Industrial Technologies Program

Program Mission

The mission of the Industrial Technologies Program is to improve the energy intensity of the U.S. industrial sector through a coordinated program of research and development, validation, and dissemination of energy-efficiency technologies and operating practices. This effort will be achieved by partnering with industry, its equipment manufacturers, and its many stakeholders to reduce our Nation's reliance on foreign energy sources, reduce environmental impacts, increase the use of renewable energy resources, improve competitiveness, and improve the quality of life for American workers, families, and communities.

Strategic Context

Accomplishing this mission through these partnership activities contributes to several national energy and environmental priorities. Improving the energy intensity of U.S. industries leads to reduction in energy use per unit output, which reduces the need to import petroleum from foreign sources, and lowers environmental emissions including greenhouse gases. Additionally, improved energy intensity will result in more efficient use of electricity, which reduces electricity demand per unit of industrial output and the need for new power plants. Finally, the adoption of more energy efficient production processes, technologies, and techniques will accelerate the pace of U.S. industrial modernization and enable U.S. companies to compete more successfully in international markets. Reduced petroleum consumption and lower environmental emissions will play a strong role in improving America's energy security and quality of the environment.

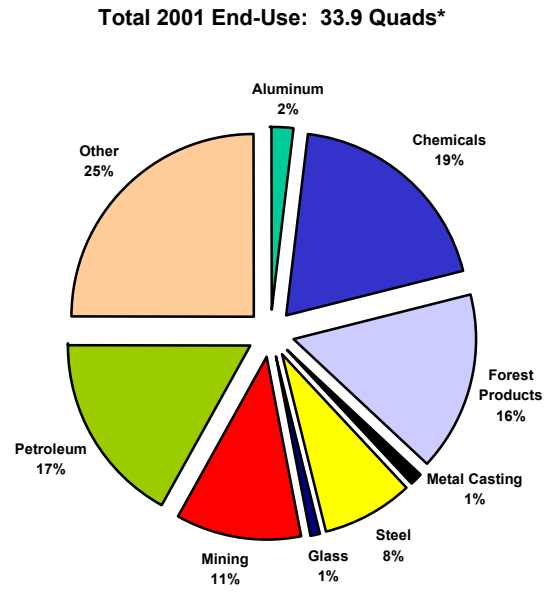
The National Energy Policy (NEP)[a] recognizes that reduced energy intensity in American industries can result in improvements in industrial productivity, product quality, safety, and pollution prevention. The NEP stresses the importance of "modernizing conservation." In addition, the NEP recommends funding "...those research and development programs that are performance-based and are modeled as public-private partnerships." Industry is aware of this need for performance-based measurements and actively participates in the tracking of performance and program results. To ensure that the public interests are upheld, R&D criteria are used during project and portfolio reviews and in the solicitation process.

Industry accounts for approximately 35 percent of all U.S. energy use. As shown in Figure 1, eight industries account for about three-quarters of U.S. industrial energy use. These industries (aluminum, chemicals, forest products, glass, metal casting, mining, petroleum, and steel) produce more than $1 trillion in goods and services annually, and employ more than three million people. According to data from the Bureau of Labor Statistics these industries generate four additional jobs in the economy for each job. Collectively, these industries provide most of the basic materials needed for the buildings, transportation, utilities, communications, and manufacturing sectors of the economy.

[a] See National Energy Policy report of the National Energy Policy Development Group (May 2001). p. 4-12. "The priority would be to improve the energy intensity of the U.S. economy as measured by the amount of energy required for each dollar of economic productivity. This increased efficiency should be pursued through the combined efforts of industry, consumers, and Federal, State, and local governments.

While acknowledging the benefits of improved energy intensity, U.S. industries seeking to implement new technologies contend with several factors that may contribute to a less than optimal investment in energy saving technologies. These factors include:

- Slow market growth
- Narrow profit margins
- High investment requirements
- Increasing competition from foreign firms
- Volatile energy prices (e.g. average industrial energy prices fluctuated up to 85 percent in 2000-2001)
- Uncertain energy supply markets
- Uncertain environmental regulations



As a result of these and other factors, America's most energy-intensive industries typically invest in research, development & deployment (RD&D) at a much lower rate than the manufacturing sector as a whole.[a] Nevertheless, other activities in the EERE portfolio better align with the Administration's R&D criteria, particularly the criterion concerning market failures that cause under-investment by the private sector. The FY2004 Budget reflects this assessment.

Management Strategy

U.S. industries possess vast technical and financial resources to accomplish business objectives but little incentive to accomplish public objectives. To accomplish the public objectives of energy security, environmental protection, and energy efficiency, the Industrial Technologies Program has developed an effective strategy to engage industries in collaborative partnerships to address national problems that neither government nor industry is capable of addressing effectively alone. This strategy involves the joint development by industry and government of national "visions of the future," and "technology roadmaps." The strategy enables the industry to identify its technology needs for the future, within which the Federal Government can define a subset for government participation. The Industrial Technologies Program has implemented highly successful vision and roadmap processes with numerous energy-intensive industries in the U.S. economy.

As a result of this strategy, the Industrial Technologies Program has been able to target its investments effectively on pre-competitive and high-risk RD&D projects that improve industrial energy intensity. The program has employed strong RD&D partnerships to accomplish these results and thus has achieved substantial cost sharing, leveraged information dissemination, and used collaborative decision making. Industry has typically contributed a fifty- percent cost share over the life of joint projects.

[a] See National Science Foundation, Research and Development in Industry: 2000. To be published on the NSF website at http://www.nsf.gov/sbe/srs/indus/start.htm.

An element of the industrial public-private partnership proposed for FY 2004 will be the encouragement of voluntary efforts by industry. This includes working with regional organizations, State agencies, and other stakeholders to develop localized RD&D partnerships that extend Industrial Technologies Program activities. This evolution of the industrial strategy will enable program activities to address local, as well as, national needs and account for local variations in environmental profiles, natural resource mixes, and industrial bases. This will enable the program to; 1) strengthen partnerships at the regional, State, and local levels; 2) extend the impacts of technology investments; 3) identify additional sources of cost sharing; 4) increase overall energy, economic, and environmental benefits; 5) coordinate State and national activities, and 6) expand participation to smaller companies, local government agencies, and local stakeholder groups.

An important aspect of the program strategy involves facilitating access to the wealth of expertise available at America's universities and the national laboratories. An important use of the industry visions and technology roadmaps is to guide universities and national laboratories in developing a stronger understanding of industrial technology needs. Another benefit of the program is to open channels for more effective communication and collaboration between these institutions and U.S. industry.

The program will continue to work with industry trade organizations and individual companies to reduce energy intensity including the use of DOE-developed new computer tools such as Motor Master +, Pump System Assessment Tool, Air Master, Adjustable Speed Drive Master, Fan Assessment Tool, Steam Scoping Tool, Steam System Assessment Tool, Process Heating Assessment Tool, and the NOx Tool. These tools are all available as part of the industry program's partnership with energy intensive industries and most of these tools can be downloaded free from the Internet at: www.oit.doe.gov/bestpractices

Current work will continue with industries including iron and steel, chemicals, forest and paper products, where partnerships have been formed to support voluntary industry actions to reduce energy intensity and indirectly help industry to reduce greenhouse gas emissions.

To implement the program strategy, the Industrial Technologies Program is organized as follows:

Industries of the Future (Specific)
- Forest and Paper Products Vision
- Steel Vision
- Aluminum Vision
- Metal Casting Vision
- Glass Vision
- Chemicals Vision
- Mining Vision
- Supporting Industries (e.g., Metal Powders, Heat Treating, Forging, and Welding)

Industries of the Future (Crosscutting)

- Industrial Materials of the Future
- High Efficiency Combustion System
- Sensors and Controls Technologies
- Industrial Technical Assistance (i.e. Best Practices and the Industrial Assessment Centers)

Prospective and retrospective peer reviews have been used to evaluate project performance and to adjust support. To verify program performance and results, all technologies commercialized (and the extent of their use) by industry are tracked.

In 2002, the Industrial Technologies Program directly contributed to industrial energy savings of over 265 trillion Btu — savings worth over $1.3 billion.[a,b] By 2001, the program helped develop more than 160 commercialized industrial technologies. Cumulative tracked energy savings from 1990 to 2002 are estimated to be over 2,650 trillion Btu as shown in Figure 2.[c]

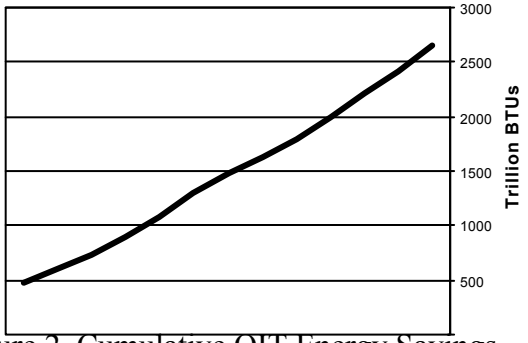


Figure 2. Cumulative OIT Energy Savings

These technology successes are the result of the "industry pull" designed into the Industries of the Future strategy. The Industrial Technologies Program currently supports over 400 RD&D projects involving over 2,000 partners. Partners include small, medium, and large companies, national laboratories, universities, states, and non-governmental organizations. By concentrating on vital, high-risk RD&D in pre-competitive areas, these diverse partners are collaborating effectively to surmount long-standing technology hurdles and accelerate the pace of technology development. Project turnover has averaged over 50 percent annually since FY98.[d] Program activities will focus on the refinement and use of industry visions and technology roadmaps to guide voluntary industry efforts to achieve

[a] Constant 2000 dollar values for energy savings shown in this budget are based upon Energy Information Administration data for 2000 as well as preliminary estimates for 2001 and 2002. Average industrial energy prices per million Btu were $5.14 in 2000; $ 4.66 in 2001 and a forecast of $4.14 in 2002.

[b] Energy savings numbers are based on the Industrial Technologies Program FY2003 GPRA support analysis on program impacts by PNNL and include savings from program activities transferred to the Biomass and Weatherization and Intergovernmental Programs.

[c] Cumulative savings includes the results of previously commercialized technologies and other programs. The graphic includes programs (e.g. Invention and Innovation) which were transferred to other EERE programs in FY 2002. Energy savings would continue to accrue even at zero budgets but at a decreasing rate and then would flatten out as savings from older activities are phased out. These savings are in addition to business as usual improvements which industry undertakes to reduce its energy costs.

[d] The measure shows the number of new R&D projects that have been started through competitive solicitation process in a fiscal year as well as the number of projects that have been stopped, including RD&D projects that have been terminated prematurely due to the failure of technology, the withdrawal of project partners, or the recommendation of industry advisors. This number may contain efforts that build up previous work on a technology the work enters a new phase.

significant energy savings, and improve yield and resource conservation, as well as to enhance economic vitality.

Program Benefits

Each year, EERE estimates the benefits of program activities to support Government Performance and Results Act (GPRA) reporting. Methods are complex and vary by program. A complete explanation of methodology and assumptions will be posted this spring on line at www.eren.doe.gov/eere/budget.html. An overview of the methods and results for the Industry Technology Program is provided below.

EERE's benefits estimate modeling starts with the Energy Information Administration's (EIA's) National Energy Modeling System (NEMS) and modifies it to create NEMS-GPRA04. The Baseline for industry programs is essentially the EIA's Annual Energy Outlook (AEO) 2002 reference case, which already includes some penetration of industrial efficiency technologies. The Program goals for industrial technology improvements are modeled by incorporating the resulting changes in industrial energy intensity in the NEMS-GPRA04 for the program case.

Because program projects address technologies, products, and processes covering a wide array of industries, resulting benefits cannot be fully assessed on a technology-by-technology basis within an integrating model such as NEMS-GPRA04. Instead, detailed assessments of potential technology improvement, market applications, and market penetration provide the basis for adjusting baseline assumptions about expected technology improvements. Program research goals improve industrial energy intensity by introducing new, more efficient (or less energy intensive) technologies and processes to the market. Deployment efforts, such as Best Practices and Industrial Assessment Centers (IAC) reduce industrial energy intensity by increasing the rate of adoption of more energy efficient technologies, processes and practices. To help improve consistency with the way technologies are represented directly in NEMS, these bottom-up program estimates are reduced by 30 percent before being incorporated into NEMS-GPRA04, as is done for estimates in other areas that cannot be fully modeled on an economic basis.

The industrial sector in the NEMS-GPRA04 integrating model consists of fifteen industry types, six non-manufacturing and nine manufacturing sectors. The manufacturing industries are modeled through a detailed process-flow or end use accounting structure. Each industry consists of three related and interacting modeling components, process/assembly, buildings, and boiler/steam/cogeneration. The models representation of technological process for each energy source for each process step in each industry and in each region begins with a Technology Progress Curve (TPC). This curve relates the amount of energy consumed per unit of output for the process over time and is sensitive to energy prices. The benefits estimates are calculated in the model by changing the TPCs over time based on the offline estimates related to saving estimates by fuel type and are used to create target energy consumption levels. The TPCs in the model for both new and existing technologies in the process/assembly component are adjusted to approximate the target delivered energy use for each of the six energy sources within the industrial model alone. The fully integrated NEMS-GPRA04 is then run

to compute the GPRA benefits metrics of primary energy savings, carbon emission reductions, and energy expenditure savings that are associated with the fuel consumption reductions.[a]

FY 2004 GPRA Benefits Estimates for Industry Technology Program (NEMS-GPRA04)			
	2005	2010	2020
Electricity Displaced Capacity (GW)	0.0	0.0	9.5
Non-Renewable Energy Savings (quads)	0.18	0.56	2.13
Oil Savings (quads)	0.05	0.13	0.46
Carbon Savings (MMT)	3.2	9.9	36.3
Energy Expenditure Savings (B2000$)	1.7	4.4	20.2

Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2004 on, and are based on program goals developed in response to the FY 2004-2008 budget guidance. Any program costs for years beyond FY 2008 needed to complete program goals are assumed to remain level in real dollars.

The benefits shown do not include productivity improvements of the modeled investments. In addition, these benefits estimates do not include the program's contribution in assisting industry in their voluntary efforts to meet climate change targets.

Estimates for reductions in needed new electricity generating capacity, energy savings, oil savings, carbon emission reductions, and energy expenditure savings resultant from realization of Industrial Technology Program goals are shown in the table above through 2020. The combination of a program focus on those industrial processes with the largest potential savings, as well as partnership opportunities, results in relatively rapid realization of energy savings, with annual savings reaching more than 2 quads by 2020. Although the industrial sector is not the primary user of oil in the United States, these technology improvements save the Nation 0.5 mmbd of oil by 2020, a significant near and mid-term contribution at the margin to dampening U.S. demand for foreign oil. Similarly, a combination of improvements to the efficiency of electric equipment (e.g., motor systems) can avoid the need for about 9.5 GW of new electricity generating capacity, the equivalent of not having to build 19 mid-sized (500 MW) power plants. Although the energy saving and carbon savings from this program are realized relatively early on as industrial plants implement best practices and new technologies to reduce energy costs and improve their profits, the benefits often persist for decades, given the long life of boilers and other energy-using industrial equipment.

[a] Benefits areannual, not cumulative, for the year given for the entire program (Interior and EWD portions). Estimates reflect the benefits associated with program activities from FY 2004 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

In addition to these quantified benefits, this program helps improve industrial productivity and reduce the costs of industry compliance with State, Federal, and local environmental requirements; helps improve local air quality (often significantly where local industry is a primary component of the economy); and helps improve the economic competitiveness of some of America's basic commodities industries. These are important sources of near and mid-term environmental and security benefits.

Program Specific Performance Goals

Between 1991 and 2010, contribute to a 20-25 percent decrease in energy intensity (Btu per unit of industrial output as compared to 1991) by the energy-intensive Industries of the Future (a potential savings of 3.6-4.5 quads); by 2020, contribute to a 30-35 percent decrease in energy intensity from 1991 (a potential savings of 6.3-7.4 quads); between 2000 and 2010, commercialize over 10 industrial energy-efficiency technologies through RD&D partnerships.

Annual Performance Results and Targets
Industrial Technologies Program

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Commercialized 10 new energy efficiency technologies in partnership with the most energy- intensive industries.	In FY 2003, commercialize 4 new technologies in partnership with the most energy-intensive industries.	Commercialize 4 new technologies in partnership with the most energy-intensive industries.
In FY 2002, helped industry save more than 265 trillion Btu of energy worth more than $1.3 billion.	In FY 2003, help industry save more than 180 trillion Btu of energy worth at least $750 million.	Help industry save more than 220 trillion Btu of energy worth at least $900 million.
	In FY 2003, turn over 25 percent of projects in the RD&D portfolio.	6800 energy intensive U.S. plants will apply EERE technologies and services achieving up to a 15 percent improvement in energy productivity per plant.
	FY 2003 Milestone: 6200 energy-intensive U.S. plants will apply EERE technologies and services achieving up to a 15 percent improvement in energy productivity per plant.	

By 2010, partner industries are expected to reduce their energy use by 2.4 quads through business-as-usual efficiency improvements (EIA projection of 0.75 percent annually). Concurrently, activities sponsored by the Industrial Technologies program aim to help these industries lower energy use by up to an additional 0.8 quads. See Figure 3.

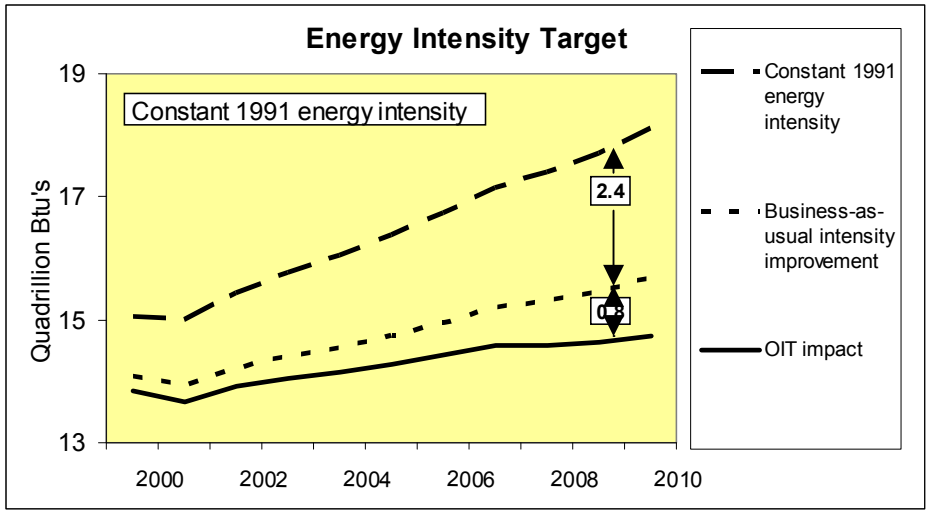


Figure 3: Energy Intensity Target

These PSPGs are supported by both Industry (Specific) and Industry (Crosscutting) activities. The Industry (Specific) and Industry (Crosscutting) goals are as follows:

- **Forest and Paper Products Goals and Objectives**
  By 2010, in partnership with industry, assist efforts to implement advanced water removal technologies in papermaking resulting, in an energy efficiency improvement of 10 percent in paper production compared to conventional industry practices.

- **Steel Goals and Objectives**
  By 2010, in partnership with industry, assist efforts to develop a commercially ready technology that will eliminate the use of energy intensive coke as a feedstock in the steelmaking process.

- **Aluminum Goals and Objectives**
  By 2010, in partnership with industry, assist efforts to develop with the aluminum industry advanced technologies, including carbothermic aluminum reduction, and inert anodes and wettable cathodes, that would result in significant net energy savings in primary aluminum production, and, in some cases, the elimination of greenhouse gas emissions from primary aluminum production.

- **Metal Casting Goals and Objectives**
  In partnership with industry, assist efforts to enable major technical advances in the metal casting industry to implement new design techniques and practices, to increase yield and reduce scrap and energy use.

- **Glass Goals and Objectives**
  In partnership with industry, assist efforts to develop advanced glass technologies that will reduce the gap between actual melting energy use (more than 11 million Btu to melt a ton of glass as measured in 1996) and the theoretical minimum (2.5 million Btu per ton) by 50 percent by 2020.

- **Chemicals Goals and Objectives**
  In partnership with industry, assist efforts to develop separation and new process chemistry technologies that will increase energy efficiency by up to 30 percent by 2020, compared to conventional 1998 technologies.

- **Mining Goals and Objectives**
  By 2010, in partnership with industry, assist efforts to develop mining technologies that can reduce the energy intensity required to crush a short ton of rock by 20-30 percent from its 1998 baseline.

- **Supporting Industries Goals and Objectives**
  By 2010, in partnership with industry, assist efforts to significantly reduce the energy intensity of material forming and finishing processes.

  In partnership with industry, assist efforts to reduce energy consumption in carburizing processes, in heat treatment of castings, and in welding processes and in aluminum alloy forging processes.

- **Industrial Materials of the Future (IMF) Goals and Objectives**
  In partnership with industry, develop 20 new materials for potential commercial adoption by 2010. Conduct R&D to develop, with industry, technologies for potential commercial adoption by 2010, consistent with needs identified in the IOF visions and technology roadmaps.

- **Combustion Goals and Objectives**
  By 2006, demonstrate a >95 percent efficient packaged boiler with NOx emissions below 5 ppm.

  By 2010, packaged boilers will be commercially available with thermal efficiencies 10-12 percent higher than conventional technology and with NOx emissions approximately half of that generally available in 2000 models.

- **Sensors and Controls Goals and Objectives**
  By 2010, in partnership with industry, develop technology necessary for the aluminum industry to move from batch production to a continuous process using new sensor systems, starting with a demonstration of the technology in the aluminum industry in 2003.

- **Industrial Technical Assistance Goals and Objectives**
  By 2010, the Industrial Assessment Centers will have completed over 13,500 Industrial Assessment Audits and trained over 2,300 engineering students.

By 2010, provide technical assistance to over 10,000 plants to save over 600 trillion Btu of energy by deploying a portfolio of assessments, tools, training, and operational practices.

Performance Indicators

Number of technologies commercialized. Energy savings from Industrial Program activities in partnership with industry. Number of new Allied Partners. Number of energy-intensive plants impacted by the program. Number of internet information page views

Significant Program Shifts

During FY 2004, R&D activities with specific industries (forest products, glass, metal casting, steel and aluminum, mining and chemicals) will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.

Funding Profile

(dollars in thousands)

	FY 2002 Comparable Appropriation	FY 2003 Amended	FY 2004 Request	$ Change	% Change
Industrial Technologies Program					
Industries of the Future (Specific) Operating Expenses	61,809	52,285	24,037	-28,248	-54.0%
Industries of the Future (Crosscutting) Operating Expenses	33,571	34,401	34,401	0	0.0%
Energy Efficiency Science Initiative Operating Expenses	1,959 [a]	0	0	0	NA
Technical Program Management Support	3,570	4,791	5,991	+1,200	+25.0%
Total, Industrial Technologies Program[b]	100,909	91,477	64,429	-27,048	-29.6%

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act of 1978"
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplants 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. 102-486, "Energy Policy Act of 1992"

[a] Reflects FY 2002, P.L.107-63 direction that half ($2,000,000) be made available to the DOE Fossil Energy Research and Development account. SBIR/STTR transferred $41,000 to this program.

[b] SBIR/STTR funding in the amount of $2,583,000 was transferred to the Science appropriation in FY 2002. Estimates for SBIR/STTR budgeted in FY 2003 and FY 2004 are $2,457,051 and $1,671,024 respectively.

Funding by Site[a]

(dollars in thousands)

	FY 2002[b]	FY 2003	FY 2004	$ Change	% Change
Albuquerque Operations Office					
Sandia National Lab	2,629	2,575	1,462	-1,113	-43.2%
Los Alamos National Lab	1,552	1,542	1,074	-468	-30.4%
National Renewable Energy Lab	1,698	1,705	1,362	-343	-20.1%
Total, Albuquerque Operations Office	5,879	5,822	3,898	-1,924	-33.0%
Chicago Operations Office					
Argonne National Lab (East)	2,080	2,019	981	-1,038	-51.4%
Total, Chicago Operations Office	2,080	2,019	981	-1,038	-51.4%
Idaho Operations Office					
Idaho National Engineering and Energy Lab	912	896	523	-373	-41.6%
Total, Idaho Operations Office	912	896	523	-373	-41.6%
Oakland Operations Office					
Lawrence Berkeley National Lab (NNSA)	633	613	282	-331	-54.0%
Lawrence Berkeley National Lab	889	913	913	0	0.0%
Lawrence Livermore National Lab	358	346	159	-187	-54.0%
Total, Oakland Operations Office	1,880	1,872	1,354	-518	-27.7%
Oak Ridge Operations Office					
Oak Ridge National Laboratory	12,902	13,016	10,929	-2,087	-16.0%
Total, Oakland Operations Office	12,902	13,016	10,929	-2,087	-16.0%
Richland Operations Office					
Pacific Northwest National Lab	1,246	1,224	736	-488	-39.9%
Total, Oakland Operations Office	1,246	1,224	736	-488	-39.9%
Washington Headquarters	76,010	66,628	46,008	-20,620	-30.9%
Total, Industries of the Future	100,909	91,477	64,429	-27,048	-29.6%

[a] "On December 20, 2002, the National Nuclear Security Administration (NNSA) disestablished the Albuquerque, Oakland, and Nevada Operations Offices, renamed existing area offices as site offices, established a new Nevada Site Office, and established a single NNSA Service Center to be located in Albuquerque. Other aspects of the NNSA organizational changes will be phased in and consolidation of the Service Center in Albuquerque will be completed by September 30, 2004. For budget display purposes, DOE is displaying non-NNSA budgets by site in the traditional pre-NNSA organizational format."

[b] These dollars reflect an estimated distribution of Industrial technologies funds based upon the results of competitive solicitations. They are not requested funds for individual laboratories.

Site Description

Sandia National Laboratories

Sandia's unique capabilities have been applied to the Chemical industry R&D activities. These capabilities include research on prototype chemical reactors, research on molecular properties using Sandia's unique computational capabilities, research on industrial separations membranes, and the development of an experimental fluid flow system used to measure properties of chemical reacting flows in greater detail than had previously been achieved. This experimental fluid flow research activity was carried in cooperation with LANL, the PNNL, four U.S. universities, and eight U.S. petroleum and chemical companies.

Los Alamos National Laboratory

Los Alamos National Laboratory (LANL) supports program work for the Chemical industry R&D area. The laboratory provides unique capabilities in theoretical scientific analysis modeling fluid flows and understanding chemical reactions and catalysis phenomena. LANL provided the computer analysis of industrial fluid flows, and the computer technology prepared for use by the civilian sector. LANL also supports the Industrial Materials of the Future activities in the development of new materials for membrane separation systems.

National Renewable Energy Laboratory

The National Renewable Energy Laboratory (NREL) supports the Best Practices program in communication activities and products. NREL supports overall Industry program analysis of the logic of individual program activities including the relationship between program goals, milestones and the budget formulation process for several areas including Industrial Materials of the Future, Aluminum and Metal Casting.

Argonne National Laboratory

Argonne National Laboratory (ANL) performs research and development for the Chemical industry R&D area. Argonne provides unique expertise in advanced separations process technologies and new innovative membrane systems. The laboratory also does research on refractory materials for the steel industry. The laboratory also has unique expertise in anode and cathode development for the aluminum industry using technology to analyze the surface effects conditions on the advanced candidate materials.

Idaho National Energy Laboratory (INEL)

For the Forest Products Industry provides critical support in project management and analysis as well as Computational Fluid Dynamics (CFD) modeling of an advanced black liquor spray atomization process. For the Steel Industry Vision provides technology support in the development of controlled thermal-mechanical processing (CTMP) of tubes and pipes for enhanced manufacturing performance and in the development and application of laser-assisted arc welding to steel.

Lawrence Berkeley National Laboratory

The Lawrence Berkeley National Laboratory (LBNL) supports technology delivery activities of the Best Practices program including assistance in facilitating Allied Partners with supplier industry organizations (e.g. Hydraulic Institute, Compressed Air and Gas Institute). The laboratory supports the tracking of Best Practices implementation results including the impact of training, software tools and other program delivery mechanisms on manufacturing plants.

Lawrence Livermore National Laboratory (LLNL)

Lawrence Livermore National Laboratory provides technology support to the Forest and Paper Products Vision in the development and testing of a Linescan camera system for imaging and measuring moisture content and in the development and testing of a guided acoustic wave monitoring to measure boiler corrosion to reduce boiler downtime and improve operating efficiency.

Oak Ridge National Laboratory

In support of the Best Practices effort, Oak Ridge National Laboratory (ORNL) provides support to the Plant-Wide Assessments and technical assistance and also the tracking of program impacts. They also help in the development and delivery of software tools and training. ORNL is the primary laboratory supporting the Industrial Materials of the Future activities to develop advanced materials for industrial use that meet technical requirements that have been identified in industry visions and technology roadmaps. ORNL's defense computational capabilities were applied in conjunction of the National Renewable Energy Laboratory in the analysis of high-temperature fluid flows.

Pacific Northwest National Laboratory

In support of the Industries of the Future (Specific) and (Crosscutting) activities Pacific Northwest National Laboratory provides key support to track past program impacts including the over 150 commercial technologies, and their energy and environmental impacts. Other efforts include the evaluation of emerging technologies. The laboratory produces an Impacts report summarizing commercial and emerging technologies and past program results and methodologies. The laboratory also performs support to Mining, Aluminum, Sensors and Controls, Glass, Industrial Materials of the Future and Forest Products.

Subprogram Industries of the Future (Specific)

Mission Supporting Goals and Measures

The **Industries of the Future (Specific)** has supported cost-shared research, development, and deployment (RD&D) of advanced technologies to improve the energy intensity and environmental performance of America's energy-intensive and waste-intensive industries. To provide the best value and optimum use of public investments, this activity focuses on a few basic materials processing industries that can achieve the highest returns on Federal investments.

The RD&D projects have focused solely on technologies that will bring broad energy efficiency benefits within the partner industries and could not be developed by individual companies acting alone. By managing an integrated portfolio, the program can identify and transfer some of the advanced technologies developed for one energy-intensive industry to applications in other industries. The effort is further leveraged through partnerships among State agencies, industry associations, and regional agencies to broaden the reach of national technology investments and enhance State economic development. During FY 2004, R&D activities with specific industries (forest products, glass, metal casting, steel and aluminum, mining and chemicals) will focus on bringing existing projects to successful commercialization and the program will evaluate opportunities for greater performance in FY 2005. The program will also continue the crosscutting activities and assist industry to improve their energy efficiency and environmental performance.

Annual Performance Results and Targets
Industries of the Future (Specific) Forest and Paper Products Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Commercialized the methane de-NO_x reburning process for wastewood, sludge, and biomass-fired stoker boilers. Demonstrated the use of low temperature plasma technology to control volatile organic compound emissions from an oriented strandboard plant.	Install prototype multiport cylinder dryers into existing full-scale dryers. Evaluate the use of high speed microwave treatment for rapid wood kiln-drying in a commercial scale kiln. Demonstrate a suite of sensors in a wood drying kiln with wireless data transmission. Design and test full-scale, advanced black liquor nozzles in industrial applications.	Continue those activities with the highest long-term national energy savings potential, such as: -Develop a new pressurized-air, energy efficient process for dewatering paper. -Demonstrate a solid waste recovery technology. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Annual Performance Results and Targets
Industries of the Future (Specific) Steel Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Commercialized hot strip mill model to improve the predictability of steel product quality, production yield, and energy efficiency. Commercialized laser contouring sensor to enable optimized operation of steel making furnaces and reduce remelt and energy consumption. Demonstrated an automated steel cleanliness tool using scanning electron technology. Commercialized oscillating combustion technology in steel manufacturing processes.	Expand the laser contouring sensor technology for ladle metallurgy and electric arc furnace market applications. Complete R&D for sustainable steel making using biomass and waste oxides. Complete evaluation of microwave de-oiling of steel mill waste sludges. Complete assessment of options for a revolutionary steel making process for the 21st century plant.	Continue those activities with the highest long term national energy savings potential such as Mesabi Nugget iron making pilot demonstration, steel industry highly variable load electric power grid impact study, and projects related to improved efficiency of electric arc furnaces. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Annual Performance Results and Targets
Industries of the Future (Specific) Aluminum Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Designed and constructed a 5,000 amp test cell for aluminum production, with an inert anode and wettable cathode and a novel cell design.	Demonstrate an intelligent pot-room control system at a commercial smelter. Demonstrate commercial viability of an improved potliner with extended lifetimes compared to the current industry standard. Determine the feasibility of carbothermic reduction technology to produce aluminum with 32-38 percent emissions reduction. Demonstrate a vertical flotation melter, with thermal efficiency 2.5 times that of a conventional furnace, at commercial scale on a plant floor.	Complete feasibility study for carbothermic reduction technology to produce aluminum that has a potential of 32-38 percent reduction in emissions related to energy consumption. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Annual Performance Results and Targets
Industries of the Future (Specific) Metal Castings Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Revised the Metal Casting Industry Vision to reflect new trends and challenges that the industry will need to address to achieve their 2020 vision goals.	Develop new Rapid Solidification Process (RSP) tooling technique that will enable metal casters to reduce lead time, improve quality of casting, and save energy.	Develop design rules based on real-time radiography for lost foam casting and the development of a computational fluid dynamics (CFD) designer software tool for the lost foam pattern production.

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Developed new design rules for high alloy steel capable of increasing yields and reducing scrap by 30 percent compared to conventional industry practice.	Develop a new multi-layer system guideline that will be available to the die casting industry. Develop radiographic standards for steel casting that will enable a 30 percent reduction in scrap compared to conventional industry practice. Complete development (for commercial application) of a new Computational Fluid Dynamics (CFD) Design Software tool for use in advanced lost foam pattern production.	Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Annual Performance Results and Targets
Industries of the Future (Specific) Glass Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Terminated installation of electrostatic cullet and batch preheating technology at a glass production facility. Demonstrated high-luminosity, low NO_x burner technology. Demonstrated sensors for monitoring glass coating process at a glass production facility. Demonstrated laser-based cutting and finishing of hand-blown glass.	Complete process development for recycling in-house fiberglass waste. Validate advanced glass furnace model and hold a technology transfer workshop. Develop a laser-induced breakdown spectroscopy (LIBS) on-line sensor for improving production efficiency.	Complete testing of sensor based technology which will result in an emission control technique that will extend furnace life by an average of 10 percent. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Annual Performance Results and Targets
Industries of the Future (Specific) Chemicals Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Began implementation of the pressure swing absorption for product recovery technology in chemical plants. Completed pilot test of membrane for olefin recovery technology.	Complete multi-phase computational fluid dynamics consortium projects. Projects participants currently include AEA Technology, Chevron, Dow Chemical, Dow Corning, DuPont, EXXON, Fluent, Millenium Inorganic Chemicals, several national laboratories, and several universities. Complete R&D and pilot test of advanced alloys for ethylene production.	Complete development off 3-D Mill Soft software for commercial application which has a potential for a 30 percent reduction in milling energy use. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support. Complete technology transfer of new metal alloy tubes for ethylene manufacturers. Complete a pilot scale test of dimpled tubes for use in chemical process heat exchangers.

Annual Performance Results and Targets
Industries of the Future (Specific) Mining Vision

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Transferred the following successful technologies to the private sector for commercialization: • Three-Dimensional Simulation of Charge Motion in Semi-autogeneous grinding (SAG) and Ball Mills to reduce energy intensity • Dense-medium cyclone optimization • Novel rewatering aids for mineral and coal fines.	Complete high-temperature superconductors for underground communication project to provide wireless underground communication, improve productivity and safety. Continue development of advanced power and control systems for fuel cell mining vehicles suitable for mining conditions in order to improve underground air quality and reduce energy use.	Complete development off 3-D Mill Soft software for commercial application which has a potential for a 30 percent reduction in milling energy use. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Applied selective flocculation of fine mineral particles to many mining operations.	Complete development of horizon sensing technology to guide mining equipment and detect change in material to prevent the extraction of waste materials. Develop fibrous monolithic composite as wear-resistant components to reduce downtime and energy use.	

Annual Performance Results and Targets
Industries of the Future (Specific) Supporting Industries

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
The Metal Powder Industries Federation agreed to become an Allied Partner.	Complete matrices of coincident research needs: • between supporting industries (SI-SI) • between SI and IOFs (SI-IOF) • between the SI-SI matrix and the SI-IOF matrix. Complete an energy and environmental metrics study of supporting industries including assessment of the strategic implementation of its results	Continue existing projects with the highest potential future energy efficiency and environmental benefits. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support.

Funding Schedule[a]

(dollars in thousands)

	FY 2002 Comparable Appropriation	FY 2003 Amended Request	FY2004 Request	$ Change	% Change
Industries of the Future (Specific)					
Forest and Paper Products Vision	10,511	8,747	4,021	-4,726	-54.0%
Steel Vision	10,119	7,329	3,369	-3,960	-54.0%
Aluminum Vision	7,948	7,103	3,265	-3,838	-54.0%
Metal Casting Vision	5,247	4,357	2,003	-2,354	-54.0%
Glass Vision	4,502	3,572	1,642	-1,930	-54.0%
Chemicals Vision	14,158	14,458	6,648	-7,810	-54.0%
Petroleum Vision	2,740	0	0	0	0.0%
Mining Vision	5,014	5,119	2,353	-2,766	-54.0%
Supporting Industries	1,570	1,600	736	-864	-54.0%
Total, Industries of the Future (Specific)	61,809	52,285	24,037	-28,248	-54.0%

[a] Industries of the Future (Specific) includes $1,440,000 in FY 2002, and $1,340,000 in FY 2003 for the State Energy Program Special Projects State Grants. In FY 2004, the State Energy Program Special Projects State Grants request has been moved to the Weatherization and Intergovernmental Program. In FY 2004, the Agriculture Vision and biomass gasification element of the Forest and Paper Products vision requests have been moved to the Biomass Program.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Industries of The Future (Specific)	**61,809**	**52,285**	**24,037**
▪ **Forest and Paper Products Vision**	**10,511**	**8,747**	**4,021**

FY 2002: Energy Performance: Approximately 15 projects were funded focusing on industrial energy efficiency and low-level heat recovery. Technical feasibility studies were also conducted which included: the development of an innovative energy-efficient paper drying technology and an assessment of deposit formation in recovery boiler convection passes.

Environmental Performance: Approximately 15 projects were funded focusing on developing advanced pollution prevention technologies, reducing pollution abatement costs, and ensuring that manufacturing facilities are acceptable to industry workers and local communities. Several technical feasibility studies were completed including the use of paper mill by-products as an economical source of fiber reinforcement for ready-mixed concrete production, the optimization of oxygen bubble size for oxygen bleaching, and the development of a control strategy to reduce the emissions from wood dust burners and wood dryers. SBIR/STTR funding in the amount of $245,000 was transferred from this subprogram to the Science Appropriation.

Improved Capital Effectiveness: Approximately 12 projects were funded focusing on systems and process efficiency, and fabrication. Feasibility studies were undertaken to understand the formation of soluble scale fouling in concentrators and evaporators; evaluate energy efficient corrugating technologies; and explore the use of natural gas rather than steam in paper drying

Recycling: Approximately 10 projects were funded to reduce energy use and fiber deterioration in recycling, improve separation technologies, and expand the use of recycled fibers. Progress continued on the development of: pressure sensitive adhesives strong enough to remain intact through the pulping process and removable prior to paper making, and an automated, efficient, fast, autonomous waste paper sorting system. A technology to induce frothing from the top of a flotation deinking cell reducing the energy requirements for deinking was demonstrated.

Sensors and Controls: Approximately 12 projects including development of actuators and control devices, process and product measurement and modeling, and data interpretation. Specifically, an acoustic wave monitor for on-line measurement of the amount of corrosion and erosion in recovery boiler tubing was developed as well as a model to diagnose and optimize control of continuous kraft pulp digesters.

Sustainable Forestry: Approximately 6 projects were funded focusing on biotechnology, tree physiology, and sustainable soil productivity. Feasibility studies were completed that evaluate

techniques to improve the uniformity of fibers from loblolly pine with increased stem growth, and the use of molecular breeding to achieve desirable traits in juvenile loblolly pine.

Participants include: The American Forest and Paper Association and their member companies, National Laboratories, the Institute of Paper Science and Technology, Pulp and Paper Education and Research Alliance members and partners, and others.

FY 2003: Energy Performance: Approximately 12 projects will focus on industrial energy efficiency and low-level heat recovery. Two technical feasibility studies will be completed: the development of an innovative energy-efficient paper drying technology and an assessment of deposit formation in recovery boiler convection passes.

Environmental Performance: Approximately 7 projects, including the use of low temperature plasma technologies for elimination of volatile organic compound emissions in the forest products industry will be demonstrated at a mill.

Improved Capital Effectiveness: Approximately 10 projects including feasibility studies to: evaluate the use of borate autocausticizing in the recovery furnace eliminating the energy-intensive lime kiln causiticizing; and to evaluate the use of wood drying hydrocarbon emissions as an auxiliary fuel for wood drying.

Recycling: Approximately 7 projects including optimizing paper making drying processes to eliminate the irreversible loss in the ability of fibers to bond together for a second time when the fibers are recycled.

Sensors and Controls: Approximately 5 projects including process and product measurement and modeling, and data interpretation. A wireless microwave-based moisture sensor will be prototyped in a lumber drying kiln to optimize wood drying.

Sustainable Forestry: Approximately 8 projects will be funded including the development of process models to predict the effect of forest management on growth and productivity of managed forest and understand the effects of intensive forest management.

Participants include: The American Forest and Paper Association and their member companies, National Laboratories, the Institute of Paper Science and Technology, Pulp and Paper Education and Research Alliance members and partners, and others.

FY 2004: Support voluntary efforts by the American Forest & Paper Association and other industry organizations to improve their energy efficiency and environmental performance through the industry's Agenda 2020. The collaborative activities will include cost-shared R&D

as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Continue those activities with the highest long-term national energy savings potential, such as: Develop a new pressurized-air, energy efficient process for dewatering paper. Demonstrate a solid waste recovery technology. Select new projects that help improve energy efficiency and environmental performance that industry would not undertake without Federal support. Participants include: The American Forest and Paper Association and their member companies, National Laboratories, the Institute of Paper Science and Technology, Pulp and Paper Education and Research Alliance members and partners, and others.

- **Steel Vision 10,119 7,329 3,369**

FY 2002: Production Efficiency: Designed and constructed pilot plant model demonstrating controlled thermo-mechanical processing for tubes and pipe. Demonstrated an automated steel cleanliness tool using scanning electron microscopy in a plant environment. Assessed role of strip casting, based on the structure and properties of strip cast material. SBIR/STTR funding in the amount of $210,000 was transferred from this subprogram to the Science Appropriation.

Recycling R&D: Identified technologies and practices to eliminate the risk of radioactive scrap entering the steel production cycle. Determined operating practices enhancing recycling of waste oxides in the steel making vessel.

Environmental Engineering: Completed long-term testing of an optical sensor for real-time measurement of gases in the EAF. Demonstrated low-NO_x, forced internal recirculating burner using by-product gases.

Revolutionary Technologies: Steel Cup Challenge: continued activities to develop a new steel conversion process based on prior year studies.

R&D participants include: American Iron and Steel Institute (member and associate member companies), Steel Manufacturers (member and associate member companies), national laboratories, and universities.

FY 2003: Production Efficiency: Continue development of controlled thermo-mechanical processing technology for tubes and pipe.

Recycling R&D: Complete R&D for recycling and re-use of basic oxygen furnace steel making slags through bench-scale testing.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Environmental Engineering: Complete R&D for sustainable steel making using biomass and waste oxides. Complete evaluation of microwave de-oiling of steel mill waste sludges.

Revolutionary Technologies: Select and initiate R&D on a revolutionary steel conversion process based on the results of the feasibility studies.

R&D participants include: American Iron and Steel Institute (member and associate member companies), Steel Manufacturers (member and associate member companies), national laboratories, and universities.

FY 2004: Continue those activities with the highest long term national energy savings potential such as Mesabi Nugget iron making pilot demonstration, steel industry highly variable load electric power grid impact study, and projects related to improved efficiency of electric arc furnaces. Support voluntary efforts by the American Iron and Steel Institute and the Steel Manufacturers Association and other industry organizations to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

R&D participants include: American Iron and Steel Institute (member and associate member companies), Steel Manufacturers Association (member and associate member companies), national laboratories, universities and other companies.

- **Aluminum Vision 7,948 7,103 3,265**

FY 2002: Primary Production Technologies: Continued preparations to demonstrate, in full-scale cell tests, commercial viability of potliners containing additives for improved performance and life. Developed control strategy using sensors for aluminum smelting cells and continued to prepare for scale up of advanced cell technologies. SBIR/STTR funding in the amount of $155,000 was transferred from this subprogram to the Science Appropriation.

Semi-Fabrication Technologies: Developed new process techniques to reduce oxidative losses in aluminum by 50 percent and stress cracking by 60 percent. Demonstrated dross reductions of 60 percent on an industrial reverberatory furnace by an advanced combustion system. Assessed spray rolling of aluminum strip at lab scale and 2X scale-up.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Over 80 different industrial, university, and laboratory partners participated in the partnership in 2002.

FY 2003: Primary Production Technologies: An intelligent pot-room control system will be demonstrated at a commercial smelter. An innovative design production cell, with an inert anode and wettable cathode, will be pilot tested at 5000 amps at a production facility.

The technical and economic viability of carbothermic reduction technology to produce aluminum with 32-38 percent reduction in emissions will be determined by laboratory-scale reactor tests.

Semi-Fabrication Technologies: A high watt density immersion heater will be demonstrated for energy efficient aluminum melting. A low dross combustion system will be demonstrated at pilot and commercial scale. Quenchant cooling will be modeled and improved for the plant floor. A vertical flotation melter will be demonstrated commercially.

Over 80 different industrial, university, and laboratory partners will participate in the partnership in 2003.

FY 2004: Complete feasibility study for carbothermic reduction technology to produce aluminum that has a potential of 32-38 percent reduction in emissions related to energy consumption.
Support voluntary efforts by the industry to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.
Over 80 different industrial, university, and laboratory partners will participate in the partnership in 2004 including Alcoa, Northwest Aluminum, Century Aluminum, Commonwealth Aluminum, and SECAT.

- **Metal Casting Vision..... 5,247 4,357 2,003**

FY 2002: Manufacturing Technologies: Developed new models and alloy properties for semisolid metal processing (SSM), new models, and pattern materials in lost foam research and Best Practices guidelines, minimized die distortion, reduced scrap rate, and improved productivity. SBIR/STTR funding in the amount of $110,000 was transferred from this subprogram to the Science Appropriation.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Materials Technologies: Completed materials research on the castability of aluminum die casting alloys, enabling new applications of advanced die casting alloys and developed new heat-treating guidelines to enable U.S. die casters to extend the life of die materials by 20-30 percent.

Environmental Technologies: Made available non-incineration technique as an alternative for ferrous foundries to reduce VOC emissions.

New Casting Applications: New design tools, improvements in casting techniques and models were developed to enable new applications of advanced casting technologies and reduce casting defects and improve quality of castings.

Program Participants**:** (in consortia) Ohio State University, University of Michigan, Case Western Reserve University, Pacific Northwest National Laboratory (PNNL), Oak Ridge National Laboratory (ORNL), Iowa State University, University of Alabama, Worcester Polytechnic Institute (WPI), University of Iowa. There were over 320 industry partners in 35 States providing cost shares to the research projects

FY 2003: Manufacturing Technologies: Research efforts include the development of new design rules and foundry practices for high alloy steel casting models to increase the yield and reduce scrap by 30 percent in steel casting. The research effort will also explore unconventional techniques to increase yields by an additional 10 percent.

Materials Technologies: Research efforts include the Semi-Solids Metals Processing (SSMP) at Worcester Polytechnic Institute (WPI). The goal of this project is to develop low-cost, energy-efficient, high quality SSM feedstock.

Demonstration of a multi-layer coating system to extend the die life of die casting dies will be completed.

Environmental Technologies: Complete the development of technical performance data and guidelines needed to advance the beneficial reuse of spent foundry sand. Information developed from the project will be disseminated widely for industry adoption through industry workshops, professional committees, and other media.

There are over 320 industry partners in 35 States providing cost shares to the research projects.

New Casting Applications: Projects include material characterization efforts to determine the detrimental effect of welding on the corrosion performance of duplex stainless steels, and a New Rapid Solidification Process (RSP) tooling technique for the die casting industry.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

FY 2004: Develop design rules based on real-time radiography for lost foam casting and the development of a computational fluid dynamics (CFD) designer software tool for the lost foam pattern production.

Support voluntary efforts by the Metal Casting industry and program participants to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

Metal Casting: Program participants include: Ohio State University, University of Michigan, Case Western Reserve University, Pacific Northwest National Laboratory (PNNL), Oak Ridge National Laboratory (ORNL), Iowa State University, University of Alabama, Worcester Polytechnic Institute (WPI), University of Iowa. There are over 320 industry partners in 35 States providing cost share to the research projects in the Program.

- **Glass Vision 4,502 3,572 1,642**

FY 2002: Production Efficiency: Performed modeling of refractory corrosion. Transferred hand-blown glass cutting technique to specialty glass industry. Developed feedstock measurement and control technology. Implemented national laboratory-based GPLUS projects (industry-responsive technology effort).

Energy Efficiency/Conservation: Validated a three-dimensional glass furnace simulation model. Conceptual design of oxy-fuel glass research facility was provided to the industry. Promoted and publicized best energy management practices for industry. SBIR/STTR funding in the amount of $70,000 was transferred from this subprogram to the Science Appropriation.

Environmental Protections and Recycling: Refined and transferred high-luminosity, low-NO_x burner technology for glass furnaces to industry. Developed technology to recover and recycle in-process fiberglass waste. Supported development of cullet re-use systems.

Innovative Uses: Continued development of new technology for improved coating of flat glass.

Deployment Logistics**:** Updated technology roadmap.

Participants include: (in consortia) Visteon, PPG, Techneglas, Owens Corning, Gallo Glass, Certain Teed, Fenton Art Glass, BOC Gases, Energy Research Company, Gas Technology

Institute, Alfred University-Center for Glass Research, Mississippi State University, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, Pacific Northwest National Laboratory, Argonne National Laboratory, Ames Laboratory, National Energy Technology Laboratory, and the States of West Virginia, Ohio, Pennsylvania, Florida, and North Carolina.

FY 2003: Production Efficiency: Complete refractory corrosion modeling efforts. Begin demonstration of feedstock measurement and control technology. Perform industry-initiated technology assessment and transfer using national laboratory-based GPLUS projects.

Energy Efficiency/Conservation: Improve three-dimensional glass furnace simulation model to more accurately represent the melting process. Investigate an innovative technology to improve heat recovery during glassmaking. Promote best energy management practices for industry.

Environmental Protections and Recycling: Produce recycled materials from in-process fiberglass waste for further testing. Design and test a prototype instrument to minimize volatilization mechanisms in glass melting furnaces. Begin testing of cullet re-use systems.

Innovative Uses: Conduct pilot-scale testing of improved technology for coating flat glass.

Deployment Logistics: Conduct technical workshops on cullet recycling and energy management. Reassess technology roadmap to refine priorities.

Participants include: Visteon, PPG, Techneglas, Owens Corning, Gallo Glass, Fenton Art Glass, CertainTeed, BOC Gases, Energy Research Company, Gas Technology Institute, Alfred University-Center for Glass Research, Mississippi State University, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, Pacific Northwest National Laboratory, Argonne National Laboratory, Ames Laboratory, and the States of West Virginia, Ohio, Pennsylvania, Florida, Indiana, and North Carolina.

FY 2004: Complete testing of sensor based technology which will result in an emission control technique that will extend furnace life by an average of 10 percent.

Support voluntary efforts by the industry to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Participants include: Visteon, PPG, Techneglas, Owens Corning, Gallo Glass, Fenton Art Glass, Certain Teed, Libby Glass, Osram Sylvania, Energy Research Company, Alfred University-Center for Glass Research, Mississippi State University, Michigan State University Oak Ridge National Laboratory, Sandia National Laboratories, Pacific Northwest National Laboratory, Argonne National Laboratory, Ames Laboratory, and the States of West Virginia, Ohio, Pennsylvania, Florida, Indiana, and North Carolina.

- **Chemicals Vision 14,158 14,458 6,648**

FY 2002: New Chemical Sciences and Engineering: Continued advanced separation technology R&D to decrease the 2+ quadrillion Btu per year of energy required to separate, process, and refine chemicals.

Manufacturing and Operations: Partnered with American Institute of Chemical Engineers (AIChE) to develop energy metrics for 5 chemical plants to incorporate new best practices and emerging technologies.

Computational Technologies: Continued advancement of multi-phase computational fluid dynamics consortium projects to reduce energy consumption and downtime.

Chemical Synthesis Technologies: Developed new process chemistry and catalysis technologies that will significantly improve chemical reactions and product yields. Increased yields in key chemical product chains by more than 30 percent. SBIR/STTR funding in the amount of $300,000 was transferred from this subprogram to the Science Appropriation.

Participants included: Praxair, Air Products, Honeywell Reaction Engineering, Sandia National Laboratories, Dupont, Dow Corning, Exxon Chemicals, Chevron, Fluent, Aspen Technology, OLI Systems, AIChE, University of Texas, Rohm and Haas, NTEC, Membrane Technology Research, Argonne National Laboratory, and Oak Ridge National Laboratory.

FY 2003: New Chemical Sciences and Engineering: Continue separation technology R&D to more efficiently separate, process, and refine chemicals. Develop new process chemistry technologies that will significantly improve chemical reactions and product yields to increase energy efficiency in key chemical product chains by more than 30 percent.

Manufacturing and Operations: Complete pilot test for new alloy for ethylene production that will save 107 trillion Btu/year by 2010.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Initiate Chemical Industry Vision 2020 led project to develop innovative energy supply systems for chemical process technologies to save 200 trillion Btu/year by 2020.

Computational Technologies: Complete multi-phase computational fluid dynamics consortium projects that will save 10 trillion Btu per year by 2020.

Chemical Synthesis Technologies: Develop new process chemistry and catalysis technologies that will significantly improve chemical reactions and product yields to increase energy efficiency in key chemical product chains by more than 30 percent.

Participants include: Praxair, Air Products, Honeywell Reaction Engineering, Sandia National Laboratories, Dupont, Dow Corning, Exxon Chemicals, Chevron, Fluent, Aspen Technology, OLI Systems, AIChE, University of Texas, Rohm and Haas, NTEC, Membrane Technology Research, Argonne National Laboratory, and Oak Ridge National Laboratory.

FY 2004: Complete technology transfer of new metal alloy tubes for ethylene manufacturers. Complete a pilot scale test of dimpled tubes for use in chemical process heat exchangers.

Support voluntary efforts by the chemicals industry to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices. This work will be coordinated with the EERE's Industry BestPractices activities which develops and delivers industrial energy efficiency tools and energy management best practice training.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

Participants include: Praxair, Air Products, Honeywell, Reaction Engineering, Argonne Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratories, Dupont, Dow Chemical, Fluent, Aspen Technology, BP Chemicals, OLI Systems, Washington University, Shell International, University of Texas at Austin, Gas Technology Institute, General Electric, TDA Research, and Aspen Technology.

- **Petroleum Vision 2,740 0 0**

FY 2002: Completed second year of 3 year, cost-shared projects on separation membranes, gas chromatograph controller, global on-stream inspection, rotary burner and biodesulfurization initiated in FY 2001. Funded several new cost-shared projects to help small refineries improve

(dollars in thousands)

FY 2002	FY 2003	FY 2004

process energy efficiency. SBIR/STTR funding in the amount of $60,000 was transferred from this subprogram to the Science Appropriation.

Participants include: Industrial Partners from ten oil refining companies, three universities, four national labs, and two industry associations (American Petroleum Institute and National Petrochemical Refiners Association.)

FY 2003: Close out projects previously funded. No new activities.

FY 2004: No new activities.

- **Mining Vision..... 5,014 5,119 2,353**

FY 2002: Facilitated updating industry vision and roadmaps. Performed research on advanced mining and processing technologies to support industry needs. SBIR/STTR funding in the amount of $105,000 was transferred from this subprogram to the Science Appropriation.

Participants included: major mining and mineral processing companies, equipment manufacturers, universities, and national laboratories including Stolar Horizon, Advanced Ceramic Research, University of Utah, University of Alaska, University of Arizona, Montana Tech, Michigan Tech, W. Virginia State University, Virginia Tech, Transtech, Pacific Northwest National Energy Laboratory, Albany Research Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, Idaho National Energy Laboratory, Consolidated Coal, Pheps Dodge Copper Corp., the Florida Institute of Phosphate Research, Caterpillar Corp. and the Fuel Cell Institute.

FY 2003: R&D includes mineral processing technologies and resource characterization. Commercialize "Oil Pro" and other projects which have ended or are ending this year. Finalize mining and exploration roadmap.

Participants included: major mining and mineral processing companies, equipment manufacturers, universities, and national laboratories including Stolar Horizon, Advanced Ceramic Research, University of Utah, University of Alaska, University of Arizona, Montana Tech, Michigan Tech, W. Virginia State University, Virginia Tech, Transtech, Pacific Northwest National Energy Laboratory, Albany Research Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, Idaho National Energy Laboratory, Consolidated Coal, Phelps Dodge Copper Corp., the Florida Institute of Phosphate Research, Caterpillar Corp. and the Fuel Cell Institute.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

FY 2004: Complete development off 3-D Mill Soft software for commercial application which has a potential for a 30 percent reduction in milling energy use. Support voluntary efforts by the industry to improve their energy efficiency and environmental performance. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices.

Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

Participants included: major mining and mineral processing companies, equipment manufacturers, universities, and national laboratories including Stolar Horizon, Advanced Ceramic Research, University of Utah, University of Alaska, University of Arizona, Montana Tech, Michigan Tech, W. Virginia State University, Virginia Tech, Transtech, Pacific Northwest National Energy Laboratory, Albany Research Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, Idaho National Energy Laboratory, Consolidated Coal, Phelps Dodge Copper Corp., the Florida Institute of Phosphate Research, Caterpillar Corp. and the Fuel Cell Institute.

- **Supporting Industries 1,570 1,600 736**

FY 2002: Developed systems for saving energy in heat treatment of castings; novel materials and process designs for thermally-stable tool and die steel; strategies for the die material and surface coatings; energy-conserving forging technology applicable to aluminum alloys; and a novel methodology for optimizing the welding process. SBIR/STTR funding in the amount of $30,000 was transferred from this subprogram to the Science Appropriation.

Participants include: (in consortia) Forging Ind. Assoc. (FIA), Lincoln Elec. Co., Worcester Polytech. Inst. (WPI), Center for Heat Treating Excellence (CHTE), Air Products and Chemicals, Boycote Thermal Processing, Caterpillar, Deere & Co., Eclipse, GMC, Houghton Int'l, Ipsen Int'l, AMCAST Ind. Corp., ALCOA, UES Software, Kolene Corp., Pratt & Whitney, Surface Combustion, Timken Co., several universities and national labs.

FY 2003: Projects include heat treatment control algorithm; effects of operating parameters on welds; effects of infrared heating on forging stock's mechanical properties; experiments to determine energy and environmental envelopes of innovative die materials and lubricants; and computational models and process studies to design alloys with improved carburization response.

Participants included: Forging Ind. Assoc. (FIA), Lincoln Elec. Co., Worcester Polytech. Inst. (WPI), Center for Heat Treating Excellence (CHTE), Air Products and Chemicals, Boycote Thermal Processing, Caterpillar, Deere & Co., Eclipse, GMC, Houghton Int'l, Ipsen Int'l,

(dollars in thousands)

FY 2002	FY 2003	FY 2004

AMCAST Ind. Corp., ALCOA, UES Software, Kolene Corp., Pratt & Whitney, Surface Combustion, Timken Co., several universities and national labs.

FY 2004: Evaluate existing FY 2003 portfolio and continue those projects that hold promise for commercialization and hold significant potential for energy savings.

Participants include: Forging Ind. Assoc. (FIA), Lincoln Elec. Co., Worcester Polytech. Inst. (WPI), Center for Heat Treating Excellence (CHTE), Air Products and Chemicals, Boycote Thermal Processing, Caterpillar, Deere & Co., Eclipse, GMC, Houghton Int'l, Ipsen Int'l, AMCAST Ind. Corp., ALCOA, UES Software, Kolene Corp., Pratt & Whitney, Surface Combustion, Timken Co., several universities and national labs.

Total, Industries of The Future (Specific)	**61,809**	**52,285**	**24,037**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Industries of the Future (Specific)	
Forest and Paper Products Vision	
▪ Forest Products projects that will not be funded in FY 2004 due to the budget cut include: Fibrous Fillers to Manufacture Ultra High Ash/Performance Paper. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.....	-4,726
Steel Vision	
▪ Two major projects that would not be funded in the Steel area are the Recycling and Reuse of Basic Oxygen Furnace Steelmaking Slags with the Michigan Technological University (MTU) and the process development of Controlled Thermo-Mechanical Processing (CTMP). Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.....	-3,960
Aluminum Vision	
▪ The planned effort to begin development of the next generation of Alternative Reduction Technologies will be delayed. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.	-3,838
Metal Casting Vision	
▪ The project with the Cast Metal Coalition (CMC) for Technology Transfer will not be funded. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria....	-2,354

Explanation of Funding Changes (cont.)

	FY 2004 vs. FY 2003 ($000)
Glass Vision	
▪ Development activities for innovative glass-making technologies resulting from the FY2003 solicitation will be ended. Efforts to transfer to industry the three-dimensional glass furnace simulation model validated in FY2003 will be terminated. Demonstration of a glass melting feedstock measurement and control technology will not be funded. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.	-1,930
Chemicals Vision	
▪ A number of chemical R&D projects would not be funded in FY04 including: Paraxylene Production with Waste Heat Absorption Refrigeration. A second project that will not be funded is Microchannel Reactor System Design. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.	-7,810
Mining Vision	
▪ Two major projects that would not be funded are the development of fuel cell for mining application and The Advanced Surface Enhancement Technology for Decreasing Wear and Corrosion project. Remaining activities will focus on continuing those projects with the greatest potential energy efficiency and environmental performance benefits. New projects will be selected that industry would not be able to undertake itself, without Federal support, in alignment with the Administration's R&D Investment Criteria.	-2,766
Supporting Industries	
▪ No new activities would be funded and existing projects would be either terminated or funding stretched out.	-864
Total Funding Change, Industries of the Future (Specific)	**-28,248**

Industries of the Future (Crosscutting) Subprogram

Mission Supporting Goals and Measures

The **Industries of the Future (Crosscutting)** activities work with industrial partners and suppliers to conduct cost-shared RD&D on technologies that have potential applications across many partner industries. The program also develops and provides the tools and technical assistance needed by industry to expedite the adoption of energy-efficiency, and clean manufacturing technologies. The program focuses on three primary areas that offer major improvements in energy efficiency and emissions reduction: (1) *advanced industrial materials* that can reduce energy use, lower emissions, increase component life, improve product quality, optimize process operating conditions, and reduce downtime; (2) *high-efficiency, clean combustion* technologies; and (3) *advanced sensors/control systems* that can increase process efficiency and productivity even in high temperature and harsh environments.

Annual Performance Results and Targets
Industries of the Future (Crosscutting) Industrial Materials for the Future (IMF)

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Launched Industrial Materials for the Future effort through the award of new R&D projects cost-shared with industry. Completed Continuous Fiber Ceramic Composite projects. Commercialized infrared plasma processing technology for surface heat treating and placement of hard coatings.	Develop a new class of iron-chromium-silicon alloys for superior corrosion resistance. Complete development of iron-aluminide-stainless steel composite tubes for carburization and coking resistance.	Develop a new class of ultra-hard borides for crosscutting industrial applications. Develop high energy density coatings of high temperature materials for energy efficient performance and to extend the lives of these materials by up to 50 percent. Develop advanced nanoporous composite materials for experimental/prototype industrial heat applications that may reduce heat losses by up to 50 percent. Develop cost-effective ceramic and refractory components for possible adoption by the aluminum and casting industries.

Annual Performance Results and Targets
Industries of the Future (Crosscutting) Combustion

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed testing and evaluation of prototype boiler design capable of greater than 94 percent efficiency and less than five ppm NO_x emissions. Completed engineering design of ultra-high efficiency, low emission refinery process heater.	Initiate design and construction of a pre-production boiler capable of greater than 94 percent efficiency and less than five ppm NO_x emissions. Initiate design and construction of a prototype ultra-high efficiency, low emission refinery process heater.	Complete design and construction of a pre-production boiler capable of greater than 94 percent efficiency and less than five ppm NOx emissions. Complete design and construction of a prototype ultra-high efficiency, low emission refinery process heater.

Annual Performance Results and Targets
Industries of the Future (Crosscutting) Sensors and Controls

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Evaluated thermal imaging system in an industrial furnace. Tested extrusion control system in plastics plant.	Complete pilot evaluation of machine vision, artificial intelligence-based combustion control system. Evaluate a magnetic resonance wood moisture monitor in a lumber mill. Monitor multiple gaseous species in steel, chemical, and glass plants using tunable diode laser system.	Develop a prototype advanced industrial wireless system linking product measurement and production control system. Complete and disseminate the analysis results to industry of advanced control systems that extract supplemental product property information from conventional sensor readings and simultaneously determine sensor reading validity. Develop novel application of magnetic resonance-based hardware in industrial plant applications.

Annual Performance Results and Targets
Industries of the Future (Crosscutting) Industrial Technical Assistance

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Continued support for Industrial Assessment Centers operating at 26 participating universities that conducted approximately 650 combined energy, waste, and productivity assessment days of service to manufacturing clients.	Continue support for Industrial Assessment Centers operating at 26 participating universities that will conduct approximately 750 combined energy, waste, and productivity assessment days of service to manufacturing clients.	Fully implement consolidated IAC management (single manager selected in FY 02) to enable the 26 IACs collectively to increase energy savings per assessment day by 10 percent over the FY 2000 baseline.
Conducted two State level energy fairs to promote replication of the Best Practices Portfolio.	Conduct 5 regional/State level energy fairs to promote replication of the Best Practices Portfolio.	Complete 15 special assessments and recommendation summaries in conjunction with the Metal Casting Industry with the goal of developing an energy "footprint" for the industry.
Complete 3 showcases of advanced energy efficiency technologies at industry sites in the Forest Products and Aluminum Industries of the Future.	Complete the first EERE-wide showcase of advanced efficiency and renewable energy technologies at industry sites in Texas (many hosted by Chemical Industry IOF Partners.)	Complete the integration of Best Practices/IAC software tools training and use.
Selected 8 plant-wide assessments to assist plant operators in the use of industrial process applications tools. These will influence replication of similar energy savings for other plants.	Select 8 plant-wide assessment sites to assist plant operators in the use of industrial process applications tools. These will influence replication of similar energy savings for other plants.	Conduct 3 regional/State level energy fairs and 1 showcase involving regional offices and Allied Partners to promote EERE emerging technologies and Best Practices.
Completed 20 new Allied Partnerships with energy-intensive companies, trade organizations, and other groups.	Complete 20 new Allied Partnerships with energy intensive companies, trade organizations, and other groups.	

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Industries of the Future (Crosscutting)					
Industrial Materials for the Future	13,423	12,698	12,698	0	0.0%
High Efficiency Combustion Systems	2,000	2,000	2,000	0	0.0%
Sensors and Controls Technology	3,699	3,774	3,774	0	0.0%
Industrial Technical Assistance	14,449	15,929	15,929	0	0.0%
Total, Industries of the Future (Crosscutting)[a]	33,571	34,401	34,401	0	0.0%

[a] Industry of the Future (Crosscutting) includes $1,560,000 in FY 2002, and $1,460,000 in FY 2003 for the State Energy Program Special Projects State Grants. The NICE^3 and Inventions and Innovations activities have been moved to the Weatherization and Intergovernmental Program.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Industries of the Future (Crosscutting)	**33,571**	**34,401**	**34,401**
▪ **Industrial Materials of the Future**	**13,423**	**12,698**	**12,698**

FY 2002: Based on a study and recommendations from the National Research Council/National Materials Advisory Board, initiated Industrial Materials for the Future Program. Issued competitive solicitations for industry, national laboratories, and universities/not-for-profit research institutes, based on IOF roadmap priorities. SBIR/STTR funding in the amount of $275,000 was transferred from this subprogram to the Science Appropriation.

Alloy Processing and Development: Completed intermetallic alloy, membrane materials, and composites and coatings development. Selected and funded 29 new research and development projects from competitive solicitation. Supported Metals Processing Laboratory at ORNL to work with IOF industries on materials problems.

Coatings, Surface Treatments, and Super-Hard Materials: Completed Continuous Fiber Ceramic Composites activities and established standards and codes; commercialized burner tubes, fan blades, burner faces, and tube hangers.

Thermochemical Data, Combinational Methods, and Modeling: No Activity

Refractories and Thermal Insulation: No Activity

Membrane and Filters for Separations: No Activity

Participants included: Oak Ridge National Laboratory, Sandia National Laboratories, Argonne National Laboratory, Weyerhaeuser, PPG Industries, Dow Chemical, Amoco, and other industry partners in CRADAs and other cooperative agreements.

FY 2003: Conduct materials research and development projects selected by competitive solicitation in FY 2002.

Alloy Processing and Development: Develop new classes of improved alloys for longer service lives and process optimization, including stainless steels and intermetallic alloys. Develop new methods of metals processing and joining, including extrusion of bimetallic tubes, ultrasonic processing during crystallization, and welded joint design.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Coatings, Surface Treatments, and Super-Hard Materials: No activity.
Thermochemical Data, Combinational Methods, and Modeling: Develop combinatorial techniques, acquire thermophysical property data, and use the information for modeling materials synthesis and behavior in high temperature industrial environments.

Refractories and Thermal Insulation: Develop improved refractories and insulating materials for high temperature processes to reduce down-time and improve energy efficiencies in the IOF industries.

Membrane and Filters for Separations: Focus on separation of gases to reduce energy use in oxygen and hydrocarbon separations.

AIM Participants included those listed in FY 02 as well as Air Products, Babcock and Wilcox, Bethlehem Steel Corporation, Boise Cascade Corporation, BP-Amoco, Cummins, Inc., Duraloy Technologies, Energy Industries of Ohio, ExxonMobil, Ford Motor Company, Institute of Paper Science and Technology, International Paper, Materials Technology Institute, Mead Corp., Nooter Fabrication, Praxair Surface Technologies, Shell Oil Products Company LLC, Special Metals, Stoody Company, The Timken Company, Sandvik Steel, Westvaco, Weyerhaeuser

FY 2004: Perform materials research and development on projects selected by competitive solicitation in FY 2002 and FY 2003. Emphasis will be in the areas of :

Alloy Processing and Development: Focus R&D on alloys with superior high-temperature strength and resistance to wear, corrosion, and fatigue and on innovative processing methods to fabricate metallic components.

Coatings, Surface Treatments, and Super-Hard Materials: Focus of R&D will be on diamond and diamond-like coatings, high intensity infrared heat treating and fusion of surfaces for stronger, more durable alloys and refractories.

Thermochemical Data, Combinational Methods, and Modeling: In order to model materials synthesis properties, and behavior in service, acquisition of thermochemical data and application of combinatorial methods for rapid screening and property optimization of candidate materials will be performed.

Refractories and Thermal Insulation: Develop superior refractories and insulating materials to improve service life and reduce heat losses in all the Industries of the Future.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Membrane and Filters for Separations: To reduce energy requirements for distillation and recrystallization and improve air quality in industrial processes, perform R&D to develop robust membranes and filters.

AIM Participants include those listed in FY 2002 and FY 2003 as well as 15 organizations

- **High-Efficiency Combustion System..... 2,000 2,000 2,000**

FY 2002: (formerly Combustion Systems) Performed R&D to develop super boiler and superior process heater (per combustion vision and roadmap targets). These projects built on advances made in very low emission burners in combination with improved systems design and better heat transfer.

Participants included the Gas Technology Institute, Southern California Gas, Cleaver-Brooks, Arthur D. Little, Callidus Technologies, and ExxonMobil.

FY 2003: Advance super boiler and superior process heater performance by reaching full-scale prototype design and construction. The prototypes will achieve maximum efficiency and single-digit ppm NO_x emissions.

Participants include the Gas Technology Institute, Southern California Gas, Cleaver-Brooks, Arthur D. Little, Callidus Technologies, and ExxonMobil.

FY 2004: Complete full scale design and production and start demonstration of the prototype technologies. The prototypes will achieve efficiency improvements of up to 15 percent and single-digit ppm NO_x emissions.

Participants include the Gas Technology Institute, Southern California Gas, Cleaver-Brooks, Arthur D. Little, Callidus Technologies, and ExxonMobil.

Industrial Gasification Transferred to Biomass Program.

- **Sensors and Control Techniques 3,699 3,774 3,774**

FY 2002: Supported IOF Roadmaps by developing non-proprietary, dynamically reconfigurable wireless architecture and conducted field trials in two paper mills. Completed laboratory development and evaluation of a real-time sensor to measure constituents in industrial melts in the aluminum, glass, and steel industries, and applied thermal imaging system to furnaces to improve operating energy efficiency. SBIR/STTR funding in the amount of $75,000 was transferred from this subprogram to the Science Appropriation.

(dollars in thousands)

Participants include: (in consortia) Timken Company, Gas Technology Institute, GE Research & Development Center, PPG, Energy Research Company, Tennessee Technological University, Oak Ridge National Laboratory

Also, participating in the collaboration are National Research Council Canada; University of Illinois, Combustion Tec, Owens Brockway Glass Containers; Kupp Werner-Pfleiderer; Sandia National Laboratories, and University of Utah; Mississippi State University; and Utah State University, Idaho National Engineering Laboratory, Albany Research Center, American Foundrymen's Society, and General Motors.

FY 2003: R&D projects include advanced mathematical processing for extracting product property and process and control information from conventional sensor readings. Accelerate industrial non-proprietary, dynamically reconfigurable wireless telemetry development. Evaluate IOF-sponsored sensor and control projects for applicability in industries other than originally intended.

Participants include: (in consortia) Timken Company, Gas Technology Institute, GE Research & Development Center, PPG, Energy Research Company, Tennessee Technological University, Oak Ridge National Laboratory

FY 2004: R&D projects include pattern recognition, machine vision and other mathematical processing techniques to improve yield and reduce waste. Demonstrate energy saving superiority of neural network-based combustion control system. Develop magnetic resonance hardware to determine wood properties. Demonstrate hydrogen sensor in hydrogen production plant. Continue to advance industrial non-proprietary, dynamically reconfigurable wireless telemetry and leverage government funds with industry funds.

Participants include: General Electric Global Research, Honeywell International, The Timkin Co., Energy Research Co., Quantum Magnetics, American Air Liquide, Tecnar Automation, Air Products and Chemicals Co., Gas Technology Institute, Oak Ridge National Laboratory, Sandia National Laboratories, Tennessee Technological University, Penn State University.

Industrial Technical Assistance	**14,449**	**15,929**	**15,929**
▪ **Industrial Assessment Centers**	**5,774**	**7,694**	**7,694**

FY 2002: Provided energy, waste, and productivity training to 120 engineering students at 26 participating universities. Conducted approximately 650 assessment days of service to manufacturing clients. Provided industrial assessment technical expertise to Industries of the

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Future Showcase Plants. Conducted a solicitation to select new Field Manager. Rutgers University was selected through a competitive solicitation. SBIR/STTR funding in the amount of $85,000 was transferred from this subprogram to the Science Appropriation.

FY 2003: Provide energy, waste, and productivity training to 140 engineering students at 26 participating universities. Conduct approximately 750 assessment days of service to manufacturing clients. Provide industrial assessment technical expertise to Industries of the Future Showcase Plants. Continues to foster a nationwide cadre of experienced and trained engineering alumni, many of whom enter the industrial community able to apply practical energy management skills learned first-hand at manufacturing client plant sites. Transition to new Field Manager.

FY 2004: Fully implement new Field Management Structure incorporating the recommendations made in the 1999 Strategic Review to help the 26 IACs to increase energy savings per assessment day.

Provide energy, waste, and productivity training to over 150 engineering students at 26 participating universities and help them continue to provide a nationwide cadre of experienced and trained engineering alumni. Conduct approximately 750 assessment days of service to manufacturing clients. Provide industrial assessment technical expertise to Showcase Plants. Fully implement the student certification program and provide approximately 150 graduating students with credentials important to them in their further graduate studies and/or in their careers in industry. Offer increased technical assistance and targeted energy efficiency assessment information and tools over the internet.

Participants include 26 universities: Colorado State University, Loyola Marymount University, Syracuse University, University of Illinois at Chicago, University of Louisiana at Lafayette, Oklahoma State University, Iowa State University , North Carolina State University, University of Massachusetts at Amherst, Mississippi State University, University of Miami, University of Florida, Oregon State University, San Francisco State University, Texas A & M University, San Diego State University, Lehigh University ,Georgia Institute of Technology, University of Utah, University of Wisconsin-Milwaukee, University of Michigan, University of Dayton, West Virginia University, Bradley University, Arizona State University, University of Texas at Arlington and Rutgers University.

▪ **Best Practices**	**8,675**	**8,235**	**8,235**

FY 2002: Provided technical assistance to 6 plant sites on use of industrial process application tools relevant to motor, pump, process heating, steam, and compressed air systems. Selected 8 plant-wide assessments for cost-shared financial assistance and development of a comprehensive

energy-saving strategy for the selected plants. Broadened the Allied Partnership to 50 companies from industry and trade associations representing all IOF industries to support wide dissemination and use of Industrial technologies information and products. Developed a Best Practices Resource Software Suite for decision-making across plant operations. Conducted 2 State level Energy Fairs.

Conducted 2 plant-wide showcases in support of IOF partnerships to demonstrate emerging technologies and their performance benefits under real-use conditions. Initiated validation of energy/environment/economic performance of 8 emerging technologies through an independent, third-party entity to help promote industry acceptance of new technologies. SBIR/STTR funding in the amount of $395,000 was transferred from this subprogram to the Science Appropriation.

FY 2003: Continue technical assistance to plant sites enabling their use of industrial process application tools relevant to motor, pump, process heating, steam, and compressed air systems; emphasize system-level improvements through implementation of energy management best practices. Select 8 plant-wide assessments for cost-shared financial assistance; develop a comprehensive energy-saving strategy for each plant and replication plan. Allied Partnerships have broadened to include all EERE technologies. The Industrial Program will pursue a goal of 100 companies, support industries, and trade associations. Use Allied Partnerships to facilitate replication of the entire Best Practices portfolio including the support of 5 regional/State-level Energy Fairs.

Support one plant-wide showcase in support of multiple EERE technologies to demonstrate emerging technologies, energy management best practices, and their performance benefits under real-use conditions. Continue validation of energy/environment/ economic performance of 8 emerging technologies through an independent, third-party entity to help promote industry acceptance and replication initiated in FY 2002.

FY 2004: Continue technical assistance to plant sites, enabling their use of industrial process application tools relevant to motor, pump, process heating, steam and compressed air systems emphasizing system-level improvements; in collaboration with industry; complete development of fan assessment tool and update other tools, as necessary.

Select 5 plant-wide assessments for cost-shared financial assistance, each award to include a comprehensive energy-saving replication plan.

Continue efforts to replicate results from prior awards in industrial facilities with similar process lines. Complete efforts to increase Allied Partners to 100 companies, support industries and trade associations; sign additional Allied Partner agreements with utilities; use Allied Partnerships to facilitate replication of the entire Best Practices portfolio.

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Complete validation and verification of the energy/ environment/economic performance of 2 emerging technologies through an independent, third-party entity to promote industry acceptance and replication. Initiate 5 additional validation and verification studies.

Participants include 34 companies that have completed plant-wide assessments, and 56 companies participating in the Allied Partners program. Companies participating in Best Practices activities include Good Humor Breyers, Delphi Automotive, Merisol USA LLC, Morning Star Packing Co., Rohm & Haas, Millennium Chemicals, Inc., V&M Star Steel, Air Products & Chemicals, Inc., and An-Cor.

Total, Industries of The Future (Crosscutting)	**33,571**	**34,401**	**34,401**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Industries of the Future (Crosscutting)	
▪ No Changes.	
Total Funding Change, Industries of the Future (Crosscutting)	**0**

Energy Efficiency Science Initiative Subprogram

Mission Supporting Goals and Measures

The Energy Efficiency Science Initiative (EESI) seeks to identify and fund "bridging" research, development and Demonstration (RD&D) that falls between fundamental exploratory science and pre-commercial applied RD&D.

By stimulating RD&D that maximizes synergies among different research fields, technologies, investigator communities, and end-use applications, this initiative expands EERE's RD&D activities among energy efficiency technologies. It also cuts across traditional energy end-use sectors by emphasizing distributed power generation applications for industrial and buildings systems, transportation, and stationary power.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Energy Efficiency Science Initiative	1,959[a]	0	0	0	0.0%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Energy Efficiency Science Initiative	**1,959**	**0**	**0**

FY 2002: In collaboration with the DOE Office of Fossil Energy, a single award solicitation will be issued to address technology gaps between exploratory science and pre-commercial applied R&D. SBIR/STTR funding in the amount of $41,000 was transferred from this subprogram to the Science Appropriation.

FY 2003: No activities.

FY 2004: No activities.

[a] There was $2,000,000 transferred to the Fossil Energy R&D appropriation as required by Committee Report language.

Technical/Program Management Support Subprogram

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY2004	$ Change	% Change
Technical/Program Management Support.....	3,570	4,791	5,991	+1,200	+25.0%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Technical/Program Management Support.....	**3,570**	**4,791**	**5,991**

FY 2002: Provided critical technical and program management support services.

FY 2003: Provide critical technical and program management support services.

FY 2004: Provide critical technical and program management support services including support for multi year planning; strategic planning; the analysis of program activities to support efforts to refocus work to achieve greater program impacts; peer reviews of R&D programs and program portfolios and management; and analysis and assessments of past program impacts and performance.

Program participants include PNNL, NREL, Energetics, Inc., BCS, Inc., and Rand Corporation.

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Technical/Program Management Support	
▪ Increase technical/program management support to evaluate opportunities to enhance portfolio analysis to improve project selection in alignment with the Administration's R&D Investment criteria.....	+1,200
Total Funding Change, Technical/Program Management Support.....	**+1,200**