INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(Dollars in Thousands)

INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Mission Supporting Goals and Objectives

Mission: Industries of the Future (Crosscutting) works with IOF industry partners and suppliers to conduct cost-shared RD&D on technologies that have potential applications across the nine vision industries as well as provide the immediate tools and technical assistance industry needs to expedite the implementation of energy-efficient, clean manufacturing technologies.

Summary: Industries of the Future (Crosscutting) comprises six program areas:

(1) Industrial Materials for the Future (IMF)
(2) Combustion
(3) Sensors & Controls
(4) National Industrial Competitiveness through Energy, Environment, and Economics ($NICE^3$)
(5) Inventions and Innovation (I&I)
(6) Industrial Technical Assistance (Best Practices and Industrial Assessment Centers)

For simplicity of presentation, several headings under which these activities previously appeared have been dropped. The activities themselves remain the same, although industrial gasification and combustion systems have been grouped together under the title "Combustion." Items 1 through 3 above were formerly grouped under the heading "Enabling Technologies." Items 4 and 5 above were formerly grouped under the heading "Financial Assistance."

The IMF, Combustion, and Sensor & Controls programs conduct cost-shared RD&D on technologies with potential application across multiple Industrial technologies vision industries. Theses programs focus on three 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 and gasification technologies; and (3) advanced sensors/control systems that can increase process efficiency and productivity even in high temperatures and harsh environments. Current efforts in gasification focus on black liquor and biomass gasification technologies in the Forest Products industry. Currently the Forest Products industry spends $4 billion annually to purchase over 90 billion of kWh of electricity. Successful

adoption of black liquor and biomass gasification technology by the industry will not only totally eliminate these costs, but will result in the industry providing over 20 GW of additional generating capacity to the grid (equivalent of 20 large coal generation power plants).

The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3) and Inventions and Innovation (I&I) Programs make a significant difference by providing modest levels of support, at the right time, to speed the development of new energy-saving, environmentally friendly technologies and to demonstrate their potential savings and commercial value. NICE^3 provides funding to state and industry partnerships (both large and small business) to demonstrate full-scale energy efficient technologies in an industrial setting. I&I provides funding and business skill development to independent inventors, small businesses, and industry who lack the financial resources and/or know-how to move their promising energy saving concepts from the research to the prototype stage.

The Industrial Technical Assistance program, which includes BestPractices and the Industrial Assessment Centers (IACs), provides the integrated delivery of energy-saving products, services, and technologies to assist the energy-intensive industries in identifying and realizing their best energy-efficient, pollution-preventing options from a systems and life-cycle cost perspective.

Crosscutting RD&D enables energy improvements in multiple industries. The Industries of the Future strategy embraces efficiency enhancements to technologies that are widely used in a broad cross-section of U.S. industry. Given the breadth of use of these technologies, even a small improvement in their efficiency can mean substantial energy and cost savings. Industrial technologies's Industrial Materials for the Future program works with the national laboratories and collaborative industry partnerships to develop new and improved materials to provide superior strength and corrosion resistance even in high-temperature industrial environments. The Combustion program seeks to improve energy efficiency, reduce emissions, enhance fuel flexibility, and otherwise meet industry's future combustion needs by working with the combustion community to develop cost-effective technologies. Combustion program also supports the development of black liquor and biomass gasification technologies in the Forest Products industry. The Sensors and Controls program is working to provide integrated measurement systems for operator-independent control of plant processes. Research is extending sensor reach and accuracy in harsh environments and improving the integration and processing of sensor data to enable on-line, automated assessment and adjustment of system parameters.

The NICE^3 and I&I programs provide help at both ends of the technology development spectrum. Individual or small business inventors can receive assistance through Industrial technologies's Inventions and Innovation program to develop promising energy-efficient concepts and supporting business plans. To move new technologies into demonstration mode, Industrial technologies's NICE^3 program assists entities wishing to demonstrate emerging technologies in partnerships with state offices. These demonstrations help prove to potential technology customers that the technologies can work well in the real world, measurably reducing industrial energy use.

The Industrial Technical Assistance Program complements the IOF RD&D efforts. Technical assistance includes a continuum of services from energy assessments and evaluations, and information on industrial equipment and systems, to tools and resources for measuring the

effectiveness of new technologies. Allied partnerships with over 200 associations and companies is an important mechanism to help leverage program RD&D development and deployment. These partnerships work within the existing industrial market infrastructure**,** leveraging off of and building on existing business relationships between supply chain companies, end users, consultants, technology developers, and utilities to raise awareness and increase adoption of new energy efficient technologies and energy management practices in IOF industries. The Industrial Technical Assistance Program helps to identify and conduct cooperative efforts with Allied Partners to develop and disseminate broad new information materials, software decision making tools, training curricula or events, and other activities that help facilitate the use of industrial energy efficiency technologies and measures. In addition, the Industrial Assessment Center (IAC) Program provides 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.

Long Term Goals and Objectives

Program Strategic Performance Goal

Specific Vision Industries R&D activities will develop a portfolio of energy saving technologies and methods that will catalyze reduced energy use in the nine energy-intensive Industries of the Future to reach annual savings of 329 trillion Btu in 2005 (compared with conventional technology), 827 trillion Btu in 2010, and 2,377 trillion Btu in 2020.

ER1-8: Crosscutting Industrial Technologies

Crosscutting Industrial Technologies R&D activities will develop a portfolio of crosscutting energy saving technologies, methods, and assistance that will catalyze reduced energy use in energy-intensive "Industries of the Future" of 178 trillion Btu of annual savings in 2005, 590 trillion Btu in 2010, and 1963 trillion Btu in 2020, compared with the EIA conventional technology baseline.

Performance Indicators:

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

Annual Performance Results and Targets [a]

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
! In FY 2001, 10 new technologies were commercialized from both the nine vision industries as well as the crosscutting programs. [b] ! In FY 2001, Industrial technologies helped industry save an estimated 262 trillion Btu of energy worth more than $1.6 billion. [c] ! Continue support for Industrial Assessment Centers operating at 26 participating universities that will conduct approximately 650 combined energy, waste and productivity assessments.	! Commercialize 10 new energy efficient technologies in partnership with the most energy intensive industries. ! Complete 2 showcase demonstrations, at industry sights, of advanced energy efficient technologies. ! In FY2002, Industrial technologies will complete 20 new Allied Partnerships with energy intensive companies, trade organizations and other groups. ! Continue support for Industrial Assessment Centers operating at 26 participating universities that will conduct approximately 320 combined energy, waste, and productivity assessment days of service to manufacturing clients. ! In FY2002, help industry save more than 265 trillion Btu of energy worth more than $1.6 billion. ! Industrial technologies internet web sites will record over 5 million page views.	! In FY 2003, commercialize 10 new technologies. ! In FY 2003, help industry save more than 280 trillion Btu of energy worth at least $1.5 billion. ! In FY 2003, project turnover will represent 25% of the FY2002 RD&D project portfolio. ! FY 2003 Milestone: 2000 energy intensive U.S. plants will apply EERE technologies and services achieving up to a 15% improvement in energy productivity per plant. ! Industrial technologies internet web sites will record some 6 million page views. ! In FY 2003, Industrial technologies will complete 20 new Allied Partnerships with energy intensive companies, trade organizations and other groups

[a] The annual performance results and targets shown are part of a coordinated and complementary effort which jointly contribute to the program strategic performance goals.

[b] To support the development of commercialized technologies solicitations are issued by Industrial technologies. For example, in FY2001 one new solicitation was issued in FY 2001 targeted to the Renewables Vision 2020 for Agriculture in support of the goals of the President's Bio-based Products and Bio-energy initiative. (ER1-8)

[c] An important element in industrial energy savings were the energy audits conducted through the continued support for Industrial Assessment Centers as well as the 15 additional assessments and 5 case studies of major industrial plants that will document a variety of system-focused implemented actions were conducted. These assessments influence important replication of similar energy savings for other plants. (ER1-8)

Industrial Materials of the Future (IMF) Goals and Objectives

- Reduce energy use in the Industries of the Future by 31 trillion Btu in 2005 (compared to conventional technology), 74 trillion Btu in 2010, and 207 trillion Btu in 2020.
- Conduct R&D to develop new materials consistent with the needs identified in the IOF visions and technology roadmaps and significantly reduce energy use in the energy-intensive IOF industries.[a]

Combustion Goals and Objectives

- Reduce energy use in the Industries of the Future by 16 trillion Btu in 2005 (compared to conventional technology), 141 trillion Btu in 2010 and 819 trillion Btu in 2020.[b]
- By 2006, demonstrate a >95% efficient packaged boiler with NO_x emissions below 5 ppm.
- By 2010, demonstrate an integrated high efficiency black liquor and solid biomass gasification/combined cycle systems with equal or greater availability than existing boilers.

Sensors and Controls Goals and Objectives

- Reduce energy use in the Industries of the Future by 1 trillion Btu in 2005 (compared to conventional technology), 9 trillion Btu in 2010, and 37 trillion Btu in 2020.
- By 2010, contribute toward transformation of current batch aluminum production into a continuous process using new sensor systems.

NICE^3 Goals and Objectives

- Reduce energy use in the Industries of the Future by 21 trillion Btu in 2005 (compared to conventional technology), 45 trillion Btu in 2010, and 121 trillion Btu in 2020.
- Demonstrate a high efficiency adjustable speed drive coupling system to reduce energy costs by 40-74% for motor driven systems in industry.
- Test and evaluate a single stage turbine with a 40% efficiency.

Inventions and Innovations Goals and Objectives

- Reduce energy use in the Industries of the Future by 61 trillion Btu in 2005 (compared to conventional technology), 112 trillion Btu in 2010, and 283 trillion Btu in 2020.
- Demonstrate an efficient and environmentally benign technology for papermaking to reduce electrical energy for papermaking by 30% and also improve paper quality.

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[a] This is a significant objective among others in the program. It will significantly contribute to achieving the energy savings identified in the preceding statement.

[b] Of the savings estimates 107 trillion Btu in 2010 and 713 trillion Btu in 2020 are associated with the forest products industry.

- By 2003, demonstrate a distillation column flooding predictor to improve petroleum refinery distillation tower throughput by 2 to 5 percent.

Industrial Technical Assistance Goals and Objectives

- Reduce energy use in the Industries of the Future as a result of the BestPractices program by 35 trillion Btu in 2005 (compared to conventional technology), 169 trillion Btu in 2010, and 438 trillion Btu in 2020.
- Reduce energy use in the Industries of the Future as a result of the IAC energy audits by 14 trillion Btu in 2005 (compared to conventional technology), 40 trillion Btu in 2010 and 58 trillion Btu in 2020.[c]
- By 2010, the IAC Program will achieve an annual energy savings of $195 million and non-energy savings of $603 million, and will have completed approximately 17,000 Industrial Assessment Audits with 3,100 engineering students trained in conducting these audits.
- By 2003, develop a total of 100 Allied Partnerships.

Annual Performance Results and Targets: *Industrial Materials for the Future (IMF)*

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• Completed analysis of the industrial materials needs common to all IOF industries. • Issued competitive solicitations to address materials needs common to all IOF industries. • Successfully commercialized use of nickel aluminide trays in heat treating furnaces to substantially reduce energy intensity. • Completed commercialization process for production of uniform metal droplets and filters.	• Launch Industrial Materials for the Future program through the award of new R&D projects cost-shared with the industry. • Complete Continuous Fiber Ceramic Composite projects. • Commercialize 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 carbonization and coking resistance.

[c] Non-energy benefits assessed by this program including productivity and environmental benefits are as much as 2-4 times greater than the energy savings.

Annual Performance Results and Targets: *Combustion*

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• Award made for black liquor biomass gasification engineering design studies for the Forest Products industry (DeRidder, LA). • Selected site (DeRidder, LA) and began design study for solid wood waste gasifier demonstration. • Completed one engineering design study for black liquor gasification in the forest products industry (Big Island, VA). • Demonstrated less than 10 ppm NO_x burner for refinery heaters.	• Begin construction of a black liquor gasifier for demonstration (Big Island, VA). • Initiate research projects to support biomass and black liquor gasification demonstrations. • Complete testing and evaluation of prototype boiler design capable of greater than 94% efficiency and less than five ppm NO_x emissions. • Complete 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 emission refinery process. • Initiate design and construction of a prototype ultra-high efficiency, low emission refinery process heater. • Start-up and shake-down of black liquor gasifier (Big Island, VA). • Conclude design study for solid wood waste gasifier demonstration (DeRidder, LA). • Begin engineering design and cost projection for Kraft black liquor gasification demonstration. • Continue research projects to support biomass and black liquor gasification demonstrations.

Annual Performance Results and Targets): *Sensors and Controls*

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• Conducted demonstration of wireless system in operating industrial plant.	• Evaluate thermal imaging system in an industrial furnace. • Test extrusion control system in plastics plant.	• Conduct 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.

Annual Performance Results and Targets: *NICE*^{3}

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• Provided assistance to 10 State/industry partnerships for the initial demonstration of energy efficiency technologies, which will facilitate their use in other industrial facilities. • Tested a high temperature, corrosive-resistant recuperator that will realize a 20-30% energy savings over conventional technology • Tested a high efficiency adjustable speed drive coupling system to reduce energy costs by 40-74% for motor driven systems in industry. • Demonstrated a combinatorial chemical analysis technology that samples 20-100 times faster than current prep-scale liquid chromatography technology.	• Provide incremental funding to 8 State/industry partnerships for the initial demonstration of energy efficiency technologies, which will facilitate their use in other industrial facilities. • Initiate the demonstration of a high efficiency adjustable speed drive coupling system to reduce energy costs by 40-74% for motor driven systems in industry. • Initiate the demonstrate a high temperature, corrosive-resistant recuperator that will realize a 20-30 percent energy savings over conventional technology.	• Provide incremental funding to 8 State/industry partnerships for the initial demonstration of energy efficiency technologies, which will facilitate their use in other industrial facilities. • Demonstrate a particle shearing device in the forest products industry that will save 1.71 million KWh annually by 2010. • Initiate the testing of a lost foam casting process that will save 256.7 Btu by 2010. • Complete the testing of a 40% efficient single stage turbine.

Annual Performance Results and Targets: *Inventions and Innovation*

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• Provided assistance to 41 inventors and small businesses to develop their meritorious energy efficiency technologies.	• Provide incremental funding to 20 inventors and small businesses to develop their meritorious energy efficiency technologies.	• Provide incremental funding to 20 inventors and small businesses to develop their meritorious energy efficiency technologies.
• Tested a distillation column flooding predictor that will improve petroleum refinery distillation tower throughput by 2 to 5%.	• Test an efficient and environmentally benign technology for papermaking to reduce electrical energy for papermaking by 30% and also improve paper quality.	• Demonstrate an efficient and environmentally benign technology for papermaking to reduce electrical energy for papermaking by 30% and also improve paper quality.
	• Test an industrial fuel cell micro-generator that will save 2.1 trillion Btu by 2010.	• Demonstrate industrial fuel cell micro-generator that will save 2.1 trillion Btu by 2010.

Annual Performance Results and Targets: *Industrial Technical Assistance*

FY 2001 Results	FY 2002 Target	FY 2003 Proposed Target
• 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 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 conducted approximately 750 combined energy, waste, and productivity assessment days of service to manufacturing clients.
• In Best Practices, completed 15 assessments and 5 case studies of major industrial plants that document a variety of system-focused implemented actions. These will influence replication of similar energy savings for other plants.	• Conduct 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.
• Completed three showcases for the Aluminum, Petroleum Refining, and Mining Industries of the Future, at 6 plants involving more than two dozen energy assessments.	• Complete 3 showcases of advanced energy efficient technologies at industry sites in the Forest Products and Aluminum Industries of the Future. • Select 8 plant site assessments to assist plant operators in use of industrial process applications tools. These will influence replication of similar energy savings for other plants.	• Complete 2 showcases of advanced energy efficient technologies at industry sites in the Mining and Chemical Industries of the Future. • Select 8 plant site assessments to assist plant operators in use of industrial process applications tools. These will influence replication of similar energy savings for other plants.

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

Program Activity	FY 2001 Comparable	FY 2002 Comparable	FY 2003 Request	$ Change	% Change
Engineered Ceramics/CFCC's	$ 5,853	$ 0	$ 0	$0	0.0%
Advanced Industrial Materials	$ 5,826	$ 0	$ 0	$0	0.0%
Industrial Materials for the Future	$ 0	$ 13,698	$ 12,698	$-1,000	-7.3%
Combustion	$ 14,387	$ 18,391	$ 15,600	$-2,791	-15.2%
Sensors and Controls	$ 3,763	$ 3,774	$ 3,774	$0	0.0%
NICE[3]	$ 5,092	$ 2,736	$ 2,736	$0	0.0%
Inventions and Innovation	$ 4,798	$ 4,372	$ 2,372	$-2,000	-45.7%
Industrial Technical Assistance	$ 15,016	$ 14,929	$ 15,929	$1,000	6.7%
Technical / Program Management Support	$ 5,002	$ 3,000	$ 4,000	$1,000	33.3%
Total, Industries of the Future (Crosscutting) *	$ 59,737	$ 60,900	$ 57,109	$-3,791	-6.2%

* Note: Industry of the Future (Crosscutting) includes $1,460 in FY2001, $1,560 in FY2002, and $1,560 in FY2003 for the State Energy Program Special Projects State Grants. FY 2001 has been reduced by $1,982,000 for SBIR/STTR transfer.

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

	FY 2001	FY 2002 *	FY 2003 *	$ Change	% Change
Argonne National Laboratory (East)	$ 150	$ 153	$ 143	$-10	-6.5%
Idaho National Engineering Laboratory	$ 320	$ 326	$ 306	$-20	-6.1%
Lawrence Berkeley National Laboratory	$ 1,420	$ 1,448	$ 1,358	$-90	-6.2%
Los Alamos National Laboratory	$ 1,050	$ 1,070	$ 1,004	$-66	-6.1%
National Renewable Energy Laboratory	$ 1,665	$ 1,697	$ 1,592	$-105	-6.1%
Oak Ridge National Laboratory	$ 14,235	$ 14,512	$ 13,609	$-903	-6.2%
Pacific Northwest National Laboratory	$ 500	$ 510	$ 478	$-32	-6.2%
Sandia National Laboratories	$ 800	$ 816	$ 765	$-51	-6.3%
All Other	$ 39,597	$ 40,368	$ 37,854	$-2,514	-6.2%
Total, Industries of the Future (Crosscutting)	$ 59,737	$ 60,900	$ 57,109	$-3,791	-6.2%

* These dollars reflect an estimated distribution of Industrial technologies funds. They are not requested funds for individual laboratories.

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

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Materials for the Future	No activities. ($0)	Based on a study and recommendations from the National Research Council/National Materials Advisory Board, initiate Industrial Materials for the Future Program. Issue competitive solicitations for industry, national laboratories, and universities/not-for-profit research institutes, based on IOF roadmap priorities. Complete Continuous Fiber Ceramic Composites Program and establish standards and codes; commercialize burner tubes, fan blades, burner faces, and tube hangers. Complete intermetallic alloy, membrane materials, and composites and coatings development. Support Metals Processing Laboratory at ORNL to work with IOF industries on materials problems. Select and fund 29 new research	Conduct materials research and development projects selected by competitive solicitation in FY 2002. 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. Conduct surface modification research and development, using infrared and laser heating, to reduce energy for heat treating and coatings of industrial components. Develop new super hard coatings and monolithic components using diamond deposition and borides. Develop improved refractories and insulating materials for high temperature processes to reduce down-time and improve energy efficiencies in the IOF industries.

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

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Materials for the Future (cont'd)		and development projects from competitive solicitation. ($13,698)	Develop combinatorial techniques, acquire thermophysical property data, and use the information for modeling materials synthesis and behavior in high temperature industrial environments. ($12,698)
Total, Industrial Materials for the Future	**$0**	**$13,698**	**$12,698**
Engineered Ceramics/CFCCs	Transferred all Engineered Ceramics/CFCC and Advanced Industrial Materials activities relating to the OPT/DER program, with their related funding, to OPT. Continued development, testing, and demonstration of CFCCs with superior high temperature strength and fatigue resistance, corrosion resistance, and wear resistance for various applications in the Vision Industries. CFCC materials helped industry realize substantial energy, economic, and environmental benefits, including higher efficiency, lower maintenance, and decreased operating costs. Demonstrated processing methods	Complete program with five projects that are now part of the Industrial Materials for the Future program. ($0)	No activities. ($0)

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

Program Activity	FY 2001	FY 2002	FY 2003
Engineered Ceramics/CFCCs (cont'd)	and feasibility of process scale-up for reliable and cost-effective ceramic composites in actual sizes and shapes consistent with industry needs for key near-term and intermediate term applications. Applications include immersion tubes for molten metals, hot gas filters for particle separation, radiant burners for glass bending, and drying applications. Long term testing and exposure of representative CFCC components were performed under application conditions for hundreds to thousands of hours. These long term exposures allow for the collection of data to support the benefits of using CFCCs and support industrial adoption and commercialization. Continued development of supporting technology effort for advanced ceramics (including CFCCs). These efforts built on results obtained from field testing and the supporting technology team evaluated components that had been tested in operating conditions for a better understanding of		

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

Program Activity	FY 2001	FY 2002	FY 2003
Engineered Ceramics/CFCCs (cont'd)	material properties and failure methods. Databases that include life and long-term reliability in appropriate environments were expanded. These efforts helped build the scientific foundation for the successful design, fabrication, characterization, and utilization of advanced ceramics for industrial applications. ($5,853) Participants included: Allied Signal Ceramics, Engineered Composites, Inc., General Electric, McDermott Technologies, Textron Systems, Oak Ridge National Laboratory, and Argonne National Laboratory.		
Total, Engineered Ceramics/CFCCs	**$5,853**	**$0**	**$0**
Advanced Industrial Materials	Shifted focus of intermetallic alloy research and development from nickel aluminize, a mature material being demonstrated by industry, to more rapid development of iron aluminides, molybdenum, and other silicides, and titanium aluminides. ($5,826)	Complete program with seven projects that are now part of the Industrial Materials for the Future program. ($0)	No activity. ($0)

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

Program Activity	FY 2001	FY 2002	FY 2003
Advanced Industrial Materials (cont'd)	Participants included: Oak Ridge National Laboratory, Sandia National Laboratory, Argonne National Laboratory, Weyerhaeuser, PPG Industries, Dow Chemical, Amoco, and other industry partners in CRADAs and other cooperative agreements.		
Total, Advanced Industrial Materials	**$5,826**	**$0**	**$0**
Combustion	**High-Efficiency Combustion Systems** (formerly Combustion Systems) Two program areas were awarded finding in FY 2000, super boilers and process heating. Both are multi-year projects with completion anticipated in FY 2004. ($1,690) Participants included the Gas Technology Institute, Southern California Gas, Donlee Technologies, Arthur D. Little, Callidus Technologies, and ExxonMobil.	**High-Efficiency Combustion Systems** (formerly Combustion Systems) Continue super boiler and process heater programs to meet combustion vision and roadmap targets. These projects build on advances made in very low emission burner projects in combination with improved systems design and better heat transfer. ($2,000) Participants included the Gas Technology Institute, Southern California Gas, Cleaver-Brooks, Arthur D. Little, Callidus	**High-Efficiency Combustion Systems** (formerly Combustion Systems) Continue super boiler and process heater program to meet combustion vision and roadmap targets. This project will be reaching full-scale prototype design and construction. The prototypes will achieve maximum efficiency and single-digit NO_x emissions. ($2,000) Participants include the Gas Technology Institute, Southern California Gas, Cleaver-Brooks, Arthur D. Little, Callidus Technologies, and ExxonMobil.

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

Program Activity	FY 2001	FY 2002	FY 2003
		Technologies, and ExxonMobil.	
Combustion (cont'd)	**Industrial Gasification** Design study awarded in FY 2000 was completed. Two additional awards were made for engineering design, cost projections, and identification of critical R&D needs for systems in industrial plants. Funding and oversight is from Industrial technologies with project management implemented through National Energy Technology Laboratory (NETL). Developed solicitation for a technology support program guided by industry and utilizing the expertise of NETL, ORNL, and NREL. Supporting technical areas include sulfur management, gas clean-up, materials, systems integration, and other combustion- related studies. ($12,697) Participants included: Georgia Pacific, Boise Cascade, GTI, Thermo-Chem, Fluor-Daniel, Oak Ridge National Laboratory,	**Industrial Gasification** Complete black liquor gasifier engineering study and procurement and initiate construction for the Big Island, VA, demonstration. Continue engineering design and cost projections for biomass gasification demonstration (DeRidder, LA). Make awards for the technology support program guided by industry and expertise of NETL, ORNL, and NREL. Supporting technical areas include sulfur management, gas clean-up, materials, systems integration, and other combustion-related studies. ($16,391) Participants include: Georgia Pacific, Boise Cascade, GTI, Thermo-Chem, Fluor-Daniel, Oak Ridge National Laboratory, National Energy Technology Laboratory, and National Renewable Energy Laboratory.	**Industrial Gasification** Procurement and construction will be completed and start-up and shake-down begun for the Big Island, VA, mill demonstration of black liquor gasification. Engineering will be completed for the DeRidder biomass gasification demonstration. Engineering design and cost projections will begin for Kraft black liquor gasification demonstration. Continue the technology support program guided by industry and expertise of NETL, ORNL, and NREL. ($13,600) Participants include: Georgia Pacific, Gaylord Container, Boise Cascade, GTI, Thermo-Chem, Fluor-Daniel, Oak Ridge National Laboratory, National Energy Technology Laboratory, and National Renewable Energy Laboratory.

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

Program Activity	FY 2001	FY 2002	FY 2003
	National Energy Technology Laboratory, and National Renewable Energy Laboratory.		
Total, Combustion	**$14,387**	**$18,391**	**$15,600**
Sensors and Control Technologies	Continued to implement program plan to achieve leapfrog advancement of sensor and control technologies that have high impact on two or more IOF industries. The focus was on bringing projects into the field demonstration phase and continuing the bench-scale research and development of projects awarded in FY 2000. Notable demonstrations included: 1) an online, laser-based ultrasonic system to measure wall thickness and eccentricity of steel seamless mechanical tubing during piercing, elongation, and rotary sizing operations, 2) an intelligent extruder which incorporated low-cost, readily available sensors into inferential control to produce quality resin products in polymer compounding, and 3) a non-proprietary, dynamically reconfigurable, wireless-network architecture that provided	Continue to identify, develop, and deploy crosscutting technologies to meet performance requirements specified in the IOF Roadmaps and thus help the IOFs attain Vision goals. Continue to achieve advances in non-proprietary, dynamically reconfigurable wireless architecture and conduct field trials in two paper mills, complete laboratory development and evaluation of a realtime sensor to measure constituents in industrial melts in the aluminum, glass, and steel industries, and apply thermal imaging system to furnaces to improve operating energy efficiency. ($3,774) Participants include: Timken Company, Gas Technology Institute, GE Research & Development Center, PPG, Energy Research Company, Tennessee Technological University, Oak	Continue to identify, develop and deploy crosscutting technologies to meet performance requirements specified in the IOF Roadmaps and thus help the IOFs attain Vision goals. Use 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 and leverage government funds with industry funds. Evaluate IOF-sponsored sensor and control projects for applicability in industries other than originally intended. Complete laboratory development and evaluation of a realtime sensor to measure constituents in industrial melts in the aluminum, glass, and steel industries and apply thermal imaging system to industrial furnaces to improve operating

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

Program Activity	FY 2001	FY 2002	FY 2003
Sensors and Control Technologies (cont'd)	standardized communication protocols and data structures for measurements with accuracy and reliability, as well as those for harsh-environment (high temperature or corrosive) sensing. ($3,763) Participants included: Timken Company, Gas Technology Institute, GE Research & Development Center, PPG, Energy Research Company, Tennessee Technological University, Oak Ridge National Laboratory, T/J Technologies Inc., Detection Limit Inc., and Concurrent Technologies Corporation, National Research Council Canada, University of Illinois, Combustion Tec, Owens Brockway Glass Containers, Krupp 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.	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.	energy efficiency. ($3,774) Participants include: Timken Company, Gas Technology Institute, GE Research & Development Center, PPG, Energy Research Company, Tennessee Technological University, Oak Ridge National Laboratory
Total, Sensors	**$3,763**	**$3,774**	**$3,774**

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

Program Activity	FY 2001	FY 2002	FY 2003
and Control Technologies			
NICE³	NICE³ provides a voluntary, non-regulatory approach to improve competitiveness, foster energy efficiency, and reduce waste. Working with the States, awarded 10 new grants to demonstrate innovative energy saving process technologies in the Industries of the Future. Completed the development of a briquetting process for industrial furnaces that will save 6 trillion Btu by 2010. ($5,092)	Incrementally fund 8 new projects to demonstrate energy saving technologies in the Industries of the Future. Complete the development of a combinatorial chemical analysis technology that samples 20-100 times faster than current prep-scale Liquid Chromatography technology. ($2,736)	Provide financial assistance to demonstrate energy saving technologies in the IOF industries. There will be approximately 8 incrementally funded grants awarded in FY 2003. Complete the development of a high efficiency adjustable speed drive coupling system to reduce energy costs by 40-74% for motor driven systems in industry. ($2,736)
Total, NICE³	**$5,092**	**$2,736**	**$2,736**
Inventions and Innovation	I&I supports the early-stage development of energy-efficient technologies. The program continued to work closely with the NICE³ Program to support an integrated delivery of Industrial technologies's services to IOF partners. The I&I program awarded	Continue funding energy saving projects initiated in FY 2001. Incrementally fund 20 grants to independent inventors and small technology-based businesses through a competitive processes.	Continue to provide financial assistance to inventors and innovators developing energy saving technologies. Two technology implementation workshops for small businesses and independent inventors are planned. The program will continue to work closely with
Inventions and Innovation	41 grants to independent inventors and small technology-based	Continue to provide assistance to small businesses and independent	the NICE³ Program to support an integrated delivery of Industrial

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

Program Activity	FY 2001	FY 2002	FY 2003
(cont'd)	businesses through competitive processes. Conducted one technology implementation workshop for small businesses and independent inventors. Completed the development of a metal casting stress relief process that will reduce energy consumption by up to 98% compared with natural-gas fired heat treatment. ($4,798)	inventors to develop skills in technology commercialization. Conduct two technology implementation workshops. Complete the development of a Distillation Column Flooding Predictor that identifies instability in a petroleum refinery distillation tower prior to flooding. The technology will improve petroleum refinery distillation tower throughput by 2 to 5 percent. ($4,372)	technologies's services to IOF partners. Incrementally fund up to 20 grants to independent inventors and small technology-based businesses. ($2,372)
Total, Inventions and Innovations	**$4,798**	**$4,372**	**$2,372**
Industrial Technical Assistance	**Industrial Assessment Centers** Continued to support IAC's efforts to provide hands-on training at 26 participating universities in energy and waste management to an additional 120 engineering students and to conduct approximately 650 new combined energy, waste, and productivity assessments. The program worked closely with the	**Industrial Assessment Centers** Provide energy, waste, and productivity training to 120 engineering students at 26 participating universities. Conduct approximately 650 assessment days of service to manufacturing clients. Work closely with other Industrial technologies programs to deliver industrial services in an integrated	**Industrial Assessment Centers** Provide energy, waste, and productivity training to 140 engineering students at 26 participating universities. Conduct approximately 750 assessment days of service to manufacturing clients. The program will work closely with other Industrial technologies programs to deliver industrial

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

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)	other Industrial technologies Technical Assistance programs to fully support an integrated delivery of services and provided industrial assessment expertise to identify and capitalize on technology applications at participating showcase plants. The IAC database, with data on over 9,000 industrial assessments, helped these plants target specific opportunities for efficiency. Engineering students who have worked with the 26 IAC's nationwide continue to graduate with the experience and skills necessary to implement energy efficiency, waste reduction, and productivity improvements. Continued to implement recommendations from the Strategic Program Review. Conducted a solicitation for Special Projects to provide IACs the opportunity to perform work that compliments Industrial technologies's R&D activities, student projects on industrial efficiency, and regional and local	fashion. Providing industrial assessment technical expertise to Industries of the Future Showcase Plants. Conduct a solicitation to select new Field Manager(s). ($5,859) .	services in an integrated fashion. Provide industrial assessment technical expertise to Industries of the Future Showcase Plants. The program continues to provide 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(s). ($7,694)

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)	initiatives that support DOE objectives. Projects support the research objectives of the professor and the institution or department. Project results will be presented to IAC Directors, incorporated into the integrated delivery process, presented at conferences, published in technical journals, and made available via the internet. Special projects are conducted in addition to industrial assessments. ($6,762)		
	Best Practices To provide better customer service and reduce costs, Industrial technologies initiated the Best Practices Program that integrated the activities of: Motors and Compressed Air, Process Heating, and Steam. Provided credible technical information and assistance to help U.S. manufacturers lower their energy bills, often with little or no capital investment. ($0)	**Best Practices** Provide technical assistance to 6 plant sites on use of industrial process application tools relevant to motor, pump, process heating, steam, and compressed air systems. Select 8 plant-wide assessments for cost-shared financial assistance and development of a comprehensive energy-saving strategy for the selected plants. Broaden the Allied Partnership to 50 companies from industry and trade associations representing all IOF industries to support wide dissemination and use	**Best Practices** 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. Efforts will

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)		of Industrial technologies information and products. Develop a Best Practices Resource Software Suite for decision-making across plant operations. Conduct 2 state level Energy Fairs. Conduct 2 plant-wide showcases in support of IOF partnerships to demonstrate emerging technologies and their performance benefits under real-use conditions. Initiate validation of energy/environment/economic performance of 8 emerging technologies through an independent, third-party entity to help promote industry acceptance of new technologies. ($9,070)	continue to increase Allied Partners to 100 companies from the IOF industries, support industries, and trade associations. Use Allied Partnerships to facilitate replication of the whole Best Practices portfolio including the conduct of 5 regional/state-level Energy Fairs. Support 2 plant-wide showcases in support of IOF partnerships 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. ($8,235)
	Motors and Compressed Air/Steam Motors and compressed air technical assistance support and expertise were provided as critical components of Industrial	**Motors and Compressed Air/Steam** Transferred and consolidated under the Best Practices Program. ($0)	**Motors and Compressed Air/Steam** Transferred and consolidated under the Best Practices Program. ($0)

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

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)	technologies's integrated delivery of technical assistance services under the Best Practices program. The programs continued to work with manufacturers to identify and target new energy efficiency and productivity opportunities and to help them develop and refine the credible, unbiased tools that assist industry in making the most informed energy decisions. ($7,020) Participants included: Oak Ridge National Laboratory, National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Macro International, and Washington State University Extension Office.		
	Steam The Steam Program continued to be a full-fledged initiative jointly partnered by DOE and the Alliance to Save Energy under Industrial technologies's integrated delivery effort under the Best Practice program. Technical assistance,	**Steam** Transferred and consolidated the program under the Best Practices program. ($0)	**Steam** Transferred and consolidated the program under the Best Practices program. ($0)

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)	information, and tools were provided to plants interested in improving the energy efficiency of their steam systems and industrial heating equipment. This program provided valuable unbiased information on system design, equipment, purchase, and operation from experts with practical experience addressing steam system challenges. As with motors and compressed air, this program aims to increase U.S. industrial energy efficiency by helping industry adopt the systems approach with boilers, steam distribution systems, steam applications, furnaces, and other equipment. The Steam program worked with suppliers, equipment manufacturers and end-users to garner the greatest impact. At the same time, integrated delivery of technical assistance provides the right level of assistance to each plant as part of the Best Practices Program. ($1,234) Participants included: Oak Ridge		

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

Program Activity	FY 2001	FY 2002	FY 2003
Industrial Technical Assistance (cont'd)	National Laboratory, National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, and Macro International.		
Total, Industrial Technical Assistance	**$15,016**	**$14,929**	**$15,929**
Technical/Prog. Management Support	Provided critical technical and program management support services. ($5,002)	Provide critical technical and program management support services. ($3,000)	Provide critical technical and program management support services. ($4,000)
TOTAL, INDUSTRIES OF THE FUTURE (CROSS-CUTTING)	**$59,737**	**$60,900**	**$57,109**