Chapter 13
Institutional Capacity

Scientific Challenge: ***To strengthen the Nation's institutional and human assets for basic science and multidisciplinary research.***

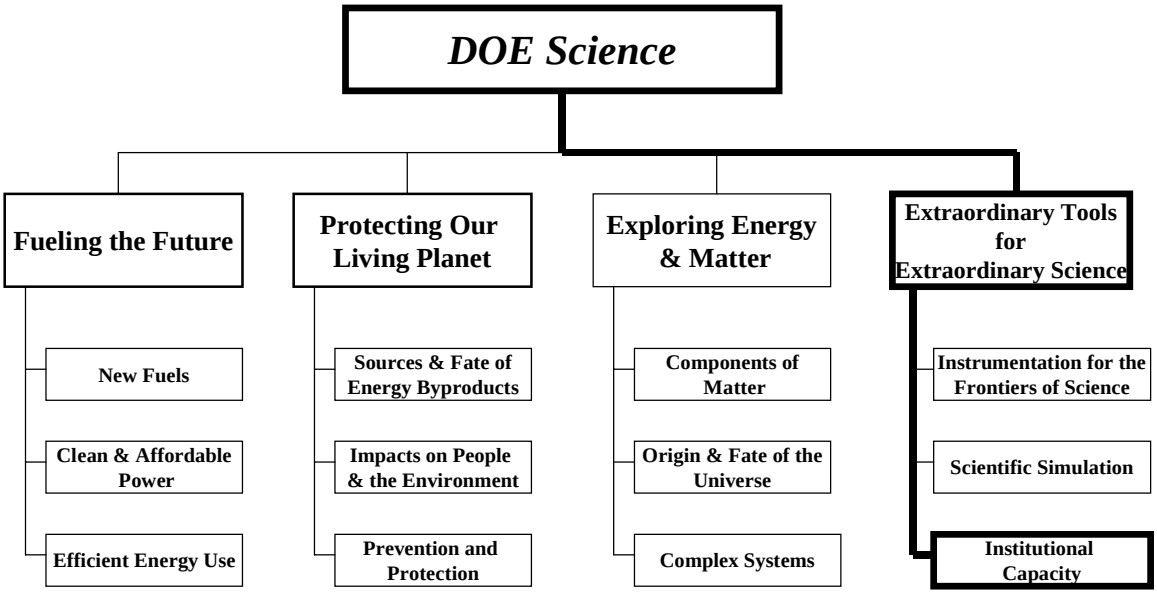

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Table of Contents

The Office of Science (SC) has statutory, programmatic, and institutional responsibilities to support the key components of the nation's science infrastructure. The Office provides institutional support for SC multiprogram national laboratories, funding for ES&H requirements at ten major SC laboratories, and line item construction funding to support general purpose infrastructure.

For science education purposes, support is provided for research at universities and colleges, and minority institutions, including graduate students and post-doctoral fellowships. A separate hands-on research internship program supports undergraduates and teachers at the Office of Science laboratories, during a summer or a semester.

SC is also responsible for broadening the scope of S&T performers in several ways. A Laboratory Technology Research (LTR) subprogram supports high risk, multidisciplinary research collaborations between SC laboratories and industry under Cooperative Research and Development Agreements (CRADAs). SC manages the DOE Small Business Innovation Research Program (SBIR), which uses small business to meet federal research and development needs, and the Small Business Technology Transfer (STTR) program, fostering small business collaborations with laboratories or universities to carry out research with commercialization potential. Targeted support through the DOE Experimental Program to Stimulate Competitive Research (EPSCoR) enhances the capabilities of eight states and the Commonwealth of Puerto Rico to carry out nationally competitive energy research, including close interactions and collaborative projects with DOE laboratories, and helps to develop science and engineering capabilities and expertise to meet future needs.

National Laboratory System

Description, Objectives, and Research Performers

The Office of Science has stewardship responsibility for five multiprogram national laboratories and five major program-dedicated laboratories. The SC programs have landlord responsibility for general purpose plant (GPP) and general purpose equipment (GPE) at all ten of these laboratories. Total funding for GPP/GPE for the multiprogram labs was $45.5M in FY 98 and $46.7M in FY 99.

SC programs support GPP funding (which is for small construction projects up to $5M) and GPE funding at Argonne, Brookhaven, Lawrence Berkeley, Oak Ridge, and Pacific Northwest National Laboratories. The Director, Office of Science, is the cognizant Secretarial Officer responsible for the institutional management of these laboratories, including the Laboratory Institutional Planning, Work for Others, and Laboratory Directed Research and Development processes. Implementation of these and SC program responsibilities helps ensure effective support and advocacy of integrated safety management, performance-based management, nonprofit contract policy, and the laboratories operating as a system. Together these laboratories have more than 1000 buildings with 14.9 million gross square feet of space and a multitude of unique scientific facilities at an estimated replacement value of over $10.5 billion. The Office of Science helps ensure mission readiness of these laboratories and helps preserve the Federal investment in these unique institutions. The SC program funding at these laboratories ranges from 70% to 20% of total laboratory funding.

Total support of the infrastructure at Ames, Fermi, Princeton Plasma Physics Laboratory, Stanford Linear Accelerator Center, and the Thomas Jefferson Accelerator, where SC provides almost all of the funding, comes from the SC budget. Also, all the laboratories fund maintenance and ES&H from their overhead accounts, which come out of program budgets. These totaled $98M in FY97, based on functional cost data submissions from the labs.

The Office of Science also provides general infrastructure support for the backlog of general purpose facility needs at the aging SC laboratories at a level of about $20M per year. The Multiprogram Energy Laboratory Facilities Support (MELFS) program has been in existence since 1981 and has invested $421M in the SC multiprogram lab infrastructure over the years. Seventy percent of these funds ($280M) addressed utility and ES&H needs while 10% ($40M) provided new buildings. As a result, these investments have corrected life safety hazards, improved health standards, reduced environmental liabilities, provided reliable utility services, reduced operating costs, and improved operating efficiencies. The program also provides funds for Payment In Lieu of Taxes (PILT) to local governments for two SC laboratories (Argonne and Brookhaven) as allowed by the Atomic Energy Act of 1954.

Research Challenges and Opportunities

The MELFS program will continue to invest in the multiprogram energy laboratories, addressing line item construction funding for the highest environmental, safety, and health risk and the greatest return on investment. The program's focus is on ES&H needs, utilities, and rehabilitation or replacement of general lab and office space. The major purpose of these programs at all ten of SC's laboratories is to ensure that research at SC laboratories can be carried out with high efficiency and reliability, while ensuring the safety of the staff and public, and without adverse impact to the environment.

The principal ongoing challenge relating to the infrastructure investments is the prioritization of requirements so that the most critical ones can be addressed first. A secondary challenge is the overall funding level for line item construction. The need to improve reliability, reduce operating costs (e.g., maintenance and energy costs), increase productivity, and improve safety and environmental security at the SC laboratories is obvious. Investments today would, in fact, result in more funding for research in future years as operating costs are reduced.

Maintaining the integrity of laboratory programs requires continued focus especially on laboratory ES&H and infrastructure. The BNL Action Plan calls on the DOE Controller to lead the Department in establishing a corporate budget formulation and execution process for ES&H and infrastructure.

Accomplishments

- The Office of Science is piloting an integrated ES&H and infrastructure planning process linked to budget formulation and execution. This process will define expectations for the conduct of infrastructure management activities in FY 1998 and FY 1999 and will be used during the FY 2000 budget process at SC multiprogram laboratories.

Science Education

Description, Objectives, and Research Performers

The Office of Science programs are responsible for construction and operation of the cutting-edge national scientific user facilities that are indispensable to university, industry, and laboratory scientists in several research fields. The SC programs also fund over $1 billion in merit and peer reviewed research at the Department's R&D laboratories. This combination of facility and research support provides the healthy science and technology base at the major SC laboratories. This base is then used by all DOE programs and other agencies in carrying out research at the labs. The Office of Science supports about $500M of peer reviewed basic research in universities, plus an additional $500M for operating the SC scientific facilities at the laboratories for university science-based users. This represents the Department's largest program contributing to the university research base and to the education and training of graduate students and post docs produced by these universities to meet future scientific manpower needs.

The Office of Science program support of university and national laboratory research impacts about 3500 graduate students and post docs each year. This is an important DOE contribution to replenishing the overall U.S. scientific pool. It is also a source of new scientific talent for DOE and its laboratories. Thousands of university graduate students use SC's major scientific user facilities to perform their research. For example, out of the 2300 scientists that use the National Synchrotron Light Source each year, DOE supports 700 graduate student users, and other agencies support 550 more. SC programs also provide graduate fellowships to outstanding students in specific program areas.

The Basic Energy Sciences Program supports the EPSCoR at $6.8M per year at research universities and colleges in the designated eighteen states and the Commonwealth of Puerto Rico. This program also contributes to developing science and engineering manpower to help meet current and future needs. Particular emphasis is placed on exploiting the unique scientific and technical capabilities present at the DOE national laboratories to accomplish the objectives of the program. Close interactions result in establishing joint collaborative research projects between laboratory scientists and the EPSCoR state personnel. These projects, in turn, will lead to establishing nationally competitive scientific expertise at the home institutions of the EPSCoR states.

Research Challenges and Opportunities

A substantial number of highly capable students drop out of science programs in their sophomore and junior years in college. Hands-on research experience at the laboratories has proven effective in inspiring undergraduate students to remain in science. The undergraduate students and faculty work with researchers at the laboratories on DOE programs during the summer of their sophomore, junior or senior year or for a semester during their junior or senior year. The laboratory researcher often becomes a mentor to the student, and many students return to the laboratory for additional programs. The experiences vary by laboratory, and are tailored to the capabilities and needs of the students and teachers as much as possible. There are very few programs focused on undergraduates in S&T in the government. The SC base support for the

program helps to leverage program support for more than twice as many students each year. Support is provided mainly to undergraduates, graduate students, and post docs at DOE laboratories and, to a lesser extent, to pre-college students.

Accomplishments

- DOE has made a substantial contribution to the undergraduate education of over 100,000 students over the 40-year life of the predecessor program, and thousands of teachers and professors have also participated in the program over the past 10 years. The base support for the program helps to leverage program support for more than twice as many students as are directly supported each year.

- DOE carries out a National Science Bowl each year, which, since its inception, has had over 60,000 high school participants in regional tournaments, leading up the national finals in Washington, DC.

Broadening the Scope of S&T Programs

Increasingly, partnerships with universities, industry, and other laboratories characterize the programs carried out at SC laboratories. Industry scientists are a growing user group at the SC laboratories, both at the scientific user facilities, under work for others, and in formal collaborations and technology transfer partnerships with the laboratories. Thousands of industry scientists are currently carrying out research at laboratory user facilities. Many others are paying full cost recovery under Work for Others for the use of laboratory resources. Still others are participating in cost-shared Cooperative Research and Development Agreements. The Laboratory Technology Research (LTR) program is a separately funded research program cost-shared with industry partners for which SC is responsible. SC also manages the Department-wide Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

Research Challenges and Opportunities

The challenge is to expand the programs. There are many commendable applications for projects under the programs for every award the Department makes.

Research Activities

The LTR subprogram provides $16M to advance the fundamental science and technology at the SC laboratories toward innovative energy applications. The LTR subprogram supports high-risk, multidisciplinary research collaborations between the SC laboratories and private industry. The research portfolio emphasizes advanced materials processing and utilization, intelligent processes and controls, and sustainable environments. Such work leverages the resources of both partners, since each frequently has unique facilities and complementary expertise. The partners jointly bring technology research to a point where industry or DOE's technology development programs can pursue final development and commercialization. The LTR subprogram enhances opportunities to pursue technology research that is of value to industry, complements basic

research program goals, and seeks to enhance public benefit from investment in scientific research at the Office of Science laboratories.

In the DOE-wide SBIR program, 2.5% of the Department's extramural R&D budget, about $76M, is set aside for a competition among small businesses. The Department's technical program offices are responsible for identifying research challenges that (1) are suitable to the capabilities of technology-based small businesses and (2) are required to fulfill mission needs. The research challenges are published as technical topics in annual solicitations and encompass a wide range of scientific subject matter, from molecularly engineered nanoscale materials, to instrumentation and concepts for high-energy accelerators to advanced fuel injection concepts for hybrid electric vehicles.

The Small Business Technology Transfer (STTR) program is similar in structure to the SBIR program except that, in STTR, the small businesses must collaborate with a research institution (usually a national laboratory or a university) serving as a subcontractor. The Department sets aside 0.15% of its extramural R&D budget for competition among small businesses in this DOE-wide program. The responsibilities of the technical program offices are very similar to those in the SBIR program.

Accomplishments

- Since its inception in 1992, the LTR subprogram has won 19 R&D 100 Awards for the most technologically significant new products of the year and 17 Federal Laboratory Consortium Awards for Excellence in Technology Transfer.

- Each year, the Department selects approximately 200 SBIR awards from 1200-1500 applications.

- Each year, the Department selects approximately 15 STTR awards, from about 100-300 applications, to explore the feasibility of innovative concepts and development.

Portfolio Summary

This portfolio area, "Institutional Capacity," encompasses activities from many programs and supporting activities that crosscut the research topics covered above. The table below summarizes specific core research activitiesthat strongly support or moderately support Institutional Capacity, including the national laboratory system, science education, and broadening the scope of S&T performers. Additional details on these research areas are presented in the Research Summary Matrix and the corresponding Research Summary Profiles.

Strongly Supportive Core Research Activities
Experimental Program to Stimulate Competitive Research (EPSCoR)
Fusion Physics Research on NSTX
General Purpose Plant & Equipment (GPP/GPE)
Laboratory Technology Research and Advanced Energy Projects
Multiprogram Energy Lab Facilities Support (MELFS)
Neutron and Light Sources Facilities

NSTX Facility Operations
Science Education Support
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

Moderately Supportive Core Research Activities
Adv. Particle Accelerator Concepts
Advanced Computing and Communications Facility Operations
Advanced Fusion Design
Advanced Fusion Materials Research
Alcator C-Mod Facility Operations
Carbon Cycle Research
CP Violation - B-Meson System
CP Violation - K-Meson System
DIII-D Facilities Operations
Economics of Global Climate
Electroweak Interactions
Experimental Fusion Physics Support
Experimental Plasma Research (Alternatives)
Facility Operations: AGS
Facility Operations: Fermilab
Facility Operations: SLAC
Fusion Physics Research on Alcator C-Mod
Fusion Physics Research on DIII-D
Fusion Technologies
General Plasma Science
General Technology: Accelerator R&D
General Technology: Detector R&D
Hadron Spectroscopy
Heavy Ion Facility Ops.& Constr.
Intertial Fusion Energy Research
Low Energy Facility Ops. & Constr.
Medium Energy Facility Ops. & Constr.
Neutrino Mass and Mixing
Nuclear Structure & Astrophysics - Low Energy Nuclear Physics
Nuclear Structure/Dynamics ... Phase Trans. - Heavy Ion Nuclear Physics
Oak Ridge Landlord
Particle Astrophysics & Cosmology
Plasma Technologies
Plasma Theory & Computation
Quark/Gluon Substructure of Nuclei - Medium Energy Nuclear Physics
Search for Higgs & Supersymmetry
Spin Structure of Nucleons
Strong Interactions, Supersymmetry & Particles
Theoretical Nuclear Physics

NOTE: Please see Appendix A for more information on the budgets, the research performers, and other related information for each Core Research Activity.