OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY
U.S. DEPARTMENT OF ENERGY

TURNING INDUSTRY VISIONS INTO REALITY

THROUGH TECHNOLOGY PARTNERSHIPS, TODAY'S INDUSTRY LEADERS SET THEIR SIGHTS ON MAJOR GAINS IN ENERGY EFFICIENCY AND PRODUCTIVITY

OFFICE OF INDUSTRIAL TECHNOLOGIES

" As U.S. industries face the economic, technological, and environmental challenges of the new millennium, the U.S. Department of Energy is there to support them. Our customer-driven Industries of the Future strategy is helping companies in some of our most energy-intensive industries to work together in developing and achieving a unified vision of the future. By sharing resources and joining collaborative partnerships, our industrial partners are accelerating the development and adoption of energy-efficient technologies and processes. On the basis of these efforts to make more efficient use of energy and materials, the Nation's industrial sector can look forward to major gains in productivity, improved environmental performance, and increased competitiveness in global markets."

Bill Richardson
Secretary of Energy

A NEW ROAD TO AN ENERGY-EFFICIENT AND COMPETITIVE FUTURE

Driven by pressures to reduce costs and improve productivity, U.S. industry is realizing the benefits of energy-efficient technologies in helping to maintain its competitive position. Faced with the rapid pace of technology innovation and the rising cost of research and development (R&D), few organizations possess the resources needed to develop advanced technologies alone.

In partnership with industry, the U.S. Department of Energy's Office of Industrial Technologies (OIT) —under the Assistant Secretary for Energy Efficiency and Renewable Energy—is helping to develop, demonstrate, and deploy technologies that could save over a quadrillion Btu of energy a year. Greenhouse gas emissions could also be reduced by over 25 million tons as a result of these new technologies and processes.

Through OIT's customer-driven Industries of the Future strategy, industry has greater influence in setting public R&D priorities and improved access to a wide array of technical expertise and facilities. The bottom-line is savings in energy and materials, cost-effective environmental compliance, increased productivity, reduced waste, and enhanced product quality.

By partnering with OIT in prioritizing and addressing its technology needs for the next two decades, industry has embarked on a new road to a more competitive and sustainable future.

The Office of Industrial Technologies is helping industry identify and pursue technology needs through public-private sector partnerships. OIT, an office of the U.S. Department of Energy, through its customer-driven Industries of the Future strategy, encourages energy-intensive industries to work together to:

- Create broad, industry-wide goals for the future
- Identify specific needs and priorities through industry-led roadmaps
- Form cooperative alliances to help attain those goals through technology partnerships

OIT's Industries of the Future Strategy

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INDUSTRIES OF THE FUTURE

OIT enables energy-intensive U.S. industries to determine their collective needs for tomorrow through its widely acclaimed Industries of the Future strategy. This strategy ensures that Federal R&D and other resources are aligned with industry's priorities. The Industries of the Future include:

- Aluminum
- Steel
- Metalcasting
- Glass
- Mining
- Agriculture
- Chemicals
- Forest Products
- Petroleum

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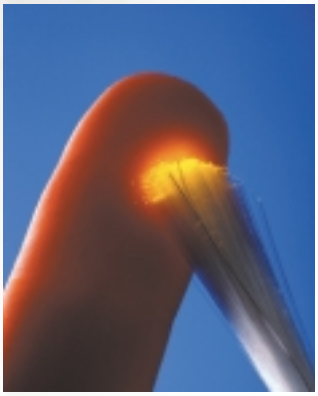
INDUSTRY VISIONS

To help determine its R&D needs, each of these industries has developed a unified vision of its future. Working cooperatively, these industries set broad "stretch" goals in such areas as energy efficiency, environment, human resources, and competitiveness.

PAGE 7

ROADMAPS

After completing its vision, each industry creates detailed roadmaps to define the critical needs and priorities for meeting its near-, mid-, and long-term goals.



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COMPETITIVE SOLICITATIONS

OIT offers competitive research, development, and demonstration (RD&D) solicitations that are guided by the technology needs identified in the roadmapping process. The industries assist in shaping OIT's portfolio by helping define needs, running solicitations, and assisting in technical review of proposals for cost-shared technology partnerships. OIT provides up to 70% of project funds and resources to selected RD&D partnerships.

PAGE 9

RESOURCE LEVERAGING

The partnering process helps industry and government maximize scarce R&D funds and resources. These partnerships also reduce investment risks.

PAGE 10

CROSSCUTTING TECHNOLOGY AND ASSISTANCE PROGRAMS

OIT also supports the development of key energy-efficient technologies, such as advanced sensors and controls, that have applications across a broad range of industries. In addition, a wide array of technical, financial, and information assistance is offered that can help reduce energy use and improve competitiveness right now in the Industries of the Future and many other industries.

PAGE 13

IOF PORTFOLIO HIGHLIGHTS, TECHNOLOGY SHOWCASES

OIT pursues a balanced portfolio of near-, mid-, and long-term projects to support energy-efficiency advances in the most energy-intensive industries. Periodically, technologies emerging from these efforts are highlighted in technology showcases to give manufacturers a firsthand look at how they work.

PAGE 16

BENEFITS

U.S. energy-intensive industries become more energy- and resource-efficient and competitive, while the entire Nation benefits from a stronger economy and a cleaner environment.

OIT EMPLOYS CUSTOMER-FOCUSED MARKETING THROUGH AN INTEGRATED DELIVERY STRATEGY

OIT offers its industrial customers a wide array of products and services to enhance energy efficiency and competitiveness. So that our many customers can benefit most from the full range of programs that we offer, OIT is striving to deliver these programs in an "integrated" manner.

"Integrated delivery" is a way of doing business that provides a coordinated and appropriate package of services to each customer—from the shop floor, to the lab, to the executive suite. It attempts to deliver the right services at the right time to the right person, according to his or her needs.

Industries of the Future

FOCUS ON THE MOST ENERGY-INTENSIVE INDUSTRIES

Economic Significance

As a group, our focus industries :

- Supply over 90% of the U.S. economy's needs for materials
- Account for more than 3 million well-paying jobs, over $1 trillion in product shipments, and about 7% of GNP plus an economic multiplier estimated at 4
- Underpin the entire industrial infrastructure and are essential in supporting a secure national defense

Energy Use

Collectively, the nine industries that are the focus of the Industries of the Future account for about 75% of all energy use by U.S. industry.

Environmental Cost

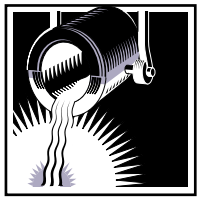
The Industries of the Future are among the most environmentally challenged U.S. industries.

Aluminum

- The U.S. aluminum industry employs more than 130,000 people, contributing more than $30 billion to U.S. GDP.
- Energy represents a large share (21%) of the value of shipments for primary aluminum, giving competitive advantage to offshore producers with access to lower-cost electricity.

Steel

- The U.S. iron and steel industry employs about 200,000 in jobs paying 50% more than the average manufacturing worker makes.
- The energy required to produce a ton of steel in integrated mills has decreased by 45% since 1975.

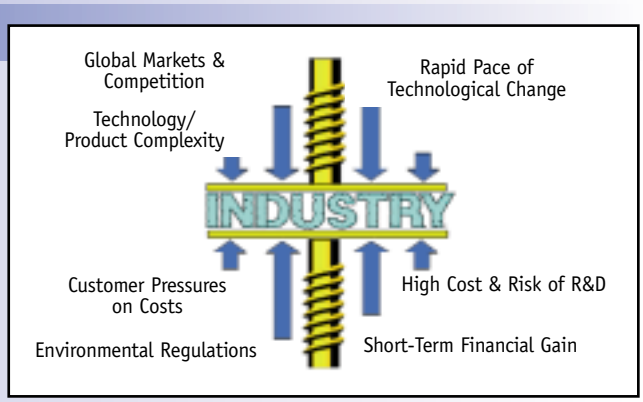


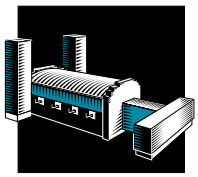
Metalcasting

- The U.S. metalcasting industry consists of 3,100 companies, 80% of which have fewer than 100 employees.
- Energy accounts for about 15% of industry costs.

Competitive Pressures

Significant competitive pressures discourage many private firms from pursuing the long-term, high-risk research necessary to support progress toward more efficient technologies. One of these pressures is the rising cost of R&D as technologies become increasingly complex and dynamic. In addition, stockholder demand for near-term profits is causing many manufacturers to shift investments away from higher-risk, longer-term research.





Glass

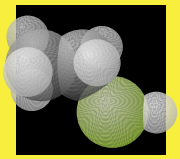
- The U.S. glass industry employs more than 150,000 workers in skilled jobs.
- Glass melting takes about twice as much energy as is theoretically necessary (due to losses and inefficiencies), but use of recycled glass dramatically cuts energy use.

Agriculture

- Over 3.4 million people are employed in the U.S. agriculture industry.
- The industry accounts for about 8% of all energy consumed by U.S. industry, and its annual energy costs are well over $14 billion.

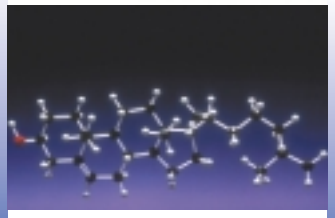
Mining

- Mining employees earn an average of $42,000 per year—among the highest of all U.S. industry.
- About 77% of all U.S. electric power generation is fueled by domestic coal and uranium mines.



Chemicals

- The U.S. chemicals industry employs over a million workers (all levels); production workers average $15.67 per hour, significantly higher than the average of $12.35 per hour for the entire manufacturing sector.
- Although chemicals is the second largest energy-using industry in manufacturing, it uses only about half of its energy as fuel; the rest is used as feedstock (input to products).



Forest Products

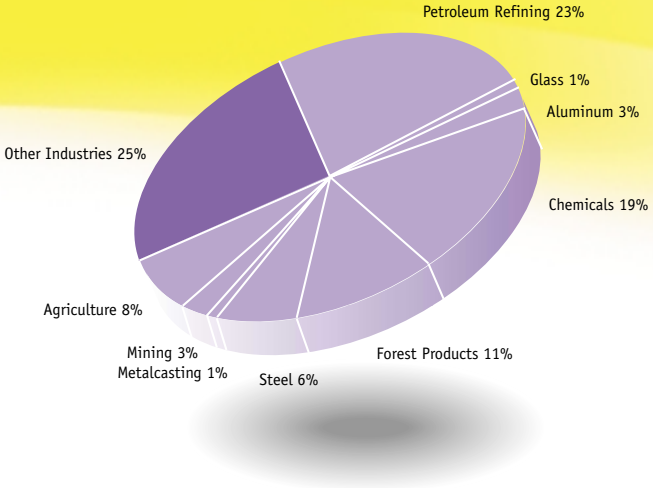
- The forest products industry employs more than 1.3 million people and ranks among the top-10 manufacturing industries in 46 States.
- The third largest energy user in U.S. industry, the forest products industry meets 57% of its energy needs from biomass.

Petroleum

- In 1995, the average hourly wage for production workers was nearly $22 per hour.
- While petroleum refining uses more energy than any other industry, over half its energy needs are met with by-products produced on-site.

Industrial Energy Use

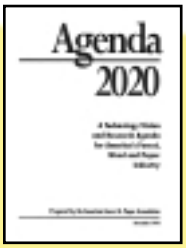
Total = 34.1 quadrillion Btu



Industry Strategic Visions and Roadmaps

HOW OIT CUSTOMERS HELP SET PRIORITIES FOR OUR TECHNOLOGY AND ASSISTANCE PORTFOLIOS

Forest Products
November 1994



Steel
May 1995

Metalcasting
September 1995

Glass
January 1996

Aluminum
March 1996

Chemicals
December 1996

Agriculture
January 1998

Mining
September 1998

Visions

As the first step in the Industries of the Future process, each of the most energy-intensive industries develops a vision of its desired future. This vision identifies key challenges confronting the industry over the next 20 years and establishes broad, industry-wide goals. These goals provide a framework for the subsequent development of a technology roadmap.

Forward-thinking industry leaders come together to identify the principal market, business, and societal trends affecting their industry. On the basis of current projections, they then identify the major challenges and barriers the industry is likely to face.

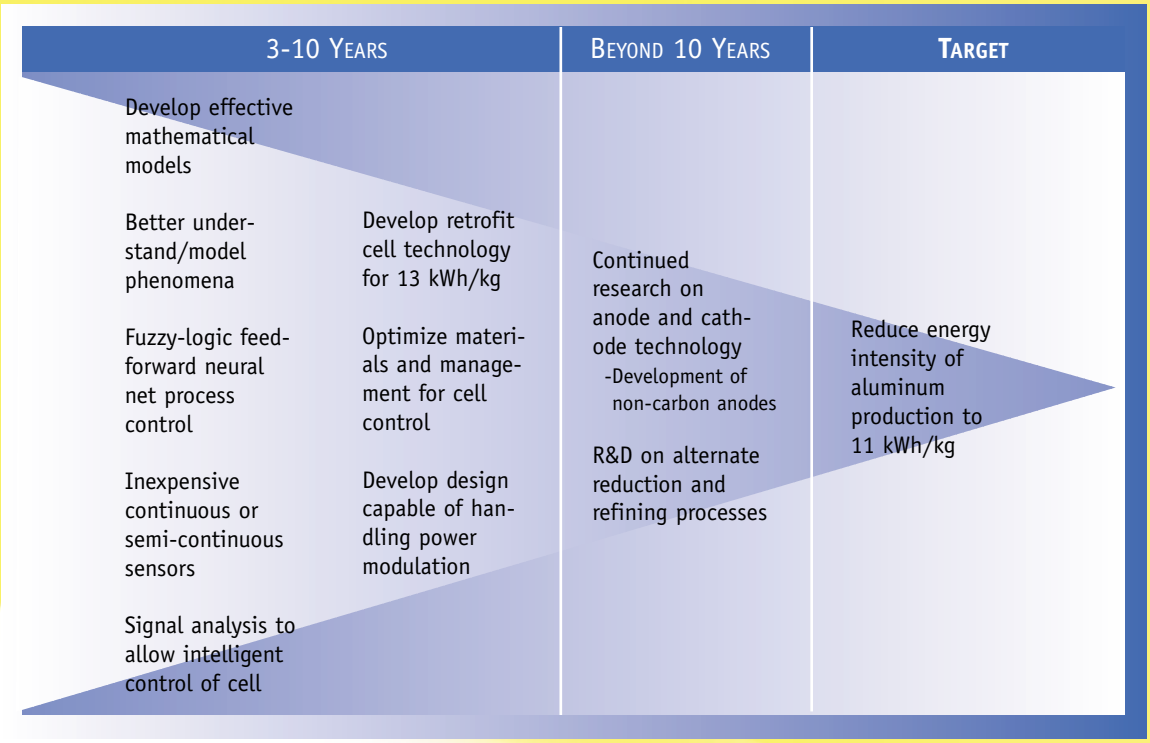
After assessing the challenges, industry representatives must then come to consensus on strategic objectives and broad performance targets that will enable the industry to meet the challenges ahead in each area.

"It has helped the industry for the first time in its 300 years come together with a real consensus on its long-term research priorities."

- W. Henson Moore
President and CEO American Forest and Paper Association
(speaking about Agenda 2020, the industry's strategic vision)

Roadmaps Identify Top R&D Needs and Logical Sequence

Research Needed to Meet Performance Target in Primary Aluminum Production



Each industry creates a roadmap identifying short- and long-term performance targets. As an example, the aluminum industry has identified the research needs required to reduce energy use during aluminum production.

Roadmaps

The roadmap provides a long-term strategy for attaining industry-defined goals. It provides specific, quantified performance targets and maps out a logical, prioritized sequence of research and development. It may also identify appropriate roles for public and private partners in the process.

Knowledgeable and experienced individuals representing a broad cross-section of the industry participate in the development of the roadmap. In addition, representatives of major suppliers, customers, and research organizations may contribute valuable insight to the process. Once a draft has been assembled, a leading industry trade association or similar group generally disseminates the document for broader industry review and coordinates integration of comments.

The completed roadmaps are widely publicized and disseminated. This helps to align the diverse R&D efforts of the public and private sectors with industry priorities.

"The [Industries of the Future process] has allowed us not only to identify but to prioritize the types of things that really make sense for us to work on together."

- Tom Usher
CEO of USX Corporation

Competitive Solicitations

FINANCIAL ASSISTANCE AWARDS TO PROPOSALS THAT MEET INDUSTRY-DEFINED CRITERIA

OIT issues competitive solicitations (requests for proposals) for research, development, and demonstration work on the technologies identified in the industry-produced roadmaps. Separate solicitations are prepared for each IOF industry, including aluminum, steel, metalcasting, glass, mining, agriculture, forest products, chemicals, and petroleum. Industry often participates in administering OIT's competitive solicitation process, assisting in the development of focus areas and the technical review of proposals.

Additional solicitations are conducted annually by OIT's National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3) program and its Inventions and Innovation program (see page 12). Other solicitations recently issued by OIT have addressed such areas as sensors and controls, and State programs.

Although processes differ somewhat for each industry solicitation, the following steps generally apply:

Requests for Proposals (RFPs) are announced in the *Commerce Business Daily* and on the OIT Web site. Cooperative partnerships among industry, academia, and National Labs are encouraged to submit proposals for the precompetitive research described in the RFPs.

Proposals received from prospective research teams are reviewed by a panel of industry experts. Selection criteria are usually based on priorities established in the technology roadmaps as well as on the broader OIT/DOE mission to promote energy efficiency and a clean environment. OIT makes the final award decisions, taking into account recommendations by industry.

The selected projects are eligible to receive financial assistance from the government. OIT generally provides 50% to 70% of the required funding.

Your Intellectual Property Rights Are Protected

OIT wants its partners to own the rights to intellectual property developed during research. Specific understandings are negotiated before cooperative research agreements are signed. Our partners also enjoy the following safeguards:

- Proprietary data are not published.
- Public release of nonproprietary data may be delayed for up to 5 years.
- The public does not have access rights to private facilities.

Resource Leveraging

INDUSTRIES OF THE FUTURE ENABLES COMPANIES TO SHARE RISKS AND MAKE THE MOST OF SCARCE RESOURCES

OIT facilitates leveraging efforts throughout the public and private sectors. To help industry coordinate and focus technology resources on industry's biggest needs, OIT performs the following activities:

- Maintains close communications with other offices in the Department of Energy, its National Lab system, and other Federal agencies
- Sponsors joint functions that bring together research performers and supporters with similar interests
- Provides IOF partners with access to a wealth of information on current and past R&D projects (essential in bringing together the right mix of skills, facilities, and experience)

Overall results of these leveraging activities include lower costs, reduced duplication of effort, and accelerated movement of technologies that can save energy and enhance competitiveness to U.S. industry.

State Industries of the Future Programs

States are selectively using the Industries of the Future strategy to boost the competitiveness of energy-intensive industries and companies within their boundaries. By joining with the national-level IOF efforts, States simultaneously improve their relationship with industry and strengthen their local economies.

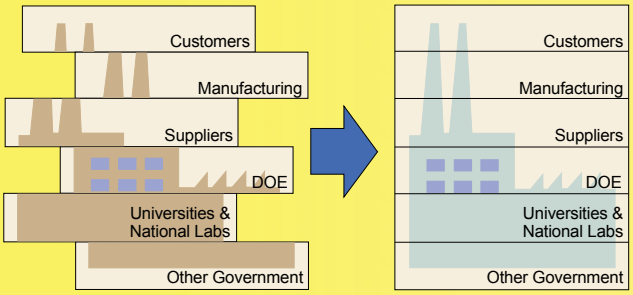
State initiatives are led and owned by industry and State officials; OIT's role is to provide support by networking with the National Labs, field offices, industry contacts, and States.

Laboratory Coordinating Council Works Closely with OIT

The Laboratory Coordinating Council (LCC) enables the Department of Energy's 17 laboratories and highly specialized research facilities to function as a single "virtual" laboratory that can be tailored to specific technology needs. The LCC works closely with OIT to enhance lab usefulness in addressing the priority needs of IOF industries.

Through the LCC, experts from various DOE labs are now working with industry on a variety of exciting projects that will reduce energy use, cut waste and pollution, and save money.

The Industries of the Future process helps make the most of scarce resources by realigning technology investments by stakeholders across the board.



Crosscutting Technology and Assistance

RD&D, TECHNICAL ASSISTANCE, AND OTHER RESOURCES IMPROVE ENERGY EFFICIENCY AND COMPETITIVENESS IN A BROAD CROSS-SECTION OF U.S. INDUSTRIES

Responding to industry's generic needs for both near- and long-term efficiency improvements, OIT provides a diverse range of tools and assistance. To increase future energy efficiency, productivity, and competitiveness, OIT works with industry to cooperatively identify and pursue R&D in Enabling Technologies and Distributed Generation. To help industry get energy-efficient technologies and processes to work for them in the near term, OIT offers Technical Assistance and Financial Assistance, as well as a wide range of information resources.

Distributed Generation

As part of DOE's focus on clean, efficient power, OIT supports the development and demonstration of ultra-high-efficiency power systems for industry. Technologies include turbines and focus on increasing the efficiency of industrial systems by 15% and lowering NO_x emissions. The Industries of the Future purchase over $16 billion of electricity annually; the chemical, forest products, and refining industries are particularly likely to reap significant benefits from these new technologies.

Enabling Technologies

A number of key technologies are important to a large cross-section of U.S. industries, including those that have adopted OIT's Industries of the Future model. Because of the widespread use of these technologies, even small energy improvements can mean substantial energy and cost savings. Research partners participate through Collaborative Research and Development Agreements (CRADAs) or via competitive solicitations.

Combustion technology improves energy efficiency, increases productivity, reduces emissions, and provides greater fuel flexibility in a wide range of industries. Projects address precompetitive combustion research, burner development, and efficiency improvements in industrial boilers and process heating systems. One long-term goal is to reduce boiler NO_x emissions from the combustion of gaseous fuels to two parts per million.

Advanced **Sensor and Control** technologies can reduce energy use, materials waste, and emissions in U.S. industry. Major thrusts are to develop sensors that can withstand high temperatures and harsh environments and to improve technologies for reliably integrating and processing information from diverse sensors to accurately analyze and remedy malfunctions.

Applications of advanced technologies and processes are often limited by the capabilities of the available materials. **Advanced Industrial Materials** (AIM) that resist high-temperature fatigue, corrosion, and wear can help U.S. industry enhance productivity, product quality, and energy efficiency. Research focuses on metallic and intermetallic alloys, structural polymers and membrane materials, and materials processing methods.

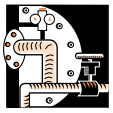
Continuous Fiber Ceramic Composites (CFCCs) provide U.S. industry with lightweight, strong, and durable materials capable of performing in corrosive, high-temperature environments. Applications of CFCCs in heat exchangers and advanced gas turbines, for example, permit operation at the higher temperatures needed to improve energy conversion efficiencies and reduce fuel use and emissions.

HELPING INDUSTRY MAKE USE OF THE LATEST ENERGY-EFFICIENT TECHNOLOGIES

Technical Assistance

OIT provides unbiased information, technical assistance, plant audits, training, decision tools, grants, and awards. Industry benefits include improved energy efficiency and productivity, and enhanced environmental quality and public recognition, as well as immediate cost savings.

The **Motor Challenge** program helps manufacturers with motor-driven applications to improve motor system performance; reduce costs related to electric motors, drives, pumps, fans, and other components; and take advantage of decision tools, training, and awards for industrial use of energy-efficient electric motors.

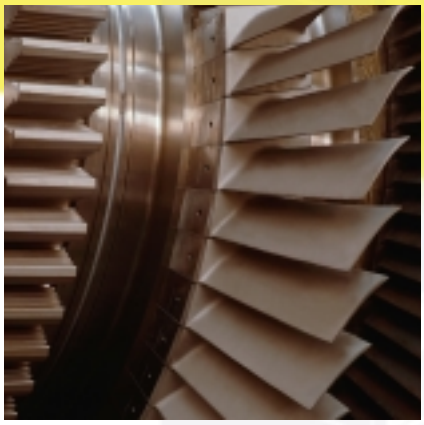


In conjunction with the Alliance to Save Energy, OIT sponsors the **Steam Challenge** to help industry adopt a systems approach to steam equipment and applications and boost productivity through more efficient steam systems.

Through **Compressed Air Challenge**, U.S. manufacturers can take advantage of education, technical training, and certification programs to achieve an estimated $150 million in cost-saving opportunities through efficient compressed air systems.

Combined Heat and Power Challenge seeks to improve significantly U.S. energy efficiency by helping manufacturers overcome the major barriers to installing combined heat and power systems: environmental permitting and siting, nonsupportive restructuring policies, and unreasonable interconnection requirements.

Industrial Assessment Centers at 30 universities conduct no-cost assessments of small and medium-size manufacturers to identify potential savings from energy efficiency improvements, waste minimization and pollution prevention, and productivity improvements.



Crosscutting Assistance (continued)

Financial Assistance

Sometimes it takes a little money to help a good idea get rolling. OIT provides limited financial assistance to encourage new, energy-saving ideas and promote collaborative demonstrations of energy-efficient technologies.

The **Inventions and Innovation** program provides grants of up to $100,000 to individual inventors and small companies with promising ideas and inventions for improving energy efficiency and environmental performance. The program also offers practical information to help advance technology commercialization and a broad range of training and support.

OIT sponsors an innovative cost-sharing grant program to encourage demonstrations of technologies that promote energy efficiency, clean production, and economic competitiveness. The program, known as **National Industrial Competitiveness through Energy, Environment, and Economics (NICE³)**, provides up to $425,000 in grants to State and industry partnerships (large and small businesses) for projects that demonstrate advances in energy efficiency and clean production technologies.

Information and Other Resources

Through OIT, industry has easy access to information and other resources that facilitate and enhance participation in the Industries of the Future strategy. OIT plays a unique and valuable role in providing unbiased technical data, flexible training materials, neutral forums, information exchange, networking opportunities, and coordination with other Federal agencies. A few of these resources include:

Expo

OIT's biennial Industrial Energy Efficiency Expo:

- Provides a forum for suppliers and customers in government and industry to discuss strategies for working together to meet energy and material efficiency goals
- Examines industrial energy, economic, and environmental policy issues in a rich variety of sessions, workshops, and exhibits
- Provides an ideal environment for manufacturers, suppliers, customers, research laboratories, universities and government program managers to network and lay the groundwork for future partnerships

Industrial Projects Locator

The IP Locator is a user-friendly electronic database of unprecedented scope that:

- Provides useful information on more than 8,000 current and recent RD&D and technical assistance projects throughout the Federal government
- Lists technologies developed in DOE's own National Lab network, in other Federal labs, and in thousands of public-private sector R&D partnership efforts
- Is available to industry and the public at no cost at www.oit.doe.gov

Facilitation Skills

The IOF program provides a neutral forum in which industry representatives can meet. Trained facilitators are available to assist industry groups in reaching consensus on priority research needs to prepare for the future.

Information Resources Catalog

OIT's Information Resources Catalog describes over 400 publications, videos, software, and other information products, tools, and services available through OIT, including:

- The OIT Web site at www.oit.doe.gov
- *The OIT Times,* our quarterly newsletter

Highlights of OIT's Industries of the Future Portfolio

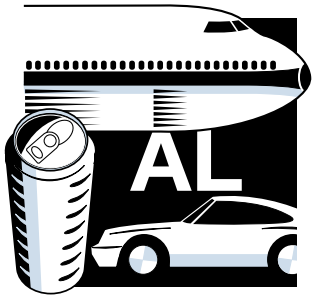
OIT's Industries of the Future portfolio possesses a unique blend of industry-specific and crosscutting R&D projects as well as financial and technical assistance projects and activities. While OIT's portfolio is developed to meet needs identified in technology roadmaps, we offer customers access to resources that can address the full spectrum of their near-, mid-, and long-term technology needs. In general, OIT seeks technology projects that target:

- Energy and materials efficiency
- Manufacturing systems and controls
- Precompetitive R&D
- Environment
- Recycling

The arrow charts in the pocket on the inside back cover provide greater detail on each industry's portfolio.

TECHNOLOGY SHOWCASES DEMONSTRATE APPLICATIONS IN OPERATING PLANTS

Advanced technologies and assistance success stories emerging from OIT's collaborative technology partnerships are periodically featured in Technology Showcases. These events allow members of an industry to get a firsthand look at a variety of energy-efficient technologies and programs currently or soon-to-be available to their industry. Attendees are given briefings, tours, and demonstrations to answer their questions and show them the technologies and business practices in use in an operating plant.



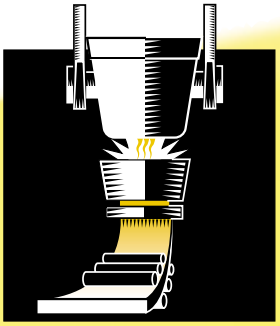
ALUMINUM

The industry has clearly defined technology barriers and performance targets for achieving its vision for the future. Priority focus areas are:

- Primary Products
- Casting
- Rolling and Extrusion
- Finished Products

Sample Projects

- Inert Anode
- Wettable Cathode
- Flotation Melter
- Advanced In-Line Sensors
- Spray Forming Sheet
- Advanced Degassing
- Molten Salt Detection/Removal
- Semi-Solids Processing
- Closed-Loop Recycling of Dross/Saltcake
- New Materials for Cathodes and Anodes
- Resistance Welding
- Scrap Decoater
- Emissions Reduction
- Heat Treatment of Cast Aluminum



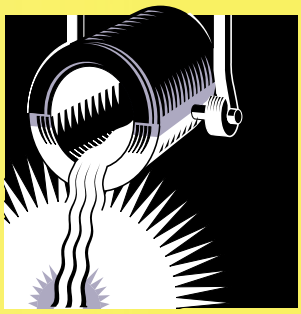
Steel

The industry has defined four critical areas in which continuous improvement will be needed if steel is to retain its position as the material of choice for the 21st century:

- Production Efficiency
- Iron Unit Recycling
- Environmental Engineering
- Production Development

Sample Projects

- Oxy-Fuel Burners for Steel Reheat
- Nickel Aluminide Steel Rolls and Furnace Fixtures
- Property Measurement Using Laser-Based Ultrasound
- EAF Dust Reduction
- Minimizing NO_x from By-Product Fuels
- Dilute Oxygen Combustion
- Advanced Control of Blast Furnace Operations
- Strip Casting: Anticipating New Routes
- Recycling of Waste Oxides in Steelmaking Furnaces
- Hot Oxygen Injection into Blast Furnaces
- Removal of Residual Elements in Recycled Steel
- Detection of Radioisotopes in Steel Scrap
- Temperature Measurement of Galvanneal Steel
- Improved EAF Refractory Service Life and Recycling



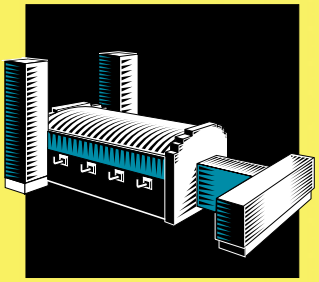
Metalcasting

The industry has developed a detailed blueprint of the technology milestones needed to achieve the goals outlined in its vision statement, *Beyond 2000*:

- Products and Markets
- Materials Technology
- Manufacturing Technology
- Environmental Technology
- Human Resources
- Profitability and Industry Health
- Partnerships and Collaboration

Sample Projects

- Advanced In-line Sensors
- Permanent Mold Technology
- Advanced Lost Foam Technology
- Die Life Extension
- Semi-Solid and Squeeze Casting
- Non-Contact Air Gauging System
- Advanced Turbine Single-Crystal Airfoils
- Advanced Ceramics Immersion Tube
- Molten Metal Filtering
- Lead-Free Copper Alloy
- CFCC Immersion-Tube Burners



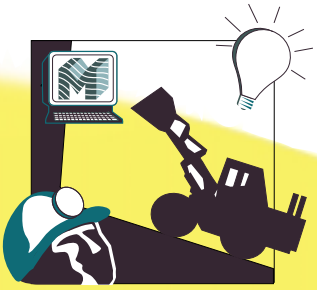
Glass

Glass: A Clear Vision for a Bright Future laid the groundwork for the industry to subsequently identify over 130 specific research needs in four focus areas:

- Production Efficiency
- Energy Efficiency
- Environmental Protection and Recycling
- Innovative Uses

Sample Projects

- Energy-Efficient Glass Coatings
- Composites and Coatings Gel Casting
- Ultraviolet Curing of Fiberglass Sleeving
- Advanced Combustion Space Models
- Refractories for Glass
- High-Temperature Properties Measurement



Mining

The mining industry seeks to retain its position as a global leader by pursuing broad goals in seven key areas:

- Efficient Production
- Exploration and Resource Characterization
- Extraction and Processing
- Emissions and By-Products Management
- Advanced Products
- Partnerships
- Communication and Education

OIT's mining team will run its first competitive R&D solicitation in FY99.

Highlights of OIT's Industries of the Future Portfolio (continued)

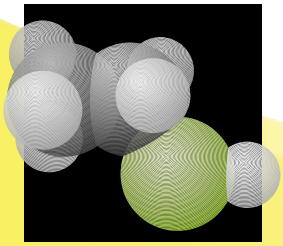
Agriculture

The industry envisions crops, trees, and agricultural wastes becoming an increasingly important source of raw materials for industry. As described in *Plant/Crop-Based Renewable Resources 2020*, simultaneous advances are required in :

Plant Input
- Waste and By-Products
- Existing Crop Parts
- Dedicated Crops
- Modified Genetics

Processing Systems
- Novel Molecules
- Bioprocesses
- Modified Chemistry
- Current Chemistry

OIT's agriculture team will run its first competitive R&D solicitation in FY99.



Chemicals

The industry's *Vision 2020* identifies four primary target areas:
- New Chemical Science and Engineering Technology
- Supply-Chain Management
- Information Systems
- Manufacturing Operations

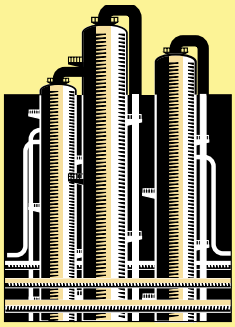
The unique nature of manufacturing processes for various chemicals necessitates the development of numerous discrete roadmaps.

Sample Projects
- Polyphosphazene Membranes
- Clean Fractionation of Renewables
- High-Performance Polymeric Membranes
- Biocatalysts for Industrial Applications
- Selective Inorganic Thin Films
- Advanced Distillation Control Methods
- CFCC Filters for Particulate Removal and Waste Heat Recovery

Forest Products

As articulated in *Agenda 2020,* the industry has endorsed research pathways in six technology areas:
- Sustainable Forest Management
- Environmental Performance
- Energy Performance
- Improved Capital Effectiveness
- Recycling
- Sensors and Controls

Sample Projects
- Wood Property Traits in Tree Species
- Intensively Managed Forest
- Built-In Pulping Catalysts
- Acoustic Separation
- Removal of Wax and Stickies
- Chlorine-Free Bleaching
- Low Lignin Content Pulp
- On-Machine Ultrasonic Sensors for Paper Stiffness
- Microwave Drying of Wood



Petroleum

The petroleum industry is currently developing an industry-wide vision. The downstream portion, focusing on refining, will be completed first.

Bottom-Line Benefits of Industries of the Future

A WINNING PROPOSITION ON MANY LEVELS

What's in it for your company?

IOF program participation offers significant benefits to individual manufacturers, suppliers, and vendors. As an IOF partner, you can:

- Reduce the cost and risk of nonproprietary R&D
- Acquire a bigger voice in directing R&D in your industry
- Stay at the forefront of technology and expand your technical knowledge base
- Leverage available funds and information resources
- Gain access to complementary technical expertise and facilities that can help your company today as well as in the future
- Enhance your corporate image

Additional benefits include possible patents or licensing agreements to participating organizations and possible launching of new products or spin-off companies. The program provides protection for proprietary technologies and capabilities. Further, private firms may be the first to benefit from more efficient technologies through pilot testing or demonstration programs.

What's in it for your industry?

All members of industry benefit from more efficient technologies once they've been commercialized. These technologies often:

- Save energy and materials
- Facilitate cost-effective compliance with environmental regulations
- Increase productivity and reduce waste
- Enhance product quality
- Result in industrial energy and cost savings that have a ripple effect throughout the U.S. economy
- Better equip U.S. manufacturers to meet competitive challenges in the global marketplace

What's in it for the Nation?

Ultimately, the IOF program benefits the Nation by helping to ensure that public funds target strategic needs. As industry adopts more efficient industrial technologies, all U.S. citizens will reap such benefits as:

- Reliable, affordable products for home and work
- A cleaner, healthier environment
- Greater energy security
- A robust economy

How can you learn more about us?

Project Fact Sheets
Learn about specific OIT projects by reading OIT's Project Fact Sheets. They're available on the Web and through the OIT Resource Center.

Brochures
Read OIT's Industry Team and Program Brochures to find out more about OIT activities in your industry, technology area, or program area of interest. Available through the OIT Resource Center.

The OIT Times
Get on the mailing list for *The OIT Times,* published quarterly to keep you informed of new activities and opportunities. Call the Resource Center to sign up.

Information Resources Catalog
Browse through OIT's Information Resources Catalog to check out OIT publications, videos, software, and other services. The catalog is on the Web and in the OIT Resource Center.

OIT Resource Center
Request specific publications from the OIT Resource Center by calling Marilyn Burgess at 202-586-2090.

OIT Web Site
Sign on to the OIT Web site to find out the latest on OIT programs, staff, projects, news, and more: www.oit.doe.gov

OIT's Aluminum Partnership Portfolio

Materials

- Intermetallic Alloy Skirts
- New Materials for Cathodes and Anodes
- CFCC Immersion-Tube Burners

Manufacturing

- Inert Anode
- Wettable Cathode
- Floatation Melter
- Explosion Prevention
- DC Plasma Melter
- Low-NO_X Melting
- Clean Casting
- Improved Casting Efficiency
- Advanced Sensors
- Advanced Degassing
- Molten Salt Detection/Removal
- Semi-Solids Processing
- Potlining Additives for Improving Efficiency
- Improved Grain Refinement Process

New Products & Markets

- Aluminum Bridge Decks
- Composites by Reactive Metal Infiltration
- Ultrasonic Impactor Joining
- Thermal Spraying (Bond Pretreatment)
- Resistance Welding
- Spray Form Al Metal Matrix Composites
- Microsmooth Aluminum Wheels

Energy

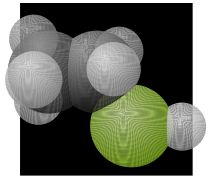
- Efficient Motor Systems
- High-Performance Steam
- Advanced Cogeneration
- Plant Energy Audits

Refining → Reduction & Melting → Casting → Rolling & Extrusion → Finished Products

Environment & Recycling

- Spent Potliner to Glass Fiber Products
- Al Scrap in Cellular Concrete
- Potlining Disposal
- Auto Shredder for Recycling

- Saltcake Recycling
- Reuse of Saltcake in Concrete Products
- Decoating Scrap Al
- Reducing Stack Emissions



OIT's Chemical Partnership Portfolio

Materials

- Selective Inorganic Thin Films
- Membrane Systems for Light Gas Separation
- Advanced Membrane for Production of p-Xylene
- CFCC Filters for Particulate Removal & Waste Heat Recovery

New Chemical Science & Engineering

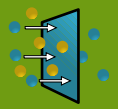
- New Nanoscale Catalysts
- Direct Production of Silicones From Sand
- Industrial Chemicals from Bio-Derived Acids
- New Electrochemical Reactors
- Clean Fractionation of Renewables
- Oxidative Cracking of Hydrocarbons to Ethylene
- Selective Oxidation of Aromatic Compounds
- Alkane Functionalization Catalysis
- Multi-phase Simulation of Fluid-Particle Systems
- Simulation Industrial Turbulent Gas-Solid Flows

New Products & Markets

- VapoSep Membrane Vapor Recovery
- Surface Activated Rubber Particles
- Chemicals for Brightness Stabilization of High Yield Bleaching Paper

Energy

- Efficient Motor Systems
- Efficient Compressed Air Systems
- Advanced Turbines for Cogeneration
- Energy & Waste Audits
- High-Performance Steam Systems



Separations

Catalysis

Bioprocesses

Computational Technologies

Environment & Recycling

- Electrodialysis for Production of Lactate Esters from Bio-based Feedstocks
- Electrodeionization for Recovery and Recycling of Waste and Water
- Low Temp Catalytic Gasification of Aqueous Process Streams
- Low-NO_X Turbine Retrofits

- Recovery of Thermoplastics for Reuse
- Flexible Chemical Processing of Polymeric Materials

OIT's Glass Partnership Portfolio

Materials

- Refractories for Glass
- Molybdenum Disilicide ($MoSi_2$) for Glass Applications
- CFCC Burners for Heating & Drying Applications

Production Efficiency

- Auto Glass Process Control
- Cullet and Batch Preheater
- Advanced Combustion Space Models
- Molten Glass Temperature Measurement

Innovative Uses

- Composites and Coatings
- Gel Casting
- Integrated Ion-Exchange Systems for High-Strength Glass

Energy Efficiency

- High-Luminosity, Low-NO_X Burner
- Plant Energy Audits
- High-Temperature Properties Measurement
- Efficient Motor Systems
- Combustion & Melting User Research Facility

Container Glass | Flat | Specialty | Fiberglass

Environmental Performance & Recycling

- Oxygen-Enriched Air Staging
- Electrophotographic Screening: TV Picture Tubes
- Modeling of Refractory Corrosion in Oxy-Fuel Furnaces
- Cullet Feedstock Purification

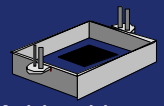
OIT's Metalcasting Partnership Portfolio

Materials

- Mg Die Casting Die Life
- Process/Design Parameters Lead Free Copper Alloys
- Cast Metal-Matrix Composites
- Cast, High Alloy Components Database
- Inoculation Studies
- Rapid Solidification of Metallic Alloys
- Solidification Control of Stationary Ingots
- Temperature Measurement of Galvanneal

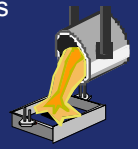
Manufacturing

- Unconventional Yield Studies
- Permanent Mold Technology
- Thin Section Steel Castings
- Advanced Lost Foam Technology
- Die Life Extension
- Semi-Solid and Squeeze Casting
- Plasma Refining
- Clean Cast Steel
- Rapid Prototype
- High Temperature Materials Lab (HTML)
- Microstructure Eng. Of Hot Strip Mills
- Laser Plasma Sensor (In-Situ)



Moldmaking

Melting



Pouring

New Products & Markets

- Non-contact Air Gauging System
- Lost Foam Process Controls
- Qualitative Reasoning for Die Casting
- Evaluation of High Molybdenum Stainless Steel
- Cast Particulate Metal Matrix Components
- Apparatus & Method for Filtering Molten Metal
- Advanced Turbine Single-Crystal Airfoils
- Nickel Aluminide Heat Trays & furnace fixtures
- Advanced Ceramics Immersion Tube
- Die Casting Copper Motor Rotors

Energy

- Cupola Neural Network Model
- Foundry Energy Assessments
- Steel Foundry Refractory Lining Optimization
- Plant Energy Audits
- Atmospheric Recovery & Regeneration in Heat Treating
- Advanced Cogeneration
- Efficient Motor Systems

Environment & Recycling

- Pollution Prevention
- Foundry Emissions Characterization & Modeling
- Scrap Reduction
- Non-Incineration Treatment to Reduce Benzene and VOC Emissions

- Dezincing of Steel Scrap
- Mobile Sand Reclamation

OIT's Forest Products Partnership Portfolio

Energy Performance

- Biomass/Black Liquor Gasification Combined Cycle
- Impulse Drying
- Microwave Drying of Wood
- Energy Audits
- Cogeneration
- Efficient Motor Systems

Sustainable Forestry

- Wood Property Traits in Tree Species
- Intensively Managed Forests
- Built-In Pulping Catalysts
- Bark Removal Apparatus

Capital Effectiveness

- Corrosivity Monitoring of Recovery Boilers
- Bleach Plant Capital Reduction

Sensors & Controls

- Feedstock-to-Product Characterization Tools
- Intelligent Control Systems
- Real-Time Monitoring of Paper Mechanical Behavior
- On-Machine Ultrasonic Sensors for Paper Stiffness
- Acoustic Humidity Sensor

Pulping

Papermaking

Converting
(Finished Products)

New Products & Markets

- Chemistry Improves Pulp Yield
- Advanced Radical Burners
- Improved Smelt Spouts
- Boiler Tubes
- Burner Nozzles/Splash Plates
- Corrosion and Wear Resistant Materials for Pulp and Paper Manufacturing

Environmental Performance

- Reducing VOC Emissions
- Chlorine-Free Bleaching
- Improved Pulping Methods
- Low Lignin Content Pulp

Recycling

- Closed Mill Technologies
- Acoustic Separation Technologies
- Removal of Wax and Stickies

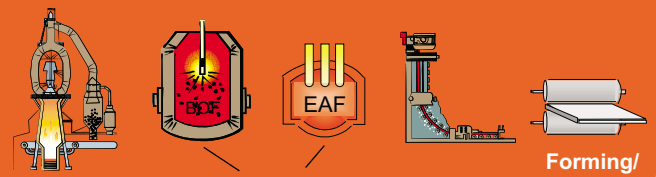
OIT's Steel Partnership Portfolio

Energy

- Dilute Oxygen Combustion
- Oscillating Combustion
- Oxy-Fuel Burners for Steel Reheat
- Heat Recovery in Heat Treating
- Plant Energy Audits
- Electric Motor Systems
- Advanced Cogeneration
- High-Performance Steam for Cogeneration

Processes

- Property Measurement Using Laser-based Ultrasound
- Advanced Process Control
  - Optical Sensors for BOF
  - On-Line Sensors for Strip
  - Phase & Temperature Measurement of Galvanneal
  - Microstructure Model for Hot Strip
- Controls for Blast Furnace Optimization
- Post-Combustion in Electric Arc Furnaces



Ironmaking | Steelmaking | Casting | Forming/ Finishing

Products and Marketing

Materials

- Nickel Aluminide Transfer Rolls andFurnace Fixtures
- CFCC Applications for Combustion or Power Systems

Environment

- Minimizing NOx from By-Product Fuels
- Very Low Emission Combustion Systems
- EAF Dust Reduction and Reuse

Iron Unit Recycling

- Dezincing of Steel Scrap
- Waste Oxide Recycling
- Utilization of Fine Particulate Materials

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