
	$ 8,125	$ 9,109	$ 8,700
Motor Challenge	More than 49 million electric motors convert electricity into useful work in U.S. manufacturing operations. The cost to industry is over $30 billion annually. In addition, motor-driven system energy usage is 70% of the total industrial electricity market. Consequently, increases in the energy efficiency of existing motor systems can lead to dramatic nationwide energy savings. Industry has traditionally looked at its equipment with a component focus, e.g., one motor, one pump, one drive system, etc., at a time. Accordingly, significant systems-oriented efficiency gains are often overlooked. The strategy of DOEs Motor Challenge Program is to create industry/government partnerships designed to assist and encourage	All Vision industries will be targeted and supported by Motor Challenge. These industries comprised over half of the U.S. manufacturing sectors motor system electricity consumption. Motor Challenge products will be tailored to each industries application-specific needs and delivered to plant sites in partnership with the industry end-user trade associations and Motor Challenge end-user Partner corporate offices. The FY 1997 Allied Partners and Excellence Partners will continue to be supported in FY 1998. Implementation of motor systems management plans at all plant sites will be intensified, as well as the documentation of energy savings results. Motor Challenge will	

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	industrial end-users to adopt the systems approach in managing, specifying, purchasing, and maintaining their electric motors, drives, and motor-driven equipment (e.g., pumps, fans, and compressors). Efforts in FY 1997 focused on expanding partnerships with both end-user and non-end-user companies (suppliers, distributors, motor repair shops, utilities), and trade associations. The partnership activities emphasize the development and dissemination of products and services designed to assist industrial clients in managing their motor-driven systems more effectively. Industry partnerships will be expanded in coordination with the Industries of the Future efforts. Motor Challenge collaboration with the Forest Products industry (as part of Agenda 2020), in assisting pulp and paper mill personnel to implement more effective motor systems management strategies, will be used as a model to develop similar partnership activities with the Chemical and Steel industries.	offer tailored technical assistance to Excellence Partners, and will facilitate the support by Allied Partners to aid in the implementation of motor system technology at each Excellence Partner plant site.	

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	Motor Challenge activity with the Allied Partners and Excellence Partners will be accelerated in FY 1997, and will focus on the implementation of action plans. One hundred Allied Partners will be signed on by the end of FY 1997, and will be using Motor Challenge products (tools, training curriculum, software) in various ways to promote motor-driven system energy efficiency to end-users. Twenty-five Excellence Partner companies and DOE will be working together to capture energy savings opportunities. Other program activities are as follows: The FY 1995 and FY 1996 Showcase Demonstration projects will be continued. A total of 15 projects will be completed by the end of FY 1997, leaving an additional 15 projects to be ongoing (30 total projects). Showcase case studies will be used to encourage other facilities with similar applications to replicated results. The Information Clearinghouse will disseminate information to	Other program activities are as follows: The FY 1995 and FY 1996 Showcase Demonstration projects will be completed (30 projects total). An additional 10 projects will be initiated in FY 1998 representing different potential applications and case studies to be shared nationally.	Activities will continue to catalyze the efforts of suppliers, distributors, utilities, states and trade associations to develop and deliver the tools and technical assistance manufacturers need to make informed decisions about motors and motor-driven systems. Efforts to target Motor Challenge technical support for Industries of the Future will be accelerated. Building on experience gained in FY 1997 and 1998 all Industries

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	over 5,000 people directly, and 10,000 more through an internet WEB site. Industry partnerships with supplier trade associations will be expanded to bring more reliable and independently validated information to end-users so they can make more informed motor system design, specification, and purchase decisions. Examples of products from the industry partnerships, include: new specification guidelines for specific equipment (e.g., air compressors), new training products and curriculum, equipment design and performance databases from multiple manufacturers, and generic application-oriented videotapes. ($5,138) No Activities. ($0)	The Information Clearinghouse will disseminate information to over 10,000 people directly, and 25,000 more through an internet WEB site. Activities will continue to catalyze the efforts of suppliers, distributors, utilities, states, and trade associations to develop and deliver the tools and technical assistance manufacturers need to make informed decisions about motors and motor systems. ($6,230) No Activities. ($0)	of the Future will be targeted and supported by Motor Challenge. Motor Challenge products will be tailored to each industry's specific needs and delivered in partnership with the appropriate industry associations and cooperating Motor Challenge Partners in each sector. ($8,000) To address a need identified by Motor Challenge Partners, and in conjunction with efforts to streamline OIT's technical assistance delivery system, expanded technical assistance on enhanced, energy efficient steam and compressed air system technologies will be offered to

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)			industrial clients. Industrial steam systems currently account for 6 quads of energy per year, over one-fifth of all energy consumed by the manufacturing sector. Compressed air systems represent $1.5 billion per year in costs and are referred to as the fourth plant utility. These activities will be modeled after the Motor Challenge strategy of developing industry/government partnerships to produce and deliver credible tools, information, and assistance. ($3,000)
	$ 5,138		
		$ 6,230	$ 11,000
NICE-3	The National Industrial Competitiveness Through Energy, Environment and Economics (NICE3) Program is in its seventh year in FY 1997. The Program, which is designed to improve competitiveness, foster energy efficiency, and reduce waste, provides funding to State and industry partnerships (on a competitive basis). NICE3 supports projects which demonstrate energy efficient, clean production technologies that	In FY 1998 several activities are planned to improve the delivery of the Program and enhance its value to the States and industry. NICE3 will fund 10-15 proposals through its competitive solicitation process. The Program will continue to offer a non-regulatory, competitive approach to improved energy efficiency, reduced emissions and pollution prevention. The Windows-based proposal preparation software first	NICE3 will fund 18-20 proposals through its competitive solicitation process. The Program will continue to offer a non-regulatory, competitive approach to improved energy efficiency, reduced emissions and pollution prevention. The Windows-based proposal preparation software will continue to be made widely available for the preparation of applications. The use of this software will reduce the cost and time required

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
NICE-3 (Cont'd)	are emerging or ready for commercialization. States identify appropriate needs and targets, and work with industry to develop proposals that define the specific technologies, processes and procedures that meet their needs and will accomplish their objectives. The Program provides incentives to stimulate investments in innovative, near term technology that supports economic growth, creates new jobs and protects the environment. NICE3 requires joint funding of at least 55% of total project costs. In FY 1997 NICE3 funded 13 new State/industry proposals through its competitive solicitation process. The Windows-based proposal preparation software that was developed in FY96 will be available to proposers for the first time. This software will greatly streamline the application process and reduce the cost and time of applications, processing and evaluation.	distributed in FY 1997 will now be widely available for the preparation of applications. Increased emphasis will be placed in the solicitation on the commercialization and deployment of projects to promote additional replications of the technology. Activities will be added to assist grant recipients in deploying successful technologies and encouraging replication for wide industrial application. Regional proposal funding workshops will be offered to projects/State agencies applying for funding, but not receiving grants. Additionally, workshops will be offered by those States with the highest proposal success rates to help promote greater penetration by less successful States. Additional partners for funding "green" projects will be sought. These activities will increase the cost leveraging of the NICE3 program. ($6,000)	to prepare proposals, evaluate them and make grant awards. Increased emphasis will continue to be placed in the solicitation on commercialization and deployment of projects to promote additional replications of the successful technologies. Activities to assist grant recipients in encouraging wide replication will be continued. Efforts will continue to provide workshops and training to assist States who have not previously been successful in receiving grants. Workshops led by States with high proposal success rates will continue to be supported in an effort to broaden the reach of the Program. ($7,500)

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
NICE-3 (Cont'd)	NICE3 will continue to encourage participants to leverage federal funds, requiring a 55% cost-share level in FY 1997. Project summary sheets and the solicitation continue to be made available on the Internet. Emphasis continued on developing case studies and focusing on ways to replicate program successes. ($5,800)		
	$ 5,800	$ 6,000	$ 7,500
Climate Wise	PARTNERSHIPS FOR TECHNOLOGY INTRODUCTION: The Climate Wise Program operates as a partnership between U.S. industry and the Federal Government and focuses on the highest energy-consuming processes and technologies currently used by the seven Industries of the Future. The Program encourages these industries to take advantage of the economic and environmental benefits associated with the adoption of advanced, energy-efficient technologies that prevent pollution and reduce overall greenhouse gas emissions.	PARTNERSHIPS FOR TECHNOLOGY INTRODUCTION: In 1998, Climate Wise plans to provide technical assistance and information on energy efficiency technologies to the Climate Wise industrial partners using prior year funds, at a greatly reduced level of effort. ($0)	Activities on Climate Wise will be brought to an orderly close and the program will be terminated. ($0)

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Climate Wise (Cont'd)	In cooperation with Climate Wise at the Environmental Protection Agency (EPA), industrial partners are expected to set and achieve meaningful emission reduction goals; undertake specific action to addresses energy, source, process, materials and behavioral problems; and report the reductions through the Voluntary Greenhouse Gas Reduction Reporting System established under section 1605b of EPAct. Climate Wise will begin working on the 16 industry-state government partnerships established in 1996. The Program expects to begin several showcase activities in Vision Industry companies that also include technologies supported by other Technology Access Programs. These activities will demonstrate the economic and environmental benefits associated with the adoption of advanced energy-efficient technologies and promote the concept of a strategic corporate-wide approach. In addition, the Program will conduct a workshop on innovative approaches to financing energy-efficient technologies for		

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Climate Wise (Cont'd)	small business and offer technical assistance to partner-companies as they progress in completing their action plans. The technical assistance will be provided through the IAC Program, new informational material and software packages, DOE labs, universities and others, to qualifying company partners. Projected results for the program in 1997 include adding about 80 company partners (increasing program participation to 3.4% of U.S. industrial energy use). ($1,000)		
	$ 1,000	$ 0	$ 0
Inventions and Innovation	The Inventions and Innovation Program comprises two major programs: The Energy-Related Inventions Program (ERIP) and the Innovative Concepts Program (InnCon). ERIP fills the vacuum created by lack of private sector, early-stage venture capital for energy technologies by offering a technical evaluation, a market assessment, training in managing the commercialization process, and funding for worthy inventions.		

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Inventions and Innovation (Cont'd)	The National Institute of Standards and Technology (NIST), with DOE funding, conducts a technical evaluation (at no cost to the inventors). NIST evaluates approximately 1,000 submissions each year. Based on successful technical evaluations, NIST recommends about 35-40 cross-cutting inventions to DOE each year for consideration of financial support. DOE then examines whether there is a sufficient market for the invention, helps the inventor to understand the business and marketing components of a successful enterprise, and awards about 20 grants per year, valued at up to $100,000 each.		
	Energy-Related Inventions Program (ERIP) and Innovative Concepts Program (InnCon) continue to assist in the development of new technology by private sector individuals and start-up businesses. ERIP, through NIST, will evaluate over 1,000 submissions with 30-31 recommended for support. Continue National Innovation Workshops to increase the quality of submissions to the Program,	Continue ERIP grants and InnCon solicitation to support Industries of the Future. Continue National Innovation Workshops to bring new energy-saving inventions into the marketplace. ($4960)	The Energy Related Inventions Program (ERIP) and the Innovative Concepts Program (InnCon) continue to assist in the development of new technology by private sector individuals and start-up businesses. The recommendations from the strategic program review conducted in FY 1997 will be fully implemented. ERIP will continue to provide evaluations and support of

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Inventions and Innovation (Cont'd)	while providing the public with educational information on legitimate sources of commercialization assistance. ($4,764)		energy-related inventions. ($4,800)
	$ 4,764	$ 4,960	$ 4,800
Technology Access Totals	$ 24,827	$ 26,299	$ 32,000

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

MANAGEMENT AND PLANNING

I. Mission Supporting Goals and Objectives:

The request supports 72 full-time equivalent (FTE) positions to maintain adequate program management and support for the Industrial Sector Program (Interior and Related Agencies). This program also includes Technical Evaluation, Analysis and Planning.

II. A. Funding Table: MANAGEMENT AND PLANNING

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Evaluation and Planning	$ 500	$ 800	$ 1,000	$ 200	25%
Program Direction	6,387	6,900	8,159	1,259	18%
Total, Management and Planning	$ 6,887	$ 7,700	$ 9,159	$ 1,459	19%

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

All Other	$ 6,887	$ 7,700	$ 9,159	$ 1,459	19%
Total, Management and Planning . .	$ 6,887	$ 7,700	$ 9,159	$ 1,459	19%

III. Performance Summary: MANAGEMENT AND PLANNING

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning	Provided technical evaluation, analysis, and planning for the program. ($500) $ 500	Provide increased technical evaluation, analysis, and planning with emphasis on development of quality metrics for the energy intensive industries. ($800) $ 800	Provide increased technical evaluation, analysis, and planning, including development of quality metrics for the energy intensive industries. ($1,000) $ 1,000
Program Direction	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $ 4,901 12.1 Civilian personnel benefits $ 1,092 1.0 Travel and transportation of persons $ 663 25.2 Other services $ 0 Funds supported the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 70 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field and to support implementation of the Industry sector requirements of the Energy Policy Act of 1992. The actual funding obligations reflected in	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $ 5,272 12.1 Civilian personnel benefits $1,170 21.0 Travel and transportation of persons $ 458 25.2 Other services $ 0 Funds support the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 72 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field and to support implementation of the Industry sector requirements of the Energy Policy Act of 1992. ($6,900)	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $ 5,451 12.1 Civilian personnel benefits $1,280 21.0 Travel and transportation of persons $ 560 25.2 Other services $ 368 Funds are requested to support the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 72 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field. The request for other services supports such activities as training, permanent change of station moves, and a small contingency.

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

Activity	FY 1997	FY 1998	FY 1999
Program Direction (Cont'd)	the object class distributions includes $269,000 of FY 1996 unobligated carryover funds. ($6,387)		$500,000 of the funding will be utilized with the policy office of DOE for work with the Environmental Protection Agency on developing mechanisms and policy for industry to pledge to reduce carbon emissions and to bank carbon credits. ($8,159)
	$ 6,387	$ 6,900	$ 8,159
Management and Planning Total	$ 6,887	$ 7,700	$ 9,159

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Tabular dollars in thousands, Narrative in whole dollars)

BUILDING TECHNOLOGY, STATE AND COMMUNITY SECTOR

PROGRAM MISSION

Residential and commercial buildings use 33 quadrillion Btus (quads) of primary energy annually. This represents more than a third of total U.S. energy consumption, and accounts for two thirds of all electricity used in the country. This energy costs building owners and operators over $220 billion each year. Because utility bills are a substantial part of family budgets, residential building energy use affects what kind of housing we can afford and how comfortable and healthy we are at home. Energy use in the commercial sector represents a cost to business and can have a substantial bearing on employee health and productivity.

Energy consumption in buildings has serious environmental implications. Carbon dioxide emissions attributable to buildings energy use in the U.S. constitute 35% of the national total. In addition, energy use in buildings is responsible for 47 percent of U.S. sulfur dioxide emissions and 22 percent of nitrogen oxide emissions, making building energy use a major cause of acid rain and smog in our communities. The Energy Information Administration projects that, if unimpeded, annual energy consumption in the buildings sector will increase to 38 quads by the year 2015.

Buildings for the 21st Century

The buildings energy industry is entering a period of complex challenges brought about by two major trends: technological innovation and electric utility restructuring. As the marketplace for energy opens up to competition, new technology applications and market-driven utility rates could engender an exciting range of energy-efficient building services and equipment, such as interactive communications and controls, integrated power generation, advanced materials and “smart appliances”. Also, technology developments outside the traditional building markets--telecommunications, fiber optics, construction efficiency, etc.--could be adapted to building energy systems. The ability to adapt, integrate, and deploy the steadily growing range of technology options will be key to improving the efficiency of new and existing buildings.

There is also a continuing need for action in the context of existing technologies. Implementation or deployment of cost-effective technologies can often be greatly delayed by user uncertainties, such as life-cycle cost, long-term performance, safety or other product attributes. Facilitating the deployment of recent technological advances, including creative applications of existing technologies, is therefore critical to reaping the benefits of R&D. Analysis of existing technologies also provides a valuable feedback loop to the next generation of products.

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

No single builder, manufacturer or other member of the construction industry is prepared or can afford to undertake alone the complex integration and deployment challenges ahead. Without DOE as facilitator and participant in cooperative arrangements, many energy-efficient technologies are not likely to be used in the buildings sector for many decades. DOE and partners need to plan, guide, facilitate, and implement the transition to more efficient technologies.

In order to respond to the changing environment and to better serve customer needs, a major effort is currently underway to create a vision and action plan for the buildings program. This effort is being referred to as *Buildings for the 21st Century*. The *Buildings for the 21st Century* strategic planning process brings together the collective genius of the design, construction, and investment industries. The *Buildings for the 21st Century* activity will be used to advance the "whole-buildings" approach to achieving a lasting transformation of the energy efficiency delivery system in buildings. The whole-buildings approach involves a consideration of all phases of the building process (design, construction, operation, maintenance, financing, insurance, retrofit/renovation, and demolition), engagement of all participants (designers, builders, code officials, owners, building managers, developers, investors, building product manufacturers and suppliers, and other members of the construction industry), as well as the optimal integration of building materials, equipment, and systems which has traditionally been the focus of DOE's research and development programs.

The *Buildings for the 21st Century's* whole-buildings approach represents a "new way of thinking" to be used in coordinating current and future buildings programs. The strategic plan itself will identify approaches and necessary actions that will require implementation strategies to simplify and focus the program priorities. More importantly, however, the strategic planning process and the permanent feedback mechanisms built into the whole-buildings implementation approach will continuously stimulate dialogue between the research community (government labs and industry researchers) and those who are ultimately responsible for buildings design, construction, and operation. The existence of a customer-focused, integrated, and dynamic buildings strategy will enable smooth technology transfer and accelerate the adoption of new technologies. Industry partnerships to develop technology initiatives, peer review and competitive solicitations for R&D are also integral to this new way of doing business.

Two *Buildings for the 21st Century* workshops have already been held where a "blue ribbon" group of public, private, nonprofit, and community leaders were invited to participate in creating the first vision and action plan around the "whole buildings" concept. These workshops were but the first steps in a continuing effort to improve the focus of the buildings programs. In the upcoming months, additional meetings will be held in order to develop technology visions and R&D roadmaps to guide the Department's future efforts and to help in tracking and evaluating the progress of all programs. Already, the residential and commercial buildings agendas are being reviewed to define the adjustments that are needed to accelerate the adoption of the *Buildings for the 21st Century* whole-buildings approach as defined by our stakeholders. Throughout the process, both Codes and Standards and State and Community Programs will be closely coordinated.

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

Vision - Buildings for the 21st Century

In the 21st century, people have higher expectations for the buildings in which they live, work, learn, and play. Good buildings provide comfort and convenience, are energy and resource efficient, are of high quality and durable, enhance health and productivity, are simple to operate and disaster resistant, generate at least a portion of their own power, and yet are affordable. Good buildings also protect those qualities in the buildings and community around them. The buildings industry, the financial community, and government policy makers have responded to these higher expectations by developing and capitalizing on the "whole-buildings" concept. As a result, U.S. industry is the leader in the global marketplace for construction and efficiency products and services. Simply stated, the vision of the Office of Building Technology, State and Community Programs (BTS) is a healthier, more prosperous future through the wise use of energy in buildings and communities.

Mission

It is the mission of the Office of Building Technology, State and Community Programs in partnership with industry and government, to develop, promote, and integrate energy technologies and practices to make buildings more efficient and affordable, and communities more livable. This involves (1) supporting the development of new, cost-effective, and environmentally sound technologies for buildings in cooperation with industry and the scientific community; (2) bringing these technologies to market working with private and public sector partners; (3) ensuring broad access to these technologies by expanding market availability and informed consumer choice; (4) establishing cost-effective building and appliance codes and standards; (5) coordinating Federal efforts with state and local governments; and (6) providing direct investment and technical support to weatherize homes of low-income families.

Goal and Objectives

The goal of the Office of Building Technology, State and Community Programs is to cost-effectively limit non-renewable energy use in buildings by improving the energy efficiency of buildings and equipment and by expanding the role of renewable energy in buildings. Specific objectives are: (1) to cost-effectively maintain energy consumption from non-renewable sources at the current level of 32 quads, accommodating the predicted growth in population, GNP, and standard of living; and (2) to double, by the year 2015, the application of solar and other renewable energy sources to buildings.

Benefits

Detailed analysis indicates that successfully achieving the program goals will result in total energy savings ranging from 1.41 to 2.04 quads by the year 2010. For consumers this represents a potential net savings of $10 billion in energy costs for the year 2010 alone. Energy cost savings may be spent by consumers to improve their quality of life, which generally involves expenditures on more labor-intensive goods and services, which will stimulate economic growth and lead to job creation. Additional benefits will accrue from the avoided construction costs of 18 gigawatts of power generation capacity, an investment estimated at $12 billion.

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

Other benefits include a reduction in atmospheric carbon emissions of up to 45 million metric tons annually by 2010 with corresponding reductions in the emissions of sulfur dioxide and nitrogen oxides. In addition, the development of advanced buildings technologies will help the U.S. maintain its role as a leading exporter of such technologies.

Strategy

The Department implements a strong, multifaceted portfolio of programs to encourage cost-effective investments in energy efficiency. Consistent with a whole-buildings approach, the programs are designed to synergistically capture the benefits of four implementation strategies: research, development and demonstration; market deployment; minimum efficiency standards for new buildings and appliances; and State and local partnerships. These strategies are carried out through programs that address these areas: building equipment and materials, building systems, codes and standards, and state and local partnerships.

Our work in building equipment and materials focuses on building components such as light sources, appliances, insulating materials and windows. The program implements a balanced and integrated approach that links parallel streams of research, development, demonstration, and deployment activities. Through cooperative efforts, opportunities are created to dramatically improve the performance of building components and accelerate their adoption in new construction and renovation/replacement applications. Research and development activities consist largely of longer-term industry cost-shared projects. Project objectives include improving the cost/performance characteristics of existing technologies; developing new, cutting-edge technologies; demonstrating the reliability and functionality of advanced technologies; and establishing U.S. industry technology positions needed to maintain technology leadership in international markets. Deployment activities, such as the ENERGY STAR program, capitalize on R&D technical innovations and complement the appliance codes and standards program by targeting consumers who can benefit from technologies that are more efficient than required by minimum compliance levels.

Our work in building systems focuses on whole-buildings integration. Research and development activities include the development of design tools and strategies to optimally integrate building components, manufactured sub-assemblies, and equipment into whole-buildings. Within building systems, Building America (residential) and Rebuild America (commercial and multi-family) are the capstone initiatives of the *Buildings for the 21st Century* strategy. Building America and Rebuild America integrate building component and systems R&D efforts with deployment activities through the formation of partnerships with organizations having a stake in the buildings industry. These partnerships foster synergism and focus R&D efforts on those technology needs and opportunities that are identified in the design, construction, operation, and retrofit of highly efficient showcase buildings and widespread applications.

The Codes and Standards program implements the legislatively mandated, multi-year effort to improve the energy performance of building equipment, appliances, and construction practices. The program is carried out through two activities; building standards and guidelines, and lighting and appliance standards. The building standards activity notably assists States in updating their mandatory and voluntary energy codes. The lighting and appliance standards program includes appliance testing, labeling, and mandatory energy conservation standards. The Codes and Standards program is a key contributor to the BTS strategy as it serves to displace the most

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

inefficient products and practices from the market. Efficiency levels are established so that they are cost-effective for the vast majority of consumers and reflect a broad consensus of opinion among builders, manufacturers, and other stakeholders. Voluntary standards, test procedures, and labeling activities increase consumer awareness so that they are more likely to consider more efficient alternatives. They also provide benchmarks for the development of market deployment initiatives such as ENERGY STAR.

State and Local Partnership programs promote energy efficiency and the adoption of renewable technologies among States, municipalities, institutions, and private citizens. State, local, and community partnerships are essential elements to providing education, weatherization, and other whole-building services. In particular these programs extend the benefits of energy efficiency technologies and practices to families at all income levels. They augment the *Buildings for the 21st Century* strategy by incorporating a state and local perspective to focus R&D agendas, deployment activities, and codes and standards development.

Through the *Buildings for the 21st Century* process and a wide range of additional activities, the Department will ensure that all its buildings programs reflect the BTS program's mission and goals and are responsive to the needs of its customers. Incorporated in this new way of doing business are two major new thrusts: a commitment to increase the amount of research dedicated to competitive solicitations, and; an improved peer and program review process to measure the quality and effectiveness of ongoing programs.

FY 1999 Budget Request

Working side-by-side with its customers, BTS is in the process of creating a new vision to serve as a basis for program development and implementation plans. The FY 1999 budget reflects the ongoing transition of the Department's building agenda towards a more focused "whole-buildings" approach that incorporates important component-based research initiatives and new industry partnerships. Complete implementation of the *Building for the 21st Century* strategy will be apparent in future BTS budget requests.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Building Technology, State, and Community Sector

Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Base	FY 1999 Request	Program Change Request vs. Base Dollar	Program Change Request vs. Base Percent
Building Systems Design Operating Expenses	$ 23,255	$ 22,986	$ 22,986	$ 36,373	$ 13,387	58%
Building Equipment and Materials Operating Expenses	$ 26,080	$ 26,921	$ 26,921	$ 46,181	$ 19,260	72%
Codes and Standards Operating Expenses	$ 11,810	$ 14,423	$ 14,423	$ 22,573	$ 8,150	57%
State and Local Partnership Programs Operating Expenses	$151,421	$156,695	$156,695	$197,700	$ 41,005	26%
Management and Planning Operating Expenses	$ 17,333	$ 12,850	$ 12,850	$ 14,718	$ 1,868	15%
Capital equipment	$ 0	$ 0	$ 0	$ 0	$ 0	0%
Subtotal, Management and Planning	$ 17,333	$ 12,850	$ 12,850	$ 14,718	$ 1,868	15%
TOTAL	$229,899 a/	$233,875	$233,875	$317,545	$ 83,670	36%
Summary						
Operating Expenses	$229,899	$233,875	$233,875	$317,545	$ 83,670	36%
Total Program	$229,899	$233,875	$233,875	$317,545	$ 83,670	36%
Staffing (FTE's)						
HQ FTEs	81	74	74	75		
Field FTEs	0	0	0	0		
Total FTEs	81	74	74	75		

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

a/ Reflects adjustment for approved reprogrammings 97-R-12 of $-1,060.0 thousand for the Small Business Innovative Research Program (SBIR) and $-83.7 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities.

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

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Building Technology, State, and Community Sector

FY 1998 Enacted	$ 233,875
- Non-Discretionary	0
FY 1999 Base	$ 233,875
Building Systems Design	
- Residential Buildings - The increase will add five new 200 home Building America communities a "zero energy" systems approach, and design tools incorporating lessons learned from Building America.	5,595
- Commercial Buildings - The increase increases the number of Rebuild America partnerships from 55 to 85, makes awards to industry-led consortia for whole-building commercial R&D, and expands efforts with industry to integrate energy performance with building-related software	7,792
Building Equipment and Materials	
- Technology Roadmaps and Competitive R&D - The increase supports competitive R&D directed by industry input	8,000
- Space Conditioning and Cogeneration - The increase supports enhanced R&D for natural gas technologies: desiccants and fuel cells	2,950

SUMMARY OF CHANGES - Building Technology, State, and Community Sector (Cont'd)

- Lighting and Appliance - The increase accelerates research on compact fluorescent lamps, novel light distribution systems, and lighting controls and impacts, and expands the Technology Introduction Partnership "TIP's" program into commercial buildings technologies and incorporates more gas products	5,738
- Building Envelope R&D - The increase is for R&D in environmentally R&D benign agents to replace chlorofluorocarbons and research in electrochromics and advanced glazings for windows	2,572
Codes and Standards	
- Building Standards and Guidelines - The increase supports efforts to increase ease in compliance and new codes	4,530
- Lighting and Appliance Standards - The increase supports standards for additional products	3,620
State and Local Partnership Programs	
- Weatherization Assistance Program - The increase supports weatherization of nearly 15,000 more low-income homes than in FY 1998	29,255
- State Energy Program - The increase supports state energy program priorities and reinforces state infrastructure	6,750
- Competitive Energy Partnerships - The increase supports new Competitive Energy Partnerships incorporating technology, financing, training, and other novel approaches to incorporating energy efficiency in communities	5,000
Management and Planning	
- Evaluation and Planning - The increase supports GPRA analysis and the design and implementation of a program evaluation process	1,768
- Program Direction - The increase supports one additional FTE	100
FY 1999 Congressional Budget Request	$ 317,545

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

BUILDING SYSTEMS DESIGN

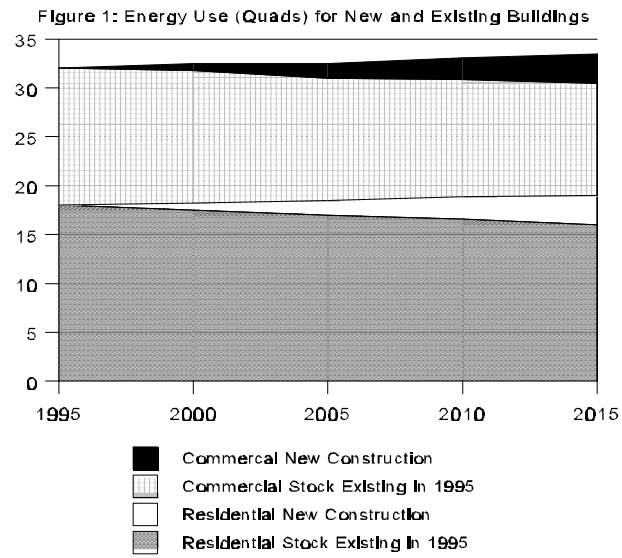
I. **Mission Supporting Goals and Objectives:**

The mission of the Building Systems program is to dramatically improve the overall energy efficiency and environmental quality of the Nation's commercial and residential buildings by improving the integration of building energy systems.

The Building Systems program accomplishes its mission by bringing together the technology specific BTS programs such as energy efficient equipment, lighting, and structure components, with system technologies such as electronic controls and automated construction processes. The result is a comprehensive program that investigates, develops and promotes the optimal mix of these technologies to accomplish whole buildings energy excellence.

Market Segments and Customers

The program's activities are divided along the lines of the two main energy-consuming building sectors: residential and commercial buildings. This segmentation reflects the very different institutional, technical and financial challenges that must be overcome to improve energy efficiency in each sector.



Building markets are further divided into new construction and retrofit categories due to important differences in needs and opportunities for energy savings. There were 83 million buildings present in the nation in 1995 and it is expected that 27 million new buildings will be constructed in the 1995-2015 time-frame. On an individual building basis, the opportunity for cost-effective energy savings is greater in new construction than it is in retrofit applications—50% compared to 20%. However, existing buildings represent a larger segment of the total building market. Figure 1 illustrates why it is important for DOE to be present in both activities. Although new construction savings are greater on a per-unit basis, most of building energy use in 2015 will be from buildings built before 1995. The short-term savings from retrofit improvements complement the long-term savings that arise from improved new construction practices and provide a steady stream of energy savings.

I. **Mission Supporting Goals and Objectives:** BUILDING SYSTEMS DESIGN (Cont'd)

Program Strategy

To service the building segments previously described, the Building Systems program supports a unique mix of research, development and deployment RD&D activities for each segment. The role and emphasis of RD&D initiatives is adapted to ensure limited resources are channeled to areas of greatest cost-effectiveness. In the residential sector, the program's efforts have been directed primarily to new construction and systems R&D. The highly fragmented nature of the residential construction industry—comprised of over 160,000 homebuilders—has inhibited the development of a strong industry-led R&D agenda. In the existing institutional framework no builder can afford to develop alone the analytical tools and system elements needed to optimize whole-building performance. **Building America** is the program designed to bring "whole-buildings" thinking and technology to the residential construction market. The program acts as facilitator and catalyst in the formation of vertically integrated industry teams that use systems engineering approaches to evaluate the systems-level cost and performance of innovative design and delivery strategies, building materials and construction techniques. Building America public/private partnerships foster synergism and help focus all residential buildings R&D efforts on the most important technology needs and opportunities.

In commercial buildings the need for government participation is greatest in the retrofit market. Existing commercial buildings frequently undergo major renovations that offer prime opportunities to adopt a "whole-buildings" approach. To seize this opportunity, building owners and managers must be made aware of the technology and financing options available to enhance building energy performance, comfort and environmental soundness. To initiate a lasting transformation of retrofit practices, BTS has developed **Rebuild America**, a comprehensive energy-upgrade implementation program for existing commercial and multi-family buildings. Rebuild America partnerships bring together the variety of interests—owners, operators, financiers, and energy specialists—necessary to effect energy performance in our nation's commercial building stock.

With Building America and Rebuild America as capstone programs, the Building Systems program plays a pivotal role in implementing the *Buildings for the 21st Century* "whole-buildings" strategy. Although different in market focus, both programs integrate building component and systems R&D efforts, with deployment activities from all BTS programs. Building America and Rebuild America are flexible programs that build on the strengths of existing efforts at State and local levels to meet the unique priorities of local communities. Their strong market focus aligns all of the program's RD&D efforts with the needs of its customers.

Planning Units

To implement its strategy and to deliver services to all target market segments and customers, the program groups its activities into two residential planning units: Residential Buildings R&D and Residential Technology Access; and two commercial planning units: Commercial Buildings R&D and Commercial Technology Access.

Residential Buildings R&D

The Residential Buildings R&D planning unit includes three key activities: Building America, Energy Efficiency in Industrialized Housing, and Design Strategies. Building America embraces R&D using a whole-buildings approach to optimally integrate building

components, manufactured sub-assemblies and equipment, and renewable energy into new homes which consume 50% less energy than typical homes built in 1990. The Building America Industry teams will provide the leadership necessary to achieve the goal of transferring major systems innovations to 15,000 new homes within five years and to 70% of all new homes within ten years. The program is designed to provide feedback to improve R&D efforts and, through direct testing and evaluation of the costs and benefits associated with new building technologies, provides critical input to the development of formal building codes and appliance standards. Feedback from Building America and other R&D activities supports code revisions and voluntary initiatives by documenting levels of excellence that may benefit many homeowners.

The importance of the factory-built home segment is growing—accounting for 8% of the current building inventory and for 30% of new home construction—offering a unique opportunity for large energy savings at minimal cost. The Energy Efficient Industrialized Housing (EEIH) program seeks to apply the large advantages of factory fabrication (quality control, automation, etc.) to the construction of energy-efficient housing. Working with the industrialized housing industry and builders, the program considers technology innovations needed in manufacturing processes—at the factory—and in construction site assembly techniques for large-scale components. Manufactured homes and large building components developed and demonstrated by the EEIH program improve indoor air quality and support the international competitiveness of U.S. manufacturers of these products.

The Design Strategies program performs research on the fundamental relationships of energy performance and develops and maintains computer design and analysis tools. These tools are used by design professionals to evaluate options for equipment and materials selection, test solar design concepts, and study alternative design strategies to minimize whole-buildings energy use. Tools and analytical methods developed by the program assist in the development of industry consensus standards and guidelines. All residential programs use the tools and analytical methods to pre-test new technology strategies.

Residential Technology Access

Technological innovations developed by Residential R&D programs are shared with the larger buildings community by means of three Residential Technology Access activities: Residential Energy Efficiency, Affordable Housing, and Home Energy Rating Systems. The Residential Energy Efficiency program consists of the activities required to incorporate the results of all R&D efforts into the knowledge base and standard practice of building professionals and homeowners, for both new construction and retrofit applications. Elements of the program are: information dissemination, education and training; technical and design assistance; on-site assistance; technology introduction and non-cash incentives (awards and recognition activities). Affordable Housing deployment activities involve working with local communities, HUD, public housing authorities and other community housing providers, to lower the utility costs of low- and moderate-income families. Home Energy Rating Systems help states overcome barriers to energy efficient financing by providing the technical support necessary to rate homes and identify energy efficiency improvement opportunities.

Commercial Buildings R&D

The Commercial Buildings R&D planning unit includes two key activities: Building Performance and Design Strategies. Consistent with a whole-buildings approach, the Building Performance program focuses on developing the analytical bases necessary to effectively

I. **Mission Supporting Goals and Objectives:** BUILDING SYSTEMS DESIGN (Cont'd)

design, operate and maintain buildings that are energy efficient, comfortable and conducive to health throughout their operational lifetime. The Design Strategies program develops the specific computer software tools required to make informed decisions on efficiency and renewable technology design strategies. These tools allow designers to simulate building performance and conduct "what-if" and trade-off analyses. Both programs contribute to the industry consensus process for standards and guidelines.

To ensure that the commercial buildings research agenda is responsive to the needs of industry, industry-developed R&D initiatives are reviewed to avoid duplication and to identify opportunities for cooperation. DOE participation with the Heating, Ventilating, Air-Conditioning and Refrigeration (HVAC&R) industry in the "*HVAC&R Research for the 21st Century*" program initiated by the Air-Conditioning and Refrigeration Institute is one example of the Department's commitment to cost-shared research partnerships with industry. Research findings are transferred through FEMP and other Federal programs, State and local programs, and Rebuild America.

Commercial Technology Access

Rebuild America spearheads the Department's deployment and outreach efforts in commercial buildings and multifamily homes. The program helps the formation of community and regional public/private consortia that plan and implement energy efficiency retrofits in existing buildings. Rebuild America partners are provided a broad range of services including, information, training, and seed financial assistance to plan and finance retrofit projects. Rebuild America integrates the results of research and development initiatives within the Building Systems and the Building Equipment and Materials programs, and in return, provides the customer feedback needed to ensure the relevance of ongoing R&D activities.

The Commercial Outreach program focuses attention on building design, construction, and facility management professionals through the formation of outreach partnerships. The Energy Star building performance label is being promoted in collaboration with the EPA. Building operation and maintenance management training curriculum is being developed in partnership with facilities management organizations. Other outreach activities aim to disseminate industry design standards and guidelines often developed from the scientific basis provided by DOE R&D programs.

I.B. Program Benefits

At the proposed funding levels, the Building Systems program is estimated to yield the following benefits:

METRIC	2000	2010	2020
Primary Energy Displaced (Quads)	0.02	0.46	.99
Energy Cost Savings ($B)	0.14	2.86	5.93
Carbon Reductions (MMTons)	0.45	9.30	20.00

I. **Mission Supporting Goals and Objectives:** BUILDING SYSTEMS DESIGN (Cont'd)

I.C. Performance Goals

Strategy/Goals for 2000

With the residential buildings sector the program will create industry consortia in partnership with communities and financial institutions to develop advanced building systems, and deploy innovative technologies to lead a national effort to reduce energy usage in new homes by over 50% and existing home by 20%. The primary focus of the initiative is to increase the nation's capability to design, build and retrofit residential buildings that will increasingly be energy efficient and affordable. In addition the program will create local and community partnerships to retrofit one million public and assisted housing units.

For the commercial sector, the program will create consortia that will aid in the retrofitting of thousands of commercial buildings in communities around the nation. Advanced technologies developed and demonstrated under the program, including building diagnostics, will reduce the energy use in new buildings by 30% when compared to 1990 baseline buildings. In addition the commercial building program will achieve substantial change in the number of new buildings designed with full consideration of energy and the provided indoor environment through a comprehensive program of design tools development and deployment. It is estimated that less than 20% of submitted designs today include an analyses of energy options. By 2000, the Building Systems program will make energy and environmental analysis an integral part of 50% of the submitted designs in the country.

Accomplishment Summary

FY 1997

-- The first community scale project of 330 houses under Building America was begun. Thirty-two (32) houses were built to 50% above local code, with savings in initial construction costs as well as long-term utility bills. In addition, Building America teams built an additional 78 tests and prototype houses in other states.

-- Award new community housing partnerships were established to retrofit 100,000 public and assisted housing units.

-- Ten new Rebuild America consortia committed to retrofitting 400 million square feet of floor space.

-- "Passive Solar Design Strategies for Low Rise Buildings" was released. This major publication was widely distributed to the architectural community and included the latest DOE developed software tool ENERGY-10.

-- Builder training programs were piloted in four states.

I. **Mission Supporting Goals and Objectives:** BUILDING SYSTEMS DESIGN (Cont'd)

FY 1998

-- Second and third community scale projects of 200 houses under Building America program are under construction. Total of 300 demonstration houses will have been completed.

-- Solicitation for new Energy Efficiency in Industrialized Housing (EEIH) contract will be awarded in FY99.

-- Major new energy simulation program combining best features and capabilities of existing DOE and DOD energy tools will be released.

-- Draft industry consensus standard on residential ventilation will be issued.

-- Builder training programs in additional four states will be undertaken.

-- HERS activities will continue in 7 states as well as national activities.

-- Recruiting 55 new Rebuild America partnerships to join the program, increasing the total number of Rebuild America communities to 195 representing all 56 states and territories.

FY 1999 - 2000

-- By FY 1999, five additional community scale projects with a total of 1000 houses will be under construction.

-- New EEIH contract and begin revamped research.

-- The commercial buildings program will establish that 50% of all designs submitted in the U.S. include analysis of energy and indoor environment.

-- Two billion square feet of commercial building floor space will be addressed by the Rebuild America program resulting in 100 trillion Btu/year savings.

-- By FY 2000, the Building America program will have developed 2500 highly energy efficient, environmentally friendly and cost effective houses and disseminated these results to 15,000 houses constructed by other builders.

-- Recruit 85 new Rebuild America partnerships to join the program, increasing the total number of Rebuild America community to 280 exceeding original goal of 250 partnerships.

II. A. **Funding Table**: BUILDING SYSTEMS DESIGN

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Residential Buildings	$ 10,157	$ 9,697	$ 15,292	$ 5,595	58%
Commercial Buildings	13,098	13,289	21,081	7,792	59%
Total, Building Systems Design	$ 23,255	$ 22,986	$ 36,373	$ 13,387	58%

II. B. **Laboratory and Facility Funding Table**: BUILDING SYSTEMS DESIGN

Argonne National Lab (East)	$ 250	$ 250	$ 250	$ 0	0%
Brookhaven National Lab	100	100	100	0	0%
Lawrence Berkeley Lab	3,400	3,200	5,985	2,785	87%
National Renewable Energy Lab	7,200	6,993	12,383	5,390	77%
Oak Ridge National Lab	3,230	3,175	4,570	1,395	44%
Pacific Northwest Lab	1,930	1,875	1,835	-40	-2%
All Other	7,145	7,393	11,250	3,857	52%
Total, Building Systems Design	$ 23,255	$ 22,986	$ 36,373	$ 13,387	58%

III. Performance Summary: BUILDING SYSTEMS DESIGN

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings	Residential Buildings R&D includes: BUILDING AMERICA: The four primary Building America teams worked to: (a) accelerate the development and adoption of building processes and technical innovations in energy efficiency into environmentally sensitive, affordable housing on a community wide scale, (b) provide feedback to improve efforts for both research into new building technologies and methods to accelerate technology adoption based on field testing and performance validation. Building America continued the integration of research improving the performance of both new and existing housing. The program produced industrialized residential housing with large scale site assembled components, including panelized, modular, and HUD-Code manufactured units.	Residential Buildings R&D includes: BUILDING AMERICA: The Building America program continues the integration of research that improves the performance of both new and existing housing. Over 80 industry members of Building America Consortia work in 12 States.	Residential Buildings R&D includes: BUILDING AMERICA: Building America will expand to include 100 industry members. Over the next four years the program will indirectly transfer systems innovation to over 150,000 production homes, will adapt systems engineering to existing homes renovation, and will achieve direct consumer savings of $115,000,000 per year. It is projected that by the year 2000, the Building America program will have directly developed 2,500 highly energy efficient, environmentally friendly, and cost-effective houses. At the same time, information will continue to be shared with the overall building industry; innovations used by Building America's team builders are expected to diffuse to all lead builders within 7-10 years. Systems integration research recommendations from the public, private Partnership for Advancing Technology in Housing (PATH) will be considered and incorporated into Building

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)			America to further efficiency and affordability.
	Each team monitored test houses and prototype production houses, with major homebuilders, 32 of which have been built to 50% above local code, with savings in initial construction costs as well as long-term utility bills. Each began developing "first-generation" communities. As the Building America Industry Consortia teams moved from evaluation of individual test houses to community-scale construction. Construction of first community scale project of 330 houses began. Short term testing was complimented by long term data collection and utility bill analysis.	Continue the emphasis on taking "lessons learned" from test houses and prototype production houses, working with major homebuilders and with additional builder members to develop two new "first-generation" communities of 200 houses. Complete a total of 300 demonstration houses.	The program will continue the learning process from test and prototype production houses, expanding upon the existing developments and starting five new "first generation" communities of 200 homes each. Critical "next generation" strategic planning and systems integration research will continue as construction begins on several "second generation" test homes to validate advancements, and to incorporate them into new home and renovation practices. Continue efforts to improve thermal distribution using validation, demonstration and training to define quantitatively the benefits of efficient distribution systems.
	An additional Building America project focused on buildings using passive solar/energy efficiency measures to meet 75 percent of their heating and cooling requirements at no additional construction cost to the owner. Working with various design/build teams, four completed homes	Research activities also focus on a thorough analysis of performance data on completed buildings built to passive solar standards. The information collected is used (1) to enhance passive solar design; (2) to re-engineer the concepts and adaptation to multiple	The program will also continue to focus on improving and simplifying advanced concepts used in the passive solar design houses constructed, at the owners expense, and monitored in FY 1997 and FY 1998. Replication of these lessons learned will begin

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)	were monitored. Data was partially analyzed. Work began on the redesign of selected concepts used in these buildings to improve performance, and adapting one design to a subdivision-scale development, creating a building using renewable energy strategies to meet all its energy needs. The Integrated Building and Construction Solutions of Pittsburgh, the Building Science Consortium, the Consortium for Advanced Residential Buildings and the Hickory Consortium; National Renewable Energy Laboratory [NREL], the Passive Solar Industries Council [PSIC] and the Florida Solar Energy Center) ($4,562)	subdivision/planned unit developments, and (3) for additional passive and hybrid solar cooling concepts. Knowledge gained from these advanced buildings are used to enhance the capabilities of the "Passive Solar Design Strategy Guidelines and Design Tool," and analysis software. (the Integrated Building and Construction Solutions of Pittsburgh, Building Science Consortium, Consortium for Advanced Residential Buildings and the Hickory Consortium; NREL, PSIC and the Florida Solar Energy Center. ($4,662)	to be performed in additional subdivision/planned unit developments, providing the opportunity to test needed passive cooling concepts and more effective means to integrate the auxiliary heating and cooling systems and other renewable energy technologies with the passive solar ones. Validation of the design and analysis tools used for these buildings will occur. In an effort to push performance levels higher, a major expansion of the Building America program will focus on the next generation of systems integration research, e.g., "zero energy home", incorporating emerging technologies and design techniques. This will provide information and experience to support Building America into the future. ($8,762)
	ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: Began working with Palm Harbor homes, a leading manufactured housing provider, to design and monitor the first manufactured houses to achieve Energy Star certification; began development of three side-by-side entry	ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: Continuing monitoring the two Energy Star Palm Harbor homes and the three entry level houses constructed in FY 1997; working with additional Manufactured Housing manufacturers; partnering with the Structural	ENERGY EFFICIENCY IN INDUSTRIALIZED HOUSING: Dissemination of research completed in FY98 will be made. The new competitive award will address the demand for affordable housing. This research will focus on the process of producing

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)	(first-time buyer) level houses with various levels of energy efficiency and IAQ features; partnered with the Structural Insulated Panel Association (SIPA) to develop a pair of houses in the state of Washington in cooperation with the American Engineered Wood Association (APA) and Habitat for Humanity International; assisted in field testing software to simulate factory site options in the production of wall panels; and completed evaluation of a innovative new floor system. Continued cooperative research with the American Lung Association and Habitat for Humanity for the construction and monitoring of four prototype houses, including the construction and monitoring of modular and industrialized housing. Monitored the performance of the four 1996 Health Houses. (Florida Solar Energy Center [FSEC], Lawrence Berkeley National Laboratory [LBNL], Penn State University [PSU], Oak Ridge National laboratory [ORNL], the University of Oregon [UO]) ($1,500)	Insulated Panel Association (SIPA); American Engineered Wood Association (APA); and Habitat to develop a pair of houses in Plains, Georgia; assisting the American Lung Association in developing an entry-level "Health House" (TM); monitoring the performance of the FY 1997 Health Houses; continuing design assistance, workshops and seminars to individual Habitat affiliates and other non-profit housing providers; and field testing of the FSEC invented FanRecycler, that economically maintains indoor air quality (IAQ), in cooperation with the Building America Industry Consortia. Emphasis is on developing energy efficient and resource efficient housing, meeting the needs of local communities. As the current research winds down, a Request for Proposals is being issued to obtain new research resources for continuation of technologies developed by the program. Award of this competitive solicitation to be made in FY99. (FSEC, LBNL, PSU, ORNL, UO) ($1,300)	energy efficient industrialized housing and large-scale site assemblage of components. Attention is on panelized, modular and HUD Code manufactured units. Partner determination for new research will be made during the RFP evaluation and award. A prototype manufacturing facility computer simulation model will be used to demonstrate adaptability of production facilities and assist in the continuing effort to improve the energy efficiency of the construction processes in two manufacturing housing plants. During FY 1999 producers of industrialized housing will continue working with Building America Consortia teams to develop new techniques for "whole house" factory production and site assemblage. Further, cooperative research will continue with the American Lung Association for the construction, monitoring and evaluation of Health Houses. ($1,800)

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)	DESIGN STRATEGIES: Contributed to the analysis and testing of residential ventilation standards, mathematical models duct measurement techniques and design tools as part of an industry consensus process (ASHRAE, ASTM, etc.). Worked with the International Alliance for Interoperability to ensure residential systems were incorporated into software standards; modified existing building computer models to analyze residential building design options. Four completed homes were monitored, data analyzed, and work began on redesigning of selected concepts used in these buildings to improve performance, to adapt one design to a subdivision-scale development, and on a building using renewable energy strategies to meet all its energy needs. (National Renewable Energy Laboratory [NREL], Lawrence Berkeley National Laboratory [LBNL], the University of Oregon [UO], and the Passive Solar Industries Council [PSIC]) ($860)	DESIGN STRATEGIES: Research passive solar heating and cooling advanced concepts used in combination with efficiency and other renewable energy measures and system engineering, creating building designs that minimize building energy loads. Adapting and testing these concepts in multiple subdivision planned unit developments. Supporting industry consensus process with ASHRAE for thermal distribution and residential indoor air quality techniques. Releasing DOE-2.2 building analysis model with new residential HVAC system, natural ventilation and roof calculations. Adding residential HVAC and natural ventilation systems into a new simulation program under development, EnergyPlus. Finalizing Multi-zone infiltration model developed in cooperation with the International Energy Agency. Beginning fundamental study of the interactive effect of heat flow and mass flow in building envelopes. Continuing work with the International Alliance for Interoperability to ensure residential energy issues are incorporated into building	DESIGN STRATEGIES: Develop test procedures and measurement techniques related to thermal distribution, air quality and air leakage with ASHRAE, and ASTM. Particular emphasis will be on technical contributions to the ASHRAE Standard for Residential Ventilation. Provide the prototypical next generation designs of low energy building concepts which the Building America consortia will incorporate. Replicate lessons learned into additional planned unit development, providing the opportunity to continue to test cooling concepts and more effective means to integrate the auxiliary systems with passive solar ones. Review and validate (as needed) design and analysis tools used for residential buildings. Incorporate new technologies, strategies and methodologies developed under the Building America and other projects into residential design tools as appropriate. Develop and modify version 2.0 of the Building Design Advisor, and other residential building design tools.

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)		software standards. (NREL, LBNL, ORNL, UO, PSIC) ($900)	Insure the products being developed by the International Alliance of Interoperability with respect to residential energy issues, are coordinated in order to guarantee these concerns are addressed appropriately. ($1,830)
	Technology Access includes: RESIDENTIAL ENERGY EFFICIENCY PROGRAM: Builders and building stakeholders in housing were trained in the integration of Building America technologies and building practices, and existing products and processes used to improve new and existing homes. Supported the Energy Value in Housing Awards in partnership with the National Association of Home Builders. Developed building guides, and energy efficient training specifications for builders. (National Association of Homebuilders Research Center [NAHBRC], Energy Efficient Builders Association [EEBA], Southface Energy Institute, National Association of Housing Redevelopment Officials [NAHRO]) ($700) AFFORDABLE HOUSING: Provided technical and design assistance to local communities,	Technology Access includes: RESIDENTIAL ENERGY EFFICIENCY PROGRAM: Focus on the integration of advanced retrofit and whole building system technologies in existing residential buildings and new building design. Continuing training for builders, building trades and other stakeholders in housing, in the use of existing products and processes used to improve new and existing homes. Rewriting building design specifications, cost and energy saving estimates, operation and construction procedures for new and existing residential buildings, including low cost, affordable housing. (NAHBRC, EEBA, Southface Energy Institute, NAHRO) ($700)	Technology Access includes: RESIDENTIAL ENERGY EFFICIENCY PROGRAM: Builders and building related stakeholders will be trained in the latest Building America technologies and building practices, how to overcome financial and technology barriers, and practices to improve new and existing homes. The trainees will be able to use a comprehensive design and renovation approach based on Building America techniques and technologies research to obtain an average of 20 percent energy efficiency gains in existing housing, while continuing to improve and expand the choices available for residential energy efficient and renewable technologies. ($1,000)

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)	housing and financial industries, and to nonprofit community development organizations, Habitat for Humanity, National Association of Housing and Redevelopment Officials, The National Partnership for Homeownership, and others. Demonstrated and validated benefits of technologies in the design of new homes and retrofit of existing homes, integrating housing technologies that improved performance and were cost effective into standard practice. Developed housing and design guides for Military housing. (Oak Ridge National Laboratory [ORNL], Argonne National Laboratory [ANL], Southface Energy Institute, EEBA, Florida Solar Energy Center [FSEC], Habitat for Humanity [HFH], NAHRO) ($1,000)	AFFORDABLE HOUSING: Providing training materials to Habitat for Humanity and assist other affordable housing organizations in developing energy efficient low cost housing. Working with the National Association Home Builders Research Center, National Center for Appropriate Technology and the Southface Energy Institute to develop training programs for builders and local contractors. Sponsoring over a dozen regional training seminars. Assisting twenty communities to develop energy efficient and/or sustainable development housing practices. Continuing a strong emphasis on approaches that aid home owners and prospective home buyers to recognize and value energy efficiency features. Providing training and education and showcased housing in partnership with local communities, housing and financial industries. Conducting small competitive solicitations for regional liaison support to local community housing agencies. (ORNL, ANL, FSEC, HFH, National Congress for Community Economic	AFFORDABLE HOUSING: Through training and on-site technical assistance improve the performance and cost effectiveness of affordable housing. Provide a coordinated and extensive education and training program in partnership with local communities, state agencies, and national associations to the housing and financial industries, nonprofit community development organizations, including Habitat for Humanity and others that will establish energy efficient housing features as standard practice. This will be done through a competitive solicitation. Target home providers that provide housing for low income families below the 80 percent of an area's median income, and that are supported through public housing. Sponsor more than two dozen residential build/design training program in partnership with local communities. ($1,400)

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Residential Buildings (Cont'd)	HOME ENERGY RATING SYSTEMS: Provided funding to seven pilot states to overcome barriers to energy efficiency financing through the use of Home Energy Ratings, training and technical and information assistance. ($1,535) $10,157	Development, Global Green USA, Southface Energy Institute, NAHRO) ($600) HOME ENERGY RATING SYSTEMS: Continuing the fourth year of funding for seven pilot states. Providing support to other competitively selected states to overcome barriers to energy efficiency financing through Home Energy Ratings and related activities. ($1,535) $9,697	HOME ENERGY RATING SYSTEMS: Half the funds are for the fifth and final year of financial support for the seven pilot states. The remainder is for other states, selected competitively, to overcome barriers to energy efficiency financing through Home Energy Ratings and related activities. ($500) $ 15,292
Commercial Buildings	Commercial Buildings R&D includes: BUILDING PERFORMANCE (includes Commercial/ Multi-family R&D): Conducted research on whole building concepts in buildings to quantify energy performance, and related non-energy performance (e.g. worker productivity). In FY97 focused on advanced perimeter daylighting systems and their	Commercial Buildings R&D includes: BUILDING PERFORMANCE (includes Commercial/ Multi-family R&D): Conducting research on whole building concepts in buildings to quantify energy performance, and related non-energy performance. Completing performance measurement of exemplary buildings constructed in FY 1995	Commercial Buildings R&D includes: BUILDING PERFORMANCE (includes Commercial/ Multi-family R&D): Award the Request for Proposal begun in FY98 and increase research on whole building concepts in buildings to quantify energy performance, and related non-energy performance. With industry teams of manufacturers,

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	integration in buildings, and performance measurement of exemplary buildings constructed in FY 1995 and FY 1996. Continued testing of Building Automation Communication Network (BACNET), the communication protocol that will allow building owners to integrate control systems from multiple vendors, and testing the advanced lighting control system in the 450 Golden Gate building in San Francisco with GSA, and PG&E. Continued work with National Science Foundation at Carnegie Mellon University to develop the "Intelligent Workplace." Started a national strategy for incorporating commissioning as a vital component of the industry construction process, with Federal Agencies and a collection of private organizations. This tool will verify building systems operate as the designer intended and provides the systems tests during commissioning to ensure maximum performance. A beta-test version of a tool which provides early detection of problems in building energy systems was completed in	and FY 1996 and publish findings on the effectiveness of the integrated systems. Continuing testing of BACNET, and advanced lighting control system with GSA and PG&E to demonstrate the effectiveness of an open communication protocol to connect equipment of various manufacturers. Continuing work with National Science Foundation at Carnegie Mellon University to develop the "Intelligent Workplace." Beginning whole building design study on school building with Southern California Edison (SCE). Completing the national strategy for incorporating commissioning as a vital component of the industry construction process which is promoted by Federal Agencies and a collection of private organizations. A commissioning planning guide for Rebuild America is being completed and distributed. An energy benchmarking tool, pivotal to early determination of potential candidates for efficiency renovation, is being expanded to include additional building types. Completing the final version of a	designers and builders, work to improve and accelerate research and adoption of building processes and technical innovations that increase efficiency and affordability. Conduct monitoring and analysis activities at two exemplary passive solar buildings. Complete Carnegie Mellon University's "Intelligent Workplace" allowing performance testing of commercial systems integration, and complete and publish findings from the lighting/controls systems integration study on the 450 Golden Gate building in San Francisco. Continue commissioning and performance monitoring of school building with SCE. With industry, begin implementing actions defined in the national strategy for incorporating commissioning as a vital component of the industry construction process. Complete commissioning equipment/system performance technical specifications. The energy benchmarking tool, will be distributed widely for use by architects and engineers. In partnership with industry, develop

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	partnership with Honeywell and the University of Colorado (UC). An energy benchmarking tool, which is pivotal to early determination of potential candidates for efficiency renovation was completed for office buildings. In cooperation with the National Institute of Occupational Safety and Health (NIOSH), began fundamental studies of the relationship between indoor environments and worker productivity. (PNNL, UC, Honeywell, NSF) ($2,000)	tool which provides early detection of problems in building energy systems in partnership with Honeywell and the University of Colorado. Holding industry workshops to determine new directions for DOE's involvement in the controls, energy service, and other critical industries. This new roadmap for the Buildings Performance R&D will be the basis for a competitive solicitation in FY99, developed and advertised in FY98. Fundamental productivity studies with NIOSH are producing first synthesis of results. Scientifically valid and statistically significant inferences regarding the effects of filtration are being reported to the building community. Contributing to the international efforts to develop scientifically valid basis for energy monitoring and verification protocols. (PNNL, LBNL, UC, Honeywell, NSF) ($2,000)	materials which promote the wide spread use of the early problem detection tool developed with Honeywell and the University of Colorado. Establish database of project performance data that documents commercial building retrofits, including energy use, financing used, and measurement and verification methods. Fundamental studies with NIOSH will report on a second hypothesis on ventilation rates. Further hypotheses will be developed in cooperation with industry and academia. Efforts on Energy Monitoring and Verification protocols will shift to the implementation and promotion stage. ($4,000)
	DESIGN STRATEGIES: Developed energy design tools for the building industry to predict performance implications of whole building design strategies and to	DESIGN STRATEGIES: Continuing the development of energy design tools for the building industry to predict performance implications of whole building design strategies.	DESIGN STRATEGIES: Release the first version of EnergyPlus, a joint effort with DOD, combining strengths and capabilities of DOE-2 with DOD's BLAST (energy analysis software). Continue development

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	answer "what if" questions. Tools allow designers to make tradeoffs early in the design, when critical decisions impacting energy use are made. Continued development of an object-based simulator for modelling advanced technologies. Completed development of DOE-2.2 (building energy simulation tool) for release in FY 1998. Completed final version of Softdesk Energy for release in early FY 1998. Released beta version of the Building Design Advisor. Worked with the Industry Alliance for Interoperability (IAI) to release the first two versions of the building software interoperability standards. Formed partnership with DOD (U.S. Army Corps of Engineers Construction Engineering Research Laboratories [CERL]) to develop EnergyPlus, an energy simulation program to replace DOE-2 and the DOD program, BLAST. Released version 1.2 of the Designing Low Energy Building/ENERGY-10 software package, providing additional daylighting and efficiency strategies, and the ability to	Releasing DOE-2.2, final release of the DOE-2 program. Completing development of object-based simulator for beta testing. Completing beta testing of the Building Design Advisor (working with utilities and the California Institute for Energy Efficiency [CIEE]) and releasing version 1.0. Working with the Industry Alliance for Interoperability, releasing the third version (2.0) of the building software interoperability standards. Continuing development of EnergyPlus. With the international community and industry, developing modules for Designing Low Energy Buildings/ENERGY-10 software allowing trade-offs among passive and active solar, photovoltaic and efficiency strategies that may compete for the limited building surface while work proceeds on Version 2.0 to incorporate more complex and advanced passive solar, whole building concepts. Releasing a new version of the BESTEST, software evaluation procedure. Continuing development of test procedures for duct distribution systems with	of software module to simulate performance of complex innovative building systems that will then be integrated into EnergyPlus. Continue development of Building Design Advisor to integrate energy considerations into the early design phase for large commercial buildings. Release Version 2.0 of the Designing Low Energy Buildings/ENERGY-10 software package for making informed decisions among solar and efficiency strategies in small commercial and residential buildings in pre-design when critical decisions affecting energy use are made. Begin Version 3.0, incorporating advanced concepts learned in the buildings studies, customized weather data, and improved passive solar calculations. Continue participation in the Industry Alliance for Interoperability to ensure that energy attributes are part of international standards for sharing information among building-related software. Incorporate ventilation and mitigation strategies from our research to improve indoor air

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	downsize mechanical systems developed with industry. Started work with the international community on procedures for evaluating design tools. Continued to contribute to the scientific basis of commercial ventilation standards and duct measurement techniques, industry standards and guidelines that relate to energy conserving designs of commercial buildings being developed by ASHRAE, ASTM, ISO and other groups. The result is timely and effective adoption of DOE supported technologies. (NREL, LBNL, PNNL, CERL, Univ. of IL) ($3,200)	industry through ASHRAE. (NREL, LBNL, CERL, Univ. of IL) ($3,200)	quality in EnergyPlus and Energy-10. Complete development of test procedures for duct distribution systems with industry through ASHRAE. ($5,020)
	Technology Access includes: REBUILD AMERICA: The Rebuild America program focuses on providing community partnerships with information needed to make informed decisions when they are renovating existing commercial and multifamily buildings. The partnerships focus on comprehensive energy projects, including energy efficiency retrofits to lighting/heating/	Technology access includes: REBUILD AMERICA: Rebuild America continues to help communities reduce energy costs in commercial and multifamily buildings. Increase partnership development and support to reach goal of 100 trillion Btu/yr saved by 2003. Two billion dollars will be saved in avoided energy bills between FY 1995 - FY 2003 for commercial building owners and multifamily housing tenants	Technology Access includes: REBUILD AMERICA:

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	cooling systems and strategies for procurement of the most cost effective gas and electricity purchases. Information products, case studies and technical assistance are provided to local decision makers to identify energy opportunities, and to design and finance building energy projects. Technology transfer activities focus on outreach to building design, construction, and facility management professionals. The program provides a two way street for research in Buildings Systems; an outreach program to ensure research results make it into practice, and a comprehensive evaluation that provides feedback on the effectiveness of current R&D programs and products based on actual needs identified in practice.	because of building retrofits completed through the Rebuild America community partnerships. These energy retrofits will yield savings that continue into the next century at a rate of $650 million/year. By the end of FY 1998, Rebuild America will be reducing energy costs and creating jobs in every state and territory in the nation. Maintain alliances with same organizations as FY 1997. Consortium is helping recruit and provide outreach for those communities developing and implementing Action Plans.	
	Formed 50 new partnerships in FY 1997 -- a total of 140 partnerships in over 40 states. Partnerships started over $1 billion dollars in energy efficiency renovations in 500 million square feet of floorspace. Helping communities implement energy efficiency programs, alliances	Fifty-five new partnerships are being recruited to join the program, increasing the total Rebuild America communities to 195, representing all 56 states and territories. These Rebuild America partners are beginning to provide 100% of the funds to plan	Recruit 85 additional partnerships to exceed the initial goal of 250. Continue two tiered strategy: 1) provide information and assistance to help locally led partnerships retrofit buildings, and 2) continue successful alliances with national organizations, e.g., U.S. Conference of Mayors,

III. Performance Summary: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	were established in FY 1995 and FY 1996 with U.S. Conference of Mayors, U.S. Chamber of Commerce, National Association of Counties, National Governors Association, Association of Higher Education Facility Officers, International City/County Management Association, National Association of Counties, and Public Technologies, Inc. (PTI)/Urban Consortium. The majority of new Rebuild America partnerships will receive only technical assistance and provide 100% of the funds to plan and carry out building energy improvements. Provided performance contracting assistance to lower utility costs for public and assisted housing. Leveraged more than $27 million in contracts for private investments in energy related improvements for housing agencies. Established commitments for the energy rehabilitation of more than 100,000 affordable housing units. Provided technical assistance to ninety five existing partnerships. Technical assistance is tailored to meet unique needs of	and carry out building energy improvements. New partners in FY 1998 are implementing Action Plans that will result in over 400 million square feet of floor space renovated, reducing annual costs by $143 million when local actions are completed. FY 1998 partners are creating 5,720 jobs in the construction trades, and reducing emissions by 0.345 MMTCE reducing smog and global warming effects from fossil fueled power plants. Partners are leveraging $40-$50 million in performance contracts for public and assisted housing, with 200,000 units committed for rehabilitation. DOE technical assistance is meeting unique needs of partnerships, e.g., development of information handbooks on technology performance and financing strategies, access to hotlines and electronic bulletin boards, peer-to-peer workshops, training seminars, and customized expertise from DOE national laboratory staff. Continuing alliances with national organizations representing local government, public housing authorities, private business,	Association of Higher Education Facility Officers, to reach national representatives of key local decision-makers. Continue and expand support of showcase community partnerships started in FY 1995 and FY 1996. These partnerships represent coalitions of diverse organizations and will reduce energy costs in schools, city/county/state buildings, small businesses, and corporations across the nation. In collaboration with DOE, partnerships will use innovative strategies to maximize market penetration and ensure that efforts continue after Federal funds are gone, e.g., institutionalizing the use of performance contracting, integration of energy improvements with the Department of Housing and Urban Development's Enterprise and Empowerment Zones, working within local chambers of commerce as part of local economic development strategy, etc. Provide products and technical assistance tailored to meet unique needs of partnerships, e.g., development of information handbooks on

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	partnerships, e.g., development of information handbooks on technology performance and financing strategies, access to hotlines and electronic bulletin boards, peer-to-peer workshops, training seminars, and customized expertise from DOE national laboratory staff. (LBNL, ORNL, PNNL, ANL, NREL) ($6,850)	universities, schools, utilities, energy service and financing companies to increase participation and leverage education and technical assistance to partners; recruiting and helping new partnerships develop action plans, providing planning workshops and training on technologies, financing, and the retrofit process; developing handbooks and guidelines to help partners and building owners understand energy efficient technologies and financing strategies; providing on-site assistance to partnerships with completed action plans; sponsoring conferences to promote spread of best practices among partners, developing WWW home pages, newsletters, technology briefs, and; promoting and recognizing partnership successful approaches and results. (LBNL, ORNL, PNNL, ANL, NREL, APPA, USCM) ($7,000)	technology performance and financing strategies, assistance in adopting whole building retrofits, access to hotlines and electronic bulletin boards, peer-to-peer workshops, training seminars, and customized expertise from DOE national laboratory staff and private sector experts. The program will increase awareness, adoption, and use of the "whole building" approach by industry and communities. ($10,580)
	OUTREACH: In collaboration with the Environmental Protection Agency, began development of an Energy Star building performance	OUTREACH: In collaboration with the Environmental Protection Agency, the program is introducing and promoting the	OUTREACH: Continue collaboration with the Environmental Protection Agency to promote and test the Energy Star building performance label, a

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)	label, a benchmark for energy efficient buildings, that will help establish value for energy efficient buildings in the commercial real estate market. Began project with International Union of Stationary Engineers (IUSE) to develop training for persons working directly with equipment operation. Continued promotion and support of the industry consensus guidelines related to energy conserving designs of commercial buildings developed with ASHRAE, ASTM, ISO and other groups. (IUSE) ($1,048)	Energy Star building performance label, a benchmark for energy efficient commercial buildings, that will help establish value for energy efficient buildings in the commercial real estate market. Designing building operations and facility management training curriculums in partnership with the International Facilities Management Association, the Association of Higher Education Facilities Officers, and other organizations responsible for training building facility managers and building operators. This builds on previous successes working with the International Union of Stationary Engineers to develop training for persons working directly with equipment operation. Continuing design assistance service for large scale commercial construction projects to increase adoption of ENERGY STAR performance label for new construction in addition to promoting other Commercial R&D products and experience. Disseminating, synthesizing, and otherwise promoting the use of industry standards and guidelines relating to energy conserving	benchmark for energy efficient buildings, that will help increase value for energy efficient buildings in the commercial real estate market. With the Office of Codes and Standards, Building Standards and Guidelines activity, run pilot projects in partnership with States and utilities to test automatic energy code compliance strategies through the awarding of the Energy Star label. Using previously developed curricula, begin building operation/facility management training and train building facility managers in partnership with the International Facilities Management Association, the Association of Higher Education Facilities Officers, and other organizations responsible for training building facility managers and building operators. Continue design assistance service for large scale commercial construction projects to increase adoption of whole building design approaches and tools, appropriate Commercial R&D products, including recognition of the ENERGY STAR performance label. Outreach activities will focus on

III. <u>Performance Summary</u>: BUILDING SYSTEMS DESIGN (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Commercial Buildings (Cont'd)		designs of commercial buildings being developed by ASHRAE, ASTM, ISO and other groups. (IUSE, APPA) ($1,089)	building design, construction, and facility management professionals. Promote use of the International Measurement and Verification Protocol to provide building owners and financiers with a tool to evaluate and increase investment in energy efficiency. ($1,481)
	$13,098	$13,289	$21,081
Building Systems Design Total	$ 23,255	$ 22,986	$ 36,373

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

BUILDING EQUIPMENT AND MATERIALS

I. **Mission Supporting Goals and Objectives:**

I.A. Statement of Mission

The mission of the Building Equipment and Materials program is to conduct research, development and deployment activities in cooperation with private industry to provide industry with the advanced technology base needed for highly-efficient, globally competitive building components (equipment, envelope subsystems and materials) and to accelerate the adoption and widespread utilization of these advanced components within both residential and commercial buildings.

Buildings are responsible for 36 percent of the nation's total energy use, including 66 percent of its electricity consumption. In addition to the $220 billion of direct cost that this represents to consumers, building energy use contributes significantly to air and water pollution and depletion of the earth's non-renewable natural resources.

The long range goal of the Building Equipment and Materials program is to reduce sector energy consumption by 50% when the program's advanced technology has fully penetrated the market. The strategy to achieve these goals is to maintain a balance between (1) creating new technologies through cost-shared laboratory research and development projects and (2) accelerating the introduction of new technologies through technology partnerships using innovative approaches. It employs three major technology pathways: Space Conditioning Equipment; Lighting and Appliances R&D; and Building Envelope R&D.

Within residential buildings, advanced gas-fired heat pump technologies now being developed have the potential to double the efficiency of conventional equipment used for space heating and cooling, and for water heating. Similarly, new lighting technologies will use less than half the energy of today's standard incandescent lamps while lasting ten times as long. Advanced refrigeration research, coupled with new thermal insulating technologies, will greatly reduce the energy use of residential refrigerator/freezers, and new technologies will also convert residential windows from a significant energy burden into a net source of building energy through a combination of high thermal performance and selective capture of solar gain.

I. **Mission Supporting Goals and Objectives:** BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Commercial buildings will also benefit from activities within the Building Equipment and Materials program. Advanced commercial chillers and small-scale fuel cells are two technologies under development that will improve commercial building energy performance while displacing electricity with natural gas during the summer peak demand periods. Scotopic lighting and advanced light distribution technologies hold promise to improve worker productivity in addition to reducing commercial building lighting energy consumption. Commercial buildings will also benefit from research and development of electrochromic windows that have the capability of varying optical and solar heat gain properties, high performance low-slope roofing systems, and the development of new coatings and materials that reduce urban heat island effects.

By the year 2000, the Building Equipment and Materials program will achieve the following:

-- market introduction of more than 10 new advanced technology products,

-- initial export shipments for 5 new products using DOE technology, and

-- accelerated market introduction of 6 new and emerging products which are the most efficient in their product class.

I.B. Program Benefits

At the proposed funding levels, the Building Equipment and Materials Program is estimated to yield the following benefits:

METRIC	2000	2010	2020
Primary Energy Displaced (Quads)	0.02	0.60	2.12
Energy Cost Savings ($B)	0.14	4.57	14.66
Carbon Reductions (MMTons)	0.41	15.04	50.81

I. **Mission Supporting Goals and Objectives:** BUILDING EQUIPMENT AND MATERIALS (Cont'd)

I.C. Performance Goals

Strategy/Goal for 2000

Space Conditioning R&D
In partnership with small business R&D firms, manufacturers, utilities and professional organizations, the Space Conditioning R&D planning unit will develop space heating, cooling and refrigeration technologies such as natural gas driven heat pumps and chillers and space cooling and refrigeration technologies using non-ozone depleting refrigerants, and accelerate market introduction through high volume purchases, utility program coordination, and technical information dissemination, resulting in 1 TBtu of energy saved in 2000.

Lighting and Appliance R&D
In partnership with small business R&D firms, manufacturers, utilities and professional organizations, the Lighting and Appliance R&D planning unit will develop advanced lighting and appliance technologies such as low-power sulfur lamps, more efficient lighting fixtures, the scotopic lighting concept, heat pump water heaters, high efficiency laundry equipment, refrigerators and commercial refrigeration equipment, and accelerate market introduction through demonstrations, volume purchases, utility program coordination, and technical information dissemination, resulting in 9 TBtu of energy saved in 2000.

Building Envelope R&D
The Thermal Insulation and Building Materials planning unit will establish an industry-acceptable single design for a low-slope roof having an R-30 insulating value and a 30-year useful life that is adopted as general practice within the building industry. The program also will complete development and demonstrate super-insulating materials that exhibit R-50 insulating value per inch, have a 20-year life, and are cost effective in building and appliance applications. Standards will be developed for measuring and labeling reflectivity on roofing and paving materials. This will enable customers to design high reflective surfaces, thus reducing cooling loads on buildings. These advances will result in 6 TBtu of energy saved in 2000.

The Windows and Glazing planning unit will, through industry partnerships, commercialize electrochromic windows for niche markets for architectural applications. Along with industry's investment in high performance window and glazing production capability, the program will double the market share of these products as compared to 1995, resulting in an energy savings of 1 TBtu in 2000.

Accomplishment Summary

I. **Mission Supporting Goals and Objectives:** BUILDING EQUIPMENT AND MATERIALS (Cont'd)

FY 1997

-- Completed preliminary design of a low-powered sulfur lamp laboratory prototype using solid state power source; target efficiency is 100 lumens per watt, target life is 10-20 years.

-- Completed laboratory research on the scotopic lighting concept.

-- Demonstrated an R-50 per inch super-insulating powder vacuum insulation panel for use in both residential and commercial appliances such as refrigerators and freezers.

-- Awarded phase II industry consortium pilot production of electrochromic window prototypes to develop expanded durability testing.

-- Launched ENERGY STAR appliance program nationally in conjunction with manufacturers and utilities to promote appliances significantly exceeding present efficiency standards.

-- Added clothes washers to the portfolio of ENERGY STAR products, qualifying models use 53% less energy than minimum efficiency standards.

-- Expanded nationwide the public housing refrigerator purchasing partnerships with 71,000 newly-designed units with a 15% energy efficiency improvement over the best currently available technology.

-- With manufacturers, demonstrated high efficiency washers for commercial and residential buildings that reduce energy consumption by over 55%.

FY 1998

-- Complete test and evaluation of a full-scale laboratory prototype of a natural gas absorption chiller using DOE's advanced DCC technology at York International.

-- Complete initial laboratory R&D to determine feasibility of prototype low-power sulfur lamp for residential applications.

I. **Mission Supporting Goals and Objectives:** BUILDING EQUIPMENT AND MATERIALS (Cont'd)

-- Develop standards for measuring and labeling reflectivity on roofing and paving products and develop a data base of materials available with high reflectivity coatings.

-- Add windows to the ENERGY STAR portfolio; double the number of retail stores labelling ENERGY STAR appliances to 2,400 nationwide; recruit five major appliance manufacturers to label ENERGY STAR appliances at the factory; and increase sales of ENERGY STAR appliances by 30% over 1997.

-- Establish "Total Equivalent Warming Index" as the analytical comparative basis for insulating foam blowing agents.

-- Successful development and demonstration of the Whole Wall Rating System.

-- Through the DOE's hotel/motel consortium, promote sales of 20 laundry hot wastewater recycling and reuse systems saving 300 million gallons of water and 2 billion Btu.

-- Expand ENERGY STAR appliances in manufactured homes to include home builders throughout the U.S..

FY 1999 - 2000

-- Complete field test of a commercial prototype DCC absorption chiller with York International.

-- Begin testing a laboratory prototype version of a natural gas Hi-Cool heat pump using advanced absorption technology.

-- Complete research and demonstrate a pre-production prototype refrigerator/freezer with an industry partner that uses 1 kWh/day of electricity, 50% less than current standards allow.

-- Demonstrate energy efficient supermarket refrigeration and heat recovery systems in three new or remodeled supermarkets.

-- Initiate sales of small residential electric heat pump water heaters by a major manufacturer, with the objective of selling 100,000 units per year by 2005.

-- Successfully demonstrate full-size electrochromic windows.

I. **Mission Supporting Goals and Objectives:** BUILDING EQUIPMENT AND MATERIALS (Cont'd)

-- Work with the Federal Trade Commission (FTC) to allow manufacturers to add the ENERGY STAR logo to the yellow and black FTC "energy guide" label for covered products, and recruit an additional 1,500 stores to label ENERGY STAR appliances nationwide.

-- Issue major solicitation on sustainable insulation.

-- Establish industry/government consensus rating system for building envelope components, i.e., walls and roofs.

-- Successfully demonstrate full-size high performance spectrally selective windows utilizing enhanced ion-beam deposition.

-- Industry/government Windows Collaboration will have significantly contributed to doubling of market share for highly efficient windows.

II. A. **Funding Table**: BUILDING EQUIPMENT AND MATERIALS

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Technology Roadmaps and Competitive R&D . .	$ 0	$ 0	$ 8,000	$ 8,000	>999%
Space Conditioning and Cogeneration	11,440	12,430	15,380	2,950	24%
Lighting and Appliance	6,798	5,342	11,080	5,738	107%
Building Envelope R&D	7,842	9,149	11,721	2,572	28%
Total, Building Equipment and Materials	$ 26,080	$ 26,921	$ 46,181	$ 19,260	72%

II. B. **Laboratory and Facility Funding Table**: BUILDING EQUIPMENT AND MATERIALS

Argonne National Lab (East)	$ 100	$ 200	$ 200	$ 0	0%
Brookhaven National Lab	600	700	700	0	0%
Lawrence Berkeley Lab	4,200	5,000	6,000	1,000	20%
National Renewable Energy Lab	900	1,100	1,100	0	0%
Oak Ridge National Lab	12,000	13,000	15,100	2,100	16%
Pacific Northwest Lab	3,800	2,000	5,600	3,600	180%
All Other	4,480	4,921	17,481	12,560	255%
Total, Building Equipment and Materials . . .	$ 26,080	$ 26,921	$ 46,181	$ 19,260	72%

III. Performance Summary: BUILDING EQUIPMENT AND MATERIALS

Activity	FY 1997	FY 1998	FY 1999
Technology Roadmaps and Competitive R&D			This effort represents a new approach to conducting research for the building sector. Based upon the direction identified in the Office of Building Technology, State and Community Programs strategic plan, development of 3-5 technology "road maps" in collaboration with industry and the research community will continue. The technology road maps will be drawn from areas identified in the strategic plan including heating, cooling and ventilation; envelope technology; lighting, appliances, cogeneration and system integration. Participants will include industry leaders, academics, national laboratories, states, and other identified contributors to each road map. The goal is to identify and implement research and technology access actions necessary to develop and bring new energy efficient technologies that will save energy and money and have beneficial environmental impacts, to the marketplace.

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technology Roadmaps and Competitive R&D (Cont'd)			These metrics will be developed in concert with industry partners as the road maps are designed. Research and development actions, that are identified as appropriate for DOE, will be undertaken through competitive procurement and will be cost-shared with partners. (TBD) ($8,000)
	$ 0	$ 0	$ 8,000
Space Conditioning and Cogeneration	Heating and Cooling includes: RESIDENTIAL ABSORPTION HEAT PUMPS: The goal of this program is to develop two different gas-fired Absorption heat pump concepts: 1) first generation GAX heat pump for markets where heating dominates energy use and 2) a second generation "Hi-cool" Absorption heat pump with 30% higher cooling performance for cooling dominated markets. To independent, industry supported evaluations judged the GAX	RESIDENTIAL ABSORPTION HEAT PUMPS: The goal of this program is to develop two different gas-fired Absorption heat pump concepts: 1) first generation GAX heat pump for markets where heating dominates energy use and 2) a second generation "Hi-cool" Absorption heat pump with 30% higher cooling performance for cooling dominated markets. In the period 1997-2000, the GAX effort will focus on moving the ASM	RESIDENTIAL ABSORPTION HEAT PUMPS: The goal of this program is to develop two different gas-fired Absorption heat pump concepts: 1) first generation GAX heat pump for markets where heating dominates energy use and 2) a second generation "Hi-cool" Absorption heat pump with 30% higher cooling performance for cooling dominated markets. In the period 1997-2000, the GAX effort will focus on moving the ASM
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	technology superior in performance and cost to other cycles and is the preferred cycle for a commercial product in 2000+. The program strategy is to develop Hi-cool basic technology in parallel with developing the GAX, working with small business, R&D firms, HVAC manufacturers and the gas industry. In the period 1997-2000, the GAX effort will focus on moving the technology from laboratory ASM to industry led field tests of complete heat pump units. The "Hi-cool" effort will focus on R&D of ASM laboratory components and initial stages of system development. The ASM is a single unit that houses the major absorption components. In FY 1997, three first generation prototype GAX heat pumps were fabricated and testing began at a national laboratory. Increased manufacturing involvement with a small business absorption chiller manufacturer began to design and	technology from the laboratory to industry led field tests of complete heat pump units. The "Hi-cool" effort will focus on R&D of the ASM laboratory components and initial stages of system development for a complete heat pump with market potential in 2005. The ASM is a single unit that houses the major absorption components. In FY 1998, complete initial laboratory testing of a first generation GAX heat pump, and initiate testing at a gas industry selected site. Working with a small business manufacturer of absorption systems, establish the design and begin fabrication of pre-production prototype units for field testing. Work with a major HVAC manufacturer of heat exchangers to complete design and begin building multiple heat exchanger for residential field test units and laboratory heat pumps. Work with manufacturers and key gas utilities to form an industry-led consortium to	technology from the laboratory to industry led field tests of complete heat pump units. The "Hi-cool" effort will focus on R&D of ASM laboratory components and initial stages of system development fora complete heat pump market potential in 2005. The ASM is a single unit that houses the major absorption. In FY 1999, complete test and evaluation of prototype GAX heat pump at a gas industry site. Work with a small business manufacturer of absorption units to build multiple prototype GAX heat pumps for a multiple field testing. With a major HVAC manufacturer of heat exchangers, design and build heat exchanger for small commercial laboratory heat pumps. With major gas utilities in an industry led consortium, continue to develop GAX prototypes, manufacturing processes, conduct field tests and market analysis. Build critical components for the scale up design of the GAX ASM units for
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	develop prototype heat pumps using GAX components. Working with a major HVAC manufacturer, developed heat exchanger design for the laboratory heat pumps. With small businesses, designed, fabricated and continued laboratory testing of critical components and high temperature materials research for two different design concepts, a branched GAX and an Solid/Vapor. (EPAct Section 2102) Phillips, Robur, Lennox, Energy Concepts, Rocky Research) ($5,212)	develop GAX prototypes, manufacturing processes, and conduct field tests and market analysis. Initiate the scale-up design of the ASM for GAX technology from residential to small commercial size unit in response to market opportunity identified by the gas industry, and HVAC manufacturers. In FY-1998, continue test, evaluation, and increased manufacturers involvement leading to commercialization. In FY 1998 laboratory testing of critical components for two different design concepts: branched GAX and solid/vapor will be completed. Fabrication and testing of prototype heat pumps and of ASM units will begin. (EPAct Section 2102) (Phillips, Robur, Lennox, Energy Concepts, Rocky Research, ORNL) ($5,400)	residential and small commercial market opportunities identified by the gas industry, and HVAC manufacturers. In FY 1999, with increased manufacturers involvement, complete a manufacturing cost analysis to verify first cost and marketability of a commercial product. In FY 1999, complete fabrication of an ASM for prototype small commercial Hi-cool branched GAX heat pump. Complete laboratory testing of high temperature heat exchanger for the Solid/Vapor heat pump concept. (Phillips, Robur, Lennox, Energy Concepts, Rocky Research, ORNL) ($6,450)
Space Conditioning and	DESICCANTS AND CHILLERS: The goal of this activity is to develop natural	DESICCANTS AND CHILLERS: The goal of this activity is to develop natural gas-fired desiccants and chillers to	DESICCANTS AND CHILLERS: The goal of this activity is to develop natural gas-fired desiccants and chillers to

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	gas-fired desiccants and chillers to reduce energy used for air conditioning, reduce electric peak loads and improve indoor air quality in commercial buildings. The FY-1997 objective is to field test and evaluate desiccant systems in comparative testing with standard HVAC cooling equipment and laboratory test advanced components. For the chiller, evaluate the performance of a high efficiency prototype commercial size chiller. Moisture and humidity problems in buildings result in significant excess energy consumption in conventional cooling equipment, in poor indoor air quality and in high costs for more frequent renovation (estimated to cost the hotel/motel industry alone $70 million a year). The wet coils and ductwork in conventional cooling systems in humid areas breed mold and bacteria which can be a health hazard. In addition, new ASHRAE requirements for greatly increased ventilation air to	reduce energy used for air conditioning, reduce electric peak loads and improve indoor air quality in commercial buildings. The FY-1998 objective is to continue field test and evaluation of additional desiccant systems for comparative testing with standard HVAC cooling equipment and initiate concept evaluation of liquid desiccant systems in laboratory testing. For the chiller, complete testing of a high performance commercial size chiller. Continue to develop two solid desiccant concepts in competitively-selected projects with cost-sharing industry partners. Expand the comparative field test of a desiccant air-conditioner concept to include large restaurants and schools. Begin a field pilot test of the desiccant pre-conditioner for treating ventilation air in combination with conventional air-conditioning systems and initiate development of fully integrated combined unit.	reduce energy used for air conditioning, reduce electric peak loads and improve indoor air quality in commercial buildings. The FY-1999 objective is to begin testing of a prototype desiccant based pre-conditioner into a modular HVAC system. Complete field testing of desiccant systems in comparative testing with standard HVAC cooling equipment and laboratory test advanced components. For the chiller, begin field testing of a modified high efficiency pre-production commercial size chiller. Continue to develop two desiccant concepts in competitively-selected projects with cost-sharing industry partners. Monitor comparative field tests of a desiccant air-conditioner concept at large restaurants and schools and complete a report on IAQ benefits, costs and energy savings in the field installations. Complete a field pilot test of the desiccant pre-conditioner for treating
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	achieve good indoor air quality place an additional dehumidification burden on air conditioning systems. Desiccants have the ability to reduce moisture levels, improve air quality and treat increased ventilation air rates with lower energy consumption than conventional systems. Continued to develop two solid desiccant concepts in competitively-selected projects with cost-sharing industry partners: continued a comparative field test of a desiccant air-conditioner concept in small restaurants and theaters and developed a desiccant pre-conditioner for treating ventilation air in combination with conventional air-conditioning systems. Completed the initial round of prototype testing and established a figure-of-merit for rating solid desiccant wheels. Initiated exploratory studies of liquid desiccant systems. The goal for large chillers is to develop, for large commercial	Continue to work with manufacturers in testing and evaluating prototype solid desiccant wheels. Begin initial tests of a new liquid desiccant absorber. Continue cost-shared development of a DCC absorption chiller at York International. Complete performance test of a full-scale laboratory prototype. Complete cost analysis and market study as a prelude to field test of a commercial prototype based on materials characterized in the dynamic corrosion studies. Complete development of the critical components for a commercial prototype unit for field test. (Semco/Trane, ICC Technologies, AIL, NREL, York International, ORNL) ($2,400)	ventilation air and complete development and initiate a field test of a unit with integrated desiccants and conventional air-conditioning. Complete the second round of testing of manufacturer prototype solid desiccant wheels. Expand liquid desiccant efforts by initiating industry cost-shared development of high efficiency liquid dehumidifiers. Continue cost-shared development of a DCC absorption chiller at York International. Perform a field test of a commercial prototype DCC chiller in cooperation with York International. A successful field test will complete the project. Evaluate opportunities for increasing performance and reducing emissions of gas engine-driven chillers, as an alternative to absorption chillers. (Semco/Trane, ICC Technologies, AIL, NREL, York International, ORNL) ($2,300)
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	buildings, absorption chillers based on DOE-patents with 40% higher cooling efficiency than the best existing (Japanese) technology. The first of two key technologies has been licensed and is being independently developed by a major manufacturer with gas industry funding. The second, the Double-Condenser Coupled (DCC) concept, is being developed in a 35% cost-shared effort with competitively-selected York International and with technical support from small business R&D firms. Completed fabrication and began performance test of a full-scale laboratory prototype DCC chiller. Initiated corrosion studies in a new dynamic test facility to identify low-cost materials. Continued development of the critical components for a commercial field test prototype. (Semco/Trane, ICC Technologies, AIL, NREL, York International, ORNL) ($2,518)		
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	FURNACES AND BOILER/COMBUSTION RESEARCH: The 11 million U.S. homes and numerous commercial buildings relying on oil-fueled space heating and water heating equipment consume 2.1 quads of oil annually. The purpose of this program is to provide the R&D for a U.S. oil heat equipment industry which has very limited R&D capability and is susceptible to foreign competition. The primary goal is to develop combustion systems which do not degrade in efficiency and which are applicable to today's more efficient buildings. To meet this goal, research continues with small business manufacturers on several designs for a low firing rate fan atomized burner (FAB), exploiting unique advantages of this new burner concept, including: a two-stage firing rate design, a low-cost design and a self-tuning design. Completed work on a basic, low excess air FAB under NYSERDA	FURNACES AND BOILER/COMBUSTION RESEARCH: Continue research with small business manufacturers on several designs for a low firing rate fan atomized burner (FAB), exploiting unique advantages of this new burner, including: a low-cost design and a self-tuning design. Under continuing NYSERDA cost sharing of small business manufacturers, conduct field testing of the basic, low excess air FAB with furnace/boiler manufacturers. Terminate work on two stage prototype FAB in favor of designs offering higher potential. Also with NYSERDA cost-sharing, continue to develop low-cost, low-NOx version of FAB with small burner manufacturer to evaluate commercial potential. Demonstrate prototype self-tuning FAB, and continue refinements to control excess air. Continue developing a CFD design tool to improve accuracy. Continue	FURNACES AND BOILER/COMBUSTION RESEARCH: Continue research with small business manufacturers on several designs for a low firing rate fan atomized burner (FAB), exploiting unique advantages of this new burner, including: a low-cost design and a self-tuning design. Through a continuation of the NYSERDA CRADA with BNL, support a small business burner manufacturer in design and testing of pre production prototype version of the simplified fan atomized burner with potential for lower production cost. Continue development of self-tuning oil burner concept improving design for lower cost, application testing, and demonstrations for potential industry partners. Demonstrate the use of Computational Fluid Dynamics (CFD) in the design of a new oil burner working in cooperation with an oil burner manufacturer. Continue technology transfer to industry
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	cost-sharing to obtain UL approval. Two-stage FAB: investigated optional controls. Low-cost design: Explored design options to simultaneously reduce burner head complexity and lower NOx emissions. Self-Tuning Burner: Initiated research in response to strong industry interest in an advanced system which maintains peak efficiency and eliminates annual tune-ups by controlling excess air with low-cost oxygen sensors. Initiated development of computational fluid dynamic (CFD) design tool for oil burners and initiated laboratory confirmation tests. Continued to provide the oil heat industry with a mechanism for the transfer of research results through the 1997 Oil Heat Technology Conference, trade shows and educational programs. (BNL) ($494)	technology transfer to industry through support of a 1998 Oil Heat Technology Conference. (BNL) ($500)	through support for 1999 Oil Heat Technology Conference. (BNL) ($500)
Space Conditioning and	REFRIGERATION: This program supports the heating, ventilating, air-conditioning and	REFRIGERATION: Building on	REFRIGERATION: In response to a 1997 industry research

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	refrigeration (HVAC&R) industry with the technology base needed to increase energy efficiency, improve the quality of space conditioning, and adopt a new generation of chlorine-free refrigerants. The goal is to reduce annual energy use for space heating & cooling, refrigeration and water heating by 30% to 60%. For new refrigerants, completed a Cooperative Research and Development Agreement (CRADA) with the chemical industry on global warming impact analysis of chlorine-free refrigerants and alternative technologies. Continued materials compatibility and lubricant research in a jointly-funded and industry-led program to replace refrigerants which deplete the ozone layer. Under a CRADA with Dupont, evaluated special refrigerant blends designed to improve efficiency at high outdoor temperatures and reduce utility peak loads. For refigeration	industry's vision of the future and a 1997 research agenda of "HVAC&R Research for the 21st Century," revise program plans to increase program potential to achieve energy savings of 30% to 60%. Conduct an independent peer review of the program. Conduct an assessment of technical and market opportunities in the heating, air-conditioning, ventilation, refrigeration and water heating sectors in commercial and residential buildings. For new refrigerants, continue last phase of a industry-led, jointly-funded research program on materials compatibility and lubricants research for a new generation of chlorine-free refrigerants. Continue CRADA with DuPont to improve air conditioning performance at high outdoor temperatures by developing new heat exchangers to efficiently use new refrigerant blends. For refigeration systems, continue research with industry cost	agenda "HVAC&R Research for the 21st Century" and technology assessment results, continue a collaborative program of industry cost shared research focused in areas of high priority, including integration of equipment and distribution system, and improved quality of conditioned air. For new refrigerants, complete the successful seven-year, industry-led, jointly-funded program of materials compatibility and lubricants research which paved the way for a new generation of chlorine-free refrigerants to replace refrigerants which deplete the ozone layer. Complete laboratory support to CRADA partner DuPont and a heat pump manufacturer in laboratory and field testing of a heat pump with improved performance at high outdoor temperatures. For refigeration systems, complete laboratory support to CRADA partner Frigidaire to develop a pre-production
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	systems, conducted research with industry cost sharing to develop and demonstrate high efficiency technology breakthroughs for supermarket refrigeration systems, residential refrigerators, and soft drink vending machines. Began baseline refrigerator tests in a cost-shared CRADA with Frigidaire to develop a refrigerator using 50% less energy than current designs. Completed a major technology and market assessment of water heating and initiated effort to develop and demonstrate advanced residential and commercial heat pump water heater technologies. Continued to develop and facilitate improved thermal distribution systems including the development of a nationally recognized test method for thermal distribution system efficiency. (ORNL, NIST, ARTI, University of Maryland, Arthur D. Little) ($2,231)	sharing to develop and demonstrate high efficiency technology breakthroughs for supermarket refrigeration systems, residential refrigerators and soft drink vending machines. For residential refrigerators, evaluate component technologies under the cost-shared CRADA with Frigidaire to develop a refrigerator using 50% less energy than current designs. Initiate development of an innovative design concept for a heat pump water heater much lower in cost and easier to install than today's technology. Complete development of a nationally recognized method of test for thermal distribution system efficiency through publication of an ASHRAE method of test procedure public review. (ORNL, NIST, LBL, BNL, University of Maryland, Arthur D. Little) ($3,130)	refrigerator/freezer using 50% less energy than current designs. Demonstrate supermarket refrigeration/HVAC energy savings in field tests of new systems with industry partners. Continue development and begin field testing innovative heat pump water heater concepts much lower in cost and easier to install than conventional technology. Continue development of the proposed ASHRAE Standard for thermal distribution efficiency through demonstrations of improved designs by field validation testing. (ORNL, NIST, LBL, BNL, University of Maryland, Arthur D. Little) ($3,130)
Space Conditioning and	FUEL CELLS FOR BUILDINGS: This activity		

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	works with industry in cost shared programs to develop and demonstrate fuel cell technologies which are cost effective and unique to buildings and are not being addressed by other fuel cell programs. Issued a competitive Program Research and development announcement (PRDA) for research and development of a processes for reforming natural to obtain Hydrogen for the fuel cell. Selected three cost sharing partners to investigate three different reforming technologies for natural gas. In the SBIR program, continue to develop two component concepts: low cost bi-polar plate using carbon fibers and carbon monoxide tolerant anodes. (International Fuel Cells, H2Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, Argonne National Laboratory) ($985)	FUEL CELLS FOR BUILDINGS: This activity works with industry in cost shared programs to develop and demonstrate fuel cell technologies which are cost effective and unique to buildings and are not being addressed by other fuel cell programs. In FY - 1998 selection of the best of three reforming concepts will be made and the design of critical components for the selected process will begin. In the SBIR program, complete development of carbon monoxide tolerant anodes and low cost bi-polar plates. International Fuel Cells, H2Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, Argonne National Laboratory) ($1,000)	FUEL CELLS FOR BUILDINGS: This activity works with industry in cost shared programs to develop and demonstrate fuel cell technologies which are cost effective and unique to buildings and are not being addressed by other fuel cell programs. In FY-1999 fabrication and laboratory testing of the selected reformer will begin. Initiate the design of a laboratory breadboard PEM fuel cell for building applications. Initiate research into high temperature membrane materials, advanced CO tolerant and high temperature catalysts. With an industrial partner, continue working with low cost bipolar plates derived from the SBIR program. (International Fuel Cells, H2Burner Technologies, Energy and Environmental Research Corporation, Materials & Electrochemical Research, EIC Laboratories, Argonne National Laboratory) ($3,000)
Space Conditioning and			

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	$ 11,440	$ 12,430	$ 15,380
Lighting and Appliance Lighting and Appliance (Cont'd)	LIGHTING R&D: The goal of this activity is to develop the technology to reduce lighting energy use by 50 percent by the year 2010, saving consumers $20 billion a year and saving 12 percent of all the electricity used in the United States each year. To achieve this goal, the program is undertaking work in three areas: advanced light sources; fixtures, controls and distribution systems; and the impact of lighting on vision. The major focus of the program is on advanced light source research because of their importance in determining overall system efficiency, the high technical risk of lamp research, and the replacement opportunities due to their relatively short life and low cost. LIGHT SOURCES: Almost two-thirds of the electricity used for lighting buildings in the US is	LIGHTING RD&D: Conduct a comprehensive technical peer review of all lighting activities using an independent panel of outside experts from industry and academia. Refocus or adjust projects as necessary based on panel report. Conduct an industry workshop to identify R&D and technology transfer needs for lighting controls, cofunded by NY State and EPA. Initiate an effort to establish a comprehensive industry-DOE road map for lighting R&D, building on the controls workshop and on a basic research road map for light sources developed in 1995 by industry as a joint initiative with DOE-EE, DOE-ER, EPRI and NSF. LIGHT SOURCES:	LIGHTING RD&D: Based on 1997 peer review and industry recommendations, refocus and expand lighting R&D program. Accelerate development of compact fluorescent lamps (CFL) and novel light distribution systems, and accelerate research on lighting controls and impacts. LIGHT SOURCES:

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	for incandescent and fluorescent lamps, costing consumers $25 billion a year. Development of advanced, highly efficient light sources could cut these costs in half over the next 15 years. The program is developing advanced lamps to accomplish this goal in the near, mid and long term.		
Lighting and Appliance (Cont'd)	NEAR-TERM: Initiated cost-shared development of a low-cost compact fluorescent lamp (CFL) with an internal electronic power supply in cooperation with a major manufacturer. CFLs are four times more efficient than incandescent lamps, but have only 2 percent of the market because of their high cost largely due to the lamp's internal power supply.	NEAR-TERM: Continue cost-shared effort to develop a low cost compact fluorescent lamp (CFL) with an internal electronic power supply. Evaluate several new electronic circuit designs and select the one most capable of low-cost manufacture. Construct breadboard prototype and test. Begin effort to modify lamp components to operate compatibility with the new electronic circuit.	NEAR-TERM: Accelerate cost-shared effort to develop a low cost compact fluorescent lamp (CFL) with industry. Optimize the selected power supply circuit for performance and low-cost manufacture and construct an improved laboratory prototype. Continue to develp lamp components compatible with the power supply. Test integrated improved power supply and lamp systems.
	MID-TERM: The low-power sulfur lamp could be six to eight times more efficient than incandescent lamps, two times	MID-TERM: Continue cost-shared effort to develop a low-power sulfur lamp and power source. Optimize design of the laboratory prototype. Evaluate	MID-TERM: Continue to optimize design and integrate the prototype low-power sulfur lamp

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	more efficient than fluorescent lamps, and have an operating life of 10 years or more. The quality of sulfur lighting is exceptional: it closely matches sunlight, but produces no harmful ultraviolet rays or heat. Continued heavily cost-shared effort to develop the fundamental lamp technology of the low-power sulfur lamp and a highly efficient, solid-state power source.	performance of each sub-system: bulb, power source, coupling and shielding, and light extraction. Evaluate system efficiency and light quality. Investigate possible failure modes and improve starting characteristics. Incorporate improvements into laboratory prototype.	with a highly efficient solid state power source. Using an independent laboratory, measure system efficiency and spectral characteristics of final prototype low- power lamp. Estimate manufacturing cost for lamp and power supply and perform a market study and identify candidate market entry points according the lamp's performance, features, cost, and other factors.
Lighting and Appliance (Cont'd)	LONG-TERM: Continued to develop a new type of cathodo-luminescent lamp, which uses a diamond-like carbon filament. This "diamond lamp" project is cost-shared by DOE's Basic Energy Sciences (ER) and industry. This high-efficiency technology, could be produced in a wide variety of shapes and sizes and can be easily dimmed and controlled. Developed an initial laboratory prototype diamond lamp and made initial efficiency measurements.	LONG-TERM: Continue development of a unique type of cathodo-luminescent lamp, the diamond lamp, with cost-sharing by DOE's Basic Energy Science (ER) and industry. Based on initial efficiency measurements, investigate methods to improve efficiency and operability. Evaluate the performance of the low energy phosphors used. Determine power source requirements and construct prototype power source.	LONG-TERM: Continue development of a unique type of cathodo-luminescent lamp, the diamond lamp, with cost-sharing by DOE's Basic Energy Science (ER) and industry. Improve the initial prototype diamond lamp and test more efficient fluorescent phosphors. Determine the configuration and characteristics of the "diamond lamp" for successful market entry. Begin to evaluate the state-of-the-art in new types of light sources for instruments and displays, (e.g., light emitting diodes and

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Lighting and Appliance (Cont'd)	DISTRIBUTION AND CONTROLS: To achieve the energy saving potential of advanced light sources, new techniques need to be developed for distributing and utilizing the light they produce. This effort currently focuses on lighting controls and CFL fixtures. Continued work in a collaborative project with an electric utility and the General Services Administration (GSA) to field test and evaluate the latest electronic/computer control systems for lighting in a large Federal office building. Lessons learned here will be reported to the GSA for application at other Federal facilities. Another problem with CFLs is that they cannot often be used in conventional fixtures because of their size and shape. Assisted manufacturers in designing more efficient and pleasing fixtures for	DISTRIBUTION AND CONTROLS: Continue the project to evaluate the use of state-of-the-art lighting controls in a federal office building. Analyze and evaluate the first year's data and prepare interim comprehensive report for sponsors. Continue to assist manufacturers in developing new fixtures for compact fluorescent lamps. Develop a reference manual for designing efficient compact fluorescent fixtures and disseminate to manufacturers. Continue to conduct workshops in fixture design for the fixture industry. Complete installation and evaluation of new types of CFL fixtures in a large hotel chain. Initiate the national design competition for CFL fixtures, co-sponsored with industry. Contestants will be students in industrial arts and engineering at universities and judges will be leading interior designers,	electro-luminescent displays) to determine their applicability to building lighting. DISTRIBUTION AND CONTROLS: Complete the lighting controls project in a large Federal office building and report results to the GSA for application at other Federal facilities. Complete the fixture design competition by transferring the winning student designs to participating manufacturers and complete arrangements for market introduction by the project's retail partners. Initiate an effort to evaluate several new technologies in telecommunications, defense and space science which may be useful for building lighting from areas such as: non-imaging optics, solid state optical devices, and materials science. Begin to develop methods to efficiently use optical fibers and hollow light guides to distribute light from highly efficient centralized light sources and/or solar concentrators

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	CFLs, particularly those that utilize dedicated sockets that will not accept incandescent lamps. Developed a plan for a national CFL fixture design competition and obtained cost-shared participation from industry.	manufacturers, and retailers.	and daylighting systems. Health care and educational facilities use proportionally much more lighting energy than other types of facilities. Perform a study of ways to tailor newly emerging lighting technology for increased use in schools, hospitals, and similar facilities.
Lighting and Appliance (Cont'd)	IMPACTS OF LIGHTING: Since the main purpose of lighting is to improve vision, energy efficient lighting systems must be also evaluated on how they affect vision. Making these judgements on a sound scientific basis is difficult because of serious gaps in knowledge of the relationship between lighting and vision. There are no generally accepted means for optimizing lighting as it affects vision and the relationship between energy savings and visual quality is largely unknown. Completed long-term laboratory work on the effects of scotopic lighting on vision and present the	IMPACTS OF LIGHTING: Refocus work on the impact of lighting on vision on improving the visual quality and energy efficiency of outdoor lighting, particularly on streets and highways. Initiate a near-term project with broad, cost-shared industry support to test the feasibility of "mesopic lighting " which modifies the spectrum of high intensity outdoor lamps to give better color quality and visual effectiveness, thereby allowing the lamps to be operated on less energy. These improved high intensity lamps have the potential to be 50 percent more efficient while creating a safer and more	IMPACTS OF LIGHTING: Evaluate initial experimental results of mesopic lighting which modifies the spectrum of high intensity outdoor lamps to produce a better quality light that improves vision, thereby allowing lamps to be operated with less energy. Energy savings of 50 percent seem possible at little additional cost. Complete initial experiments in which subjects are tested in a modified auto drivingsimulator. Begin planning for field tests using mesopic street lights with co-funding and technical assistance from the four

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	results to industry. Further work on the use of scotopic lighting in buildings will depend upon industry participation. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center) ($2,366)	pleasant nighttime environment for pedestrians and motorists. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center, TBD) ($2,400)	largest manufacturers of lighting in the U.S. (GE, Fusion Lighting, LANL, LBNL, ORNL, Lighting Research Center, TBD) ($4,080)
Lighting and Appliance (Cont'd)	Technology Access: TECHNOLOGY INTRODUCTION PARTNERSHIPS: Program fills the gap between traditional federal R&D programs for new technologies (such as the Building Technology R&D programs), and the mass-market for energy efficient products by removing market barriers. There are three major elements to the program: (1) conducting applied, focused development and pilot demonstration of emerging technologies with industry that increase the efficiency of appliances, heating, cooling, and refrigerating equipment, and building components like	Technology Access: TECHNOLOGY INTRODUCTION PARTNERSHIPS: The major objectives for FY 1998 are to broaden demonstrations beyond lighting and washers; organize volume purchases beyond public housing into private multi-family housing; establish the Energy Star as a uniform national program that can be used by utilities as a platform to promote efficient appliances.	Technology Access: TECHNOLOGY INTRODUCTION PARTNERSHIPS: The major objectives for FY 1999 are to expand the program into commercial building technologies, broaden the program by adding more gas appliance demonstrations, and incorporate gas products into volume purchases, strengthen the links with research and development programs, and add to the portfolio of products in consumer education efforts.

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Lighting and Appliance (Cont'd)	windows; (2) demonstrating markets for energy efficient products by organizing volume purchases and promoting energy efficient products with utilities, manufacturers, and home builders and (3) facilitating commercialization of energy efficient products for the mass-market by identifying very efficient products and educating consumers to invest in products that are significantly more efficient than mandated by appliance standards.		
	EMERGING TECHNOLOGY DEMONSTRATIONS: The purpose of emerging technology demonstrations is to build manufacturer, utility, and consumer confidence in new, energy efficient technologies and products through cost-shared development and demonstrations with industry. Completed demonstrations of horizontal axis washer technology in commercial installations with U.S.	EMERGING TECHNOLOGY DEMONSTRATIONS: Demonstrate sulfur lamp in Air Force and U.S. Post office installations and disseminate results to aerospace and other industries. Demonstrate efficient water heating and hot water energy recovery technologies with industry.	EMERGING TECHNOLOGY DEMONSTRATIONS: Demonstrate a "drop-in" heat pump water heater for residential use with a major manufacturer, based on DOE R&D programs. Develop a specification for the heat pump water heater to be used in organizing volume purchases. With a major manufacturer and gas utility partner, demonstrate a

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Lighting and Appliance (Cont'd)	manufacturers; demonstrated energy savings from horizontal axis washers with a major manufacturer in water-strapped community. Installed sulfur lamp demo at U.S. Air Force base. The sulfur lamp has been developed to demonstration stage through DOE - supported R&D.		new engine-driven, integrated gas cooling and water heating technology. Demonstrate the energy savings potential from modifications to consumer electronics products that can reduce or eliminate power "leakage" in standby modes. Evaluate products from DOE buildings R&D programs for demonstrations, such as centralized light distribution system and desiccant cooling systems.
	VOLUME PURCHASES: The purpose of organizing volume purchases is to demonstrate markets to manufacturers for emerging products by organizing volume purchases. Assisted in developing specification for new round of advanced refrigerator purchase for public housing through competitive procurement with utility groups; expanded the commitments for 1996 refrigerator volume purchase to 60,000 refrigerators by public housing authorities. Implemented a volume purchase for clothes	VOLUME PURCHASES: Continue technical performance monitoring and evaluation of 60,000 apartment-sized refrigerators in public housing units. Organize buyers groups for compact fluorescent lighting, high-efficiency clothes washers, and window air conditioners.	VOLUME PURCHASES: Organize volume buyers to commit to a purchase of heat pump water heaters. Organize utilities to promote sales of high efficiency gas appliances, such as integrated space conditioning/water heaters and condensing furnaces.

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	washers in cooperation with water utilities and housing buyers group.		
Lighting and Appliance (Cont'd)	CONSUMER EDUCATION: The purpose of consumer education is to educate consumers on the value of purchasing energy efficient products. This is accomplished by identifying energy efficient products for consumers with the Energy Star designation and assisting Energy Star products with manufacturers, utilities and others who will promote Energy Star products directly to consumers. Launched a consumer education program for energy efficient appliances with EPA using the Energy Star label. Recruited 8 utilities to use the Energy Star as the aegis for promoting efficient consumer products; signed agreements with retail chains, local retailers' associations representing over 1,000 stores to promote Energy Star appliances. Added windows to the Energy Star portfolio. (ORNL, PNNL, D&R, Southeast	CONSUMER EDUCATION: Establish the Energy Star as the common program aegis for regional market transformation efforts and utility marketing and DSM programs. Begin recruiting manufacturers of high efficiency appliances and windows to label Energy Star products at the factory. Develop a protocol with FTC to allow incorporation of the Energy Star logo on the yellow "Energy Guide" label for qualified appliances. Monitor sales of Energy Star products to measure success of consumer education. (ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance) ($2,942)	CONSUMER EDUCATION: Add commercial products like chillers and boilers to the Energy Star product portfolio; add gas products like water heating technology to the Energy Star consumer education portfolio. Sign agreements with all major appliance manufacturers to apply voluntary Energy Star labels at the factory. Add new appliances, such as water heaters and dryers, to the Energy Star portfolio. Incorporate Energy Star as a voluntary element of the FTC "Energy Guide" label. Continue to measure sales of Energy Star products to measure success of the program. Initiate a campaign to educate consumers about the benefits of early retirement of inefficient residential appliances. (ORNL, PNNL, D&R, Southeast Manufactured Housing Alliance)

III. Performance Summary: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	Manufactured Housing Alliance) ($4,432)		($7,000)
		$ 5,342	
	$ 6,798		
			$ 11,080
Building Envelope R&D	The goal of the Building Envelope R&D Activity is to develop with industry proven energy efficient materials and envelope components, including windows, ready for commercialization. The use and development of environmentally benign and recyclable materials is a major driving force in the research agenda. Building Envelope research focuses on five elements: Thermal Insulation and Building Materials; Urban Heat Islands; Electrochromics; Superwindow Technology; and Advanced Glazings. A Technology Access unit is also included transferring the results emanating from the Urban Heat Island research and the Window research efforts. In accordance with the 1992 EPAct requirements to work with	The goal of the Building Envelope R&D Activity is to develop with industry proven energy efficient materials and envelope components, including windows. The use and development of environmentally benign and recyclable materials is a major driving force in the research agenda. Building Envelope research focuses on five elements: Thermal Insulation and Building Materials; Urban Heat Islands; Electrochromics; Superwindow Technology; and Advanced Glazings. A Technology Access unit is also included transferring the results emanating from the Urban Heat Island research and the Window research efforts.	The goal of the Building Envelope R&D Activity is to develop, with industry, proven energy efficient materials and envelope components, including windows. The use and development of environmentally benign and recyclable materials is a major driving force in the research agenda. Building Envelope research focuses on five elements: Thermal Insulation and Building Materials; Urban Heat Islands; Electrochromics; Superwindow Technology; and Advanced Glazings. A Technology Access unit is also included transferring the results emanating from the Urban Heat Island research and the Window research efforts.

III. Performance Summary: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)	industry, DOE sponsored the National Program Plan, version 4 (NPP4) for the thermal performance of building envelope systems and materials. The plan was developed by the Building Environment and Thermal Envelope Council (BETEC) under the auspices of the National Institute of Building Sciences (NIBS). DOE received the NPP4 in FY 1995. This plan outlined research needs for enhancing the energy efficiency of buildings defined by the building science industry and practitioners. DOE used the findings of this plan to develop a program of research in close cooperation with industry. The program initiated a new relationship with industry.		
	Building Envelope R&D includes: THERMAL INSULATION AND BUILDING MATERIALS: Six new CRADAs were initiated in FY 1997, which addressed research needs identified in the NPP. In addition, a National user	Building Envelope R&D includes: THERMAL INSULATION AND BUILDING MATERIALS: Continuing industry driven research and development, expand use of the National User facility by industry (six additional	Building Envelope R&D includes: THERMAL INSULATION AND BUILDING MATERIALS: The FY 1999 program will continue the energy performance focus activities while at the same time further engaging industry in it's

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)	facility, the Building Technology Center (BTC) at Oak Ridge National Laboratory, was established to facilitate cooperative research projects among industry, academia and government. FY 1997 Research, development, demonstration and deployment projects include: Zero ozone depletion and global warming foam insulations, high R-value super insulations, advanced manufacturing processes for super insulations, thermal performance label for whole wall R-value, R-30/30 roof (30 year life/ R-value = 30). (ORNL, LBNL) ($1,880)	CRADA's are being developed). FY 1998 projects include: wind resistant roofing, manufacturing processes for super insulations, thermal performance label for whole wall R-value, R-30/30 roof (30 year life/R-value = 30), participation in International efforts to quantify total wall performance, resolve technical issues regarding replacement blowing agents for thermal insulating foams, (i.e., Total Equivalent Warming Index [TEWI] issues), and a new program on sustainable insulations and envelopes. (ORNL, LBNL) ($2,290)	efforts to address the environmental context of advanced materials and structures. The Total Equivalent Warming Index (TEWI), a joint industry government process to develop a descriptor of alternative refrigerant and insulation blowing agents, pointed out the need for a comprehensive energy and environmental assessment of advances and alternatives. The FY 1999 program will focus on the government/industry cooperative program to "level the playing field," by developing a uniform analytical basis for energy and environmental performance. FY 1999 projects include: Measurement and analysis of significant energy savings of attic, duct, wall, window, roof, and foundation technologies. Determination of performance characteristics, and development of advanced manufacturing processes for sustainable, environmentally safe, affordable, next generation insulation

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)			alternatives, including superinsulations and non-HCFC foams. Evaluation of indigenous insulating materials such as straw (baled and sheaves), expanded clays, sawdust, perlite, vermiculite, lava, fly ash and other natural or waste materials. Development and demonstration of advanced building insulation application technology concepts, for retrofit and new construction. The Building Envelope Research Center will measure and evaluate overall system thermal performance for walls and roofs under real world conditions. Advanced self-drying roof systems with an effective R-value of 30, and service life of thirty years (R-30/30 roof) will become available in the commercial roofing industry. (ORNL, LBNL) ($3,090)
	URBAN HEAT ISLAND RESEARCH: Continued developing materials and ecological strategies to reduce	URBAN HEAT ISLAND RESEARCH: Coordinate heat island studies, demonstrations, and technology marketing with	URBAN HEAT ISLAND RESEARCH: Continue coordinating heat island studies with other Federal agencies,

III. Performance Summary: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)	energy requirements for air conditioning and improve environmental conditions of buildings. Research supported accelerated development of highly reflective building products, improving the integrity of building envelopes, and achieving faster and more extensive monitoring results at demonstrations on Federal facilities and in local communities, with the involvement of private sector partners. Research provided the scientific foundation to bring significant savings to households nationwide; potential return of $10 billion per year was demonstrated if full deployment of the proposed market development strategy is applied. (LBNL) ($681)	other agencies including EPA, NASA, DOT, HUD, USDA, USAID and roofing products manufacturing companies. Analyze urban air temperature, air quality, and satellite imagery data in several U.S. cities. Model community-wide cooling effects of light surfaces and vegetation in urban communities on building energy use, air temperature and ozone formation. Continue collaboration with pavement and roofing industry to adopt standardized reflectivity measurement and product labeling. Prepare a database of highly reflective roofing and pavement materials. Provide technical support establishing a system for air pollution control credits for using highly reflective surfaces and vegetation plantings in urban areas to offset anticipated pollution from new urban development. Coordinate procurement specifications with GSA and other Federal agencies to facilitate use of highly reflective	roofing and pavement product manufacturers. With the National Laboratories, continue analyzing urban air temperature, air quality and satellite imagery data in additional U.S. cities. Tools will be developed for cities to use in quantifying community-wide cooling effects of light surfaces and vegetation on building energy use, air temperature and ozone formation. Implement standardized and voluntary reflectivity measurement and product labeling in conjunction with the Energy Star program. Expand the database of highly reflective roofing and pavement materials. Continue establishment of air pollution credits for reflective surfaces and vegetation for urban development as an offset to ozone standards. Continue work with GSA to use highly reflective surfaces on Federal facilities. (LBNL, ORNL) ($700)

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)		surfaces on government facilities. (LBNL, ORNL) ($700)	
	The Windows and Glazing activity develops advanced window technologies and the design, rating and information tools needed to optimize the use of these technologies. Research on advanced window technologies and processes focuses on electrochromics, very high-R value "SuperWindow" technology and spectrally selective "cool" windows. Performance and simulation research establishes the basis for the technically credible rating of window and glazing products being adopted by industry's voluntary energy rating system. Under "Technology Access", the SuperWindow collaborative works with industry to foster a market transformation leading to a doubling of the average energy efficiency of annual window sales.	The Windows and Glazing activity develops advanced window technologies and the design, rating and information tools needed to optimize the use of these technologies. Research on advanced window technologies and processes focuses on electrochromics, very high-R value "SuperWindow" technology and spectrally selective "cool" windows. Performance and simulation research establishes the basis for the technically credible rating of window and glazing products being adopted by industry's voluntary energy rating system. Under "Technology Access", the SuperWindow collaborative works with industry to foster a market transformation leading to a doubling of the average energy efficiency of annual window sales.	The Windows and Glazing activity develops advanced window technologies and the design, rating and information tools needed to optimize the use of these technologies. Research on advanced window technologies and processes focuses on electrochromics, very high-R value "SuperWindow" technology and spectrally selective "cool" windows. Performance and simulation research establishes the basis for the technically credible rating of window and glazing products being adopted by industry's voluntary energy rating system. Under "Technology Access", the SuperWindow collaborative works with industry to foster a market transformation leading to a doubling of the average energy efficiency of annual window sales.
Building Envelope	ELECTROCHROMIC RESEARCH: Continued both	ELECTROCHROMIC	ELECTROCHROMIC

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
R&D (Cont'd)	contractors for first stage of Phase II of the cooperative agreement for the electrochromics government-industry partnership; and continued the National laboratories core research team to support the industry partnership, other industry efforts, fundamental research affecting the next generation technologies; materials characterization; and new deposition technologies. The partnership is a multiphase program to develop and commercialize electrochromic windows. In late FY 1996, an interim Phase II.a was awarded to resolve longer term durability of large electrochromic samples. The goal is to develop full size electrochromic prototypes ready for demonstration, and acceptable in terms of cost and performance with early architectural markets. The Phase II cooperative agreement, scheduled to be completed in FY 1998, will be	RESEARCH: Continue Phase II of the cooperative agreement for the electrochromics government-industry partnership; and continue the National laboratories core research team. In FY 1998, the winning team(s) are being selected to develop a pre-production line for intermediate size windows. Also, Mobile Window Thermal Testing (MoWiTT) facility for conducting field tests will test mock-ups of the first full size electrochromic skylights prototypes are being completed. In addition to the Phase II research DOE continues to conduct, and support industry with, fundamental research aimed at the next generation lower cost systems applicable to widespread adoption. In FY 1998, test of linear arrays are completed and technical assistance is being provided to transfer ion-beam deposition technology to industry. This technology is applicable to	RESEARCH: Continue the cooperative agreement for the electrochromics government-industry partnership. Continue the National laboratories core research team which supports the industry partnership. During FY 1999, industry designs for an automated production line for full size windows will be completed and implementation initiated to be operational by 2001 -- producing full size windows ready for demonstration and acceptable in terms of cost and performance with early architectural markets. Full size prototypes windows and skylights will be fabricated (non-automated) in FY 1999 for interim field testing. This phase will conduct field testing and conclude in FY 1999. DOE will also provide technical support to US industry in durability testing. In FY 1999, technical assistance for ion-beam deposition technology will be
Building Envelope R&D (Cont'd)	completed and field tested in FY 2000. In addition to the Phase II	both electrochromic and durable (i.e. retrofit) low-E/spectrally	provided for upgrades based on industry tests and scale up, and

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	research which focuses on nearer term applications, DOE will conduct, and support industry with, fundamental research aimed at the next generation lower cost systems applicable to widespread adoption. In FY 1996 and FY 1997, initial industry evaluation of ion-beam enhanced deposition technology was conducted, resulting in the design of a linear array of ion guns for coating full size prototypes. (LBNL, NREL, GO) ($3,240)	selective coatings. Industry partners are expected to move to pilot plant demonstrations of ion-beam technology after 1998. (LBNL, NREL, GO) ($3,815)	evaluation of new coatings optimized for this process. (LBNL, NREL, GO) ($4,415)
Building Envelope R&D (Cont'd)	SUPERWINDOW TECHNOLOGIES: Maintained the technology base, including the materials and systems analytic and testing capability to support industry development of high-performance superwindow and spectrally selective window technologies. Support continued of the technology base (user facilities, engineering design tools, etc.) for assisting industry, particularly small to medium window companies, in upgrading	SUPERWINDOW TECHNOLOGIES: Maintaining the technology base, including the materials and systems analytic and testing capability to support industry development of high-performance superwindow and spectrally selective window technologies. Continuing expansion of the technology base (user facilities, engineering design tools, etc.) for assisting industry, particularly small to medium	SUPERWINDOW TECHNOLOGIES: Continue materials and systems analytic and testing capability to support industry development of high-performance superwindow and spectrally selective window technologies particularly for small to medium-sized window companies. Continue support for development of durable coatings utilizing ion-beam enhanced deposition technology. (LBNL) ($350)

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	products. Defer until FY 1998 expansion of support for development of durable coatings utilizing ion-beam enhanced deposition technology. (LBNL) ($242)	window companies, in upgrading products. Expanding support for development of durable coatings utilizing ion-beam enhanced deposition technology to provide industry with a detailed assessment of the performance and benefits. The new thermal and solar coating technologies are resulting in more than doubling the "capture potential" of energy-efficient windows through the retrofit market products produced by small- to medium-sized manufacturers and the export market. (LBNL) ($350)	
Building Envelope R&D (Cont'd)	ADVANCED GLAZING (Performance and Simulation Research): Continued laboratory and field tests of advanced glazing technology. Industry's highest priority for DOE is to provide the research and technical support for a fair, accurate, and technically credible window energy rating system. DOE has been working closely with the technical committees of the National	ADVANCED GLAZING (Performance and Simulation Research): Continuing laboratory and field tests of advanced glazing technology as per industry priorities. WINDOW 5X was developed having the capabilities to optimize the design of a wider range of products. Technical support of the basic rating system is being completed and research is	ADVANCED GLAZING (Performance and Simulation Research): Continue laboratory and field tests of advanced glazing technology, performance and simulation research. DOE will continue to work with the National Fenestration Rating Council (NFRC) and other technical associations to guide the research for the energy rating system. The NFRC rating program is being used for new

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)	Fenestration Rating Council (NFRC), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), and the American Society for Testing and Materials (ASTM) to guide this research. International collaboration on this advanced glazing performance research continued, including technical support to the International Standards Organization (ISO) TC-163/WG-2. The NFRC rating program is being used for the new ISO standards which will aid U.S. firms' ability to compete in foreign markets. A public domain computer program WINDOW 5 Beta version with advanced modules (THERM 2.0 (32 Bit) heat transfer module; LAMINATE; etc.) was completed with modules released. The WINDOW 5X program series will have new capabilities to optimize the design of a wider range of products (e.g., angle and spectrally selective coatings, vinyl	continuing to support the NFRC comprehensive rating program, in accordance with their five year plan. Continuing technical support of the SuperWindow Collaborative (a.k.a. Efficient Window Collaborative). Technical support of NFRC's initial commercial building windows guidelines is being completed. An ad hoc "cross society" review team (e.g., NFRC, Primary Glass Manufacturers' Council (PGMC), American Architectural Manufacturers Association (AAMA), American Institute of Architects (AIA), etc.) is formed to guide the development of the initial guidelines and to define future products, including the commercial building fenestration handbook, computer design tools, and a key architect pilot demonstration project. (LBNL, NFRC, Univ. of Mass., FSEC) ($894)	International Standards Organization (ISO) standards which will aid U.S. firms' ability to compete in foreign markets. Continue development and complete draft of the Commercial Buildings Fenestration Handbook; complete initial modules of supporting computer design tools. Initiate key architect pilot demonstration project to evaluate and revise the design tools and strategies for use of the handbooks and tools. The results from this project will identify future needs for product development. (LBNL, NFRC, Univ. of Mass., FSEC) ($1,594)

III. Performance Summary: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	lineals, skylights, export windows, curtain walls, etc.) and a lower cost of designing and rating all products. In FY 1997, technical support of the basic rating system was completed and research shifted to support the NFRC comprehensive rating program, in accordance with their five year plan, and to support the SuperWindow Collaborative (a.k.a. Efficient Window Collaborative). Also, technical support was provided for NFRC's initial commercial building windows guidelines. (LBNL, NFRC, Univ. of Mass., Florida Solar Energy Center [FSEC]) ($849)		
Building Envelope R&D (Cont'd)	Technology Access includes: HIGHLY REFLECTIVE SURFACES: No Activities. ($0)	Technology Access includes: HIGHLY REFLECTIVE SURFACES: Publicizing results of Urban Heat Island Research and support other groups including: roofing manufacturers, utility companies, air quality management districts, local governments, other Federal	Technology Access includes: HIGHLY REFLECTIVE SURFACES: Continue implementing recommendations of Urban Heat Island research. Continue to promote benefits in communities in terms of energy efficiency, carbon reductions and effects on ambient air temperature. Expand program to

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)		agencies, and non-governmental organizations in implementing the research recommendation. Evaluating community benefits and costs of using highly reflective roofing and pavement materials in combination with urban forestry strategies to reduce formation of urban heat islands and their detrimental effects. Establishing partnerships and leverage support from other agencies and organizations and programs with interest in managing urban heat islands and their detrimental effects. Developing cost effective strategies and materials to help implement results of urban heat island research. Supporting existing program partners and enlist additional partners to further expand potential applications for energy efficiency in buildings, improve community environment, and expand market opportunity for use of highly reflective surfaces as an integral part of sustainable development in cities. (LBNL, American Forests)	fifteen more target cities for an end of year total of twenty-eight. (LBNL, American Forests, ORNL) ($572)

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
		($100)	
Building Envelope R&D (Cont'd)	SUPERWINDOW COLLABORATIVE: Provided technical assistance program to manufacturers, particularly for small to medium companies, for industry restructuring in response to increased demand. Partnerships with key component producer teams and key companies, key user groups and the NFRC collaborative were implemented. Initial projects included both pilot regional projects and projects focused on the development and adaptation of DOE/LBL computer tools (e.g., Alpha version, multi-media RESFEN with DOE-2 engine), information products and industry based training tools. The new computer tools will reduce the cost of producing and rating new designs and provide for low-cost, user friendly specification and selection of energy efficient windows. In FY 1997, pilot regional projects were initiated to	SUPERWINDOW COLLABORATIVE: Expand technical assistance program to manufacturers, particularly to small to medium companies, for industry restructuring in response to increased demand. Partnerships are implementing action plans. Projects are focusing on the development and adaptation of DOE/LBL computer tools (WINDOW 5 and RESFEN), information products and industry based training tools development continued. Evaluating pilot regional projects and revise the new tools and information products. In FY 1998, the first cycle of these regional projects are being completed. Regional projects are being expanded (cycle 2) to new locations with the revised tools and products. Also,providing support for initial implementation, by user and producer teams of technical assistance, training and	SUPERWINDOW COLLABORATIVE: Expand technical assistance program to manufacturers. New projects continue on the development and adaptation of DOE/LBL computer tools (WINDOW 5 and RESFEN), information products and industry based training tools. In FY 1997 and FY 1998, pilot regional projects were initiated to evaluate and revise the new tools and information products. Regional projects will be expanded. During FY 1998, the industry-sponsored Efficient Windows Collaborative (EWC) Project was organized to address the implementation of education, training and technical assistance programs. The DOE role focuses on technical support of these activities through the EWC and technical support directly with industry on their development of advanced technologies. This support involved demonstration

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Building Envelope R&D (Cont'd)	evaluate and revise the new tools and information products. Initial regional projects included both sunbelt and frostbelt states. The Collaborative also coordinated and leveraged other Federal and regional programs (e.g., education, training, promotion and endorsements) affecting selection and specification of efficient windows. Detailed analyses for establishing criteria for Federal endorsements (Collaborative support, Energy Star, etc.) were developed and were reviewed by the Collaborative with recommendations provided to DOE. Collaborative teams' activities to increase demand and provide technical assistance will facilitate a major transformation of the industry leading to a doubling of the average energy efficiency of annual window sales in the target year (originally 2005) over the base year (1991). Supporting	education projects. User and Producer teams are leveraging DOE investments by over 20 to 1. Collaborative teams' activities to increase demand and provide technical assistance are facilitating a major transformation of the industry: Companies selling over 90% of all windows are making incremental improvements in over half of their products. In FY 1998, widespread implementation of the program began: tools and information products are being provided to manufacturers who produce over 90% of all windows; over 50% of all window customers are being reached, and detailed training by producer and user teams are being provided to manufacturers who produce over 70% of all windows. (LBNL, Univ. of Minn., FSEC, ASE) ($1,000)	projects, analysis of results, and preparation of technically sound guidelines and design and training tools. For example, during FY 1998, demonstration results showed significant energy saving and also first cost saving for builders where high performance spectrally selective windows allowed for smaller, less expensive air conditioning equipment. Further demonstrations, analytic support and training will allow builders in several sunbelt states to duplicate these benefits during FY 1999. New glazing technologies can reduce the cooling load in sunbelt homes by 40-70 percent. (LBNL, Univ. of Minn., FSEC, ASE) ($1,000)

III. <u>Performance Summary</u>: BUILDING EQUIPMENT AND MATERIALS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
	goals include increasing the market share of efficient glazing (e.g., low-E, solar control) from 35% to over 80 to 90%. Companies selling over 90% of all windows will make at least incremental improvements in rated energy performance with major improvements made in over half of their products. (LBNL, Univ. of Minn., FSEC, Alliance to Save Energy (ASE)) ($950)	$ 9,149	$ 11,721
	$ 7,842		
Building Equipment and Materials Total	$ 26,080	$ 26,921	$ 46,181

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

CODES AND STANDARDS

I. **Mission Supporting Goals and Objectives:**

I.A. Statement of Mission

The mission of the Codes and Standards program is to implement a legislatively mandated, multi-year effort to improve the energy efficiency in the Nation's buildings through energy efficiency standards, codes and guidelines for buildings, building equipment, and appliances. Setting efficiency standards leads to substantial increases in the average energy performance of buildings and equipment. This mission will be accomplished by early involvement of stakeholders and relevant Federal and state agencies in order to maximize benefits and minimize burdens utilizing the best, new, cost-effective, and environmentally friendly technologies.

The Codes and Standards activity consists of the following two program activity areas:

Lighting and Appliance Standards:

During its typical operating lifetime of 10 to 15 years, the operating cost of an appliance may be several times greater that its initial purchase price. Nevertheless, many consumers do not consider energy efficiency when making their purchases. Although the energy efficiency of most products can be significantly improved, manufacturers have been reluctant to invest in more efficient technology that may not be accepted in the highly competitive marketplace. Recognizing the large potential for energy savings, many states began to prescribe minimum energy efficiency standards for appliances. In response to the burden of complying with a myriad of differing state standards, manufacturers supported the development of Federal standards that would preempt those of the states.

The Energy Policy and Conservation Act (EPCA) established a conservation program for major household appliances including furnaces, water heaters, refrigerators and freezers, central air conditioners and central air conditioning heat pumps, room air conditioners, dishwashers, clothes washers, clothes dryers, direct heating equipment, pool heaters, kitchen ranges and ovens, fluorescent ballasts, and television sets. The Energy Policy Act of 1992 (EPAct) expanded the coverage to include commercial building heating and air conditioning equipment, water heaters, certain incandescent and fluorescent lamps, distribution transformers, and

electric motors. EPAct also established maximum water flow rate requirements for certain plumbing products and provides for voluntary testing and consumer information programs for office equipment, luminaires, and windows.

The program consists of essentially three parts: testing, labeling, and mandatory energy conservation standards. The Department is to prescribe test procedures that measure the energy efficiency and energy use and provide an estimate of annual operation cost of each appliance. The Federal Trade Commission (FTC) is required to prescribe labeling rules for the residential appliances. The Department and FTC share responsibility for labeling of the commercial equipment. Through amendments to EPCA, Congress prescribed initial Federal energy efficiency standards and established schedules for DOE review of these standards. The Department is required to promulgate amended energy efficiency standards designed to achieve the maximum improvement in energy efficiency which the Secretary determines are technically feasible and economically justified.

The Department actively encourages the participation and interaction of all interested parties at all stages of the rulemaking process. Early and frequent interactions among manufacturers, efficiency/environmental advocates, states, utilities, retailers and consumers provide a balanced discussion on potential standards levels as well as critical information required to conduct the analysis. In 1995, the Department examined, through a series of stakeholder meetings and interviews, issues surrounding the appliance standards program. The findings from these meetings and interviews became the basis for a rule outlining procedural and analytical changes for the appliance standards process which was published in July 1996. This new process will avoid the recurrence of problems similar to those that surfaced in 1994 and 1995 by ensuring: early involvement of stakeholders; increased predictability of the rulemaking timetable; increased use of industry expertise, early elimination of impractical or problematic design options, enhanced analysis of impacts, improved analytical methods; and support of consensus rulemaking. these initiatives will be implemented to facilitate the development of future rules. The Department is also exploring the relationship between market-pull approaches and standards and examining multiple paths to reach the same energy conservation goal. Among other factors, the Department is examining alternatives which maximize consumer benefits and minimize negative impacts on manufacturers and others. Such alternatives could include product labeling and education programs to feature the benefits of energy-efficient equipment; yet at the same time recognizing the market niche which exists for certain less efficient products.

In fiscal year 1999, utilizing the new rulemaking process, the Department will 1) revise test procedures as required by manufacturers to ensure that innovative designs can be properly tested; 2) perform engineering and economic analyses to evaluate cost-effective energy efficiency standards; and 3) begin rulemaking to revise standards, as required by legislation, in response to changes in the consensus standards for commercial equipment.

I. **Mission Supporting Goals and Objectives:** CODES AND STANDARDS (Cont'd)

Building Standards and Guidelines:

Technical feasibility and cost effectiveness are key to designing and constructing buildings that are more comfortable than today's buildings yet require less than one-third as much energy. However, several market barriers prevent architects, engineers, and builders from doing so. Those who design and construct buildings (often not the same people who own and operate the buildings) tend to focus on the first cost rather than operating costs. Building operating costs are often hidden and passed on to others. Information on the feasibility, cost, and benefits of improving building energy efficiency is often not available.

Building energy standards and guidelines can assist in overcoming such barriers. The Building Standards and Guidelines program provides technical assistance to States, designers and builders in implementing codes, assistance to states to update and implement their building energy codes; assistance to building industry voluntary codes organizations to upgrade their codes to include measures which are technically feasible and cost-effective; and promulgates Federal building energy efficiency standards. The Building Standards and Guidelines program strategy is to promote, assist, and act as a catalyst in developing and implementing building energy efficiency codes, standards, and guidelines that are technically feasible, economically justified, and environmentally beneficial. By working in the market to eliminate the most inefficient technologies and building practices, this program complements the Department's efforts to develop and introduce advanced, highly efficient technologies.

In fiscal year 1999, the Department will focus on: (1) the benefits of newly adopted state codes and recently promulgated Federal codes by providing technical assistance and incentive funding to support training of designers, builders, and code officials for implementation of these new codes; (2) the promulgation of upgraded Federal standards; and (3) support of improvements to the next generation voluntary residential code and completion of the voluntary commercial code.

I. **Mission Supporting Goals and Objectives:** CODES AND STANDARDS (Cont'd)

I.B. Program Benefits

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

METRIC	2000	2010	2020
Primary Energy Displaced (Quads)	0.01	0.83	2.19
Energy Cost Savings ($B)	0.06	5.69	14.71
Carbon Reductions (MMTons)	0.18	17.57	46.11

I.C. Performance Goals

The goal of Codes and Standards programs is to increase baseline efficiency levels for regulated residential appliances, commercial and industrial end-use technologies, and the Nation's building stock. The Codes and Standards programs will save consumers and businesses over $10 billion annually by the year 2020. These savings and lower costs increase profits of business while providing savings for consumers that can be used to purchase other goods in the economy. In addition, more efficient products are more competitive internationally and have environmental benefits from reduced atmospheric emissions.

Accomplishment Summary

Lighting and Appliance Standards

FY 1997

The Appliance and Lighting standards Program began implementing its new rulemaking process which includes an annual procedure in which stakeholders are consulted in determining the prioritization of rulemakings.

-- Final rules for energy conservation standards were issued for refrigerator products and for room air conditioners.

I. **Mission Supporting Goals and Objectives:** CODES AND STANDARDS (Cont'd)

-- Notices of Proposed Rulemaking (NOPR) were issued to incorporate legislated standards and test procedures for plumbing equipment and large electric motors.

-- Final rules to amend test procedures were issued for furnaces/boilers, vented home heating equipment and pool heaters, fluorescent and incandescent lamps, clothes washers, kitchen ranges and ovens, and externally vented refrigerators.

FY 1998

-- Issue final rule for energy conservation standards for kitchen ranges and ovens.

-- Issue NOPRs for energy efficiency standards for lamp ballasts and water heaters.

-- Issue Advance Notice of Proposed Rulemaking (ANOPR) for energy conservation standards for clothes washers.

-- Initiate energy conservation standards rulemaking for residential central air conditioners/heat pumps.

-- Issue final rule to amend test procedures for water heaters, including small and instantaneous water heaters.

-- Issue final rule to incorporate legislated standards and test procedures for plumbing equipment and large electric motors.

-- Issue NOPR to amend test procedures for residential central air conditioners/heat pumps.

-- Issue determination regarding test procedures and standards for electric distribution transformers.

FY 1999 Planned

-- Issue final rule regarding energy conservation standards for lamp ballasts and water heaters.

-- Issue NOPR for energy conservation standards for clothes washers.

-- Issue ANOPR for energy conservation standards for residential central air conditioners/heat pumps.

I. **Mission Supporting Goals and Objectives:** CODES AND STANDARDS (Cont'd)

-- Issue final rule for test procedures for residential central air conditioners/heat pumps.

-- Issue NOPR regarding test procedures for electric distribution transformers.

-- Issue NOPR to incorporate legislated standards and test procedures for commercial HVAC and water heaters.

-- Initiate rulemaking to amend test procedures for dishwashers.

-- Initiate energy conservation standards rulemaking for electric distribution transformers and large electric motors (1-200 hp).

-- Initiate determinations regarding test procedures and standards for small electric motors and high intensity discharge (HID) lamps.

Building Standards and Guidelines

1994-1997:

-- Assisted 32 states in updating or implementing their residential building energy efficiency codes. As part of this process, achieved over $2.7 million in cost sharing with state, utility, and producer partners.

-- Assisted in the updating and simplification of the Model Energy Code (MEC) for residential buildings. Developed and disseminated tools that simplify the process of complying with the Code. Assisted in the development of the next generation voluntary commercial building energy standard (American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineering Society (ASHRAE/IES) Standard 90.1-1989R) for public review. This updated standard is expected to cost effectively achieve savings of 25 percent over the current voluntary standard.

I. **Mission Supporting Goals and Objectives:** CODES AND STANDARDS (Cont'd)

FY 1998:

-- Ten states are being assisted in updating or implementing their residential building energy efficiency codes to the 1998 Model energy Code or early adopters version of the next generation code, Standard 90.1-1989R.

-- Issue final rules regarding standards for energy efficient construction in Federal residential and commercial buildings.

-- Tools that simplify the process of complying with ASHRAE/IES Standard 90.1 - 1989 and upgraded successor for commercial building energy consumption are being improved and disseminated.

FY 1999 Planned:

-- Assist 10 states in implementation of ASHRAE/IES Standard 90.1 - 1989R using DOE-developed tools an above code commercial building incentive program.

-- Develop and disseminate tools for implementing new Federal construction standards.

-- Assist 5 states in updating their residential building code to the 1995 MEC and 10 states to update to 1998 MEC.

II. A. **Funding Table**: CODES AND STANDARDS

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Building Standards and Guidelines	$ 6,808	$ 8,423	$ 12,953	$ 4,530	54%
Lighting and Appliance Standards	5,002	6,000	9,620	3,620	60%
Total, Codes and Standards	$ 11,810	$ 14,423	$ 22,573	$ 8,150	57%

II. B. **Laboratory and Facility Funding Table**: CODES AND STANDARDS

Lawrence Berkeley Lab	$ 2,000	$ 2,000	$ 2,000	$ 0	0%
National Renewable Energy Lab	700	700	700	0	0%
Oak Ridge National Lab	200	200	200	0	0%
Pacific Northwest Lab	2,500	2,500	2,500	0	0%
All Other	6,410	9,023	17,173	8,150	90%
Total, Codes and Standards	$ 11,810	$ 14,423	$ 22,573	$ 8,150	57%

III. Performance Summary: CODES AND STANDARDS

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines	UPDATE STATE CODES: Implemented a cooperative, co-funded incentive grants program and a technical assistance program to actively assist states in updating and implementing their residential and commercial codes. Developed and implemented programs, tailored to specific states and user groups, to increase awareness of codes and support adoption of codes. TRAINING: Provided a variety of materials including Train-the-Trainer activities addressing compliance and enforcement training for architects, engineers, code officials, and home builders. Conducted Regional Workshops to focus on identifying and discussing training and information requirements based on the needs of the regional, state, and local stakeholders.	UPDATE STATE CODES: Implement a cooperative, co-funded incentive grants program and a technical assistance program to actively assist states in updating and implementing their residential and commercial codes. Develop and implement programs, tailored to specific states and user groups, to increase awareness of codes and support adoption of codes. TRAINING: Provide a variety of materials including Train-the-Trainer and distance learning activities addressing compliance and enforcement training for architects, engineers, code officials, and home builders. Estimate that 500 code officials, designers, and builders will be trained via downlinking and enforcement of the upgraded Model Energy Code and the 1998 federal building energy code, 10 CFR 435. The distance learning training activities will increase	UPDATE STATE CODES: Implement a cooperative, co-funded incentive grants program and a technical assistance program to actively assist states in updating and implementing their residential and commercial codes. Develop and implement programs, tailored to specific states and user groups, to increase awareness of codes and support adoption of codes. TRAINING: Provide a variety of materials including Train-the-Trainer and distance learning activities addressing compliance and enforcement training for architects, engineers, code officials, and home builders. Estimate that 10,000 code officials, designers, and builders will be trained via downlinking and State enforcement of the upgraded Model Energy Code and the 1998 federal building energy code, 10 CFR 435. The distance learning training activities will

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

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines (Cont'd)		overall market penetration by 25 percent. Conduct Regional Workshops to focus on identifying and discussing training and information requirements based on the needs of the regional, state, and local stakeholders.	increase overall market penetration by 25 percent. Conduct Regional Workshops to focus on identifying and discussing training and information requirements based on the needs of the regional, state, and local stakeholders.
	ASSISTANCE: In addition to assisting states upgrade their codes for new residential and commercial buildings, focussed on assisting states to implement the provisions of their code regarding upgrading existing buildings to code standards at time of permitting for renovation and retrofit. Established cooperative funding and agreements with consortia of states, utilities, trade associations, and others to carry out these programs.	ASSISTANCE: In addition to assisting states upgrade their codes for new residential and commercial buildings, focus on assisting states to implement the provisions of their code regarding upgrading existing buildings to code standards at time of permitting for renovation and retrofit. Establish cooperative funding and agreements with consortia of states, utilities, trade and professional associations, and representatives of the energy-efficiency industries, energy and environmental advocacy groups, and others interested in accelerating the availability of actual code compliance trainers, financial and in-kind resources, information and	ASSISTANCE: In addition to assisting states upgrade their code for new residential and commercial buildings, assist states to implement the provisions of their code regarding upgrading existing buildings to code standards at time of permitting for renovation and retrofit. Establish cooperative funding and agreements with consortia of states, utilities, trade and professional associations, and representatives of the energy-efficiency industries, energy and environmental advocacy groups, and others interested in accelerating the availability of actual code compliance trainers, financial and

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

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines (Cont'd)		materials. As a result of these cooperative arrangements, 10 early implementation state/building industry partnerships will be formed and 10 case studies will be implemented.	in-kind resources, information and materials. As a result of these cooperative arrangements, 10 new implementation state/building industry partnerships will be formed and 10 case studies will be disseminated. In addition, four DOE/State/local government or building industry partnerships will be initiated. To encourage adoption of updated codes, initiate a CODE+ demonstration project where commercial buildings are constructed, operated and designed to perform better than Standard 90.1R, using the Energy Star rating system developed under the Building Systems Design activities.
	ANALYSIS: Conducted comparative analyses of relative energy efficiency of state residential building codes as compared to the Model Energy Code, 1995 and an analysis of the state relative energy efficiency of state commercial building codes as compared to proposed American Society of Heating,	ANALYSIS: Conduct comparative analyses of relative energy efficiency of state residential building codes as compared to the Model Energy Code, 1998.	ANALYSIS: Conduct comparative analyses of relative energy efficiency of state commercial building codes as compared to proposed ASHRAE/IES Standard 90.1-1989R. Publish Determination concerning whether the Model Energy Code

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

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines (Cont'd)	Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society (ASHRAE/IES) Standard 90.1-1989R. PROCESS: Processed state certifications of compliance updating their energy codes with respect to the Model Energy Code, 1995. Continued to monitor and evaluate the progress of local governments relative to building energy efficiency codes. Reported on the activities related to the requirements of EPACT 101. Processed requests for deadline extensions from states unable to meet the submission date identified in the Federal Register notice 1996. (EPAct Section 101) ($5,773) VOLUNTARY AND FEDERAL ENERGY CODES: Issued proposed rules of energy codes for Federal residential and commercial buildings. Continued	PROCESS: Process state certifications of compliance updating their energy codes with respect to the Model Energy Code, 1995. Continue to monitor and evaluate the progress of local governments relative to building energy efficiency codes. Report on the activities related to the requirements of EPAct 101. Process requests for deadline extensions from states unable to meet the submission date identified in the Federal Register Notice 1996. (EPACT Section 101) ($6,523) VOLUNTARY AND FEDERAL ENERGY CODES: Begin preparation of technical assistance materials such as code compliance and user manuals, as well as various software in support of 1998 Federal codes. Issue final	1998, would improve the efficiency of residential buildings. Process state certifications of compliance updating their energy codes with respect to the Model Energy Code, 1998. Continue to monitor and evaluate the progress of local governments relative to building energy efficiency codes. Report on the activities related to the requirements of EPAct 101. Process requests for deadline extensions from states unable to meet the submission date identified in the Determination. (EPACT Section 101) ($10,500) VOLUNTARY AND FEDERAL ENERGY CODES: Prepare and distribute technical assistance materials such as code compliance

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

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines (Cont'd)	support of interim Federal codes for one full year after final Federal codes have been published to facilitate Federal employees and their contractors transition to the new Federal codes. Began analysis of passive and active solar space cooling and heating technologies for inclusion in Federal residential code. Continued support of voluntary energy codes, including analysis of the technical feasibility and economic impacts of amendments to the American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineers Society (ASHRAE/IES) Standard 90.1-1989 for commercial buildings and supported the updating and simplification of the Model Energy Code for residential buildings. Prepared and distributed code compliance manuals, builder's guides, and trade-off software to support adoption and implementation of the Model Energy Code, 1995 and	rules of energy codes for Federal residential and commercial buildings. Initiate a national training effort to teach Federal employees and their contractors the provisions of the 1998 Federal codes. Continue support of interim Federal code for one full year after 1998 Federal codes have been published to facilitate transition to the new codes. Continue analysis of passive and active solar space cooling and heating technologies for inclusion in Federal residential code. Continue to support voluntary energy codes, including analysis and response to public comment on the proposed upgrading of ASHRAE/IES Standard 90.1-1989 for commercial buildings and support for the updating and simplification of the Model Energy Code for residential buildings. Begin development of code compliance manuals, builder's guides, and trade-off software, to include the use of passive and active solar	and user manuals, as well as various software in support of 1998 Federal codes. Implement national training effort to teach Federal employees and their contractors the provisions of the 1998 Federal codes. Issue proposed rules amending the Federal commercial and the Federal residential codes to include passive and active solar space cooling and heating technologies. Continue to support voluntary energy codes, including analysis and responses to public comment on the proposed upgrading of ASHRAE/IES Standard 90.1-1989 for commercial buildings and support for the updating and simplification of the Model Energy Code for residential buildings. Complete development of code compliance manuals, builder's guides, and trade-off software, to include the use of passive and active solar space cooling and heating technologies, in support of

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

Activity	FY 1997	FY 1998	FY 1999
Building Standards and Guidelines (Cont'd)	ASHRAE/IES Standard 90.1-1989. (EPACT Section 101) ($1,035)	space cooling and heating technologies, in support of existing voluntary codes. (EPACT Section 101) ($1,900)	existing voluntary codes. (EPACT Section 101) ($2,453)
		$ 8,423	
	$ 6,808		
			$ 12,953
Lighting and Appliance Standards	TEST PROCEDURES: Conducted research to develop, maintain, simplify, and improve test procedures for appliances. Revised the test procedures to ensure innovative designs can be fairly tested. Processed manufacturer requests for test procedure waivers. Tested appliances as required for enforcement actions. Issued final rules to amend test procedures for furnaces/boilers, vented home heating equipment and pool heaters, fluorescent and incandescent lamps, clothes washers, kitchen ranges and ovens, and externally vented	TEST PROCEDURES: Conduct research to develop, maintain, simplify, and improve test procedures for appliances. Revise the test procedures to ensure innovative designs can be fairly tested. Work with international standards organizations particularly those from Canada and Mexico, to harmonize testing so as to reduce testing requirements for manufacturers and enhance foreign sales of U.S. products. Process manufacturer requests for test procedure waivers. Test appliances as required for enforcement actions. Publish determination regarding	TEST PROCEDURES: Conduct research to develop, maintain, simplify, and improve test procedures for appliances. Revise the test procedures to ensure innovative designs can be fairly tested. Work with international standards organizations particularly those from Canada and Mexico, to harmonize testing so as to reduce testing requirements for manufacturers and enhance foreign sales of U.S. products. Process manufacturer requests for test procedure waivers. Test appliances as required for enforcement actions. Publish final rule for test
Lighting and Appliance Standards (Cont'd)			

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

Activity	FY 1997	FY 1998	FY 1999
	refrigerators. Published Notices of Proposed Rulemaking (NOPR) to incorporate legislated standards and test procedures for plumbing equipment and large electric motors.	test procedures and standards for distribution transformers. Publish final rule to amend test procedures for water heaters, including small and instantaneous water heaters. Issue final rule to incorporate legislated standards and test procedures for plumbing equipment and large electric motors. Publish NOPR to amend test procedures for residential central air conditioners/heat pumps.	procedures for residential central air conditioners/heat pumps. Dependent on determination published in FY 1998, publish NOPR regarding test procedures for distribution transformers. Publish NOPR to incorporate legislated standards and test procedures for commercial HVAC and water heaters. Initiate rulemaking to amend test procedures for dishwashers.
Lighting and Appliance Standards (Cont'd)	STANDARDS: Implemented process improvement initiatives. Issued the final rules for energy conservation standards for refrigerator products and for room air conditioners. Continued pro-active role in support of consensus standards organization in regard to covered commercial products. Continued to work with equipment manufacturers to ensure products are properly certified and that they meet the standards. In cooperation with interested stakeholders began	STANDARDS: Implement the new process. Issue the final rule for energy conservation standards for kitchen ranges and ovens. Publish revised NOPR for energy efficiency standards for lamp ballasts and water heaters. Revise Advance Notice of Proposed Rulemaking (ANOPR) for energy conservation standards for clothes washers. Initiate energy conservation standards rulemaking for residential central air conditioners/heat pumps. Support the consensus standards	STANDARDS: Implementing the new process, issue final rule regarding energy conservation standards for lamp ballasts and water heaters. Publish NOPR for energy conservation standards for clothes washers. Publish ANOPR for energy conservation standards for residential central air conditioners/heat pumps. Initiate energy conservation standards rulemaking for distribution transformers and large electric motors (1-200hp). Initiate determinations regarding test

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

Activity	FY 1997	FY 1998	FY 1999
	investigating alternative means of accomplishing the goals of the standards program without revising mandatory standards.	organization in regard to covered commercial products. Work with equipment manufacturers to ensure products are properly certified and that they meet the standards. Work with interested stakeholders on investigating alternative means of accomplishing the goals of the standards program without revising mandatory standards.	procedures and standards for small electric motors and high intensity discharge (HID) lamps. Support the consensus standards organization in regard to covered commercial products. Begin rulemaking to revise standards, as required by the legislation in response to changes in the consensus standards. Work with equipment manufacturers to ensure products are properly certified and that they meet the standards. With stakeholders, investigate alternative means of accomplishing the goals of the standards program without revising mandatory standards.
Lighting and Appliance Standards (Cont'd)	LABELING: Supported voluntary efficiency rating and labeling programs for commercial office equipment and luminaries. Worked with industry to develop mandatory labeling requirements for EPAct covered commercial products. (NIST, LBNL, PNL, NREL) ($5,002)	LABELING: Support of voluntary efficiency rating and labeling programs for commercial office equipment and luminaries. Work with industry to develop mandatory labeling requirements for EPAct covered commercial products. (NIST, LBNL, PNL, NREL) ($6,000)	LABELING: Support voluntary efficiency rating and labeling programs for commercial office equipment and luminaries. Work with industry to develop mandatory labeling requirements for EPAct covered commercial products. (NIST, LBNL, PNL, NREL) ($9,620)

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

Activity	FY 1997	FY 1998	FY 1999
	$ 5,002	$ 6,000	$ 9,620
Codes and Standards Total	$ 11,810	$ 14,423	$ 22,573

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

STATE AND LOCAL PARTNERSHIP PROGRAMS

I. **Mission Supporting Goals and Objectives:**

The goal of the State and Local Partnership Programs is to promote energy efficiency and the adoption of renewable energy technologies among States, municipalities, institutions, and private citizens thereby helping the Nation realize a stronger economy, a cleaner environment, and a more secure future. The State and Local Partnership Programs include the Weatherization Assistance Program, the Competitive Energy Partnerships Program, which includes the Municipal Energy Management Program and the State Energy Program (consolidating the State Energy Conservation Program, the Institutional Conservation Program, as well as the Energy Extension Service, which were formerly separate programs).

-- Weatherization Assistance Program (Weatherization): The goal of the Weatherization program is to provide cost-effective energy efficiency services to constituencies that cannot afford the investment and who, without the program, could not benefit from energy efficiency technologies. The DOE Weatherization Assistance Program has long served as the core program for delivering energy conservation services to low-income Americans. The benefits of weatherization contribute to achieving national and social goals including: cleaner air through reduced emissions of criteria pollutants and CO2; reduced consumption of imported fuels through reduced residential consumption; reduced demand on other social programs such as fuel assistance, housing, and health care; and implementation of innovative energy conservation technologies and transfer of this technology into the private marketplace. The program's effectiveness is enhanced by the flexibility of DOE weatherization funding, which enables States and local agencies to leverage additional funding from low-income housing programs, utilities, and in the case of weatherization of rental properties, from property owners. A recently completed metaevaluation of 17 State-level evaluations indicates that advanced energy audits and improved practices in weatherizing homes have produced 80 percent higher average energy savings today as compared to the measured savings in 1989. The Weatherization Assistance Program benefit/cost ratio for energy savings alone is up from 1.06 in 1989 to 1.79 in 1996. The benefit to society, which includes employment, health and safety and other nonenergy effects, is more than double the cost of the program.

I. **Mission Supporting Goals and Objectives:** STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

In FY 1999, Weatherization's performance will be measured in the following ways:

-- Number of low-income homes weatherized (estimated 78,200)

-- Number of persons directly and indirectly employed to conduct weatherization activities (estimated 8,013 direct jobs created and 3,526 jobs indirectly supported)

-- Amount of atmospheric carbon reduced (estimated .043 MMTCE annually)

-- Energy saved (estimated annual savings: 2.5 Tbtu)

Accomplishments:

-- Weatherized 63,335 homes in FY 1998

-- Annual energy savings of 2 Tbtu

-- Additional funds leveraged will double the above figures

-- Carbon emission avoidance of .035 MMTCE in FY 1998

-- State Energy Program (SEP): The goal of SEP is to provide a supportive framework with sufficient flexibility to enable the States to address their own energy priorities in concert with national priorities. Traditionally, State Energy Offices have been able to leverage their Federal funds for this program at the rate of 4 non-Federal dollars for each Federal dollar received, and have leveraged as much as 13 to 14 non-Federal dollars for each Federal dollar for some activities. Maintaining a strong State Energy Office capacity, and the delivery network these offices provide, is essential to the achievement of national energy objectives. The State offices also coordinate energy, environmental, and economic policies in response to the new challenges of the 21st century. States have a primary key role in the development and deployment of sustainable technologies and are focusing on the following: alternative fuels and alternative fueled vehicles, efficient electric motors and drives, power production from renewable resources, integrated resource planning, industrial waste minimization and waste-to-energy technologies, building efficiency, and solar industrial process heat, just to name a few.

I. **Mission Supporting Goals and Objectives:** STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

Because of the unique capabilities of the State Energy Offices, EERE's End-Use Sector offices partner with States to deploy key EERE technologies through the Special Projects portion of SEP. Over the past three years, the End-Use Sector offices have funded $35 million through SEP for these technology deployment activities.

In FY 1999, this program will continue to increase the extent to which federal, state and local governments work with other public and private sector entities, including schools and hospitals, to achieve widespread adoption of available energy efficiency and renewable energy technologies, and to demonstrate the use of emerging technologies which could be of benefit to all sectors of the economy. This includes working with the building industry and consumers for improvements in the nation's residential energy efficiency.

In FY99 SEP performance will be measured in the following ways:

-- Amount of non-federal funds invested in energy efficiency and renewable energy activities. Each SEP dollar is expected to leverage at least $4 in state, utility and other private sector funds in FY 1999

-- Number of jobs created. It is estimated that SEP activities will create or support 6,105 jobs in FY 1999

-- Energy saved. It is estimated that SEP activities will save 5.7 TBtu in FY 1999

-- Carbon emissions prevented (estimated to be .093 MMTCE in FY 1999)

SEP accomplishments:

-- States continued to increase resources devoted to expanding market opportunities for energy efficiency and renewable energy technologies, e.g., State Energy offices act as catalysts for public/private partnerships that encourage technology and deployment. For example, such cooperative efforts have led to successes in manufacturing, recycling, and the increasing use of energy efficient motors by industry.

-- Creation of 4,991 jobs in FY 1998

-- Energy savings of 4.7 TBtu in FY 1998

I. **Mission Supporting Goals and Objectives:** STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

-- Carbon emission avoidance of .076 MMTCE in FY 1998

-- Each SEP dollar leveraged at least $4 in non-DOE funds

-- Competitive Energy Partnerships: The goal of Municipal Energy Management Program (MEMP) is to demonstrate innovative and realistic technologies, strategies, and methods that help urban America become more energy efficient and environmentally responsible. This program focuses on the application of new technologies/techniques and management practices to deliver local energy services more efficiently, improve the local revenue base, and foster community-wide energy sustainability. Grants to conduct urban applied research and demonstration projects are awarded through an annual competitive solicitation process to ensure the best deployment of resources. An additional request of $5 million will permit extension of competitive grants to support community-wide partnerships, involving private sector as well as public sector partners, to target sustainable energy opportunities that reduce criteria pollutants and greenhouse gases, while improving the quality of life, environmental health, infrastructure, and economic vitality of local communities.

The performance of the Competitive Energy Partnerships funded in FY 1999 will be measured by:

-- Reduction in greenhouse gases (.016 MMTCE annually)

-- Energy savings (1.02 Tbtu annually)

-- Jobs created (1,089 jobs)

MEMP accomplishments in FY 1998:

-- Creation of 265 jobs

-- Energy savings of 0.25 Tbtu

-- Carbon emission avoidance of .004 MMTCE

-- Each MEMP dollar leveraged $4 in non-DOE funds

I. **Mission Supporting Goals and Objectives:** STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

The goal of State and Local Partnership Programs is to accelerate the deployment of renewable energy and energy efficiency technologies while providing management and administrative support for the State and Local Partnership and Targeted Deployment Programs.
Performance will be measured by:

-- An increase to 90 percent of all State energy program offices which are linked to regional support offices' electronic mail

-- An increase to 85 percent of all State energy program offices which are full participants in use of the SAGA (Systems Approach to Grant Administration) system

-- Level of customer satisfaction with the service with State and Local Partnership Programs

Accomplishments:

-- Successful implementation of new program structure

-- 70 percent of States full participants in use of the SAGA system

-- Successful implementation of Special Projects portion of SEP, awarding $11 million from and in conjunction with other EERE research, development, demonstration, and outreach efforts to support State and local EERE technology deployment and technology access efforts.

II. A. Funding Table: STATE AND LOCAL PARTNERSHIP PROGRAMS

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Weatherization Assistance Program	$ 120,845	$ 124,845	$ 154,100	$ 29,255	23%
State Energy Program	29,000	30,250	37,000	6,750	22%
Competitive Energy Partnerships	1,576	1,600	6,600	5,000	313%
Total, State and Local Partnership Programs . . .	$ 151,421	$ 156,695	$ 197,700	$ 41,005	26%

II. B. Laboratory and Facility Funding Table: STATE AND LOCAL PARTNERSHIP PROGRAMS

All Other	151,421	156,695	197,700	41,005	26%
Total, State and Local Partnership Programs	$ 151,421	$ 156,695	$ 197,700	$ 41,005	26%

III. Performance Summary: STATE AND LOCAL PARTNERSHIP PROGRAMS

Activity	FY 1997	FY 1998	FY 1999
Weatherization Assistance Program	Continue level of training and technical assistance activities: improve techniques to identify and install the most cost-effective weatherization measures; analyze health/safety issues; promote the use of advanced residential technologies, including those from DOE's R&D efforts. (NREL, ORNL, PNL) ($2,000)	Continue level of training and technical assistance activities: improve techniques to identify and install the most cost-effective weatherization measures; analyze health/safety issues; promote the use of advanced residential technologies, including those from DOE's R&D efforts. ($1,900)	Continue level of training and technical assistance activities: improve techniques to identify and install the most cost-effective weatherization measures; analyze health/safety issues; promote the use of advanced residential technologies, including those from DOE's R&D efforts. ($2,300)
	WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 61,120 low-income homes. ($118,845)	WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 63,335 low-income homes. ($122,945)	WEATHERIZATION ASSISTANCE: Provide State grants to weatherize 78,200 low-income homes, 1/3 of 1 percent of the eligible homes nationwide. The relative scarcity of funds means that only the very neediest can be served. Latest performance data indicates that every dollar invested in the program yields $1.80 in benefits. ($151,800)
	$ 120,845	$ 124,845	$ 154,100
State Energy Program	STATE ENERGY PROGRAM: In a consolidated grant type format, the State Energy Program	STATE ENERGY PROGRAM: Provide grants to 50 States, D.C. and five territories for energy	STATE ENERGY PROGRAM: Provide grants to 50 States, D.C. and five territories for energy

III. Performance Summary: STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
State Energy Program (Cont'd)	will provide grants to 50 States, D.C. and five territories for energy efficiency programs including schools and hospitals. The new consolidated grant approach simplifies administrative and related functions associated with the separate programs which it replaces and provides States increased flexibility to address their own priorities. Continue to promote broad-based program to support innovative approaches, such as third party financing, revolving loan funds, integrated resource planning, and energy technology commercialization services. ($29,000)	efficiency programs. Continue to promote broad-based program to support innovative approaches, such as incentive funding, revolving loan funds, integrated resource planning, and energy technology commercialization services. Increase program emphasis on technology transfer and on partnering with States to explore leveraging strategies. In addition to basic support provided under Program Direction account, provide technical assistance/training with focus on developing State-level capabilities to use collaborative partnerships for EE/RE utilization. ($30,250)	efficiency programs. Continue to promote broad-based program to support innovative approaches, such as incentive funding, revolving loan funds, integrated resource planning, and energy technology commercialization services. Increase program emphasis on technology transfer and on partnering with States to explore leveraging strategies. For example, the State of Wisconsin's Daylighting Retrofit Demonstration Program shows the cost effectiveness and feasibility of active daylighting technologies. In addition to basic support provided under Program Direction account, provide technical assistance/training with focus on developing State-level capabilities to use collaborative partnerships for EE/RE utilization. Each federal dollar allocated to SEP leverages $4 in non-federal funds for energy efficiency programs. Involve States in providing better

III. Performance Summary: STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
State Energy Program (Cont'd)			performance measures for State SEP activities. ($37,000)
	$ 29,000	$ 30,250	$ 37,000
Competitive Energy Partnerships			Provide technical and financial support to communities to improve energy efficiency and the use of renewable energy community-wide. Three key activities will be undertaken. First, competitively solicit innovative proposals from communities, with public and private partners. The successful proposals will include practical, tangible techniques for making communities more prosperous and healthy such as: the integration of efficient and renewable technologies using a building systems engineering approach; overcoming barriers to the rapid adoption of new efficient technologies; and reducing mobility needs through refinements in land use planning. Communities will also provide feedback to advance the next

III. Performance Summary: STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Competitive Energy Partnerships (Cont'd)			generation of applied research. Second, aggregate community-wide markets and refine performance-based financing mechanisms to reduce barriers to first cost and perceived risk. Third, provide technical assistance and training on the adoption of new technologies and techniques for improving energy efficiency. This effort is based on the experience that communities need flexibility to design energy saving programs that respond to their own circumstances and goals. Partners can include business improvement districts, homebuilders, retailers, public institutions, non-profits, State governments, and the private sector. "An example on this might be working with public and private partners to share lessons learned by Federal Energy Saving Performance Contracting to finance energy conservation measures, especially in a deregulated electric utility market". Projects will be carefully

III. Performance Summary: STATE AND LOCAL PARTNERSHIP PROGRAMS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Competitive Energy Partnerships (Cont'd)			evaluated on short and medium term energy and dollar savings, job creation, and benefits to the environment. (TBD) ($5,000)
	Through the Municipal Energy Management Program, conducted (co-fund) approximately 18 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provide technical assistance to local jurisdictions in replicating successful projects. Continue regional workshops and dissemination of information to a broad urban audience. (Urban Consortium) ($1,576)	Through the Municipal Energy Management Program, conduct (co-fund) approximately 18 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provide technical assistance to local jurisdictions in replicating successful projects. Continue regional workshops and dissemination of information to a broad urban audience. (Urban Consortium) ($1,600)	Through the Municipal Energy Management Program, conduct (co-fund) approximately 18 applied research projects in buildings, municipal processes, transportation, and sustainable urban energy systems. Provide technical assistance to local jurisdictions in replicating successful projects. Continue regional workshops and dissemination of information to a broad urban audience. (Urban Consortium) ($1,600)
	$ 1,576	$ 1,600	$ 6,600
State and Local Partnership Programs Total	$ 151,421	$ 156,695	$ 197,700

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

MANAGEMENT AND PLANNING

I. **Mission Supporting Goals and Objectives:**

MISSION

The Office of Building Technology, State and Community Programs (BTS) is responsible for increasing the efficiency of energy use and encouraging the use of renewable rather than conventional energy in buildings by developing new, cost-effective technologies and encouraging the full use of those currently available. The mission of the Office's Management and Planning program is to provide the information needed for defining the set of activities that will most effectively achieve sector goals; for determining the appropriate level of resources consistent with effective execution of those activities; for ensuring that the desired results are achieved; and for enabling other agencies and the private sector to understand these activities in their decision making. Management and Planning also provides the personnel to conduct sector programs.

The overall goal of the Management and Planning program area is a well-planned and managed program for the buildings sector, a program that will achieve sector goals in the most cost-effective manner possible. The report of the Task Force on Strategic Energy Research and Development of the Secretary of Energy Advisory Board, "Energy R&D: Shaping our Nation's Future in a Competitive World", recognizes the importance of both effective planning and management in the conduct of federal energy programs, and stresses the need for more emphasis in these areas.

STRATEGY

Effective management requires efficient organizational design, adequate human resources, sufficient information, and good communication, both within the organization and with outside parties. A solid analytical foundation is basic to understanding the potential for increasing the penetration of energy efficient and renewable technologies in the building sector, and for achieving the correct balance and direction of programmatic activities. The organization maintains strong capabilities in data and information, model development, and analysis to ensure that decisions regarding program direction and resource allocation are guided by the best possible information. Analytical capabilities

and the supporting data base 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.

FY 1999 FUNDING REQUEST

Management and Planning provides analytical support and management staff to the buildings sector programs. It consists of: (1) Evaluation, Planning and Analysis which is responsible for the data, analytical tools, and analyses required for program planning, prioritization, and management; and (2) Program Direction, which supports the personnel to manage the sector programs. The FY 1999 funding request is $14.7 million. Details of the request for each activity are given below.

-- The FY 1999 Request for Evaluation, Planning and Analysis is for collecting and processing technology and sector data, modeling and tools development, analytical studies and planning support, support for customer-focused services for state and local grants programs, regional planning and services to in-state customers, connecting states to the electronic program information systems, and helping states access other resources.

-- The FY 1999 request for Program Direction will provide salaries, benefits, travel, and support for FTEs to manage Buildings Technologies, State and Community Programs. 75 FTEs will be located at DOE headquarters in Washington.

PROGRAM BENEFITS

Benefits from a successful Management and Planning program are reflected in progress toward achieving the overall sector goals which are reflected in energy and consumer cost savings, employment increases, balance of trade improvements, and emissions reductions. While the Management and Planning program does not directly achieve these benefits, it provides information, guidance, and direction necessary for the operating programs to realize them. The program also develops information useful to the private sector in assessing the costs and benefits of improving the efficiency of energy use in buildings.

PERFORMANCE MEASURES

Accomplishment of the following performance measures during FY 1999 will indicate success for the Management and Planning program.

-- Credible estimates of the benefits expected from BTS's proposed FY 2000 activities, as reflected in the evaluations of external reviewers. Development of performance measures/milestones as required by the Government Performance and Results Act (GPRA), to measure annual progress toward achievement of BTS program benefits.

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

-- Effective response to the mandates of the GPRA in the areas of benefit estimation and evaluation;

-- Implementation of the recommendations of the President's Committee of Advisors on Science and Technology contained in the report Federal Energy Research and Development for the Challenges of the Twenty-First Century, including portfolio analysis, increased focus on international activities, and assisting with the development of a cogent plan for an expanded buildings R&D program;

-- Assistance with the development and implementation of the evolving BTS Strategic Plan;

-- Maintenance and improvement of the Office's analytical capability, especially in the areas of planning and the development of background information to support quick response tasks.

In FY 1999 the Management and Planning program will continue to provide the necessary metrics for evaluating overall program success, monitoring progress toward the achievement of sector goals, and evaluating changes in program emphasis as appropriate.

II. A. Funding Table: MANAGEMENT AND PLANNING

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Evaluation and Planning	$ 10,409	$ 5,500	$ 7,268	$ 1,768	32%
Program Direction	6,924	7,350	7,450	100	1%
Capital Equipment	0	0	0	0	0%
Total, Management and Planning	$ 17,333	$ 12,850	$ 14,718	$ 1,868	15%

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

Brookhaven National Lab	$ 450	$ 400	$ 400	$ 0	0%
Lawrence Berkeley Lab	800	600	600	0	0%
National Renewable Energy Lab	200	100	100	0	0%
Oak Ridge National Lab	500	100	100	0	0%
Pacific Northwest Lab	1,300	1,300	1,300	0	0%
All Other	14,083	10,350	12,218	1,868	18%
Total, Management and Planning	$ 17,333	$ 12,850	$ 14,718	$ 1,868	15%

III. Performance Summary: MANAGEMENT AND PLANNING

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning	TECHNOLOGY AND SECTOR DATA: Merged OBT and State and Community Programs Data. Updated and expanded the core information data base to include information on program successes, renewable technologies, efficient technologies for commercial buildings, and building sector imports and exports. Upgraded data on the performance of energy-efficient commercial buildings and to compare their predicted and actual performance. Developed the Buildings Roadmap System to improve the efficiency of data retrieval and manipulation. Compiled standardized, current technology characterization information for advanced building technologies and materials. ($800)	TECHNOLOGY AND SECTOR DATA: Develop and upgrade data required for the planning and evaluation of buildings RD&D and grants programs. Update and expand the Core Databook and Core Presentation Catalog to include information on program successes, renewable technologies, energy-efficient technologies, and building sector imports and exports. Upgrade data on the performance of energy-efficient residential buildings and compare their predicted and actual performance. Compile standardized, current technology characterization information for advanced building technologies and materials. Expand database on costs and performance of options for improving the efficiency and expanding the use of renewables in residential buildings. Continue collaboration and cooperation with EIA in end-use data gathering and analysis. ($800)	TECHNOLOGY AND SECTOR DATA: Develop, organize, interpret and disseminate the basic data required as input to energy policy formulation for buildings and the planning, management and evaluation of the BTS program. This data includes building and technology characteristics, disaggregated information on energy use in the buildings sector [by end-use, fuel, economics, demographic parameters, etc.], environmental data, building industry characteristics, and market data. Where necessary, develop data [e.g., measured data on energy use]. In other cases, gather data from other sources, and interpret and compile in a useful form. Continue collaboration and cooperation with EIA in end-use data gathering and analysis. ($1,068)
	MODELING AND TOOLS: Cooperated with the Energy	MODELING AND TOOLS: Cooperate with the Energy	MODELING AND TOOLS: Cooperate with the Energy

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

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning (Cont'd)	Information Agency in improving the building sector representations in the National Energy Modeling System (NEMS) and supported incorporation of such advanced technologies as the GAX heat pump, building-integrated PV, spectrally-selective glazings, sulfur lamps and passive and active solar heating into the model. Continued development of a standard market penetration methodology for use in evaluation of emerging building technologies. ($449)	Information Administration and support incorporation of such advanced technologies as the GAX heat pump, building-integrated PV, spectrally-selective glazings, sulfur lamps and passive and active solar heating into the NEMS model. Continue a standardized market penetration approach for emerging building technologies. ($300)	Information Administration to refine and update buildings energy use data. Support incorporation of data on advanced technologies. Maintain computer software to allow easy access to and manipulation of buildings characteristics and consumption data. ($300)
	ANALYTICAL STUDIES AND PLANNING SUPPORT: Continued studies of potential international markets for U.S. energy-efficient building technologies. Updated retrospective information on benefits achieved by past OBT and state and community programs ("The Bottom Line"). Updated and refined estimates of benefits expected from current program activities ("Quality Metrics"). Provided information and inputs for planning and budgeting. Quantified potential cost-effective renewable contributions to meeting	ANALYTICAL STUDIES AND PLANNING SUPPORT: Provide credible estimates of the benefits of BTS activities, as reflected in the evaluations of external reviewers. Compile the BTS contributions to the EE Strategic and Multi-Year Plans, Budget Requests, and other planning documents. Improve understanding of risk and its role in program planning. Update and expand information on consumer economics. Analyze and evalute the BTS program portfolio under a variety of future scenarios to optimize performance,	ANALYTICAL STUDIES AND PLANNING SUPPORT: Conduct topical analyses on research needs and opportunities, international technology development, potential carbon savings and associated costs, impacts of utility deregulation, and other subjects as appropriate. Activities supported will include portfolio analysis, GPRA evaluation and benefits analysis, analysis of emerging trends in buildings energy use, estimates of potential carbon savings, and implications of utility deregulation. Design and implement

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

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning (Cont'd)	energy service demands in buildings. ($710)	accounting for time frame, risk, environmental impacts, and costs. ($700)	an evaluation process for all BTS programs and services to more effectively identify opportunities to improve resource allocations. ($1,600)
	SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Responded to state requests for assistance in implementing consolidated state grants, in conducting regional planning and in providing high quality services to in-state customers; increased the number of states connected electronically to the program information system; and helped states access energy-related resources of other Federal agencies. Also supported program oversight, provided advisory board support and responded to Congressionally-mandated reporting requirements. ($3,450)	SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Provide customer-focussed services in the state and local grant programs. Funds will be used to: respond to state requests for assistance in implementing consolidated state grants, in conducting regional planning and in providing high quality services to in-state customers; increase the number of states connected electronically to the program information system; and help states access energy-related resources of other Federal agencies. Also support program oversight, provide advisory board support and respond to Congressionally-mandated reporting requirements. ($3,700)	SUPPORT FOR STATE AND LOCAL GRANT PROGRAMS: Continue to provide customer-focussed services in the state and local grant programs. Respond to state requests for assistance in implementing state grants, in conducting regional planning and in providing high quality services to in-state customers; increase the number of states connected electronically to and upgraded, Windows-based program information system; cooperatively develop performance metrics with States; and help states access energy-related resources of other Federal agencies. Support program oversight, provide advisory board support and respond to Congressionally-mandated reporting requirements. ($4,300)

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

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning (Cont'd)	Provided support to the Energy Information Administration (EIA) for existing activities. These funds were required to support the core EIA data and modeling activities needed to set energy efficiency program needs and measure program results. This reimbursement included the following programs: efficiency and renewables data collection, and analysis, end-use energy consumption surveys, greenhouse gas data collection studies, mid-term energy demand modeling, and integrated end-use energy data compilation. This approach provided for much closer and effective coordination and prioritization of data collection, analysis, and evaluation needs. It also assisted in ensuring consistency of analyses, improving the utilization of key information for both strategic and program level decisionmaking and providing increased value for external users of the information. ($5,000)	These activities previously funded here in FY 1997, are funded under EIA through direct appropriation. ($0)	No Activities. ($0)
	$ 10,409	$ 5,500	$ 7,268

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

Activity	FY 1997	FY 1998	FY 1999
Program Direction	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $5,415 12.1 Civilian personnel benefits $1,150 21.0 Travel and transportation of persons $354 25.2 Other services $5 Provided salaries, benefits, travel, support, and realignment costs for 81 FTEs to manage Building Technology, State, and Community programs, including responsibilities under the Energy Policy Act of 1992. Funding provided staffing requirements to conduct OBT and OTFA programs, as well as costs for relocations and transfers among locations in the field in accordance with strategic alignment. FEMP requirements are now identified in its separate section of the budget. ($6,924)	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $5,365 12.1 Civilian personnel benefits $1,176 21.0 Travel and transportation of persons $620 25.2 Other services $189 Provide salaries with cost of living increase, benefits, travel, support, and realignment costs for 74 FTEs to manage Building Technology, State, and Community programs, including responsibilities under the Energy Policy Act of 1992. The request for other services supports employee training, permanent change of station moves, and a contingency. Funding will provide staffing requirements to conduct BTS programs. ($7,350)	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $5,465 12.1 Civilian personnel benefits $1,176 21.0 Travel and transportation of persons $620 25.2 Other services $189 Provide salaries with cost of living increase, benefits, travel, support, and realignment costs for 75 FTEs to manage Building Technology, State, and Community programs, including responsibilities under the Energy Policy Act of 1992. The request for other services supports employee training, permanent change of station moves, and a contingency. Funding will provide staffing requirements to conduct BTS programs. ($7,450)
	$ 6,924	$ 7,350	$ 7,450

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

Activity	FY 1997	FY 1998	FY 1999
Capital Equipment	Limited capital equipment acquired primarily to support the BTS research and development activities. These purchases were made from operating expense funds according to established reprogramming guidelines. ($0)	Limited capital equipment will be acquired primarily to support the BTS research and development activities. These purchases will be made from operating expense funds according to established reprogramming guidelines. ($0)	Limited capital equipment will be acquired primarily to support the BTS research and development activities. These purchases will be made from operating expense funds according to established reprogramming guidelines. ($0)
	$ 0	$ 0	$ 0
Management and Planning Total	$ 17,333	$ 12,850	$ 14,718

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Tabular dollars in thousands, Narrative in whole dollars)

FEDERAL ENERGY MANAGEMENT PROGRAM

PROGRAM MISSION

I. A. Statement of Mission

The Federal Energy Management Program (FEMP) leads the Federal sector in reducing the cost of government by advancing energy efficiency, water conservation and the use of solar and other renewable energy. As the world's largest consumer of energy, the Federal Government has a tremendous opportunity to put in place sound business practices. These business practices will save hundreds of millions of taxpayer dollars each year; dollars that can be spent for productive uses, or credited to support a balanced budget, instead of being used to pay energy bills. The Energy Policy Act of 1992 requires the Federal Government to become more energy efficient. President Clinton reinforced this requirement in Executive Order 12902. This order directs Federal agencies to improve their energy efficiency 30 percent by 2005, compared to their 1985 levels. Meeting these requirements has the potential to deliver cumulative energy cost savings of more than $15 billion by 2015. While these activities warrant funding on their own merits, they also offer environmental benefits and demonstrate to state and local governments and the private sector how energy management can stimulate markets and create local jobs. The Executive Order assigned responsibility for coordinating agency compliance efforts to the Department's Federal Energy Management Program.

Federal Energy Management has a solid record of success but must double its efforts to achieve the 30 percent goal. The Federal Energy Management Program has achieved impressive gains, exceeding its interim goal of reducing energy consumption in Federal buildings by 10 percent per square foot between 1985 and 1995. Since 1985, Federal energy consumption has declined by almost 24.0 percent. Over a ten year period, these reductions translate into $14.2 billion in Federal savings with associated environmental benefits. Additional savings are expected to accrue through 2015 from many of the efficiency investments in place in 1995. However, the EPAct and Executive Order goals have challenged agencies to make even greater cuts in energy use. To help agencies meet this challenge, the Federal Energy Management Program has developed broad, streamlined Super Energy Savings Performance Contracts that allow Federal agencies to reap early benefits from energy efficiency and renewable energy improvements. With these contracts, private firms incur the costs of installing energy retrofits at Federal facilities in exchange for a share of the resulting energy savings. To support this effort, the Department will continue activities begun in FY 1998 of recovering funds from other agencies as reimbursements provided under Interior and Related Agencies Appropriations Act of 1998, P.L. 105-83. This law allows the Department of Energy to accept funds from Federal agencies in return for FEMP’s assistance with Energy Savings Performance Contracts and other private financing mechanisms. These recovered funds will continue to be used to administer even greater energy efficiency, water conservation, and use of renewable energy by means of privately financed mechanisms, including Energy Savings Performance Contracts. These recoverable funds will cover all necessary program expenses, including contractor support, to achieve overall FEMP program objectives for greater

energy savings. Initial appropriations in FY 1998 and FY 1999 provide the principal source of funds for the start-up of FEMP's assistance to other agencies. In the initial years of the process, revenues are expected to be small relative to appropriations, but will build in later years as assisted agency savings are realized. In FY 1999, FEMP will contingent upon additional legislative authority, expand its ESPC assistance to support energy improvements in Federal leased space. In addition, FEMP plans to initiate ESPCs for mobile equipment including aircraft, ships, and heavy duty vehicles as a new component of its technical and financial assistance programs.

FEMP continues to work with Federal agencies, states, utilities, energy service companies, product manufacturers and other interested parties to bring all relevant public and private resources to bear on meeting the need to accelerate Federal buildings energy efficiency improvement. FEMP is implementing internal improvements to streamline and target its operations to those activities that will achieve the greatest return on the Federal dollar, while at the same time ensuring responsive, high quality assistance to all Federal agencies. FEMP delivers assistance through the six Energy Efficiency and Renewable Energy Regional Support Offices in order to match local resources with local Federal facility needs. Funding needed to supplement agency appropriations is being aggressively pursued through regional Super Energy Savings Performance Contracts (ESPCs), utility and industry partnerships and GSA negotiated utility area-wide contracts, and through Federal-state partnerships. FEMP's new ways of doing business are leading to increased success, lower program cost per dollar saved, and greater levels of quality service.

The Federal Energy Management Program is a customer-focused organization providing services to other Federal agencies. When FEMP succeeds at its mission, agencies have the skills, the means, and the initiative to undertake projects to use energy and water more efficiently, and to promote the use of renewable resources. FEMP focuses on making sure agencies complete energy efficiency and renewable energy projects; since only by completing projects can the Federal sector achieve its broader energy and cost saving goals. For example, savings within DOE from years of completing energy projects have generated over $10.0 million in annual savings. The Federal Energy Management Program sets a positive example for the Nation by transferring the Federal energy experience to State and local governments and ultimately to the private sector.

By using its energy wisely, the Federal Government not only sets a good example but increases its productivity and gets better value for its energy dollars spent. Through Federal leadership and purchasing power, energy efficient products obtain a foothold in the economy and the Government gets even greater value for its purchase. Environmental waste and damage are reduced through energy efficiency and environmentally-sound technologies and techniques. In addition, these investments help preserve the capital infrastructure of the Federal Government, preventing premature deterioration. Government operations and practices become a model for other agencies, State and local governments, corporate purchasers, and energy and facility managers.

In order to achieve its mission, FEMP must provide: (1) alternative methods of financing projects, (2) technical assistance for project identification, training and up-to-date technical information necessary to successfully implement projects, (3) leadership in Federal energy management by demonstrating success in its own DOE facilities, and (4) transfer of knowledge about successful projects to

encourage others to achieve additional progress toward the goals. A more detailed discussion of these activities is included under Section I., Mission Supporting Goals and Objectives.

I. B. Program Benefits

Estimated FEMP program benefits are based on accomplishing both the requirements and goals of the Energy Policy Act of 1992 and Executive Order 12902 for the years 2000 and 2005, as noted in Section I.C., Performance Measures, below. These projected benefits result directly from the actions of all Federal agencies to effectively manage their energy utilization in buildings. Savings projected include anticipated savings in new construction, as well as in retrofit of existing facilities. Estimates of the potential benefits for mobility efficiency improvements are provided but are contingent upon enabling legislation. There are also savings through impacts of increased purchasing and utilization of high efficiency energy consuming products under the Federal Procurement Challenge. To achieve these savings, success is dependent upon reducing barriers to and implementing energy efficiency improvements. These actions are, in turn, dependent upon the steady investment of Federal resources in both: FEMP activities to provide technical assistance, alternative financing mechanisms, and interagency coordination; and related activities at other Federal agencies. Initiation of work on ESPCs for Federal-leased space, combined heat and power and biomass co-firing in Federal boilers, will lead to additional benefit estimates once the Federal market potentials have been assessed. Additional benefits of energy management, although not currently projected, will accrue as well, including increased worker productivity and improved health and safety conditions. A long-term benefit of all these activities is building an infrastructure in Federal agencies that institutionalizes energy efficiency as a standard business practice. Benefits have been adjusted to reflect a 1 percent per year decrease in buildings square footage.

FEMP Quality Metrics Based on Benefits with Current Legislation

Metric (Annual Savings Achieved in Year)

Federal Buildings*	**2000**	**2010**	**2020**
Total Primary Energy Displaced (Quads)	.061	.165	.235
Total Cost Savings in Year*** (1995 $-Billions)	.418	1.039	1.566
Carbon Equivalent Savings (MMTCE)	1.16	3.00	4.23

FEMP Potential Quality Metrics Benefits with New Legislation

Metric (Annual Savings Achieved in Year)

Federal Buildings*	**2000**	**2010**	**2020**
Total Primary Energy Displaced (Quads)	.061	.165	.235
Total Cost Savings in Year*** (1995 $-Billions)	.418	1.039	1.566
Carbon Equivalent Savings (MMTCE)	1.16	3.00	4.23
Federal Mobility**			
Total Primary Energy Displaced (Quads)	0	.071	.071
Total Cost Savings in Year*** (1995 $-Billions)	0	.373	.352
Carbon Equivalent Savings (MMTCE)	0	1.40	1.40
Totals			
Total Primary Energy Displaced (Quads)	.061	.236	.306
Total Cost Savings in Year*** (1995 $-Billions)	.418	1.412	1.918
Carbon Equivalent Savings (MMTCE)	1.16	4.40	5.63

The above estimates were made using the conventions of the Office of the Energy Efficiency and Renewable Energy's GPRA Quality Metrics process. Assumptions are as follows:

* The Federal government procures "green power" in a restructured utility environment at the rate of one percent of consumption in FY 2000, 4 percent in 2010 and 2020.

** Contingent upon additional legislative authority, Energy Savings Performance Contracts for Federal mobility are estimated to save 10% of current mobility energy in 2010.

*** Actual Federal deficit reduction potential is dependent upon the mix of financing used to achieve the savings, e.g., the higher the proportion of direct appropriations to support efficiency, the higher the potential for direct savings to the government. The higher the portion of alternate/private financing, the lower the direct savings due to higher costs of projects which use financing by the private sector.

PROGRAM MISSION - FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Note: FEMP cumulative buildings energy cost savings from FY 1995 levels are projected to be $7.8 billion by 2002, netting $15 billion by 2015. This reflects savings from Federal capital investment in place through 1995, as well as from investments projected to be made from FY 1996 through 2005.

I. C. Performance Measures

The following represents some of the performance measures that will be used by FEMP to track its commitments to meeting its 2005 goal of improving energy efficiency by 30% from the 1985 baseline, on a Btu/gross square foot basis.

Summary of 1997 Accomplishments:

-- Awarded 1 Government-wide "FREE Savings" Super Energy Savings Performance contracts for agencies to use.

-- Achieved an additional $40 million or more in private sector investment in Federal facility energy projects.

-- Transferred 3 "Greening" models to other Federal sites.

-- Implemented and documented 3 renewable energy projects including 2 solar hot water systems and one photovoltaic system installed at 2 National Parks and one Bureau of Reclamation facility.

-- Issued 7 new energy efficient product recommendations.

-- Initiated 8 additional Energy Savings Performance Contracts at Government-operated facilities that will be models to Federal agencies.

FY 1998 Performance Measures:

-- Increase the routine use of renewable energy technologies at Federal facilities through the completion of one government-wide solar technology Super-Energy Savings Performance Contract (Super-ESPC).

-- Complete two model delivery orders integrating cost-effective solar technology and energy efficiency.

-- Complete solicitation and award for 5 Regional Super-Energy Savings Performance Contracts totaling about $3.8 billion in contract authority.

-- Award initial three Western Region Super-ESPC delivery orders and award two ESPC delivery orders at DOE sites.

PROGRAM MISSION - FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

-- Conduct audits that identify 30% energy savings at selected agencies.

-- Document transfer of Greening Models to show replication at other Federal sites.

-- Assist 10 additional renewable energy projects as a direct result of the first 3 projects.

-- Publish 15 new technical information products, including 10 energy efficient product recommendations.

-- Provide 30 technical project recommendations to agency facilities.

FY 1999 Performance Measures:

-- Support expansion of Energy Savings Performance Contracting Authority to include mobility, leased space for buildings and water conservation.

-- Complete two Energy Savings Performance Contracts for renewable energy.

-- Assist 15 new renewable energy projects.

-- Publish 22 technical information products, including 12 energy efficient product recommendations.

-- Provide 45 technical project recommendations to agency facilities, including audits and greening projects as well as general energy efficiency projects.

-- Initiate 2 Federal projects to demonstrate combined heat and power and biomass cofiring in Federal power plants.

FY 2000 Performance Measures:

-- Initiate ESPCs as a result of projected new legislative authority for mobility, leased space for buildings and water conservation.

-- Track energy savings and costs as well as leveraged dollars from private sector investments.
-- Achieve 20% building energy reduction compared to 1985 energy use baseline.

FY 2001 - 2002 Performance Measures:

-- Reduce DOE energy consumption by 30% versus the 1985 baseline.

Significant Accomplishments and Program Shift

Significant Accomplishments:

Through FEMP's efforts, the Federal Government has already achieved success in energy efficiency and cost savings. Fiscal year 1996 highlights show that Federal buildings energy consumption continued to fall dramatically, resulting in more than $1.95 billion in energy savings in FY 1996, with cumulative savings of $14.2 billion (1996 constant dollars) from the 1985 baseline. In FY 1996, the Government continued its pattern of efficiency improvement by achieving a 15.2% efficiency improvement in buildings compared to 1985 usage. Six agencies, the Departments of Energy, Agriculture, Commerce, Justice, NASA, and Interior, have already achieved the year 2000 20 percent reductions, with 11 more agencies exceeding 10 percent reductions.

To achieve greater energy savings, FEMP accelerated its efforts to help agencies find the necessary capital for their energy efficiency projects. FEMP issued an Energy Savings Performance Contracting regulation (10 CFR 436), designed to significantly increase investments in cost-effective energy efficiency measures in existing Federal buildings beyond what can be purchased with scarce appropriated funds. FEMP is continuing to put in place 6 regional Super Energy Savings Performance Contracts covering all agencies and facilities across the Nation and prepared the way for a dozen more. As a result of FEMP negotiations, utilities continue to commit millions for energy efficiency and renewable energy improvements.

FEMP continues its approach of stationing teams of experts in all six Regional Support Offices to help Federal energy managers in the field implement efficiency improvements in their buildings and operations. FEMP has worked with the Office of Management and Budget to implement the Federal Procurement Challenge formally called the Energy Efficiency and Resource Conservation Challenge. The Federal Procurement Challenge is a voluntary, government-wide commitment that uses the buying power of the Federal Government to support and expand markets for the latest energy efficiency and water conservation products, create new entry markets for advanced, energy-saving technologies and products, and reduce operating costs for Federal agencies. Twenty-two agencies have accepted the Challenge and are working to achieve its goals. FEMP will expand efforts in this area and make more information available on the most energy efficient products for agencies to procure.

FEMP completed three new "Greening" projects in FY 1996: The Pentagon Showcase; The Presidio; and The Department of Energy Headquarters, Forrestal and Germantown Buildings. A report on Greening DOE Headquarters was submitted to the Secretary on Earth Day, April 22, 1996, which summarized 84 recommendations. Twenty-five of those recommendations are underway such as general use of efficient lighting, windows, and low volatile organic compound paint. This effort is now focussed on developing an Energy Savings Performance Contract to implement green designs. Working with the National Park Service, the Greening of the Grand Canyon and the Presidio are complete, while Greening activities are underway at Yellowstone and Yosemite National Parks. FEMP is successfully moving ahead in making information available about the Greening technologies available to all Federal facilities, and in applying the technologies to showcase facilities. The final version of the Greening Federal Facilities, an Energy and Environmental

PROGRAM MISSION - FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Resource Guide for Federal Facility Managers handbook and internet information was available in FY 1997, the electronic version is on the FEMP web page, and a Federal Greening Initiatives CD was published in 1997.

During FY97, FEMP's training program began a detailed self assessment that will provide continuous improvement to training courses. The pilot satellite training courses were very successful, enabling the training program to reach significantly more students at reduced costs. The SAVEnergy audit program continues to focus on turning audits into projects. As the Regional Energy Savings Performance Contracts (SuperESPC's) are implemented, the audit program is adjusting to provide audits that can easily be turned into delivery orders under the ESPCs. Technical Project assistance supports integrated projects like the energy efficiency and renewable retrofits at the Bureau of Reclamation's Carl Hayden Visitors Center at Glen Canyon Dam. Retrofits include lighting, controls, refurbishing a solar water heater and replacing the windows. Savings from the overall package will pay for itself in five years.

Program Shift:

Prior to FY 1996, FEMP taught hundreds of Federal energy managers how to initiate Energy Savings Performance Contracts. In each case, FEMP assisted the agencies in putting in place their own contracts. However, in FY 1996 FEMP initiated a new "FREE Savings" Super Energy Savings Performance Contracting approach. This new approach allows agencies to "order energy savings" from FEMP regional or national energy savings performance contracts. This new approach streamlines and centralizes the complex contracting functions but allows facilities from all agencies to tailor the savings techniques to their specific needs. This will speed the introduction of privately-financed energy efficiency measures into the Federal sector. In FY 1998, in accordance with Congressional intent, FEMP will continue the process of recovering funds from other agencies as reimbursements provided under P.L. 105-83. This law allows the Department of Energy to accept funds from Federal agencies in return for FEMP's assistance with energy savings performance contracts and other private financing mechanisms. Fund may be recovered from agencies after energy cost savings are realized and retained by the Department until expended. They will then be used in support of overall FEMP program objectives to achieve greater energy efficiency, water conservation, and use of renewable energy by means of privately financed mechanisms, including Energy Savings Performance Contracts.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Federal Energy Management Program

Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Base	FY 1999 Request	Program Change Request vs. Base Dollar	Program Change Request vs. Base Percent
Federal Energy Management Program						
Operating Expenses	$ 19,800	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%
TOTAL	$ 19,800	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%
Summary						
Operating Expenses	$ 19,800	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%
Total Program	$ 19,800	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%
Staffing (FTE's)						
HQ FTEs	23	20	20	20		
Field FTEs	0	0	0	0		
Total FTEs	23	20	20	20		

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Federal Energy Management Program

FY 1998 Enacted	$	19,800
- Non-Discretionary	$	0
FY 1999 Base	$	19,800

Federal Energy Management Program

- Project Financing - The increase will support expansion of ESPC in buildings and support expansion to mobility and position the Federal government to take advantage of utility opportunities for energy efficiency	+5,964
- Technical Guidance and Assistance - The increase includes increased delivery of project assistance and technical information products as well as Federal procurement of energy efficient technologies such as consolidated purchasing to stimulate markets and lower prices and simplified design and purchasing of solar systems for Federal customers	+4,404
- Planning, Reporting, and Evaluation - The increase includes additional technical and analytical support to resolve issues related to energy and water conservation and renewable energy use to make updated policy changes that will impact energy markets such as utility restructuring and green power procurement	+2,600
- Program Direction - The increase supports additional FTEs needed to manage expanded finance and technical assistance program efforts	+1,100
FY 1999 Congressional Budget Request	$ 33,868

FEDERAL ENERGY MANAGEMENT PROGRAM
(dollars in thousands)

I. **Mission Supporting Goals and Objectives**:

In performance of its mission, the Federal Energy Management Program is an integrated program working to achieve the Federal energy management goals set forth in the Energy Policy Act of 1992, and in the Executive Order 12902 and other relevant laws. FEMP must provide: (1) alternative methods of financing projects, (2) technical assistance for project identification, training and up-to-date technical information necessary to successfully implement projects, (3) leadership in Federal energy management by demonstrating success in its own DOE facilities, and (4) transfer of knowledge about successful projects to encourage others to achieve additional progress toward the goals.

PROJECT FINANCING: FUNDING THE BEST PROJECTS

FEMP will use a variety of mechanisms to help agencies finance projects and achieve budget savings. It will maximize its efforts to emphasize the expanded use of non-Federal funding to invest in Federal energy savings projects. These projects, which achieve a partnership with industry and the agencies, can reduce future utility budgets by as much as 25 times the amount invested by the Government. FEMP will continue to act as the central point of contact within the 100+ Federal agencies to establish Energy Savings Performance Contracts, to disseminate guidance, interpret policy, and train Federal employees on using this contracting mechanism. The critical step in expanding the use of these contracts will be the establishment of a series of FEMP "Free Savings" Super Energy Savings Performance Contracts (ESPC) for use by all agencies and by demonstrating their success at DOE facilities. These contracts will allow Federal facilities rapid access to the private capital and energy services that was envisioned in the language establishing Energy Savings Performance Contracting authority. FEMP plans to put in place over 20 of these Government-wide contracts to allow all agencies to order energy savings from energy savings performance contracts for all efficiency, solar and renewable technologies. In addition, FEMP will concentrate on expanding the use of utility incentive programs and financing mechanisms. These programs can provide incentives, utility financing and specialized technical assistance to complete Federal energy projects. As utilities move to greater competition, FEMP is needed to evaluate emerging opportunities within the restructuring utility industry and report to other agencies on using the new utility services ranging from incentives to loans for energy retrofit services.

FEMP also will provide direct financial assistance to implement the very best projects that bring new products and services to the Federal marketplace. These projects can provide the leadership in the Federal sector in a specific technology, financing, or contracting mechanism to overcome the initial reluctance of the Federal and private sector markets to try new methods and products despite their potential. This approach to managing the risk of new products and services will ensure the speedy introduction of all appropriate energy and cost savings approaches.

Together these efforts will create over $5 billion in Federal energy savings contracts, paid from delivered energy cost savings. These efforts will lead to over $1 billion in annual Federal energy cost reductions from 1995 levels by the year 2010.

I. <u>Mission Supporting Goals and Objectives</u>: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

TECHNICAL GUIDANCE AND ASSISTANCE: IDENTIFYING AND IMPROVING THE BEST PROJECTS

FEMP's technical expertise is provided to agencies to support many more projects than FEMP can assist directly, by ensuring Federal energy managers have access to the latest information and techniques to help them make their own investment decisions. The Technical Assistance Program will continue to provide and improve assistance to agencies for specific targeted projects, including SAVEnergy audits, and project design assistance for energy efficiency, renewable energy and water conservation projects. These projects will serve as practical examples to the rest of the Federal sector and provide targeted cost-effective use of FEMP's resources. These projects are a source for new technical information and validate technical information in the real world of budget constraints, contract requirements, and competing demands. Technical information such as case studies will be made available on as many of these projects as possible. Some of the projects are agency showcases which serve as examples for that agency and all Federal facilities. Project assistance provides technical support for "FREE Savings" Super Energy Savings Performance Contracts delivery order development work, especially in setting examples of projects that save high percentages of energy. All Technical Assistance programs support these efforts.

The SAVEnergy program targets those sites with the greatest opportunities through a pre-screening process, then develops a SAVEnergy Action Plan to carry forward typical audit data and analysis into cost-saving energy and water projects. The Program emphasizes providing the necessary information to turn the audit into a "FREE Savings" Super Energy Savings Performance Contract. Design or project assistance ranges from identifying the best opportunities through feasibility studies, design reviews, and technical specification recommendations to suggestions for funding. This area is also the central focus within FEMP for the expansion of cost-effective renewable energy use within the Federal Sector. The program has participated directly in the implementation of cost-effective solar projects with the National Park Service, Federal Bureau of Prisons, General Services Administration, Departments of Defense, Interior, Transportation and other agencies.

The program also focuses on efforts to reduce water use comprehensively as required by EPAct. Water efforts include identifying Federal customers' technical and educational needs, deployment of tools and training to meet those needs, and facilitation of projects which will demonstrate and measure water conservation potential and transfer that knowledge to other Federal sites. The water program is closely linked with SAVEnergy and "FREE Savings" Super Energy Savings Performance Contracts to move water conservation opportunities to actual project installation.

The Technical Assistance Program will also continue to provide and improve training, technical information, and decision making tools. This technical information and training helps agencies make the most energy efficient and life-cycle cost effective decisions when spending resources that affect energy. FEMP is exploring new ways to maintain quality training for agencies at reduced funding levels by charging tuition, empowering self-supporting "DOE-Qualified Instructors," and expanding leveraging access to students through partnering with other agencies in the use of teleconference training and self-paced computer based multi-media training packages.

I. <u>Mission Supporting Goals and Objectives</u>: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

FEMP is also working with utilities and other non-government partners to provide training, information, and tools at regionally based Resource Centers that use FEMP materials and the partners' human resources.

Energy Efficient Procurement uses the Government's buying power - at least $12-15 billion in annual purchases of energy and water-related products - to support sound Federal purchasing practices and speed the commercialization of cost-effective new technologies that save energy and water. The Federal Procurement Challenge is a keystone activity in this effort. Product Energy Efficiency Recommendations (PEERS) identify the most efficient products in a two-page format useful for energy managers and their procurement officials. FEMP will seek out a Federal agency prepared to be the lead purchaser of a new high energy efficient product. FEMP will assist this agency with specification writing, preparing the RFP, and in finding other purchasing partners to attract substantive proposals.

FEMP provides technical capabilities and software tools to evaluate energy projects quickly, in a fuel neutral analysis, to identify the most life-cycle cost-effective projects in a facility. Through new technology demonstrations, FEMP partners with industry to evaluate new, cost-effective, energy efficient, U.S. manufactured technologies that are not yet widely used in the Federal sector. FEMP will partner with other DOE programs, such as the Motor Challenge, to apply those programs to Federal customers, and to bring the many opportunities of the Federal Sector to those programs.

Additional funds in FY 1999 will expand all efforts to achieve base 2005 energy efficiency and renewables goals and thus result in assistance to about 20 more projects, more training and 7 additional new technical information products, as well as other related tasks. Additional funds will also specifically target new tasks that reduce carbon use in the Federal sector. Additional funds will expand efforts to help agencies buy the most energy efficient products to leverage existing agency funding for equipment purchases and provide energy savings and carbon reductions for low or no incremental cost. Additional funds will also increase support to Federal facilities participating in the President's Million Solar Roofs initiative, and other cost-effective solar technology purchases, especially by providing streamlined access to solar technologies. Other new activities include expanding use of combined heat and power, as well as biomass co-firing in Federal facilities.

PLANNING, REPORTING AND EVALUATION: SUPPORTING AGENCIES

With the need to significantly increase the number of energy projects resulting from the Energy Policy Act of 1992 and Executive Order 12902, FEMP evaluates existing programs to find the most effective and efficient, cost-saving projects and practices to transfer to others for implementation. The Energy Policy Act of 1992 and Executive Order 12902 require greater analyses, therefore, energy efficiency products, water conservation, renewable energy projects, and life-cycle analysis data are assessed and validated to verify energy savings and environmental benefits. By finding new ways of implementing programs, transferring their successes, overcoming barriers, applying quality metrics, and sharing lessons learned with other agencies, state and local governments, and the private sector, FEMP anticipates much greater agency participation in a wide range of programs to increase energy and water efficiency in the Federal

I. <u>Mission Supporting Goals and Objectives</u>: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Government. FEMP will continue to maximize its support for agencies with strong and effective partnerships with industry, utilities and States in FY 1999.

Significant barriers remain for Federal facilities in implementing energy efficiency improvements. Energy issues compete with agency mission and other priorities and messages. FEMP is working to institutionalize energy efficiency so that facility management practices that minimize energy consumption become the standard way of doing business. FEMP is developing regional delivery of services for information and technical assistance and creating new ways to reach facility managers. One way FEMP is addressing procurement barriers is by creating innovative methods to contract for energy services and providing guidance to purchasing officials on energy efficient products. As described earlier, FEMP recently streamlined the process for using energy savings performance contracting to fund projects by issuing regional contracts that significantly reduce the time needed to identify and develop new projects. This regional contract delivery for all agencies along with the recovery of funds from other agencies requires significant analysis and management of a changing organization. Finally, uncertainty in the energy markets stemming from deregulation such as electric utility restructuring and green power procurement are also concerns in implementing energy efficiency improvements.

II. A. **Funding Table**: FEDERAL ENERGY MANAGEMENT PROGRAM

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Project Financing	$ 7,000	$ 7,900	$ 13,864	$ 5,964	75%
Technical Guidance and Assistance	6,800	6,300	10,704	4,404	70%
Planning, Reporting, and Evaluation	4,200	3,800	6,400	2,600	68%
Capital Equipment	0	0	0	0	0%
Program Direction	1,800	1,800	2,900	1,100	61%
Total, Federal Energy Management Program	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%

II. B. **Laboratory and Facility Funding Table**: FEDERAL ENERGY MANAGEMENT PROGRAM

Argonne National Laboratory	25	0	0	0	0%
Brookhaven National Laboratory	25	0	0	0	0%
Lawrence Berkeley National Laboratory	1,922	1,978	3,040	1,062	54%
Lawrence Livermore National Laboratory	55	0	0	0	0%
National Renewable Energy Laboratory	6,609	7,527	10,064	2,537	34%
Oak Ridge National Laboratory	1,276	1,483	3,354	1,871	126%
Pacific Northwest National Laboratory	2,383	2,174	3,110	936	43%
Sandia National Laboratory	240	120	160	40	33%
All Other	$ 7,265	$ 6,518	$ 14,140	$ 7,622	117%
Total, Federal Energy Management Program	$ 19,800	$ 19,800	$ 33,868	$ 14,068	71%

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Project Financing	Applied several model Energy Savings Performance Contracts for use by all agencies as a means of expediting private sector partnerships in financing and implementing energy and cost savings. These contracts provide a contracting mechanism to cover all geographic regions and enable facilities to take advantage of all life-cycle, cost effective energy efficient, solar and renewable technologies. Provided guidance and training on the establishment and use of Energy Savings Performance Contracts by other agencies. Provided information, guidance, and assistance to all Federal organizations on the use of utility incentives as the utility industry evolves to a more competitive environment. Provided direct project financing for the most promising technologies, financing, and contracting mechanisms to speed introduction. Provided technical support to identify barriers to the use of unique financing methods including the use of private financing for water conservation and mobility energy efficiency improvements and for solar and renewable energy projects. Together these efforts provided $275 million in Federal budget savings over the life of the projects. (NREL,	Continue to apply several FREE Savings Super Energy Savings Performance Contracts for use by all agencies as a means of expediting private sector partnerships in financing and implementing energy and cost savings. These contracts will provide a contracting mechanism to cover all geographic regions and enable facilities to take advantage of all life-cycle, cost effective energy efficient, solar and renewable technologies. Continues to provide guidance and training on the establishment and use of Energy Savings Performance Contracts by other agencies and demonstrates their successful use at DOE facilities. Provides information, guidance, and assistance to all Federal organizations on the use of utility incentives as the utility industry evolves to a more competitive environment. Provides direct project financing for the most promising technologies, financing, and contracting mechanisms to speed introduction. Provides technical support to identify barriers to the use of unique financing methods including the use of private financing for water conservation and mobility energy efficiency improvements and for solar and renewable energy projects.	Accelerate the application of several "FREE Savings" Energy Savings Performances Contracts for use by all agencies as a means of expediting private sector partnerships in financing and implementing energy and cost savings. Also, eight new technology specific contracts will be awarded. These contracts will provide a contracting mechanism to cover all geographic regions and enable facilities to take advantage of all life-cycle, cost effective energy efficient, solar and renewable technologies. Continues to provide guidance and training on the use of "FREE Savings" contract by other agencies and demonstrate their successful use at DOE facilities. Provides information, guidance, and assistance to all Federal organizations on the use of utility incentives as the utility industry evolves to a more competitive environment. Increase, to no more than $1.0 million for direct project financing for the most promising technologies, financing, and contracting mechanisms to speed introduction. Provides technical support to identify methods of private financing for water conservation and mobile equipment including aircraft, ships, and heavy

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Project Financing (Cont'd)	PNNL, LBNL, ORNL, McNeil Technologies, Inc.) ($7,000) $ 7,000	Together these efforts will create over $5 billion in Federal energy savings contracts, paid from delivered energy cost savings. There is a substantial increase in speed at which the "FREE Savings" Energy Saver Contracts are put in place, ensuring that contracts for all regions of the country are solicited or awarded by the end of FY 1998. Increase the routine use of renewable energy technologies at Federal facilities through the completion of one government-wide solar technology Super ESPC. (NREL, PNNL, LBNL, ORNL, McNeil Technologies, Inc.) ($7,900) $7,900	duty vehicles, energy efficiency improvements and for solar and renewable energy projects. Together these efforts will create over $5 billion in Federal energy savings contracts, paid from delivered energy cost savings. There is a substantial increase in speed at which the "FREE Savings" Energy Savings Performance Contracts are put in place, ensuring that contracts for all regions of the country are solicited or awarded by the end of FY 1999 and that at least 12 "FREE Savings" contracts are solicited for advanced and emerging technologies. It is estimated that FEMP will receive about $2 million as payment from other agencies for their services. These funds will be used to support agencies in meeting EPACT and Executive Order goals. (NREL, PNNL, LBNL, ORNL, McNeil Technologies, Inc.) ($13,864) $ 13,864
Technical Guidance and Assistance	Technical Assistance Program provided and improved a range of assistance to specific projects in	Technical Assistance Program continues to provide and improve a range of assistance to specific projects	Technical Assistance program provides the technical and training foundation for all of FEMP's efforts

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technical Guidance and Assistance (Cont'd)	Federal agencies on energy efficiency, renewable energy and water conservation. Provided SAVEnergy audits and action plans at targeted sites with the greatest opportunities. Provided project assistance ranging from feasibility studies, design reviews, technical specifications and funding recommendations. Provided and improved training, technical information, and tools to support more projects than FEMP can assist directly. Provided training in lighting, software tools, and renewable technologies. Helped agencies buy the most energy efficient and water conserving products through barrier reduction, policy guidance and product recommendation. Developed and provided software and other tools that help agencies evaluate energy and water projects. Evaluated new, cost-effective energy efficient, U.S. manufactured technologies that are not widely used in the Federal Sector and shared evaluation with Federal users. (NREL, LBNL, PNNL, ORNL, SNL, ORISE, McNeil Technologies, Inc.) ($6,800)	in Federal agencies on energy efficiency, renewable energy and water conservation. Continues to provide SAVEnergy audits and action plans at targeted sites with the greatest opportunities. Continue to provide project assistance ranging from feasibility studies, design reviews, technical specifications and funding recommendations. Continues to provide and improve training, technical information, and tools to support more projects than FEMP can assist directly. Provides training in lighting, software tools, and renewable technologies. Continues to help agencies buy the most energy efficient and water conserving products through barrier reduction, policy guidance and product recommendation. Develops and provides software and other tools that help agencies evaluate energy and water projects. Continues to evaluate new, cost-effective energy efficient, U.S. manufactured technologies that are not widely used in the Federal Sector and shares evaluation with Federal users. (NREL, LBNL, PNNL, ORNL, ORISE, McNeil Technologies, Inc.) ($6,300)	to identify and implement technically sound and cost-effective energy efficiency, water, and renewable projects at Federal facilities. The overall goal of the program is to enable Federal agencies to make energy efficiency and other aspects of Federal resource management "business as usual." It complements and works with FEMP's Alternative Financing Program. Provides SAVEnergy audits and action plans at targeted sites targeted to lead to alternative financing. Provides project assistance ranging from feasibility studies, design reviews, technical specifications and funding recommendations. Provides and improves training, technical information, and tools to support more projects than FEMP can assist directly. Provides training in energy efficient technologies through classroom, satellite courses and other cost effective delivery mechanisms. Helps agencies buy the most energy efficient and water conserving products through barrier reduction, policy guidance and product recommendation. Develops and provides software and other tools that help agencies screen for energy and water saving projects. Evaluates new,

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technical Guidance and Assistance (Cont'd)			cost-effective energy efficient, U.S. manufactured technologies that are not widely used in the Federal sector and shares evaluation with Federal users. Additional funds will expand all efforts to achieve base 2005 energy efficiency and renewables goals and thus result in assistance to about 20 more projects, more training and 7 additional new technical information products. Additional funds will also specifically target new tasks that reduce carbon use in the Federal sector. Additional funds will expand efforts to help agencies buy the most energy efficient products to leverage existing agency funding for equipment purchases and provide energy savings and carbon reductions for low or no incremental cost. Additional funds will also increase support to Federal facilities participating in the President's Million Solar Roofs initiative, and other cost-effective solar technology purchases, especially by providing streamlined access to solar technologies. Other new activities include expanding use of combined heat and power, as well as biomass co-firing in Federal facilities. (NREL, PNNL, LBNL, ORISE, SNL,

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technical Guidance and Assistance (Cont'd)	$ 6,800	$ 6,300	McNeil Technologies, Inc.) ($10,704) $ 10,704
Planning, Reporting, and Evaluation	Provided interagency coordination and management for developing and implementing energy efficiency, water conservation and renewable energy projects. Provided policy analysis of key issues related to Federal energy and water conservation and renewable energy use, including policy impacts of energy market changes, and Federal energy efficiency improvements as a contributor to environmental and economic benefits and goals. Supported databases of Federal facilities, energy consumption and costs, facility managers, energy efficiency, solar and other renewables and water conservation projects. These databases were used to fulfill mandated reporting requirements. Provided help to agencies in the delivery of an effective technology transfer program to ensure that Federal energy reduction goals were clearly understood and that FEMP's programs were able to be implemented by Federal energy managers and Federal employers.	Continue technical support to provide interagency coordination and management for developing and implementing energy efficiency, water conservation and renewable energy projects in the field. Continue support of policy analyses of key issues related to Federal energy and water conservation and renewable energy use, including policy impacts of energy market changes, and Federal energy efficiency improvements as a contributor to environmental and economic benefits and goals. Continue to support databases of Federal facilities, energy consumption and costs, facility managers, energy efficiency, solar and other renewables and water conservation projects. These databases are used to fulfill mandated reporting requirements. Continue to support agencies in the delivery of an effective technology transfer program to ensure that Federal energy reduction goals are clearly understood and the FEMP's programs are able to	Increase technical support to provide interagency coordination and management for developing and implementing energy efficiency, water conservation and renewable energy projects with emphasis on the field. Increase support of policy analyses of key issues related to Federal energy and water conservation and renewable energy use, to make updated policy changes to increase impacts of energy market changes, e.g., electric utility restructuring and green power procurement and Federal energy efficiency improvements as a contributor to environmental and economic benefits and goals. Continue to enhance databases of Federal facilities, energy consumption and costs, facility managers, energy efficiency, solar and other renewables and water conservation projects. These databases are used to fulfill mandated reporting requirements and used to support reporting of energy efficiency impacts and perform analyses of Federal carbon emissions

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Planning, Reporting, and Evaluation (Cont'd)	The theme of the information campaign as part of the technology transfer program was centered around the power of individual actions that can be taken to increase energy efficiency awareness and to use energy wisely, i.e., individual actions that make a difference. The campaign included the use of multi-media education tools, teleconferences, resources guides, action kits, and building the FEMP network of partners. The Regional Energy Action Project team of experts stationed in six regions (Seattle, Chicago, Denver, Boston, Atlanta, and Philadelphia) helped Federal energy managers in the field identify regional efficiency improvement opportunities in their buildings and operations. This approach, applied in all six regional support offices, resulted in 20 efficiency projects through these Regional teams. (PNNL, NREL, ORNL, McNeil Technologies, Inc.) ($4,200)	be implemented by Federal energy managers and Federal employers. The theme of the information campaign will continue to center around the power of individual actions that can be taken to increase energy efficiency awareness and to use energy wisely, i.e., individual actions that make a difference. The campaign includes the use of multi-media educational tools, teleconferences, resources guides, action kits, and building the FEMP network of partners. The Regional Energy Action Project team of experts in six regions (Seattle, Chicago, Denver, Boston, Atlanta, and Philadelphia) will continue to provide ongoing support to FEMP's hands-on highly responsive, and customer-oriented new way of doing business. They will help Federal energy managers in the field identify efficiency improvements in their buildings and operations and ensure the delivery of a full range of regional technical, financial, outreach and related services. This approach will result in 20 efficiency projects through these Regional teams. (PNNL, NREL, ORNL, McNeil Technologies, Inc.) ($3,800)	and efficiency related carbon reductions. Increase support to agencies through a series of regionally focused meetings. Deliver effective technology transfer programs to ensure that Federal energy reduction goals are clearly understood and the FEMP's programs are able to be implemented by Federal energy managers and Federal employers. The theme of the information campaign will continue to center around the power of individual actions that can be taken to increase energy efficiency awareness and to use energy wisely, i.e., individual actions that make a difference. The campaign includes the use of multi-media educational tools, teleconferences, resources guides, action kits, and building the FEMP network of partners. The Regional Energy Action Project team of experts in six regions (Seattle, Chicago, Denver, Boston, Atlanta, and Philadelphia) will provide ongoing support to FEMP's hands-on highly responsive, and customer-oriented new way of doing business. They will help Federal energy managers in the field identify efficiency improvements in their buildings and operations and ensure the delivery of a full range of regional technical, financial, outreach and

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Planning, Reporting, and Evaluation (Cont'd)			related services. This approach will result in 50 efficiency projects through these Regional teams. (PNNL, NREL, ORNL, McNeil Technologies, Inc.) ($6,400)
	$ 4,200	$ 3,800	$ 6,400
Capital Equipment	Limited capital equipment was acquired to support the research and development activities described above. These purchases were made from operating expense funds according to established reprogramming guidelines. ($0)	Limited capital equipment will be acquired primarily to support the research and development activities described above. These purchases will be made from operating expense funds according to established reprogramming guidelines. ($0)	Limited capital equipment will be acquired primarily to support the research and development activities described above. These purchases will be made from operating expense funds according to established reprogramming guidelines. ($0)
	$ 0	$ 0	$ 0
Program Direction	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $1,419 12.1 Civilian personnel benefits $271 21.0 Travel and transportation of persons $91 25.2 Other services $19 Provided salaries, benefits, travel support, realignment costs for 23 FTEs to manage the Federal Energy	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation $1,280 12.1 Civilian personnel benefits $256 21.0 Travel and transportation of persons $110 25.2 Other services $154 Provide salaries, benefits, travel support, realignment costs for 20 FTEs to manage the Federal Energy Management Programs under the	The following is a breakdown of the funding by Object Class: 11.9 Personnel compensation* $1,348 12.1 Civilian personnel benefits $257 21.0 Travel and transportation of persons $350 25.2 Other services $945 Provide salaries, benefits, travel support, realignment costs for 20 FTEs to manage the Federal Energy Management Programs under the
Program Direction			

III. Performance Summary: FEDERAL ENERGY MANAGEMENT PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
(Cont'd)	Management Programs under the Energy Policy Act of 1992. ($1,800)	Energy Policy Act of 1992. The funding in other services includes training, employee incentive awards, library services, and a small contingency. ($1,800)	Energy Policy Act of 1992. The funding in other services includes training, employee incentive awards, library services, and a small contingency. ($2,900)
	$ 1,800	$ 1,800	$ 2,900
Federal Energy Management Program Total	$19,800	$19,800	$33,868

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Tabular dollars in thousands, Narrative in whole dollars)

POLICY AND MANAGEMENT

PROGRAM MISSION

Policy and Management provides analytical support to the Building, Transportation, Industrial, and Federal Energy Management Programs and helps to integrate research and development across the diverse EERE programs. EERE's sector programs include a number of related projects that serve the interests of multiple customers. EERE's research and development activities are complemented by research in other energy programs. EERE's Policy and Management works closely with its public and private sector partners to avoid redundancy and direct R&D to achieve the greatest return on the public's investment. This category also includes resources for activities required by the Government Performance and Results Act the Energy Policy Act of 1992, and for the development and maintenance of a performance management system. Many of the critical activities described in this section were formerly funded through the Policy and Management category and supplemented through directed funding from the Building, Transportation, Industrial and Federal Energy Management sectors. In FY 1999, DOE has changed the methodology for budgeting for Policy and Management activities.

In FY 1999, Policy and Management has been restructured to improve the integration among the energy efficiency programs. It now contains resources at Headquarters and in the Field Organizations for: (1) Program Management to manage the business of the Energy Conservation program and ensure the effectiveness and accountability of the programs. These resources include staff salaries and related expenses; (2) Contractual Support for Program Management, Crosscutting Functions and landlord related expenses; contracted expertise and management systems. Crosscutting activities include activities whose scope directly impacts specific programs but is also broad enough to extend beyond individual sectors, and therefore, require "Corporate" attention. Contracted expertise is required to evaluate the investments made by the programs and improve the effectiveness of the delivery of programs, manage program deliverables, measure results, and implement the strategic priorities of the program. Functions include coordinating and integrating work among the various end-use sectors, ensuring effective coordination with and communication to stakeholders and supporting Congressional and Administration requirements unforeseen in the development of the FY 1999 budget but necessary to the effective implementation of the FY 1999 budget. (3) Integrated Delivery Mechanisms to improve the delivery of diverse programs to constituent communities through International Market Development programs, Information and Communication programs, the Centers of Excellence, and Strategic Policy Initiatives.

The FY 1999 budget request consolidates all strategic crosscutting functions, analytical research, expanded activities of the Regional Support Offices, and enhanced performance measurement and program evaluation into the Policy and Management category. This consolidation eliminates the need for supplemental directed funding from the sectors. The rationale for this change is to ensure that

PROGRAM MISSION - POLICY AND MANAGEMENT (Cont'd)

resources are available to maintain critical corporate functions which ensure the effective management of the EERE program, avoid duplication of effort among the sector programs, and ensure transparency. In FY 1998 policy and management functions will require some funding from the sectors for strategic crosscutting functions to meet specific program missions not directly supported (no more than $7,000,000, a 15% reduction from the previous year). The FY 1999 budget amounting to $44,432,000, includes $5,000,000 for strategic crosscutting functions, which is a 29% reduction from FY 1998. Also, a new program request amounts to $4,500,000 and represents expanded activities at the Regional Support Offices for Center of Excellence ($2,000) and support to DOE strategic policy initiatives such as climate change and utility restructuring ($2,500). Please refer to the Comparative Budget Table following this section.

FY 1999 Congressional Budget Request - Comparative Table
Energy Conservation - Policy and Management
(dollars in thousands)

Policy and Management Personal Costs	FY 1997	FY 1998	FY 1999 Request
Headquarters Salaries & Related Expenses	$4,861	$4,162	$3,990
Golden Salaries & Related Expenses	2,655	3,896	4,018
RSO Salaries and Related Expenses	8,281	9,063	9,972
Subtotal	15,797	17,121	17,980
Policy and Management Contractual Services			
Headquarters Cost of Business	3,878	4,069	6,262
Golden Cost of Business	1,850	650	772
RSO Cost of Business	3,395	3,327	5,018
Crosscutting Activities	0	0	5,000
Subtotal	9,123	8,046	17,052
Policy and Management Integrated Program Delivery			
International Market Development	2,600	2,600	2,900
Information and Communications	1,500	1,550	2,000
Centers of Excellence	0	0	2,000
Strategic Policy Initiatives	0	0	2,500
Subtotal	4,100	4,150	9,400
Total Policy and Mgmt (Total Obligational Authority)	29,020	29,317	44,432
Unobligated Carryover Balances	-2,617	-737	0
Total Policy and Mgmt (Total Budget Authority)	**26,403**	**28,580**	**44,432**
Crosscutting Functions (Sector Contributions)			
Assistant Secretary Initiatives	7,561	7,000 *	0
Integrated Sector Programs	650	0	0
Subtotal	8,211	7,000	0
COMPARATIVE TOTAL	**$34,614**	**$35,580**	**$39,932** **

* ***In FY 1998, Policy and Management functions will require some funding from the sectors for strategic crosscutting functions to meet specific program missions not directly supported in Policy and management. These activities will be managed by the sectors in accordance with appropriations committee guidelines, with oversight by appropriate DOE reviewing authorities.***

** ***The comparative totals indicate a modest increase for cost of living and increases in contractual support but a 29% decrease in strategic crosscutting activities.***

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Policy and Management - EC

Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Base	FY 1999 Request	Program Change Request vs. Base Dollar	Program Change Request vs. Base Percent
Policy and Management - EC						
Operating Expenses	$ 26,403	$ 28,580	$ 28,580	$ 44,432	$ 15,852	55%
TOTAL	$ 26,403	$ 28,580	$ 28,580	$ 44,432	$ 15,852	55%
Summary						
Operating Expenses	$ 26,403	$ 28,580	$ 28,580	$ 44,432	$ 15,852	55%
Total Program	$ 26,403 a/	$ 28,580	$ 28,580	$ 44,432	$ 15,852	55%
Staffing (FTE's)						
HQ FTEs	60	51	51	45		
Field FTEs	130	152	152	157		
Total FTEs	190	203	203	202		

a/ Reflects adjustment of $+253.0 thousand for approved reprogramming 97-R-15a for program direction activities utilizing prior year balances.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Policy and Management - EC

FY 1998 Enacted	$ 28,580
FY 1999 Base	0
	$ 28,580

Policy and Management - EC

- Salaries and Related Expenses (HQ) - The increase in budget authority does not reflect that there is a funding reduction in FY 1999 when compared to FY 1998 which will utilize FY 1997 unobligated carryover balances	+565
- Contractual Services (HQ) - The increase reflects a change in methodology for requesting strategic crosscutting activities to more effectively manage EE sector programs, and a nominal increase for the Working Capital Fund	+7,193
- Salaries and Related Expenses at Golden Field Office - The increase reflects the estimated FY 1999 payraise and one additional FTE in FY 1999	+122
- Contractual Services at Golden Field Office - The increase is primarily for support services for programmatic activities due to estimated workload requirements and also for landlord costs	+122
- Salaries and Related Expenses at Regional Support Offices - The increase supports additional staffing at the RSOs for increased activities in deployment of energy efficiency initiatives at the state and local government levels	+640
- Contractual Services at Regional Support Offices - The increase supports advisory and assistance services in the formulation, review and implementation of programmatic initiatives	+1,960

SUMMARY OF CHANGES - Policy and Management - EC (Cont'd)

- International Market Development Program - The increase supports expanded international market development efforts designed to strengthen the domestic efficiency market base	+300
- Information and Communications Program - The increase supports expanded information and communication activities and improved efficiency in delivery of services	+450
- Centers of Excellence - The increase supports focused efforts on consolidation of delivery of energy efficiency initiatives, technical assistance, and services to state and local government and other entities for sustainable development and disaster remediation efforts	+2,000
- Strategic Policy Initiatives - The increase supports critical DOE technical and economic studies and evaluations in conjunction with the DOE Office of Policy toward the development of a comprehensive "corporate" policy on climate change related issues including emissions trading credits, early incentive programs, and possible tax incentives	+2,500
FY 1999 Congressional Budget Request	$ 44,432

POLICY AND MANAGEMENT - EC
ENERGY CONSERVATION
(dollars in thousands)

I. **Mission Supporting Goals and Objectives**:

A.1. Headquarters Staffing Functions for Program Management
The critical Headquarters functions in the Policy and Management Category include: (1) Headquarters Executive Management; (2) Headquarters Project Management; (3) oversight of Program and Contract Implementation at the Golden Field Office; and (4) oversight of grant administration, promotion of regional energy-related planning and liaison between states and other major partners at the Regional Support Offices. These staff perform all project management activities associated with the programs, ranging from policy development and long-range planning to general administration including functions such as: (1) preparation of technical research and development plans; (2) assessment of scientific and technical needs and priorities; (3) development and defense of budgets; (4) review, evaluation and funding of research proposals; (5) monitoring, evaluation, and directing laboratory work and allocation of resources; (6) oversight of university and industrial research programs; (7) control of interagency liaison and negotiations; (8) development of corporate goals, multi-year planning, corporate formulation of budget requests and presentation and explanation of those requests; (9) management and execution of corporate-level and crosscutting communications, information transfer and outreach to EERE customers and stakeholders; (10) policy analysis, program benefits assessment, performance measurement and program performance assessment.

A.2. Golden Field Office Staffing Functions for Program Management
The Golden Field Office responsibilities include: (1) Program and Contract Implementation; (2) grant administration, promotion of energy-related planning and liaison between other major partners. These staff perform all project management activities associated with the programs, including functions such as: (1) preparation of technical research and development plans; (2) assessment of scientific and technical needs and priorities; (3) review, evaluation and funding of research proposals; (4) monitoring, evaluating and directing laboratory work and allocating resources; and (5) oversight of university and industrial research programs. These staff have a significant level of responsibility in the implementation of relevant portions of the Energy Policy Act of 1992 (EPACT).

A.3. Regional Support Office Staffing Functions for Program Management
Expand responsibilities of the Regional Support Offices to include: (1) implementing "reengineered" grant making functions initiated in FY 1996 to enhance the flexibility of grantees in choosing how to best achieve the goals of increased deployment of energy efficiency and renewable energy technologies and practices; (2) facilitating and promoting energy-related planning and collaborating with regional interests to ensure that EERE programs and technologies are effectively deployed at the State and local levels. (3) informing EERE Headquarters Program Offices of regional, state and local issues, actions and opportunities; (4) providing limited technical assistance for State Consolidated Grants; and (5) representing EERE interests through participation in such activities as Regional Federal Executive Boards, Regional Energy Boards, Energy Councils, and other energy-related issues and organizations. The Regional

I. Mission Supporting Goals and Objectives: POLICY AND MANAGEMENT - EC (Cont'd)

Support Offices perform a vital role in the identification and facilitation of EERE activities with and between the States and major partners.

A summary of the staffing supported in the Policy and Management request follows:

FTE Data	FY 1997	FY 1998	FY 1999
Headquarters	60	51	45
Golden Field Office	25	35	36
Regional Support Offices	105	117	121
Totals	**190**	**203**	**202**

B1. Contractual Support for Program Management and Crosscutting Functions
Contractual Services for Program Management at Headquarters, the Golden Field Office and the Regional Support Offices include rent, utilities, communications, printing, supplies and materials, and transportation. In addition, certain outside, independent expertise is required to assist Headquarters and Field staff with technical and financial analyses in a cost effective manner. This expertise is required in the areas of: (1) Program and Contract Evaluation; (2) Performance Measurement and acceleration of continuous improvement efforts to enhance the productivity and performance of the workforce; (3) Information dissemination to and coordination with customers and stakeholders; (4) technical analysis of policies, standards, and proposed legislation on EERE's ability to execute the authorized and appropriated programs effectively (for example: evaluating the effects of climate change, and better understanding how Clean Air Act implementation can be improved).

B.2. Expected Benefits
The most important benefit of the staffing and contractual support in Program Management and Crosscutting functions is the ability for the EERE program to consolidate and coordinate its diverse array of energy efficiency programs into one strategically aligned program. The program also benefits through consistency of program benefits and performance measures. A number of EERE's research and development activities are crosscutting; coordination is critical, not only among sectors, but also with other Federal programs and industry.

Policy and Management's efforts also lead to consistent performance measurement and program evaluation. Performance measures and estimates of program benefits, cited throughout this budget request, were developed or facilitated through this function. These staff perform the pivotal functions in implementation of relevant portions of the Energy Policy Act of 1992 (EPACT) and the Government

I. <u>Mission Supporting Goals and Objectives</u>: POLICY AND MANAGEMENT - EC (Cont'd)

Performance and Results Act of 1993 (GPRA). The benefits of contracting outside expertise include: (1) independent reporting of results; (2) honest broker function with customers and stakeholders; and (3) cost effective analysis.

C.1. International Market Development

The International Market Development programs strive to increase the exports of energy efficiency technologies which leads to a stronger domestic market. By addressing market barriers, the programs "pull" rather than "push" the technologies into the marketplace, thereby bringing domestic economic growth and jobs, a cleaner environment, and a lower price for these technologies now and in the future in all markets.

This program uniquely serves the energy efficiency industry by identifying market opportunities, assisting in infrastructure building and emphasizing information dissemination and exchange. This program strengthens the U.S. energy efficiency industry's ability to effectively meet increasingly aggressive competition from the European Community and Asia in a world-wide market for energy efficiency products and services estimated to be at least $84 billion per year. The International Market Development programs promote U.S. exports through a variety of projects described below. These projects target key markets (particularly in countries-in-transition and developing countries) with a final goal of maximizing U.S. private sector participation.

The Committee on Energy Efficiency Commerce and Trade (COEECT) coordinates the energy efficiency export activities of U.S. Federal Agencies and provides a venue for the private sector to provide input into Federal export programs and policy to ensure they benefit and strengthen U.S. industries.

Energy Efficiency Centers provide "port of entry" assistance to the U.S. industries in specific geographical regions, offer access to local energy decision makers, and assist in the development of energy efficiency standards. This assistance helps to create markets for U.S. energy efficiency technologies. By facilitating contacts between U.S. businessmen and local decision makers, the Energy Efficiency Centers have been instrumental in increasing U.S. exports and provide an excellent complementary resource to the COEECT programs. Additionally, the Centers are repositories of local legal, technological and cultural data vital to business success in these specific regions.

Programs such as Asia Pacific Economic Cooperation (APEC), Center for the Analysis and Dissemination of Demonstrated Technologies (CADDET), and Greenhouse Gas Technology Information Exchange (GREENTIE) seek to obtain and share information on market opportunities and cutting edge technologies being demonstrated by other countries. Each of these programs holds workshops and seminars on U.S. technologies, develops information systems and databases on efficient technologies, develops region-specific product and service registers and vendor lists, and forms and supports region-specific private sector liaison groups for U.S. energy efficiency technology cooperation.

I. <u>Mission Supporting Goals and Objectives</u>: POLICY AND MANAGEMENT - EC (Cont'd)

C.2. Estimates of Benefits
The International Market Development programs yield benefits to the environment and the domestic and international economy. Reduced energy use in countries purchasing U.S. energy efficiency technologies creates greater market pull, increases economic growth in these countries as well as the U.S., creates domestic jobs and Federal tax revenues, as well as protecting the environment through reduced energy intensity.

C.3. Performance Measurements

1997
-- Set deployment strategies with the assistance of U.S. industries that include trade missions and technical assistance
-- Increase local contacts for U.S. business in countries which have Energy Efficiency Centers
-- Improve information dissemination and data exchanges between U.S. businesses and buyers in other countries through CADDET, APEC, and GREENTIE

1998
-- Improve coordination of Federal export assistance
-- Increase export activities in Latin America
-- Increase contacts between U.S. firms and local experts and buyers through the Energy Efficiency Centers
-- Link information dissemination and data exchanges accomplished through APEC, CADDET and GREENTIE to U.S. exports

1999
-- Increase exports of energy efficiency technologies in key markets
-- Increase in Federal tax revenues resulting from exports
-- Link information dissemination, technical assistance and participation in international organizations to export increases

D.1. Information and Communications
The Information and Communications activities continue to support the Department of Energy's effort to disseminate information about energy efficiency and renewable energy technologies to customers and stakeholders through the Energy Efficiency and Renewable Energy Clearinghouse (EREC) and the Energy Efficiency and Renewable Energy Network (EREN).

EREC will continue to support a comprehensive program to provide tailored information and technical and business assistance to individuals, small businesses, and State and local governments -- adding value to EERE's efforts to achieve the effective use of energy efficiency and renewable energy technologies.

Through EREN, existing State, private and laboratory databases which provide details on demonstrated technologies and other technical information will be linked to facilitate the efficient exchange of information through the Internet.

I. Mission Supporting Goals and Objectives: POLICY AND MANAGEMENT - EC (Cont'd)

These programs reduce market barriers by directly educating consumers at the Federal, State, local and individual level. The objectives of the program are to: (1) provide accurate and unbiased information on energy efficiency and renewable energy technologies to the public so that EERE's customers can make informed decisions in the marketplace, resulting in an increase in the adoption of renewable energy and energy efficiency technologies and efficient energy practices; (2) raise the general awareness of the state-of-the-art energy efficiency and renewable energy technologies.

D.2. Estimate of Benefits
Educating the public and businesses of the benefits of energy efficiency and renewable energy technologies is evidenced by: (1) increased domestic sales and exports of energy efficiency and renewable energy products and services; (2) increased market acceptance of emerging technologies and recognition of the benefits of these technologies; (3) increased market size and capacity for these technologies.

D.3. Performance Measures

1997
-- EREC responded to 111,017 inquiries based on funding levels
-- EREN realized 20% increase in development and usage over previous year
-- EREC and EREN achieved a 95% customer satisfaction rating (evaluated through surveys and user feedback)

1998
-- EREC responds to 60,000 inquiries based on funding levels
-- EREN realizes 10% increase in development and usage over previous year
-- EREC and EREN will maintain a 95+% customer satisfaction

1999
-- EREC responds to 95,000 inquiries based on funding request
-- EREN maintains 10% increase in development and usage over previous year
-- EREC and EREN maintain a 95+% customer satisfaction rating (evaluated through surveys and user feedback)

E.1. Centers of Excellence
The Centers of Excellence are a new concept for improving the delivery of diverse programs to entire communities. The Centers are the Center of Excellence for Sustainable Development (CESD) at the Denver Regional Support Office (piloted in FY96), and the Center of Excellence for National Disaster Remediation (CENDR) at the Atlanta Regional Support Office (to be established in FY99). Both Centers of Excellence will provide the Department of Energy with a liaison to State, local government and other entities to serve as a central point for the dissemination of information concerning energy efficiency and renewable energy technologies for development and disaster recovery, and provide and arrange for technical assistance for State, local government and other entities.

I. <u>Mission Supporting Goals and Objectives</u>: POLICY AND MANAGEMENT - EC (Cont'd)

E.1.a. The CESD was begun as a pilot project through existing directed funds at the Denver Regional Support Office in March 1996 in response to requests for technical assistance from local governments. The Denver Regional Support Office restructured its mechanism for responding to constituent requests by forming the CESD. CESD's functions are to (1) provide technical assistance to State and local governments as well as individuals and other entities, in using energy efficiency and renewable energy technologies to meet their economic and environmental goals; (2) provide tools, manuals, case studies and other forms of assistance through a variety of mediums to help local governments invest existing Federal development resources in ways that maximize local and national economic, energy and environmental benefits; and (3) assist local governments in accessing related technical and financial assistance programs from other Federal, state and private organizations. Under the pilot, CESD provided technical assistance and training to several local governments and organizations, as well as developing a coordinated multi-lab program to ensure the effective provision of technical assistance. CESD also created a World Wide Web site as an efficient means of disseminating information on how local governments can create and implement strategies in which energy technologies are used to achieve economic and environmental benefits simultaneously.

E.1.b. CENDR was envisioned after severe flooding which resulted in an energy crisis in the city of Grand Forks, North Dakota. The Atlanta Regional Support Office responded quickly to the city's request for assistance and worked closely with DOE's Office of Emergency Management, the Federal Emergency Management Agency, the Housing and Urban Development Agency, and the General Services Administration to procure and contract for the installation of thousands of Ground Fault Temporary Service hookups for residents without power. As a result of this and other experiences, officials recognized the opportunity for energy efficiency and renewable energy technologies in improving disaster recovery assistance. CENDR will be created to (1) promote the use of energy efficiency and renewable energy technologies to mitigate initial loss on natural disasters, and aid in the immediate response to address vital needs following a natural disaster; (2) provide emergency planning and response organizations with the information and technical assistance necessary to conduct fast and effective recovery from natural disasters, mitigate loss from future disasters, and rebuild infrastructure utilizing energy efficiency and renewable energy technologies; and (3) assist state energy offices in updating emergency management plans in a unified style and fashion.

E.2. Estimate of Benefits

Under the CESD pilot and the Atlanta Regional Support Office's ad-hoc efforts, several significant benefits have already been realized. CESD created a "Virtual Lab" with eight national laboratories to integrate and consolidate the technical assistance available to State, local governments and other entities. CESD entered into partnerships with and provided grants to several organizations of local officials responsible for planning and development to include energy efficiency and renewable energy in their plans (organizations include the U.S. Conference of Mayors, the National Association of Counties, the American Planning Association, the National Association of State Energy Offices, Empowerment Zones and Enterprise Communities). CESD has provided training to several organizations which has resulted in opportunities for technology deployment at State and local levels (organizations include International City-County Managers Association and the National Association of State Energy Offices).

The Atlanta Regional Support Office responded to communities requesting assistance with disaster relief, created partnerships with DOE's Office of Emergency Management, the Federal Emergency Management Agency, Housing and Urban Development Agency, General Services Administration for more effective assistance to local governments and others hit by natural disasters, held a

pre-hurricane workshop with many private sector representatives and emergency management officials from Guam, Hawaii, Puerto Rico, the Virgin Islands and from throughout the southeastern U.S. on electric power interruption, and assisted State governments with improved disaster planning in areas affected by recurring natural disasters, including hurricanes, tornadoes, floods, etc.

E.3. Performance Measures

1999
-- Create the Centers of Excellence for Sustainable Development and National Disaster Remediation
-- Based on the level of funding, CESD provides technical assistance to 10-20 State and local governments and other entities
-- Based on level of funding, CENDR provides technical assistance to 10-20 State and local governments and other entities
-- Increase technical assistance provided by the "Virtual Lab" to State and local governments and other entities
-- Increase resources provided through the Internet and usage of Websites

F.1. Strategic Policy Initiatives
The Department has identified several key Climate Change issues which require technical analysis and evaluation. These issues include low-carbon electricity restructuring, credit incentives and trading, and economic, scientific and programmatic impacts of proposed climate change initiatives. Substantial analysis is required to design a rational and effective policy to meet greenhouse gas emission goals. Without this analysis in the early phases of policy development, cost-effective programs such as crediting may fall short of their potential. Analysis activities supported in this category will ensure that the Department and the Administration facilitate the maximum effectiveness of public and private sector commitments in greenhouse gas emission goals.

F.2. Estimate of Benefits
A comprehensive climate change analysis will provide critical information in a number of important areas including the greenhouse gas emissions benefits expected to flow from competitive electricity markets, the economic benefits of "early banking" provisions for greenhouse gas reductions, projected energy and emissions paths for key developed and developing countries, and the design of modalities for international emissions trading and the clean development mechanism that can substantially reduce costs to U.S. industry.

F.3. Performance Measures
-- Comprehensive climate change analysis produced and disseminated

II. A. Funding Table: POLICY AND MANAGEMENT - EC

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	$ Change	% Change
Policy and Management					
Headquarters					
Salaries and Related Expenses	$ 4,398	$ 3,425	$ 3,990	$ 565	16%
Contractual Services	3,000	4,069	11,262	7,193	177%
Subtotal Headquarters	$ 7,398	$ 7,494	$ 15,252	$ 7,758	104%
Golden Field Office					
Salaries and Related Expenses	$ 2,655	$ 3,896	$ 4,018	$ 122	3%
Contractual Services	1,850	650	772	122	19%
Subtotal Golden Field Office	$ 4,505	$ 4,546	$ 4,790	$ 244	5%
Regional Support Offices					
Salaries and Related Expenses	$ 7,421	$ 8,101	$ 8,741	$ 640	8%
Contractual Services	2,979	4,289	6,249	1,960	46%
Subtotal Regional Support Offices	$ 10,400	$ 12,390	$ 14,990	$ 2,600	21%
Subtotal, Policy and Management	$ 22,303	$ 24,430	$ 35,032	$ 10,602	43%
International Market Development Program.	$ 2600	$ 2600	$ 2900	$ 300	12%
Information and Communications Program	1,500	1,550	2,000	450	29%
Centers of Excellence	0	0	2,000	2,000	100%
Strategic Policy Initiative	0	0	2,500	2,500	100%
Total, Policy and Management - EC	$ 26,403	$ 28,580	$ 44,432	$ 15,852	55%

II. B. Laboratory and Facility Funding Table: POLICY AND MANAGEMENT - EC

All Other	26,403	28,580	44,432	15,852	55%
Total, Policy and Management - EC	$ 26,403	$ 28,580	$ 44,432	$ 15,852	55%

III. Performance Summary: POLICY AND MANAGEMENT - EC

Activity	FY 1997	FY 1998	FY 1999
Policy and Management - Headquarters - Salaries and Related Expenses	The following is a breakdown of the funding by Object Class: HQ POLICY AND MANAGEMENT - ENERGY CONSERVATION 11.9 Personnel compensation $3,708 12.1 Civilian personnel benefits $980 21.0 Travel and transportation of persons $173 22.0 Transportation of things $0 25.1 Advisory and assistance services $0 25.2 Other services $3,846 26.0 Supplies and Materials $32 Executive management activities at HQ supported 60 FTEs in FY 1997. Activities supported include: liaison with senior officials in Congress, the White House, OMB, and other agencies as well as State and local governments, and the private sector. These activities provide for the executive management, formulation and operation of the EERE programs including: establishing goals and objectives for the programs; assessing performance and effectiveness; and supporting the FY 1992 Energy Policy Act requirements and the Government Performance and Results Act.	The following is a breakdown of the funding by Object Class: HQ POLICY AND MANAGEMENT - ENERGY CONSERVATION 11.9 Personnel compensation $3,246 12.1 Civilian personnel benefits $766 21.0 Travel and transportation of persons $150 22.0 Transportation of things $0 25.1 Advisory and assistance services $0 25.2 Other services $4,019 26.0 Supplies and Materials $50 Executive management activities at HQ will support 51 FTEs in FY 1998. Activities include: liaison with senior officials in Congress, the White House, OMB, and other agencies as well as State and local governments, and the private sector. These activities provide for the executive management, formulation and operation of the Energy Efficiency programs including: establishing goals and objectives for the programs; assessing performance and effectiveness; and supporting the FY 1992 Energy Policy Act requirements and the Government Performance and Results Act. Total obligations in FY 1998 are	The following is a breakdown of the funding by Object Class: HQ POLICY AND MANAGEMENT - ENERGY CONSERVATION 11.9 Personnel compensation $3,000 12.1 Civilian personnel benefits $600 21.0 Travel and transportation of persons $190 22.0 Transportation of things $200 25.1 Advisory and assistance services $0 25.2 Other services $11,212 26.0 Supplies and Materials $50 In FY 1999, a total of $3,990,000 is requested to support 45 FTEs for the executive management activities at HQ. Activities to be supported include: liaison with senior officials in Congress, the White House, OMB, and other agencies as well as State and local governments, and the private sector. These activities provide for the executive management, formulation and operation of the EERE programs including: establishing goals and objectives for the programs; assessing performance and effectiveness; and supporting the FY 1992 Energy Policy Act requirements and the

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters - Salaries and Related Expenses (Cont'd)	In FY 1997 funding obligations for HQ operations totaled $8,739,000. This included $7,145,000 in new budget authority, $253,000 internally reprogrammed for the shortfall in Federal salaries, from prior year balances from the Policy and Management accounts. ($4,398) $ 4,398	estimated at $8,231,000. This includes $7,494,000 in new budget authority and up to $737,000 in FY 1997 unobligated carryover from all of Policy and Management. Funding Requirements for Headquarters FTEs totals $4,162,000 of which $3,425,000 will be from new budget authority (shown in annotation below) and up to $737,000 will be funded from FY 1997 unobligated carryover from other Policy and Management accounts. ($3,425) $ 3,425	Government Performance and Results Act. ($3,990) $ 3,990
Headquarters - Contractual Services	WORKING CAPITAL FUND (WCF): The WCF supported all administrative services for headquarters employees such as: rent, automated office support, contract close out and audits, telephone services, postage, printing and graphics, and similar services previously included in the Departmental Administration account under the Energy and Water Development Appropriations. In FY 1997, a total of $3,846,000 was obligated for the WCF. This	WORKING CAPITAL FUND (WCF): A total of $4,019,000 for the WCF will support all administrative services for headquarters employees such as: rent, automated office support, contract close out and audits, telephone services, postage, printing and graphics, and similar services.	WORKING CAPITAL FUND (WCF): A total of $4,180,000 is requested for the WCF to support all administrative services for headquarters employees such as: rent, automated office support, contract close out and audits, telephone services, postage, printing and graphics, and similar services. The Office of Energy Efficiency and Renewable Energy (EE) has programs under the jurisdiction of both the Interior and Related Agencies (Interior) and Energy and Water Development (EWD) Appropriations

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters - Contractual Services (Cont'd)	included $3,000,000 in new budget authority and $846,000 in FY 1996 unobligated carryover funds from former Policy and Management activities. The Office of Energy Efficiency and Renewable Energy (EE) has programs under the jurisdiction of both the Interior and Related Agencies (Interior) and Energy and Water Development (EWD) Appropriations Committees. FY 1997 was the first year of operation of the WCF and the $3,000,000 was requested and appropriated on the basis of a 50/50 ratio for Interior and EWD.		Committees. FY 1997, the funding for the WCF was requested on a 50/50 ratio for Interior and EWD. In FY 1998 and FY 1999, split for the WCF more closely parallels the ratio of the FTEs. This is a more equitable distribution of the funding request since the costs of the Working Capital Fund are primarily driven by the number of staff supported, and approximately 75% of this Office's FTEs are in Interior.
	Rent was the largest component of the WCF with FY 1997 obligations of $2,581,000. ($3,000)	Rent is the largest component of the Working Capital Fund in FY 1998 with FY 1998 funding requirement of $2,802,000. ($4,019)	An estimated $2,817,000 will be needed for rent in FY 1999. ($4,180)
	CONTRACT SUPPORT: A total of $32,000 in unobligated carryover funding supported contractual services for supplies and materials. In FY 1997, crosscutting activities were funded primarily from within the Energy Efficiency programs which most benefitted from the work. ($32)	CONTRACT SUPPORT: A total of $50,000 will support contractual services for supplies and materials. ($50)	CONTRACT SUPPORT: Funds are requested for support services such as: mailroom; travel processing; environment, health, and safety support; computer systems development; computer harware and software installation, configuration, and maintenance activities; and budget and program formulation and presentation activities. ($2,082)

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters - Contractual Services (Cont'd)	CROSSCUTTING SUPPORT: In FY 1997, crosscutting activities were funded primarily from within the Energy Efficiency programs which most benefitted from the work. ($0)	CROSSCUTTING SUPPORT: In FY 1998, the Office of Energy Efficiency and Renewable Energy, in accordance with committee guidelines and regulations, will work to identify viable options that will permit the continuation of the most critical crosscutting activities at a $7,000,000 level. ($0)	CROSSCUTTING SUPPORT: A total of $5,000,000 is requested for the consolidation of all crosscutting functions, analytical research, enhanced performance measurement and program evaluation activities included for program development and review; performance-based planning; budget formulation and execution; and personnel management. Contract support is requested to provide analysis, information and decision support to all levels of EE management for planning; budget formulation and financial management; project monitoring, management, and integration; communication, outreach and customer service to EE corporate customers to facilitate meeting corporate goals. Principle activities to be undertaken include: development of a revised EE strategic plan; continued refinement of the Strategic Principles planning process to perform scenario-based portfolio analysis and support decision-making; corporate formulation of budget requests and presentation and explanation of the requests; management and execution of

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters - Contractual Services (Cont'd)			corporate-level communications, information transfer and outreach to corporate customers; analysis of markets and polices; and development of comprehensive, state-of-the art and peer reviewed program benefit estimates and performance measures across all EE programs (both required by the Government Performance and Results Act of 1993); technical analysis of Federal and state policies, standards, and proposed legislation on EERE's ability to execute authorized and appropriated programs; evaluation of climate change policies and their impact on EERE research and development; analysis of impacts of reauthorization of Clean Air Act; strategic partnerships with non-governmental organizations to evaluate impact of EERE policy on the economy; partnerships with private sector and non-governmental organizations to evaluate new deployment opportunities for EERE technologies; partnerships with national and private laboratories to determine R&D priorities. ($5,000)
	$ 3,000	$ 4,069	$ 11,262

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters Subtotal	$ 7,398	$ 7,494	$ 15,252
Golden Field Office - Salaries and Related Expenses	The following is a breakdown of the funding by Object Class for the Golden Field Office: 11.9 Personnel compensation $2,115 12.1 Civilian personnel benefits $390 21.0 Travel and transportation of persons $147 22.0 Transportation of things $3 23.2 Rental payments to others $250 23.3 Communications, utilities, and miscellaneous charges $37 24.0 Printing and reproduction $3 25.1 Advisory and assistance services $1,477 25.2 Other services (training, service agreements) $14 26.0 Supplies and materials $69 FY 1997 funding supported 25 FTEs to permit the continued operation of the Golden Field Office (GO) which was established in late 1992 to consolidate all field responsibilities for the Energy Efficiency and Renewable Energy (EE) programs at the National Renewable Energy Laboratory (NREL), six EE Support Offices, and the Golden Field Office. This	The following is a breakdown of the funding by Object Class for the Golden Field Office: 11.9 Personnel compensation $3,080 12.1 Civilian personnel benefits $616 21.0 Travel and transportation of persons $155 22.0 Transportation of things $45 23.2 Rental payments to others $255 23.3 Communications, utilities, and miscellaneous charges $45 24.0 Printing and reproduction $5 25.1 Advisory and assistance services $260 25.2 Other services (training, service agreements) $15 26.0 Supplies and materials $70 The FY 1998 funding will support 35 FTEs to permit the continued operation of the Golden Field Office (GO) which consolidated all field responsibilities for the Energy Efficiency and Renewable Energy (EE) programs at the National Renewable Energy Laboratory (NREL), six EE Support Offices, and the Golden Field Office. This	The following is a breakdown of the funding by Object Class for the Golden Field Office: 11.9 Personnel compensation $3,161 12.1 Civilian personnel benefits $645 21.0 Travel and transportation of persons $162 22.0 Transportation of things $50 23.2 Rental payments to others $260 23.3 Communications, utilities, and miscellaneous charges $45 24.0 Printing and reproduction $0 25.1 Advisory and assistance services $372 25.2 Other services (training, service agreements) $15 26.0 Supplies and materials $70 The FY 1999 request will support 36 FTEs to permit the continued operation of the Golden Field Office (GO) which was established in late 1992 to consolidate all field responsibilities for the Energy Efficiency and Renewable Energy (EE) programs at the National Renewable Energy Laboratory (NREL), six EE Support Offices, and

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Golden Field Office - Salaries and Related Expenses (Cont'd)	dedicated field organization is responsive to a technology program that spans a large continuum ranging from scientific research to commercialization and outreach activities. Also, it emphasizes customer orientation, innovation and partnerships, not only with private industry, but with Federal laboratories, States, and localities.	dedicated field organization is responsive to a technology program that spans a large continuum ranging from scientific research to commercialization and outreach activities. Also, it emphasizes customer orientation, innovation and partnerships, not only with private industry, but with Federal laboratories, States, and localities.	the Golden Field Office. This dedicated field organization is responsive to a technology program that spans a large continuum ranging from scientific research to commercialization and outreach activities. Also, it emphasizes customer orientation, innovation and partnerships, not only with private industry, but with Federal laboratories, States, and localities.
	GO managed and administered the Management and Operating contract for NREL and as such is the Federal manager for NREL program planning and execution, budget and financial management, information resource management, site infrastructure and construction, environment safety and health, procurement oversight, work for non-DOE entities, and various other program functions. Nearly one-half (45%) of the Energy Efficiency and Renewable Energy program at NREL was in support of Energy Conservation programs including significant efforts in areas such as Alternative Fuels Utilization, Electric and Hybrid Propulsion, Building Systems Research, Municipal Solid Wastes, Industrial Separations, and Integrated Resource Planning.	GO manages and administers the Management and Operating contract for NREL and as such is the Federal manager for NREL program planning and execution, budget and financial management, information resource management, site infrastructure and construction, environment safety and health, procurement oversight, work for non-DOE entities, and various other program functions. Approximately half of the Energy Efficiency and Renewable Energy program at NREL will be in support of Energy Conservation programs including significant efforts in areas such as Alternative Fuels Utilization, Electric and Hybrid Propulsion, Building Systems Research, Municipal Solid Wastes, Industrial Separations, and Integrated Resource Planning.	GO manages and administers the Management and Operating contract for NREL and as such is the Federal manager for NREL program planning and execution, budget and financial management, information resource management, site infrastructure and construction, environment safety and health, procurement oversight, work for non-DOE entities, and various other program functions. Approximately half of the Energy Efficiency and Renewable Energy program at NREL will be support of Energy Conservation programs including significant efforts in areas such as Alternative Fuels Utilization, Electric and Hybrid Propulsion, Building Systems Research, Municipal Solid Wastes, Industrial Separations, and Integrated Resource Planning.

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Golden Field Office - Salaries and Related Expenses (Cont'd)	GO also managed a wide variety of efficiency and renewable programs by contracting with commercial vendors, non-profit entities, and colleges and universities. These GO activities included all DOE actions from initial solicitation through the business and technical management of each contract. ($2,655)	GO also manages a wide variety of efficiency and renewable programs by contracting with commercial vendors, non-profit entities, and colleges and universities. These GO activities will include all DOE actions from initial solicitation through the business and technical management of each contract. ($3,896)	GO also manages a wide variety of efficiency and renewable programs by contracting with commercial vendors, non-profit entities, and colleges and universities. These GO activities will include all DOE actions from initial solicitation through the business and technical management of each contract and performance measurement. These staff also have significant level of responsibility for implementation of relevant portions of EPACT. ($4,018)
	$ 2,655	$ 3,896	$ 4,018
Golden Field Office - Contractual Services	A total of $1,850,000 was for contractual services to support the continued operation of the Golden Field Office. Needed contractual services included such activities as rent, utilities, communications, printing, supplies and materials, transportation of things, and advisory and assistance services. ($1,850)	A total of $650,000 will support landlord activities including contractual services associated with the operation of the Golden Field Office. The landlord activities include: expendable office supplies and materials; telecommunications and utilities costs; training; purchase of goods and services from Government accounts; printing and graphics; postage; maintenance and service agreements; publications; rental payments to GSA and others; advisory and assistance services; support services; and program support activities. ($650)	A total of $772,000 is requested for landlord activities including contractual services associated with the operation of the Golden Field Office. The landlord activities include: expendable office supplies and materials; telecommunications and utilities costs; training; purchase of goods and services from Government accounts; printing and graphics; postage; maintenance and service agreements; publications; rental payments to GSA and others; advisory and assistance services; support services; and program support activities. The increase

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Golden Field Office - Contractual Services (Cont'd)			reflects a nominal increase for activities such as support services and rent. ($772)
	$ 1,850	$ 650	$ 772
Golden Field Office Subtotal	$ 4,505	$ 4,546	$ 4,790
Regional Support Offices - Salaries and Related Expenses	The following is a breakdown of the funding by Object Class for the Regional Support Offices:	The following is a breakdown of the funding by Object Class for the Regional Support Offices:	The following is a breakdown of the funding by Object Class for the Regional Support Offices:

REGIONAL SUPPORT OFFICES (RSOs) - ENERGY CONSERVATION

RSO FY 1997 Object Class	
11.9 Personnel compensation	$5,980
12.1 Civilian personnel benefits	$1,167
13.1 Benefits for former personnel	$274
21.0 Travel and transportation of persons	$823
22.0 Transportation of things	$37
23.1 Rental payments to GSA	$1,315
23.2 Rental payments to others	$45
23.3 Communication, utilities, misc. charges	$287
24.0 Printing and reproduction	$3
25.1 Advisory and assistance	

REGIONAL SUPPORT OFFICES (RSOs) - ENERGY CONSERVATION

RSO FY 1998 Object Class	
11.9 Personnel compensation	$6,740
12.1 Civilian personnel benefits	$1,361
13.1 Benefits for former personnel	$ 0
21.0 Travel and transportation of persons	$917
22.0 Transportation of things	$45
23.1 Rental payments to GSA	$1,460
23.2 Rental payments to others	$50
23.3 Communication, utilities, misc. charges	$316
24.0 Printing and reproduction	$27
25.1 Advisory and assistance	

REGIONAL SUPPORT OFFICES (RSOs) - ENERGY CONSERVATION

RSO FY 1999 Object Class	
11.9 Personnel compensation	$7,284
12.1 Civilian personnel benefits	$1,457
13.1 Benefits for former personnel	$ 0
21.0 Travel and transportation of persons	$1,177
22.0 Transportation of things	$54
23.1 Rental payments to GSA	$1,602
23.2 Rental payments to others	$75
23.3 Communication, utilities, misc. charges	$345
24.0 Printing and reproduction	$50
25.1 Advisory and assistance	

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Regional Support Offices - Salaries and Related Expenses (Cont'd)	services $1,126 25.2 Other services (training, service agreements) $333 25.3 Purchases of goods/services from Govt. accounts $50 25.7 Operation and maintenance of equipment $50 26.0 Supplies and materials $136 31.0 Acquisition of equipment: ADP equipment $50 A total of $11,676,000 was obligated in FY 1997 to the continued operation of the six streamlined Regional Support Offices (RSOs). The funding included $10,400,000 in new budget authority and $1,276,000 in FY 1996 unobligated carryover. A total of $7,421,000 in obligations supported 105 FTEs including $274,00 for personnel costs (such as severance pay and unemployment compensation) associated with the previous close-out of four RSOs. The staff implemented "reengineered" grantmaking functions initiated in FY 1996 to enhance the flexibility for grantees to choose how to best achieve the goals of increased deployment of energy efficiency and renewable energy technologies and practices. Also, the RSOs implemented technology deployment activities to promote partnering with	services $1,182 25.2 Other services (training, service agreements) $142 25.3 Purchases of goods/services from Govt. accounts $50 25.7 Operation and maintenance of equipment $50 26.0 Supplies and materials $50 31.0 Acquisition of equipment: ADP equipment $ 0 A total of $12,390,000 will support the continued operation of the Regional Support Offices (RSOs) in FY 1998. Of this total, $8,101,000 will support 117 FTEs at the RSOs. The staff will continue to implement "reengineered" grant-making functions to enhance the flexibility for grantees to choose how to best achieve the goals of increased deployment of energy efficiency and renewable energy technologies and practices and they will implement technology deployment activities to promote partnering with customers and stakeholders in the field. ($8,101)	services $1,450 25.2 Other services (training, service agreements) $731 25.3 Purchases of goods/services from Govt. accounts $165 25.7 Operation and maintenance of equipment $120 26.0 Supplies and materials $280 31.0 Acquisition of equipment: ADP equipment $200 A total of $14,990,000 is requested to provide for the continued operation of the Regional Support Offices (RSOs) in FY 1999. Of this total, $8,741,000 will support 121 FTEs at the RSOs. The staff will continue to implement "reengineered" grant-making functions to enhance the flexibility for grantees to choose how to best achieve the goals of increased deployment of energy efficiency and renewable energy technologies and practices and they will implement technology deployment activities to promote partnering with customers and stakeholders in the field. Also, the RSOs will facilitate and promote energy-related planning at state and local government levels; report to Headquarters on partnerships and opportunities with constituent communities for EERE; provide

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Regional Support Offices - Salaries and Related Expenses (Cont'd)	customers and stakeholders in the field. ($7,421)		limited technical assistance for state consolidated grants; represent EERE interests through regional organizations (i.e., Regional Federal Executive Boards, Regional Energy Boards, Energy Councils). ($8,741)
	$ 7,421	$ 8,101	$ 8,741
Regional Support Offices - Contractual Services	A total $4,255,000 supported the continued operation of the six Regional Support Offices and included $2,156,000 in FY 1997 new budget authority and $1,276,000 from FY 1996 unobligated carryover balances. Needed contractual services included such activities as rent, utilities, communications, printing, supplies and materials, transportation of things, and advisory and assistance services. ($2,979)	A total of $4,289,000 is for contractual services in FY 1998 to support the continued operation of the six Regional Support Offices. Needed contractual services included such activities as rent, utilities, communications, printing, supplies and materials, transportation of things, and advisory and assistance services. ($4,289)	A total of $6,249,000 is requested in FY 1998 for contractual services to support the continued operation of the six Regional Support Offices. Needed contractual services include such activities as rent, utilities, communications, printing, supplies and materials, transportation of things, and advisory and assistance services. Increase advisory and assistance and other services will support anticipated workload increases required to process ongoing and planned initiatives relating to Climate Change, utility restructuring, Clean Air Act reauthorization, etc. The RSOs will also accelerate continuous improvement efforts to enhance productivity and work force performance. ($6,249)
	$2,979	$ 4,289	$ 6,249

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Regional Support Offices - Subtotal	$ 10,400	$ 12,390	$ 14,990
International Market Development	COEECT facilitated REIA-Asia conference to showcase U.S. technologies; assist U.S. companies to capitalize on international voluntary programs; continuation and expansion of long-term international deal-making activities; creation of training exercises and demonstrations for international energy firms. ($1,000)	COEECT will continue to develop and implement an international strategy for U.S. energy efficiency industries; increased focus on Latin America. ($900)	COEECT will continue to develop and implement an international strategy for U.S. energy efficiency industries; conduct trade missions to emerging markets; utilize local experts to assist U.S. firms in identifying viable customers; continued focus on Asia markets and increased focus on Latin America. ($1500)
	Promote continued access to Energy Efficiency Centers through contracted work and Internet. ($100)	Promote continued access to Energy Efficiency Centers through contracted work and Internet. ($100)	Promote continued access to Energy Efficiency Centers through contracted work and Internet and linkage to COEECT activities. ($100)
	CADDET: Continued support for U.S. participation in this international cooperative effort. Support the collection and dissemination of information on U.S. EE and RE technologies. Collect and disseminate to U.S. industry data on innovative applications of EE technologies in other countries. Conduct workshops to increase worldwide awareness of U.S. EE products and services. ($870)	CADDET: Continue support for U.S. participation in this international cooperative effort. Support the collection and dissemination of information on U.S. EE and RE technologies. Collect and disseminate to U.S. industry data on innovative applications of EE technologies in other countries. Conduct workshops to increase worldwide awareness of U.S. EE products and services. ($960)	CADDET: Continue support for U.S. participation in this international cooperative effort. Support the collection and dissemination of information on U.S. EE and RE technologies. Collect and disseminate to U.S. industry data on innovative applications of EE technologies in other countries. Conduct workshops to increase worldwide awareness of U.S. EE products and services. ($660)

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
International Market Development (Cont'd)	APEC: Continued the U.S.'s leadership role in the energy efficiency subcommittees of this international cooperative effort. Continue dialogue and involvement with member countries. Identify viable market opportunities and coordinate activities with U.S. EE industry. Develop specific projects to showcase U.S. technologies in member countries. ($555)	APEC: Continue the U.S.'s leadership role in the energy efficiency subcommittees of this international cooperative effort. Continue dialogue and involvement with member countries. Identify viable market opportunities and coordinate activities with U.S. EE industry. Develop specific projects to showcase U.S. technologies in member countries. ($590)	APEC: Continue the U.S.'s leadership role in the energy efficiency subcommittees of this international cooperative effort. Continue dialogue and involvement with member countries. Identify viable market opportunities and coordinate activities with U.S. EE industry. Develop specific projects to showcase U.S. technologies in member countries. ($590)
	GREENTIE: Continued participation in this international effort to reduce green house gas emissions. Continue support for the upkeep of the directory of green house gas technology centers and the supporting networks. Continue support for Greentie National Team activities. Provide U.S. industry information on potential market opportunities in targeted regions. ($75)	GREENTIE: Continue participation in this international effort to reduce green house gas emissions. Continue support for the upkeep of the directory of green house gas technology centers and the supporting networks. Continue support for Greentie National Team activities. Provide U.S. industry information on potential market opportunities in targeted regions. ($50)	GREENTIE: Continue participation in this international effort to reduce green house gas emissions. Continue support for the upkeep of the directory of green house gas technology centers and the supporting networks. Continue support for Greentie National Team activities. Provide U.S. industry information on potential market opportunities in targeted regions. ($50)
	Continued implementation of Ukraine Energy Efficiency Financing Initiative with FY 1996 funds. ($0)	Complete implementation of Ukraine Energy Efficiency Financing Initiative begun in FY 1996. ($0)	Complete implementation of Ukraine Energy Efficiency Financing Initiative begun in FY 1996 and capitalize on opportunities created for U.S. industries. ($0)
	$ 2,600	$ 2,600	$ 2,900

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Information and Communications Program	Continued operation of EREC with reduced funding (Energy and Water $0) to provide technical assistance and information in response to increasing public inquiries (approximately 60,000 per year). ($1,100)	Continue operation of EREC to provide technical assistance and information in response to increasing public inquiries (approximately 95,000 per year). ($1,100)	Continue operation of EREC to provide technical assistance and information in response to increasing public inquiries (approximately 95,000 per year). Improve the timeliness and quality of products delivered to increase level of customer satisfaction; produce report on customer inquiries, responses and customer satisfaction. ($1,250)
	Continued support, promotion and use of EREN, a coordinated system linking multiple existing information and technical assistance services. ($400)	Continue support, promotion and use of EREN, a coordinated system linking multiple existing information and technical assistance services. ($450)	Continue support, promotion and use of EREN, a coordinated system linking multiple existing information and technical assistance services. Improve development of website and maintain and update relevant and timely information on EERE programs and technologies; produce report on customer usage and satisfaction. ($750)
	$ 1,500	$ 1,550	$ 2,000
Centers of Excellence	No Activities. ($0)	No Activities. ($0)	The Centers of Excellence for Sustainable Development, CESD, are designed to provide a more efficient delivery mechanism to move EERE technologies into the market place. CESDs will also strive to address the needs of customers who seek a comprehensive portfolio of EERE

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Centers of Excellence (Cont'd)			programs and services which cut across all sectors at the lowest possible cost to EERE. Specifically, the FY 1999 budget will focus on two critical areas: provide access to EERE technologies to mitigate the effects of disasters on State and local governments and other entities; and provide technical assistance to more adequately address their increasing demands concerning the role of energy efficiency in fostering economic growth and protecting the environment. Natural disaster activities include partnering with states and local organizations to facilitate demonstration of energy efficient technologies following natural disasters. Technical assistance: the Centers will also assist the states, professional/technical organizations and institutions of higher learning who have demonstrated the resolve to revise building codes and construction practices in order to reach out to builders, homeowners, and the insurance industry in a concerted effort to accelerate use of EERE technologies. ($2,000)
	$ 0	$ 0	$ 2,000

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Strategic Policy Initiatives	No Activities. ($0)	No Activities. ($0)	This request supports critical climate change Technology Initiatives including: low-carbon electricity restructuring; credit incentives and trading; and economic, science, and program evaluations. The President established basic principles and a credible framework for taking action on climate change. However, substantial additional analyses will be required to design a rational and effective policy to meet the greenhouse gas emission goals. Without such analysis in the early phases of policy development, important policies such as early crediting are likely to fall short of their potential to contribute to cost-effective emission reductions. This request is an essential component of the President's climate proposal, and will enable the Department and the Administration to ensure that early commitments of public and private resources devoted to emission reduction have maximum effectiveness. The early credit concept, in particular, requires a substantial analytical effort to define and implement. While the current voluntary reporting program established under Energy Policy Act Section 1605(b) has proved useful, it

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Strategic Policy Initiatives (Cont'd)			is wholly inadequate to generate a verifiable, credible property right for early emission reduction credits. The original 1605(b) reporting system required well over $1.0 million to develop through a series of focused technical workshops and follow-up analysis, and a similar amount would be necessary to improve the system to generate early emission credits. The proposed analyses will be performed in conjunction with the DOE Office of Policy and are especially important given the likely interactions between early crediting, tax incentives, and R&D priorities. There currently are no resources available to provide integrated analyses of detailed policy options, increasing the risk that such policies could either work at cross-purposes or could squander significant public and private resources on duplicative and redundant efforts. For example, basic issues such as whether tax incentives should be made available for projects that also apply for early credit have not been analyzed, where a danger of windfall tax benefits clearly exist. The President also called for integrated scientific and economic assessments to guide the

III. Performance Summary: POLICY AND MANAGEMENT - EC (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Strategic Policy Initiatives (Cont'd)			establishment of a long-term concentration target and to continually inform policy development. ($2,500)
	$ 0	$ 0	$ 2,500
Policy and Management - EC Total	$ 26,403	$ 28,580	$ 44,432