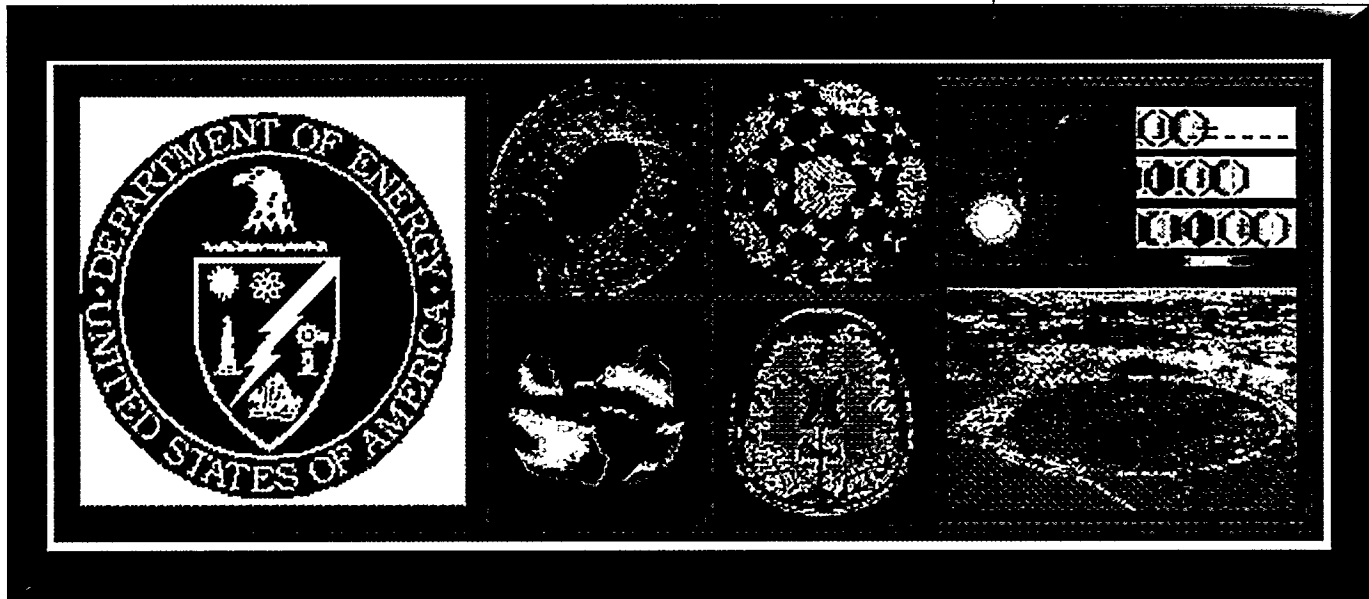


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The Office of Energy Research
U.S. Department of Energy



Energy Research Strategic Plan

August 1995

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THE MISSION OF THE OFFICE OF ENERGY RESEARCH

The Office of Energy Research supports the Department's missions and contributes to the welfare of the Nation by improving and advancing the science and technology foundations and effective utilization and management of the Department's laboratories necessary to achieve:

- efficiency in energy use,
- diverse and reliable energy sources,
- a productive and competitive economy,
- improved health and environmental quality, and
- an improved fundamental understanding of matter and energy.



DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.



OUR PROGRAMS

Research and development is an essential element of economic prosperity and a traditional source of strength for the U.S. economy. During the past two decades, the way of introducing technological developments into the national economy has changed steadily.

Previously, industry did most long-term technology development and some basic research with private funding. Today, the Nation's industry relies mostly on federally-funded research to provide the knowledge base that leads to new technologies and economic growth. In the 1980s, U.S. firms lost major technology markets to foreign competition. In response, many firms increased emphasis on technology development for near term payoff while decreasing long term research for new technology.

The purpose of the Office of Energy Research of the U.S. Department of Energy (DOE) is to provide basic research and technology development that triggers and drives economic development and helps maintain U.S. world leadership in science. We do so through programs of basic and applied research that support the Department's energy, environmental and national defense missions and that provide the foundation for technical advancement. We do so by emphasizing research that maintains our world leadership in science, mathematics, and engineering and through partnerships with universities, National Laboratories, and industries across the Nation.

The Office of Energy Research investment in basic research (approximately \$1.7 billion in fiscal year 1995) is the fourth largest among the fifteen Federal agencies that are the primary supporters of basic research. This level follows only the National Institutes of Health, the National Science Foundation, and the National Aeronautics and Space Administration. With the additional investment in equipment and construction of the major research facilities, our investment is second only to the National Institutes of Health. We manage over 90 percent of the nation's research in high energy physics and nearly 90 percent of the Nation's research in nuclear physics

The Program Offices of the Office of Energy Research

U.S. Department of Energy
Basic Energy Sciences

Basic Energy Science

The Future
of Energy
on Earth
Is the Energy
of the Stars

Fusion Energy



High Energy and Nuclear Physics



Applied Mathematical Science



Biological and Environmental Research

and we conduct the largest Federal basic research program on materials. The office is a major contributor to the Nation's science and technology capability.

The programs of the Office of Energy Research span five focus areas, namely:

OUR VISION FOR 2010

The Office of Energy Research ensures the Department's success and the Nation's economic, energy, and environmental welfare by being:

- the recognized leader in world-class research and energy science;
- a key contributor to U.S. leadership in developing clean, economical, and sustainable energy technologies, and environmentally conscious materials, technology, and industrial processes;
- the benchmark for domestic and international partnerships among academe, government, and industry;
- a recognized leader in operating research and development programs with a high commitment to scientific excellence, worker and public health and safety, and preserving environmental quality; and
- an effective steward of the Department's laboratory system.

- Research and development that produces knowledge needed for technology to fulfill the Department's energy, environment, and industrial competitiveness missions. Programs in this area are Fusion Energy, Applied Mathematical Sciences, and Basic Energy Sciences, with its research in the materials, chemical, and applied mathematical sciences, engineering and geosciences, and energy biosciences. Similarly, research on environmental effects, health effects, general life sciences, the human genome, nuclear medical applications, global climate change and related analytical

technology are in this area under our Biological and Environmental Research program.

- Fundamental research in energy and matter. This research advances knowledge for future technologies and helps maintain U.S. world leadership in science. High Energy and Nuclear Physics programs are in this category.
- Construction and operation of major experiments and user facilities. These facilities are advanced research tools needed for forefront research. They include accelerators for high energy and nuclear physics research, neutron sources, magnetic fusion facilities, and synchrotron light sources for physical and biological research. They also include topical facilities for research on combustion and environmental molecular sciences. Energy Research makes available thirty such facilities to scientists and engineers from industry, universities, DOE programs, and others. We are completing the construction of four new facilities

that will begin operation in the next four years.

- Partnerships with the private sector in areas proposed by industry. Our partnerships both ease the application of scientific outputs from the program and further the Department's mission. This category includes our Technology Transfer program, Cooperative Research and Development Agreements, and other partnership arrangements with industry. It also includes partnerships with the Department's technology programs, and the Small Business Innovative Research Program, which we manage for the entire Department of Energy.
- High-quality and timely educational assistance and scientific and technical information services provided to a wide range of customers. These efforts, which are inherent to the research programs, include support for nationally competitive graduate and postdoctoral research fellowships, and teacher training through hands-on research at national laboratories.

Energy Research programs and facilities are largely at universities and National Laboratories. The Office has a special role in assuring the vitality and responsiveness of these institutions. Our interest and commitment to universities springs from their responsibilities for the next generation of scientists and engineers. These young people bring the best and the brightest minds to the Department's programs and make the creative enthusiasm of youth available to tackle national problems.

The National Laboratories, with their multidisciplinary scientific teams, carry out large-scale coordinated research on complex national problems. These problems include global climate change, advanced and environmentally conscious manufacturing, advanced materials and processing, medical applications, high performance computing and communications, mapping the human genome, high energy physics and nuclear physics. The National Laboratories make major contributions. Among them have been definition and early development of the entire field of nuclear medicine and the ground breaking applications of large scale, high speed computing and interactive computing. The Laboratories are invaluable resources for the future.

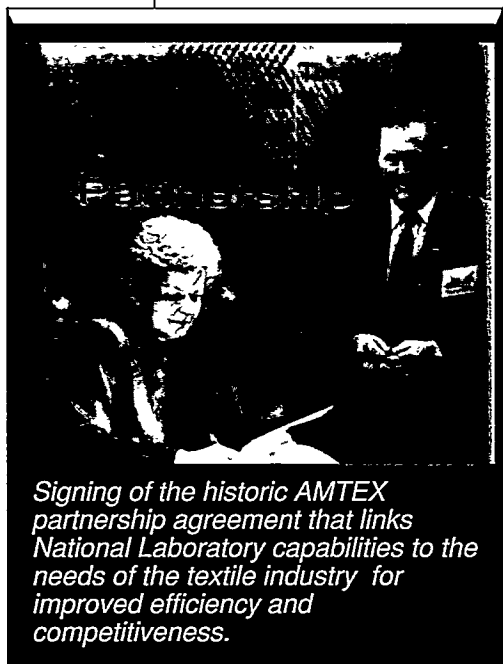
WE SUPPORT NATIONAL AND DEPARTMENTAL GOALS

On February 22, 1993, President Clinton and Vice President Gore published *Technology for America's Economic Growth, A New Direction to Build Economic Strength*. In this publication the Administration announced a policy of using federal research and development to accomplish three goals:

- Long-term economic growth that creates jobs and protects the environment
- A government that is more productive and more responsive to the needs of its citizens, and
- World leadership in basic science, mathematics, and engineering

The Department of Energy Strategic Plan, *Fueling a Competitive Economy*, challenges the Department's science and technology programs to help industry compete effectively in the near-term while meeting industry's need for long-term research. The plan calls on the science and technology programs to provide the fiscal accountability and environmental responsibility that the public expects. *Fueling a Competitive Economy* lays out the Department's five business lines and four critical success factors.

This Office of Energy Research Strategic Plan, in turn, supports the Department's Strategic Plan. It emphasizes scientific inquiry in support of major Departmental missions and of technology critical for economic prosperity. The plan stresses partnerships with other Departmental programs, universities, and industry to serve as catalysts for solving important problems. In the plan we anticipate increased involvement in the important problems of society through multidisciplinary research and development where our core competencies are strongest. Our plan also stresses international cooperation as an effective and efficient avenue for solving large and complex problems that one nation cannot efficiently solve alone.

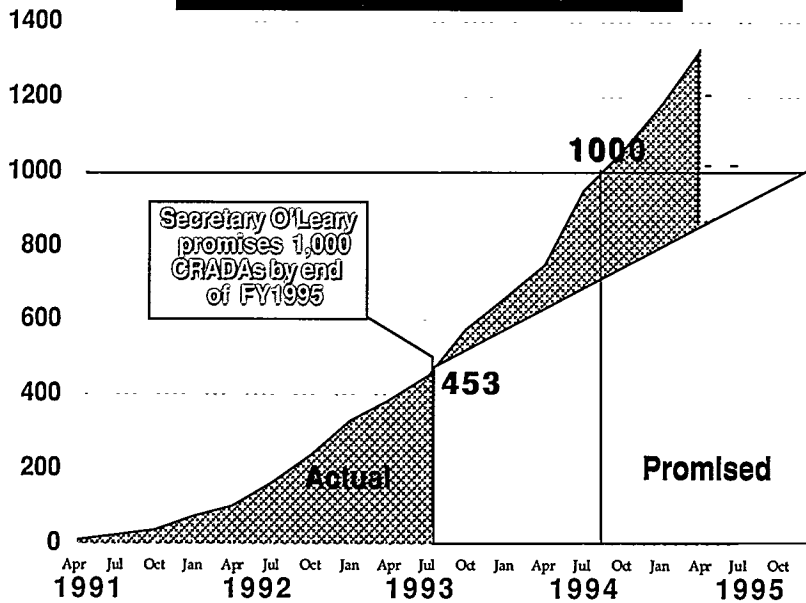


Signing of the historic AMTEX partnership agreement that links National Laboratory capabilities to the needs of the textile industry for improved efficiency and competitiveness.

In this plan we honor our commitment to stewardship of fundamental research in energy and matter and to world leadership in basic

Cumulative DOE CRADAs*

(1331 as of 4/24/95)



* Cooperative Research and Development Agreement (CRADA)

We have had great success with our CRADAs and have met our goal of 1000 CRADAs a full year early.

research. This means continued availability of the best and most advanced facilities and instrumentation for research. It also means fiscally and environmentally responsible construction, operation, and decommissioning of facilities.

During the past two years we signed over 200 Cooperative Research and Development Agreements (CRADAs) with industry. We participated in over 800 other collaborations across all sectors of the economy. There are notable examples, such as, the analysis of complex generic chemical structures. This work is underway at the Carbohydrates Center of the University of Georgia in support of over 135 corporations.

The Partnership in New Generation Vehicle Program is a cooperative program between industry and DOE's Office of Energy Research, Office of Energy Efficiency and Renewable Energy, and Office of Fossil Energy. One of its major activities is to develop new computer models for predicting emissions from advanced automotive designs. Another cooperative program, between the Office of Energy Research and the Office of Fossil Energy, promises new technologies for the domestic oil and gas industry.

OUR CUSTOMERS

Energy Research supplies scientific knowledge, tools and information. Delivered products include technical data, measurements, theories, computational capabilities, scientific instruments, diagnostic and design tools, and emerging technologies. These products are used by our customers in a variety of circumstances. Much of the research is broad, providing knowledge that benefits more than one customer, technology, sector, or application. Current research in combustion chemistry, for example serves many uses. Its products find use in technology development of home furnaces, industrial boilers, a new generation of vehicles, and the prevention of toxic wastes.

Our customers include more than 9,700 scientists and engineers who use our major user facilities and those who are recipients of approximately 1,800 university research grants. The government laboratories and contractors that we support are also our customers. Similarly, industries and small businesses that engage in cooperative research with our office or apply for financial assistance are our customers.

OUR CORE VALUES

The Office of Energy Research is a results-oriented organization that plans, funds and manages technically excellent and cost-effective research programs that support the Department's missions. We have a long-range perspective while seeking opportunities for near-term applications, and we share responsibility for maintaining the scientific and technical capability of the Nation. To achieve our vision, we recognize we must conduct ourselves according to the core values listed below and we seek evaluation of our performance on living these values.

- We value creativity and innovation
- We are customer-oriented
- We are committed to excellence and continuous improvement
- Our people are our most important resource
- We rely on individual scientists, technical teams, and facilities that make it possible to accomplish our mission
- We are team players and promote teamwork, at home and abroad
- We respect the environment and promote employee and public safety and health
- We are leaders, responsible for our actions
- We are effective stewards of the taxpayer's funds utilized for research and development programs
- We practice the highest standard of ethical behavior
- We communicate openly and effectively
- We foster employee and customer diversity

Our customers also include the Congress and its staff, the Office of Management and Budget, and other Federal research policy agencies such as the Office of Science and Technology Policy. Within the Department, our customers include the technology program offices such as Fossil Energy, Energy Efficiency and Renewable Energy, and Environmental Management. The DOE Operations Offices, the Chief Financial Officer, the Policy Office, and the Office of the Secretary are customers. Other Federal research and development agencies such as the Department of Defense and the National Science Foundation are also customers. These customers rely upon our programs for research facilities, information, plans, and effective management of part of the Nation's scientific and technological enterprise.

PROGRAM GOALS, STRATEGIES, AND SUCCESS INDICATORS

We have identified six goals that describe what the Office of Energy Research expects to accomplish in science and technology in the coming years. Four other goals describe what Energy Research expects to achieve in improving its business and management practices, including fully satisfying environment, safety and health responsibilities. Strategies under each goal tell how we plan to reach it. Success indicators show how Energy Research plans to measure its progress in accomplishing each goal.

8

Goal

1

Advance sustainable energy production and use, economic growth, and a healthy citizenry through research and technology transfer, leading to new and improved technologies.

“Applied research done in a basic atmosphere has a sophistication that is hard to duplicate in a less scientific atmosphere...”

Basic research done in an applied atmosphere has a kind of no-nonsense aggressiveness that is hard to duplicate when other basic research is done entirely by itself.

-Alvin Weinberg,
1967

To achieve its mission of efficient energy use, a productive and competitive economy, and to improve environmental quality the Department must have results from research in basic energy sciences, environmental sciences, life sciences, and high performance computing and communication. Achievement of sustainable development will provide future generations with a continuing broad range of options to respond to energy, environmental, and development challenges.

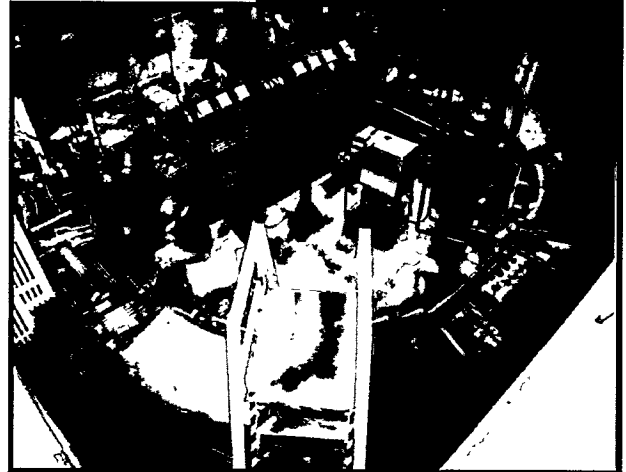
Our biological science programs in mapping and sequencing the human genome, in structural biology and in medical applications continue to have enormous impacts in biomedical research, technology and industry. Examples are new radionuclides, radiopharmaceuticals, and instrumentation for imaging in molecular nuclear medicine, especially with positron-emission-tomography (PET). These advances lead to new tests and drugs for treating cancer, heart disease, and neurological diseases such as alcoholism and cocaine abuse. Boron neutron capture therapy is in clinical trials for treating brain and skin cancers.



A National Laboratory scientist prepares a filter for use with a DNA sequencing technique that could greatly speed up the identification of gene patterns. The human genome consists of as many as 100,000 genes. Mapping the entire genome's structure may help researchers find ways to prevent or cure birth defects and hereditary diseases.

Strategies that we will use to reach the goal:

- Invest in peer reviewed and focused basic research programs.
- With industry partners, apply DOE strengths in biotechnology, medical applications, computational science, information technologies, chemical techniques, and materials synthesis and processing to solving national problems.
- Develop and apply molecular biology tools for finding and identifying health effects.
- Strengthen partnerships with semiconductor, gas and oil, metals, chemicals, ceramics, magnetics, computer and biotechnology industries.
- Raise the visibility of Energy Research's services and products.
- Pursue basic and applied research supporting Presidential and Departmental initiatives, e.g., Partnership for a New Generation Vehicle (PNGV).
- Actively involve customers in research program planning and evaluation.



The Loma Linda Proton accelerator, the world's smallest proton synchrotron, is the first designed specifically for therapy and is revolutionizing certain forms of cancer treatment. The first patient was treated in October 1990 at the Loma Linda University Medical Center in California. The underlying principles for this accelerator were the direct outcome of accelerator technology developed to pursue basic high energy physics research.

Indicators of our success in meeting this goal are:

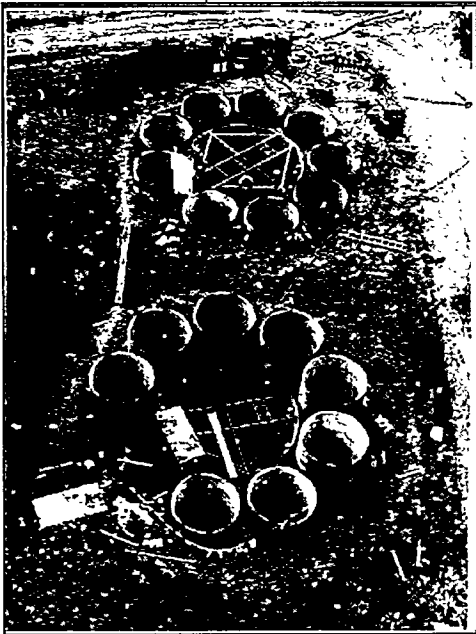
- Program-developed technologies adopted by DOE and other agencies, industry, and the public.
- DOE technology program and industrial customers participate in program planning.
- Customers give positive reactions, including showing increasing importance of our support to their business.
- Value added to the Nation as measured by economic studies.
- Highest quality of science produced (positive peer reviews, licenses, awards, and other).
- Industry and government customers choose Energy Research to supply science and technology in its areas of core competency.

Goal **2** *Understand and anticipate environmental effects of energy production and use, and develop advanced products, processes, and technologies to improve environmental quality.*

For the United States to enhance environmental quality, maintain economic growth, and stay competitive, energy usage and energy options must be sustainable over time and be environmentally sound. Our research and development competencies in chemistry, biology, physics, earth sciences, ecology, and the environmental and computational sciences enable us to address the intertwined energy and environmental challenges. Our programs seek to understand the interrelationships that exist within industrial processes, energy supply and use, and the environment. This is vital when the activities result in the production of products and by-products that could impair the Earth's environment.

Strategies that we will use to reach the goal:

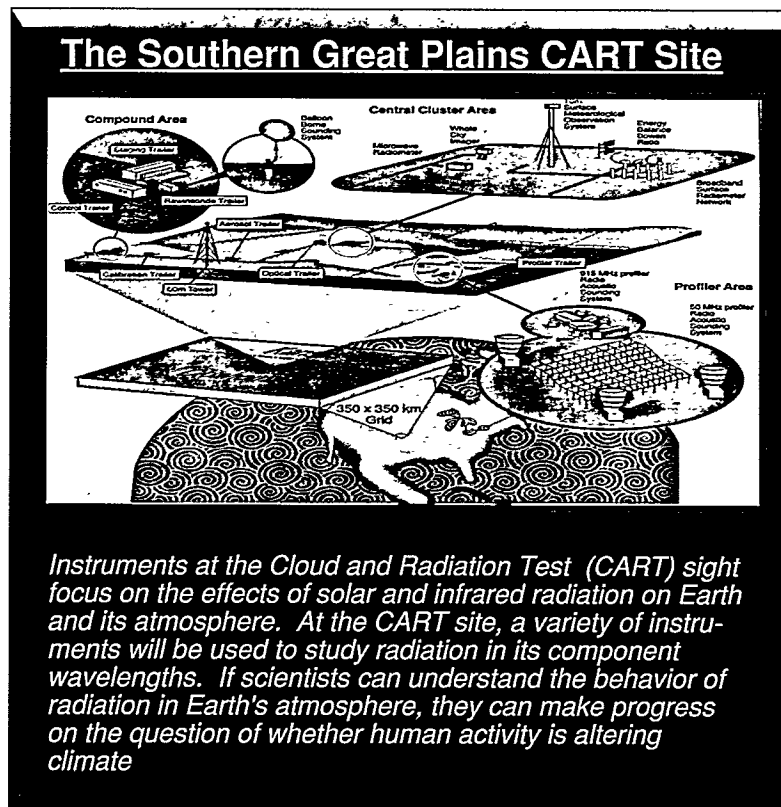
- Develop improved characterization techniques to ascertain and describe environmental issues.
- Research on safe and cost-effective environmental remediation and restoration methodologies and technologies.
- Focus on science-based prediction of environmental change.
- Champion science-based risk assessment.
- Carry out research addressing the potential for climate change, climate change mitigation, and consequent physical and biological adaptations.
- Continued merit review with peer evaluation of all research activities.



Lysimeters (8ft dia x 10 ft deep concrete cylinders developed by Defense Programs for studying radioisotope leaching in landfills) at the Oak Ridge National Laboratory. In a joint project between the University of Tennessee and ORNL, the Lysimeters will be filled with earth containing organic contaminants, and genetically-engineered bacteria will be introduced and studied for their bioremediation activity.

Indicators of our success in meeting this goal are:

- DOE and industry adopt techniques we identify or develop.
- Our products lead to reduced costs of acceptable environmental restoration technology.
- Improved and accepted methods for predicting environmental change become available.
- Industry and government adopt science-based risk assessment for establishing government regulations.
- Industry and government customers use methods developed in the program for mitigation and adaptation in environmental change.

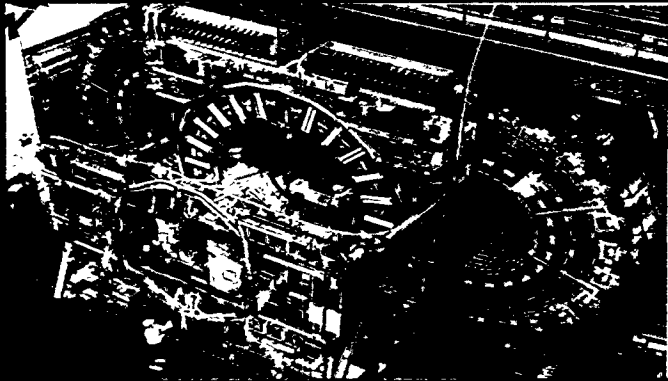


Goal **3** *Provide new insights into the nature of energy and matter to better understand our natural world.*

Fundamental science is a necessary foundation for applied programs that advance industrial competitiveness, maintain the Nation's science and technology capability, and provide improved approaches to our energy future. A major component of fundamental research is the study of the detailed structure of matter and energy.

Our fundamental research seeks to understand the structure and interactions of atomic nuclei and to understand the fundamental forces and particles of nature at the subnuclear level. Recent

discoveries and technological advances improve our understanding of compelling scientific and intellectual issues. These issues include the origin of mass and why there is a preponderance of matter over antimatter in the universe. They also include the nature of the invisible matter that accounts for up to 90% of the mass of the universe.



Technicians perform maintenance on the central section of the 5,000-ton Collider Detector at Fermilab. Detectors such as this take snapshots of particle collisions in Fermilab's Tevatron accelerator in search of top quarks, and other unusual events.

Strategies that we will use to reach the goal:

- Pursue fundamental research in new scientific phenomena, especially in high energy and nuclear physics.

“Science reveals new worlds to explore, and by implication new opportunities to seize and new-futures to create.”

—Vice President Al Gore, *Science in the National Interest*, 1994

- Champion the recommendations of the High Energy Physics Advisory Panel's "Future Vision Subpanel" as the new direction for high energy physics.
- Prepare for and carry out research and development on the next accelerator beyond the Large Hadron Collider.
- Use the interagency Nuclear Science Advisory Committee to update the plan for nuclear physics.
- Enhance interagency, international and private sector involvement.
- Continue using peer review to assure quality research.

Indicators of our success in meeting this goal are:

- Highest quality of science produced (positive peer reviews, licenses, awards, and other).
- Understanding of subnuclear forces improves significantly.
- Important new phenomena discovered.
- Success in accomplishing the physics program outlined in the High Energy Physics Advisory Panel's "Future Vision Subpanel."
- Fulfillment of the long range plan for nuclear physics developed by the interagency Nuclear Science Advisory Committee.
- The United States sustains its scientific leadership in high energy and nuclear physics.
- Level of international cooperation leads to greater achievement of departmental and stakeholder research goals within budgets available.
- DOE and Federal strategy documents reflect the importance of fundamental science.

Standard Model of Elementary Particles

ELEMENTARY PARTICLES

Leptons	U	C	t	γ	Force Carriers
	d	s	b	g	
	ν_e	ν_μ	ν_τ	Z	
	e	μ	τ	W	
	Three Generations of Matter				

The search for the top quark has been under way ever since the bottom quark was discovered at Fermilab in 1977. In 1995, Top Quark was discovered by researchers at Fermilab -- providing strong evidence for the Standard Model, the prevailing theory of the particles and forces that determine the fundamental nature of matter and energy.

Goal 4 *Develop fusion as a cost-effective, publicly acceptable energy technology for sustainable development.*

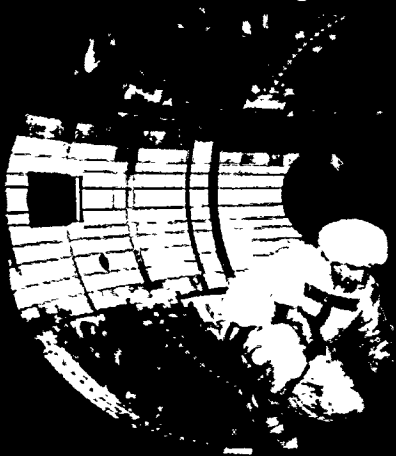
Worldwide growth in population and living standards assures continued growth in the demand for electricity well into the future. Successful commercialization of fusion energy in the mid-21st Century will enhance the Nation's energy security and provide an environmentally acceptable alternative to fossil fuel combustion.

Fusion energy is potentially a virtually inexhaustible energy source. A pound of fusion fuel contains the energy equivalent of 12 million pounds of coal, 25 thousand barrels of oil, 142 million cubic feet of natural gas, or 4.5 pounds of fission fuel. Fusion will not release greenhouse gases associated with global warming nor chemicals associated with acid rain. It will not contribute to other forms of atmospheric pollution. These inherent attributes of fusion energy have led the Nation and the Department of Energy to consider fusion energy an important source of electricity generating capacity.

Strategies that we will use to reach the goal:

- Develop fusion energy as an integral part of an international fusion program, while maintaining a strong domestic program.
- Study the physics of burning plasmas, develop blankets for collecting fusion energy, and test nonnuclear tokamak technologies in ITER.

- Develop improved concepts for future power plants
- Develop components required for production and use of fusion power (magnetic and inertial), including low activation materials.
- Use the National Ignition Facility for studying the physics of inertial fusion fuel targets.



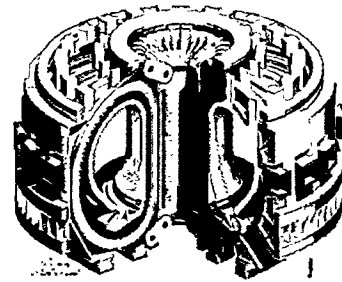
An engineer inspects the interior of the vacuum vessel at the heart of Princeton's Tokamak Fusion Test Reactor.

- Involve industry and the public early and often.

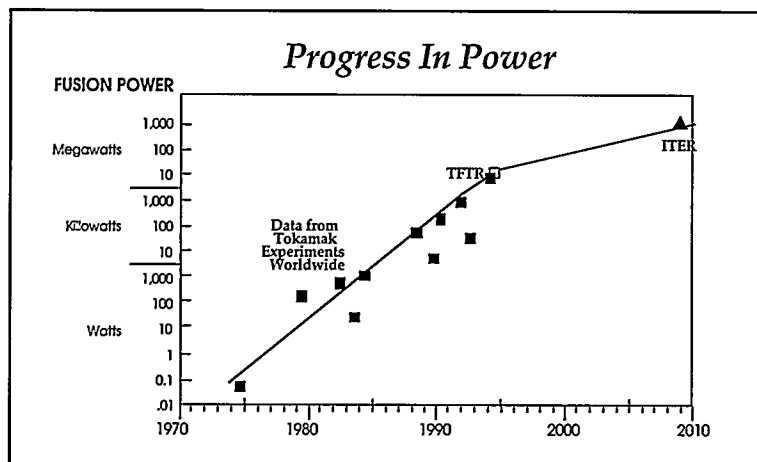
Indicators of our success in meeting this goal are:

- Sustained progress toward fusion conditions in plasma experiments.
- Demonstrate advanced concepts for use in a Demonstration Power Plant.
- The United States meets its commitments in the Engineering Design Activity of ITER.
- U.S. Industry participates substantially in any major project.
- Technology developed in the Fusion Program transfers successfully to industry.
- ITER's initial blanket operated and tested successfully.
- Establishment of a fusion neutron source and use of it for initial testing of low activation materials.
- Public awareness of fusion energy broadens.
- Targets for energy applications tested on the National Ignition Facility.

*International Thermonuclear
Experimental Reactor*

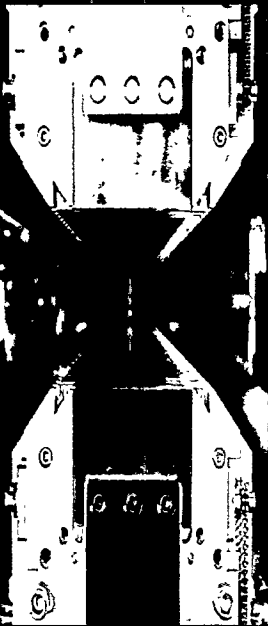


The ITER project has become the focus of the four major world fusion programs to demonstrate the scientific and technological feasibility of fusion energy. The U.S., the European Union, Japan, and the Russian Federation agreed to cooperate on an engineering and design effort, covering both design and R&D for the ITER tokamak.



Goal **5** *Sustain scientific leadership and improve U.S. competitiveness by providing world class scientific facilities and Department of Energy laboratories, with an adequate infrastructure.*

The Advanced Light Source



The Advanced Light Source (ALS) produces the world's brightest light in the ultraviolet and soft x-ray regions of the spectrum and provides unprecedented opportunities for research. A National User Facility located at Lawrence Berkeley Laboratory, the ALS is available to researchers from academe, industry and government laboratories.

The Department's research and development laboratories are highly valuable national resources with unequaled technical staff and assets. The laboratories conduct complex, multidisciplinary research that is not easily done in a university or industrial environment. An additional function of many laboratories is to provide large facilities for research. These advanced facilities provide an unparalleled experimental capability beyond what their own institutions can provide for scientists and engineers from industry, academia, the Department and other governmental laboratories. The host laboratory provides scientific expertise and infrastructure support to help users make the most effective use of the experimental apparatus. As large sites, the laboratories contain many supporting facilities such as steam plants, buildings, waste disposal systems, and roads which have to be maintained.

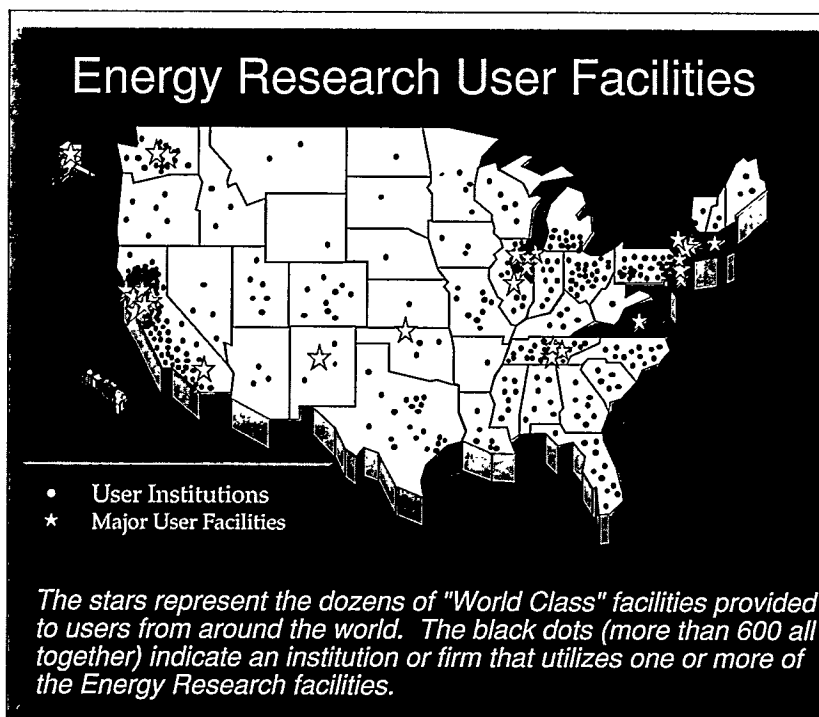
Strategies that we will use to reach the goal:

- Invest in technology development to advance capability and reduce cost of new scientific facilities.
- Review the need for existing scientific facilities based on their continuing contribution to research programs.
- Champion adequate funding for infrastructures at laboratories, for full use of facilities, and for innovation in the laboratories.
- Provide effective institutional planning and oversight (including environment, safety, and health; work for non-Department of Energy customers, and appraisals).
- Reduce laboratory costs by working with laboratory Management and all relevant DOE organizations.
- Consult industry, universities and other potential users in the planning, construction and operation of facilities.
- Conduct merit review with peer evaluation of research projects.

Indicators of our success in meeting this goal are:

- Highest quality of science produced (positive peer reviews, licenses, awards, and other).
- Increased use of facilities (number of users, hours of operation).

- Users express satisfaction with the performance of our facilities and the support they received.
- Facilities operate cost-effectively, including energy use, timely maintenance, and replacement of facilities when justified.
- Environment, safety, and health requirements are satisfied.
- Active facilities are reliable and available to support departmental programs and the scientific community; inactive and surplus facilities are disposed of responsibly.
- Construction and facility upgrading projects meet cost and schedule milestones and technical specifications.
- Scientific facilities' performance is at the forefront of science and matches or exceeds the best in other countries.
- International user participation improves productivity and reduces facilities' costs.
- Other agencies and industry increase their cooperation with and support of the program.
- The Congress commits to multiyear support of large construction projects.



Goal 6 *Advance the National Information Infrastructure by developing and demonstrating new information technologies for DOE applications.*

Energy Research supports the development of communication, computational science and engineering capabilities enabling more efficient recovery, control, and use of energy supplies. Energy systems involve technical complexities that are difficult to portray in mathematical and engineering models. Modern science and engineering rely on such models and the information technologies that support them. This creates new concepts, technologies, and processes for energy and other practical applications.

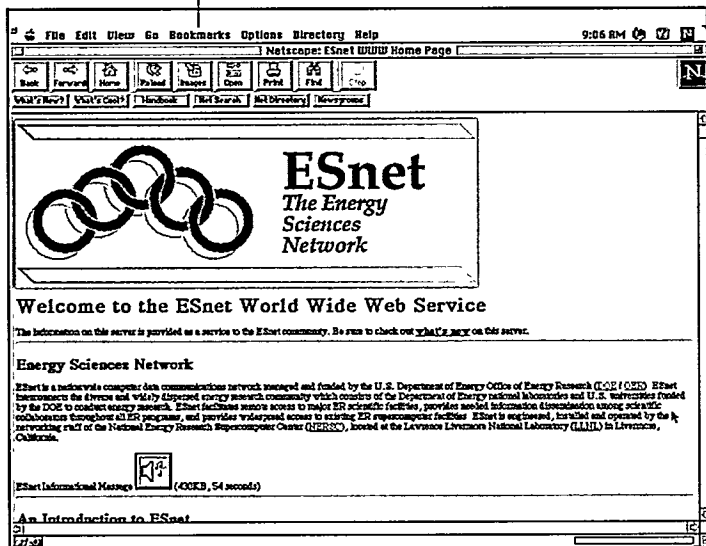
Strategies that we will use to reach the goal:

- Support peer-reviewed research and development in advanced computing, communications, and information technology and their application to challenges in energy science and in engineering.
- Participate as a leader in DOE and interagency activities for the National Information Infrastructure.
- Provide the technology for remote access to Energy Research facilities to achieve a "virtual laboratory" environment.

- Prototype energy demand and supply management as a National Information Infrastructure application.

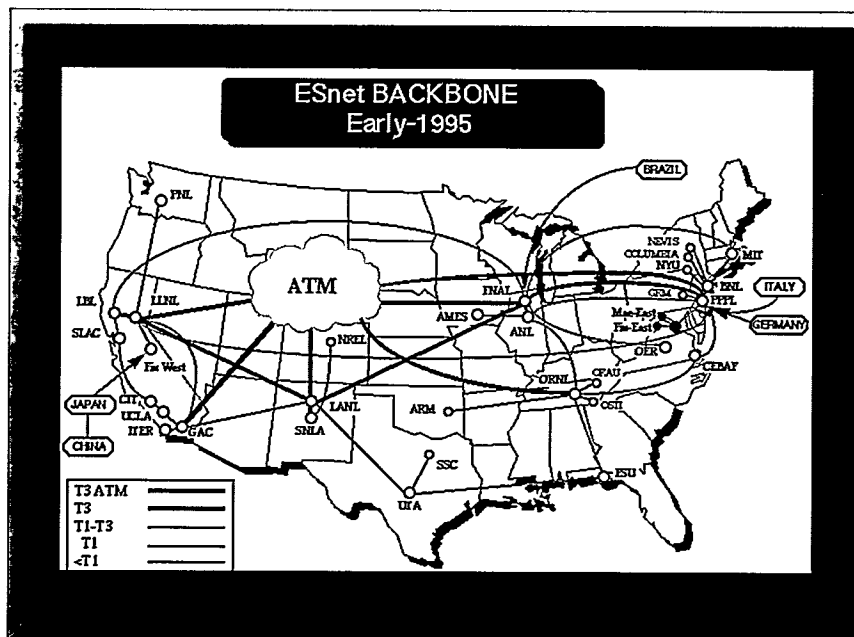
Indicators of our success in meeting this goal are:

- Internal and external partners show increased satisfaction.
- Advanced Light Source and ITER on-line as "virtual laboratories."
- Utilities become increasingly involved in deployment of the National Information Infrastructure.



ESnet World Wide Web Home Page

- “Federated databases” for computational biology developed and opened for use.
- Installation and successful operation of an electronic proposal process.
- Energy savings engendered by successful demonstration of prototypes of demand management information technologies.
- Highest quality of research performed.
- Energy Research makes increased use of National Information Infrastructure for meetings at a distance.
- Performers of Energy Research make high level use of the National Information Infrastructure.
- Private and public sector customers adopt technologies developed in the program.



All Americans have a stake in the construction of an advanced National Information Infrastructure (NII), a seamless web of communication networks, databases, and consumer electronics that will put vast amounts of information at users' fingertips. Development of the NII can help unleash an information revolution that will change forever the way people live, work, and interact with each other. The ESnet is becoming a core infrastructure component for research activities within DOE.

Goal 7 *Ensure Energy Research's programs are managed to increase quality, more efficiently use human and material resources, and sustain protection of the environment and the health and safety of workers and the public.*

Management, environment, safety, and health practices must be developed and implemented in a cost-effective, value-added manner to ensure high quality Energy Research programs and facilities. We must lead in developing and using innovative approaches to conduct our business, including powerful electronic management and communication tools that enhance the quality of our managers and programs.

Strategies that we will use to reach the goal:

- Maintain a proactive program of integrated environmental, safety, and health technical support.
- Establish effective teams with other departmental elements for key process improvements.
- Carry on an Energy Research Quality Initiative to become a departmental model for teamwork and Total Quality Management practices.
- Establish a quality staff development, recognition, and awards program.
- Strengthen a successful partnership with the union that represents workers in the Office of Energy Research.
- Ensure environment, safety and health operations are visible and documented.
- Align resources with strategies and priorities.



Bob Thompson and Andre Masud conduct a construction safety inspection of the Advanced Proton Source project near Chicago.

Indicators of our success in meeting this goal are:

- Adaptation of best cost-effective management practices in the pursuit of excellence.
- Energy Research programs do not adversely effect the quality of the human environment appreciably.
- Establishment of individual development programs and incentives that work as intended.
- Improved management practices as measured by timeliness and effectiveness of our environment, safety and health actions.
- The Energy Research community is in the forefront of cost-effective protection of the environment and the health and safety of workers.
- Our customers use of innovations originating in the program to improve, streamline, and enhance their environment, safety and health and safety actions.
- Energy Research is active in a department-wide forum on environment, safety and health policy.

Goal **8** *Ensure that Energy Research activities, results and benefits are widely known, valued, and trusted.*

Our customers and stakeholders expect timely diffusion and distribution of the data, skills, and technology derived from the program. The public demands more accountability in government actions and spending and more results at lower costs. All members of the Energy Research family must serve the communication needs of their internal and external customers knowledgeably and responsibly.

Strategies that we will use to reach the goal:

- Develop and carry out an effective communications program for Energy Research programs.
- Foster customer and stakeholder participation in Energy Research's portfolio of research investments.
- Actively respond to internal and external review recommendations.
- Ensure public participation in key program decisions.
- Focus on customer satisfaction, i.e., survey customers and act on results.
- Increase our leadership and active participation in DOE and interagency activities.
- Promote a customer oriented policy for the Department's laboratories.

Liane Russell

Dr. Russell is a genetics researcher at Oak Ridge National Laboratory. She received the 1993 Enrico Fermi Award "for her outstanding contributions to genetics and radiation biology; including her discovery of the role of x- and y-chromosomes in sex determination in mammals and knowledge of the effects of radiation on the developing embryo and fetus. Her findings have been the benchmark for study of mutations in mammals and for assessing the risk to humans world-wide."



Indicators of our success in meeting this goal are:

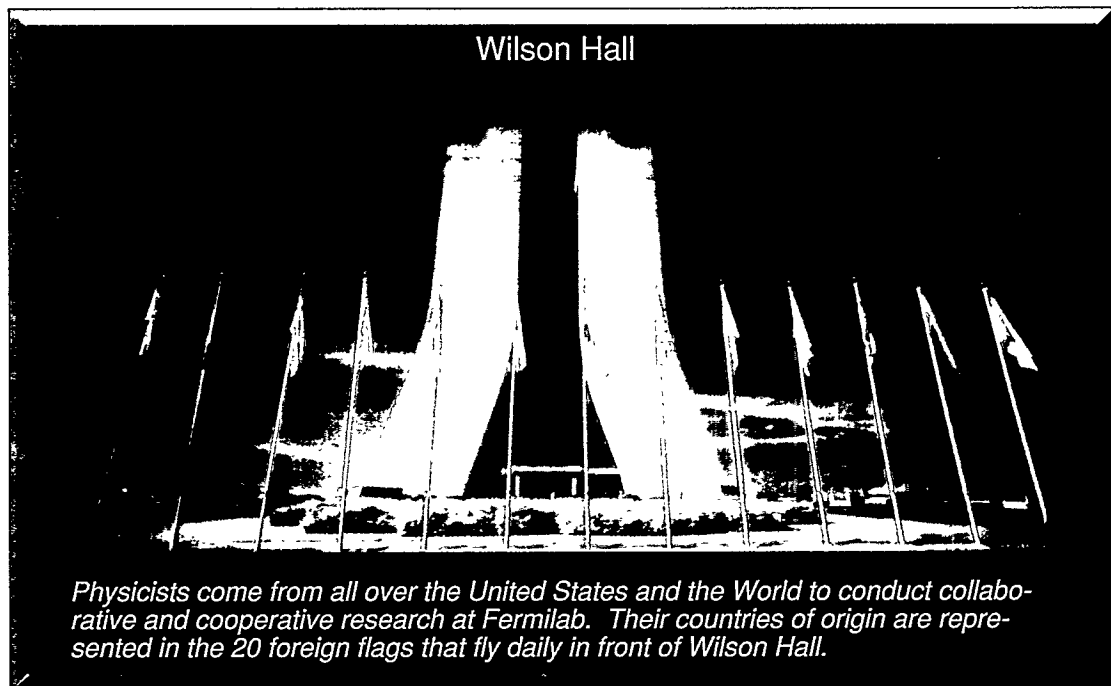
- Annual surveys show an increase in customer and public satisfaction with Energy Research, including increased Administration and Congressional support.
- Increased Energy Research leadership of departmental and interagency groups and initiatives.
- Programs receive favorable peer reviews and expert advisory committee assessments.
- Departmental successes receive increased acknowledgment publications, citations, and awards.

Goal 9 *Increase the effectiveness of U.S. investment in research programs and facilities through interagency and international cooperation and collaboration.*

Due to economic growth and improved education, many countries are now doing research at the frontiers of science and technology. Domestic and international partnerships based on sharing the costs and benefits of research can reduce facility budgets, leverage R&D investments, tap greater intellectual resources, and increase effectiveness of our science programs. Global climate research is an example of such a major international activity. Fusion energy is also progressing as a joint international effort. There is extensive collaboration in high energy and nuclear physics. International collaboration is rapidly emerging in human genome research.

Strategies that we will use to reach the goal:

- Involve industry, universities and other potential users in planning and execution of facility construction and operation.
- Champion interagency and international involvement in planning, construction and use of very large projects.

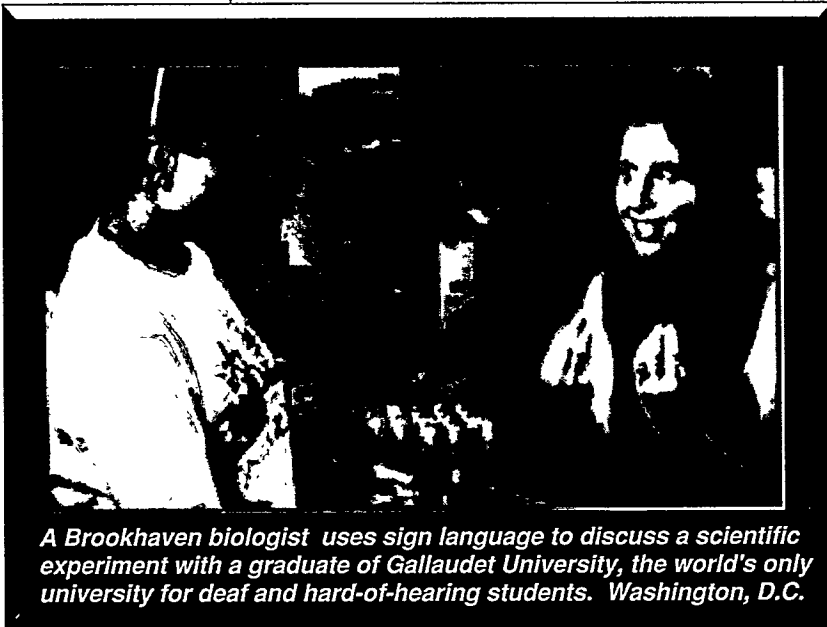


- Champion international participation as an element in studies undertaken by panels and committees that advise Energy Research programs, e.g., the High Energy Physics Advisory Panel.
- Champion the continued use of scientific merit as the principle governing access to national and international science facilities.
- Consider international collaboration in developing program plans to leverage research and development investments.
- Champion establishment of an international forum for promoting intergovernmental collaboration in science projects.
- Participate vigorously as a significant partner in the ITER project.
- Pursue serious international collaboration in all phases of high energy and nuclear physics, and in studies of new neutron sources.

Indicators of our success in meeting this goal are:

- Significant strategic interagency and international consultations, partnerships and collaborations instituted to achieve departmental and stakeholder research goals.
- International interest in Energy Research projects increases.
- Level of international cooperation improved, while maintaining principle of merit-based access to large science facilities.
- An intergovernmental process to facilitate international collaboration on mega-science projects is carried out.
- The Department of Energy negotiates U.S. participation in the Large Hadron Collider project.
- A timely decision is made on the nature of U.S. participation in ITER construction.
- Japanese funded RHIC Spin Project integrated into the Relativistic Heavy Ion Collider's heavy ion program
- Energy Research does not wastefully compete with other research facilities, domestically or internationally.
- The Office of Energy Research is sought out by other U.S. Government agencies and other governments in the development of R&D collaborations.
- The Department of Energy rebuilds and reinforces its image as a reliable international partner.

Goal **10** *Strengthen the science and technical capability and promote the diversity of the Nation's work force.*



A Brookhaven biologist uses sign language to discuss a scientific experiment with a graduate of Gallaudet University, the world's only university for deaf and hard-of-hearing students. Washington, D.C.

Our future will be ever more technologically complex. The widespread use of electronic systems, continuing advances in medical technology, and the ever increasing presence of computers in the work place are some obvious examples. The role of new and changing technologies in our economy, in public policy discussions, and in our everyday environment demands a higher level of science education and technical competence in the Nation's work force and the public.

There is the potential to make greater contributions to the education of younger students, to diversify our scientific and technical work force, and to inform the public on scientific and technical issues. The Office of Energy Research has historically played an important role in the training of young scientists and engineers by supporting research grants to universities and students conducting research at Department laboratories.

Energy Research supports the Department's programs in training and education. This is especially true in energy science and technology, the environment and the impact of science on the economy. Beyond support of programs for university science education, Energy Research supports the DOE-wide program in science and mathematics for kindergarten through 12th grade.

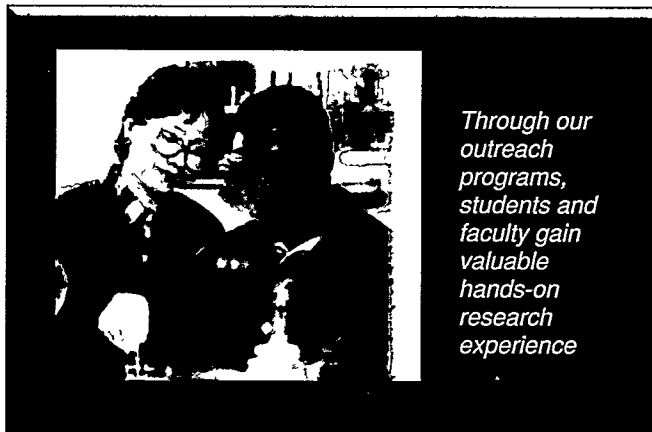
Strategies that we will use to reach the goal:

- Maintain adequate investments in university research programs.

- Use the capabilities of the National laboratories for mathematics and science education
- In partnership with DOE education programs, promote involvement of Energy Research program participants in science and mathematics education.
- Give special emphasis to traditionally under represented research staff, students, institutions, and small and disadvantaged businesses.

Indicators of our success in meeting this goal are:

- Increased number, preparedness, and diversity of scientific and technical persons entering the Nation's work force.
- Greater participation by under represented groups in science and engineering in Energy Research supported research and facilities and as Energy Research program staff.
- Improved proficiency and number of students and postdoctoral fellows receiving support at laboratory user facilities and with Energy Research grants.
- Effectiveness of teachers and faculty members trained in Energy Research programs and laboratories in improving science and mathematics curricula for K-12 and undergraduate students.
- Program activities to increase and improve the understanding of mathematics and science by students and the public.



Through our outreach programs, students and faculty gain valuable hands-on research experience



Shar-Ron A. Ellis
Science Teacher

Richard Write
Elementary
School

(Chicago, Illinois)

"As a teacher, I often become so focused on my students that I forget about the science that goes on outside of my classroom. My experience at Argonne has removed the blinders and exposed me to advanced instrumentation like video microscopes and the Spec 20. With this technology, my students will do more hands-on experiments and will start questioning things that they used to take for granted."







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