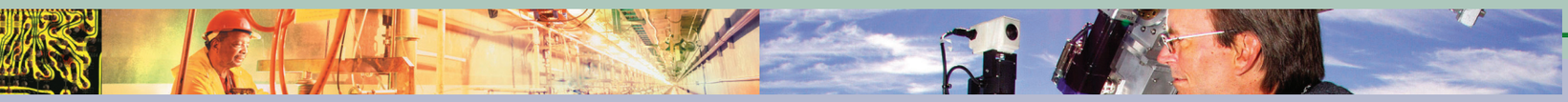


Strategic Theme 3

Scientific Discovery and Innovation

Strengthening U.S. scientific discovery, economic competitiveness, and improving quality of life through innovations in science and technology

The United States has always been a Nation of innovators and the Department of Energy has been a major contributor to that legacy. DOE-supported basic research has produced Nobel Laureates, numerous paradigm-shifting scientific discoveries, and revolutionary technologies that have spawned entirely new industries. Such breakthroughs have created fundamentally new energy options, underpinned U.S. national security during challenging times, and contributed to the health of our citizenry and the stewardship of our Nation's environmental resources. This great engine of U.S. innovation has played an important role in fueling a strong economy and one of the highest standards of living the world has ever known.

As we look toward the future, we are entering a new era that is characterized by increasingly rapid changes in the pace of discovery and innovation. These changes present both opportunities and challenges, requiring a new U.S. commitment to science and innovative approaches for accelerating the realization of benefits from our research enterprise.

In February 2006, the President announced the American Competitiveness Initiative (ACI) to encourage American innovation and strengthen our Nation's ability to compete in the global economy. The Department has a core responsibility under ACI to cultivate the U.S. scientific base in a way that enables our Nation to compete and win in the global marketplace of ideas and commerce. More specifically, ACI directs the Department of Energy to:

• Increase financial support for innovation-enabling research to support high-leverage fields of physical science and engineering.

• Increase investments in the U.S. scientific infrastructure, particularly at the Department's scientific user facilities, to ensure the U.S. an order of magnitude dominance in key scientific fields that will transform the 21st Century global economy, e.g., biotechnology, nanotechnology, materials science, high-speed computing, and climate change research.

• Improve the capacity, maintenance, and operations of DOE laboratories through new investments and continued pursuit of best practices.

• Provide mentored experiences for K-12 teachers at National Laboratories that will transform teachers of science into "teacher scientists" who can encourage and inspire the next generation of scientists and engineers.

• Provide training opportunities at the Department's National Laboratories as a way to increase the skills and knowledge of the Nation's scientific and technical workforce.

Accordingly, over the next six years, the Department will pursue innovations in science and technology to help ensure that it meets its national science strategic goals.

Scientific Discovery and Innovation Challenges

The U.S. must remain vigilant as other nations invest heavily in science and technology in an attempt to match our economic productivity and compete with U.S. industry. America's investment in the physical sciences, which many consider to be the cornerstone of the Nation's scientific enterprise, must be strengthened to capture the promise of emerging scientific disciplines that will define the technological progress over the next 100 years. The Nation's incremental changes in technology are not sufficient to maintain the world leadership in industry and academia. The scale and complexity of science and global challenges require multidisciplinary and multinational responses. The Nation's scientific workforce and science literacy must be grown to prepare citizens to compete for jobs and increase overall economic productivity. The following strategic goals address these scientific discovery and innovation challenges.

Scientific Discovery and Innovation Strategic Goals

Goal 3.1 – Scientific Breakthroughs

Achieve the major scientific discoveries that will drive U.S. competitiveness, inspire America, and revolutionize approaches to the Nation's energy, national security, and environmental quality challenges.

Description: The Department has made science-driven innovation a top priority because of a growing awareness of shifts in the energy structure. Also the pace of technological progress must be accelerated to solve critical national challenges. Revolutionary breakthroughs are required and DOE will lead a renaissance in scientific discovery that will rekindle the American spirit and provide the base of new knowledge and the resulting new options and solutions to these seemingly intractable challenges. The Department cannot rely on incremental changes in technology to significantly reduce our dependence on foreign oil, dramatically decrease energy use, increase production, or solve long-term environmental challenges such as climate change.

Strategies to reach this goal

• Advance the basic energy sciences to realize transformational discoveries built on the foundations of basic research in materials sciences, chemical sciences, related scientific disciplines and tools, and major scientific user facilities for creating atomic-scale structures.

• Expand efforts in biological and environmental research, including genomic and related biological sciences by: creating fundamentally new energy sources and conversion processes; improving climate and earth system modeling; and understanding prediction and control of environmental contaminant fate and transport.

• Increase research to advance the knowledge of plasma and fusion energy sciences to the point where a determination of commercial feasibility of one or more leading designs is possible.

• Advance the computational sciences and the leadership-class computational capabilities required for today's frontiers of scientific discovery.

• Advance fundamental knowledge in high energy physics and nuclear physics that will result in a deeper understanding of matter, energy, space, and time.

Goal 3.2 – Foundations of Science

Deliver the scientific facilities, train the next generation of scientists and engineers, and provide the laboratory capabilities and infrastructure required for U.S. scientific primacy.

Description: The foundations of great science are the people, the powerful scientific instruments, and the laboratories that provide important venues for multi-disciplinary collaboration. The Department serves a critical role within the U.S. science enterprise as managers of the largest system of National Laboratories and major scientific user facilities. Tens of thousands of researchers depend on these facilities and this support forms a core element of the innovative engine that drives the U.S. economy. Many of the world's leading scientists are employed at DOE National Laboratories and annual DOE research grants support the work of scientists, engineers, and technicians at more than 300 universities. In addition, the Department constructs and operates the largest and most advanced set of scientific facilities in the world. These facilities are open to the science community on a competitive basis. The 19,000 scientists who work at these facilities conduct some of the most complex and innovative research being performed today. Skillful management and prudent investment strategies are needed to ensure that the laboratories are staffed and equipped with the necessary resources to support the Department's mission. DOE will ensure that scientific facilities are operated efficiently and effectively and that students are given every opportunity to learn and grow as future scientists, technicians, and engineers.

Strategies to reach this goal

• Complete construction and begin operation of major scientific user facilities.

• Improve the operations of the National Laboratory system using a collaborative approach.

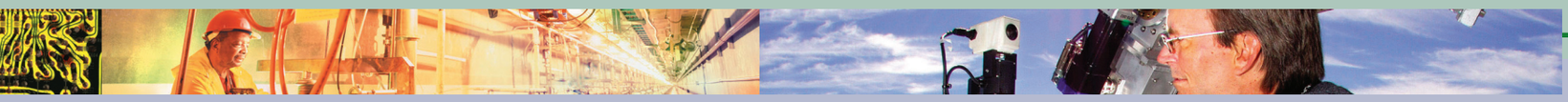
• Increase the operating efficiency and safety of the National Laboratories and scientific user facilities, guided by a ten-year site planning process.

• Develop an approach by working with other Federal agencies to recruit the next generation of leaders in science, technology, and engineering.

• Better communicate the importance of science and technology to inspire participation in the innovation economy.

Goal 3.3 – Research Integration

Integrate basic and applied research to accelerate innovation and to create transformational solutions for energy and other U.S. needs.



Description: The Department of Energy manages a mission-driven portfolio of research that spans from the most basic research, exploring the origins of the cosmos, to applied research designed to solve emerging challenges in energy, environment, and national security. The scale and complexity of this research portfolio provides an enormous competitive advantage to the Nation as multidisciplinary teams of scientists, using the most advanced scientific instruments in existence today, are able to respond quickly to national priorities and changes in opportunities at the frontiers of science. As just one example, the Department mobilized enormous resources during the past few years to reclaim world leadership in high-performance computing at a time when other countries had all but taken over this strategically important capability that is vital to long-term U.S. scientific leadership and U.S. competitiveness. This agility in responding to challenges and opportunities is increasingly characterized by DOE's ability to achieve meaningful integration between the basic and applied research communities. The Department's ability to expand on this tradition will only strengthen its competitiveness and the national ability to rapidly convert the fruits of science into the revolutionary technologies that will change forever how our Nation provides for life's most basic needs—whether it be to light the night, heat a home, transport food, cure an illness, or to understand the beginning of time itself.

Strategies to reach this goal

- Strengthen the ties between the basic research and applied mission programs in Departmental planning.
- Ensure continuous cooperation and information flow between basic and applied research efforts through integrated research management and initiatives.
- Develop strategic partnerships with other Federal research agencies and the public and private sectors to leverage the combined intellectual capital and science resources to solve the Nation's challenges in energy, environment, and national security.

External Factors

The following external factors could affect the Department's ability to achieve the Scientific Discovery and Innovation theme:

World Events

Other nations are rapidly expanding their own science and technology capacity, which increases competition for resources (particularly human resources) and reduces the attractiveness of the U.S. as an innovation leader.

Policy Decisions

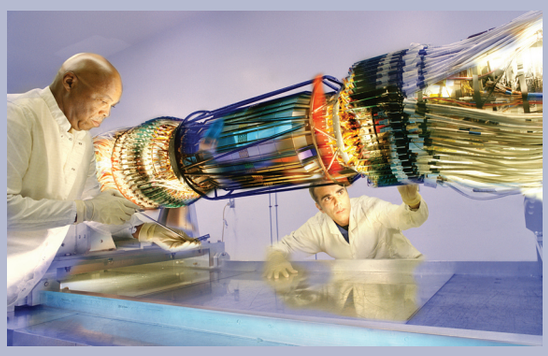
Policies implemented for national security reasons may affect the free exchange of scientific and technical information or access to U.S. facilities by visiting scientists.

Social and Economic Trends

Perhaps the greatest challenge is our inability to attract top-notch scientific talent due to social constraints (security concerns) and/or a poorly performing economy that encourages scientific talent to work elsewhere.

Development Communities

One of the great strengths of the U.S. Science and Technology (S&T) system is the close interaction between the scientific community and Federal agencies, which leads to appropriate policy and funding decisions.

Science Advisory Committees

Advisory Committees remain a cornerstone of our process for evaluating future scientific opportunities and needs while retaining their independence. At the same time, Federal S&T agency leaders must retain the ability to make independent decisions as significant opportunities arise or national circumstances demand.