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MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

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SUBJECT: FY 2007 Administration Research and Development Budget Priorities

This memo highlights the Administration's research and development (R&D) priorities and emphasizes improving management and performance to maintain excellence and leadership in science and technology. The memo provides general guidance for setting priorities among R&D programs, interagency R&D efforts that should receive special focus in agency budget requests, and reiteration of the R&D Investment Criteria that agencies should use to improve investment decisions for and management of their R&D programs. These updated R&D budget priorities reflect an extensive, continuous process of consultation with the President's Council of Advisors on Science and Technology (PCAST) and collaboration within the interagency National Science and Technology Council (NSTC).

General R&D Program Guidance

The combination of finite resources and a multitude of new research opportunities requires careful attention to funding priorities and wise choices by agency managers. As we have reiterated previously in these annual memos, agencies must vigorously evaluate existing programs and, wherever possible, consider them for modification, redirection, reduction or termination, in keeping with national needs and priorities. They must justify new programs with rigorous analysis demonstrating their merit, quality, importance and consistency with national priorities. Agencies may propose new, high-priority activities, but these requests should identify potential offsets by elimination or reductions in less effective or lower priority programs or programs where Federal involvement is no longer needed or appropriate.

In general, the Administration favors Federal R&D investments that:

- advance fundamental scientific discovery to improve future quality of life;
- address societal and environmental impacts of science and technology, including ethical, national security and homeland security issues;
- sustain specifically authorized agency missions and support the missions of other agencies through stewardship of user facilities;
- enable potentially high-payoff activities that require a Federal presence to attain long-term national goals, including national security and energy independence;
- support technological innovation to spur economic competitiveness and new job growth;
- enhance the health of our Nation's people;
- strengthen science, mathematics and engineering education and accomplishments to enable superior performance in math and science;
- ensure a scientifically literate population and a supply of qualified technical personnel commensurate with national need;
- enhance our ability to understand and respond to global environmental issues;
- maximize efficiency and effectiveness of the R&D enterprise through means such as competitive, peer-reviewed award and review processes and phase-out of programs that are only marginally productive or are not important to an agency's mission; and
- strengthen international partnerships that foster advancement of scientific frontiers and accelerate the progress of science across borders.

Agencies are expected to conduct programs in accordance with the highest standards of ethical and scientific integrity, and to have clear guidelines on issues such as conflict of interest, protection of privacy, and the treatment of human subjects. Agency participation in coordination of relevant standards through NSTC is expected, following the example of the U.S. Federal Policy for the Protection of Human Subjects, known as the Common Rule.

Agencies should maximize the coordination and planning of their R&D programs through the NSTC. Two areas requiring special agency attention and focus through the NSTC are Federal scientific collections and R&D assessment.

- Agencies should assess the priorities for and stewardship of Federal scientific collections, which play an important role in public health and safety, homeland security, trade and economic development, medical research, and environmental monitoring. Agencies should develop a coordinated strategic plan to identify, maintain and use Federal collections and to further collections research.
- Determining the effectiveness of Federal science policy requires an understanding of the complex linkages between R&D investments and economic and other variables that lead to innovation, competitiveness, and societal benefits. An interagency process is needed to develop a new framework for understanding the impact of R&D investments, define appropriate data elements for monitoring and assessing this impact, contribute to the international effort to understand the impact of globalization of science and technology, and improve the basis for national science policy decisions.

Interagency R&D Priorities

While some priority R&D areas fall mainly within the purview of a single agency, such as fusion energy research at the Department of Energy, other areas require strong interagency coordination. The following interagency R&D priorities should receive special focus in agency budget requests. Agencies that receive funding for these activities should be prepared to participate in applicable interagency coordination groups to produce: 1) a clear and concise definition of program activities and priorities within the overall priority area; 2) an inventory of the programs in the baseline budget; 3) agency trade-offs that will provide the resources to help produce a coordinated, cross-agency program with greater impact than that of the individual activities; and 4) an interagency implementation plan.

Homeland Security R&D

Significant advances in securing the homeland and winning the war on terror have been made over the past few years through the focused application of our nation's science and technology capability. Highlights of these accomplishments have been documented in the OSTP report *Science and Technology: A Foundation for Homeland Security.* But many challenges remain and much research and development is still required to further reduce vulnerabilities. Agencies should place increased emphasis on R&D efforts that support: quick and cost-effective decontamination capabilities following a biological, chemical, nuclear or radiological incident; predictive modeling to assess the rate of geographic spread of emerging and/or intentionally released infectious diseases; enhanced biometric systems; secure land and maritime borders through more reliable technologies for screening cargo and visitors; increased effectiveness of existing security systems through automation; improved understanding of the social and cultural dynamics of regional population groups; safety of the Nation's food supply and agricultural systems; and social and behavioral research to anticipate, counter and diffuse threats to our homeland security and enhance response and recovery capabilities. As we continue the rapid development of near-term technologies, we need to enhance fundamental studies that may lead to transformational concepts for solving truly difficult challenges including the remote detection of nuclear material and/or devices and the remote detection and/or disabling of explosive devices ranging from suicide vests to vehicle-borne bombs.

High-End Computing and Networking R&D

While the importance of each of the Networking and Information Technology R&D (NITRD) program areas continues, investments in high-end computing and cyber infrastructure R&D should be given higher relative priority due to their potential for broad impact. Agency plans in high-end computing must be consistent with the 2004 *Federal Plan for High-End Computing* and should aggressively focus on supercomputing capability, capacity and accessibility issues by emphasizing coordination, leveraging the efforts of all agencies and, where appropriate, use of coordinated multi-agency investments. Advanced networking research (including test-beds) on hardware and software for secure, reliable, distributed computing environments and tools that provide the communication, analysis and sharing of very large amounts of information will accelerate discovery and enable new technological advances. Agency requests should reflect these program priorities by reallocating funds from lower priority efforts. Agencies supporting R&D in these and all NITRD areas are expected to participate in interagency planning through the NSTC to guide future investments. Reflecting the importance of cyber security, agencies

should continue to work through the NSTC to generate a detailed gap analysis of R&D funding in this area.

National Nanotechnology Initiative

Continued Federal investment in the agency programs that make up the National Nanotechnology Initiative (NNI) facilitates breakthroughs and maintains U.S. competitiveness in this field. The NNI should support both basic and applied R&D in nanotechnology and nanoscience, develop nanoscale instrumentation and metrology, and disseminate new technical capabilities to industry. Because research at the nanoscale offers natural bridges to interdisciplinary collaboration, especially at the intersection of the life and physical sciences, the Administration encourages novel approaches to accelerating interdisciplinary and interagency collaborations. Activities such as joint programs utilizing shared resources, as well as support for interdisciplinary activities at centers and user facilities, are encouraged. To ensure that nanotechnology research leads to the responsible development of beneficial applications, high priority should be given to research on societal implications, human health, and environmental issues related to nanotechnology and develop, where applicable, cross-agency approaches to the funding and execution of this research.

Priorities in the Physical Sciences

Investments in the physical sciences likely to lead to or enable new discoveries about nature or strengthen national economic competitiveness continue to be important. Priority will be given to research, instrumentation and facilities that aim to close significant gaps in the fundamental physical understanding of phenomena that promise significant new technologies with broad societal impact.

High-temperature and organic superconductors, molecular electronics, wide band-gap and photonic materials, thin magnetic films, and quantum condensates are examples of novel atomic and molecular-level systems that are only partially understood, and where coherent control holds great potential.

Physical science research often demands instruments and facilities requiring a wide range of investments from bench-top devices such as scanning microscopes to the national-scale synchrotron and neutron user facilities. Of particular interest are investments that could enable the development of next-generation light sources and instruments capable of resolving electronic, chemical, and mechanical properties of structures with sub-nanometer resolution. In their budget submissions, agencies should demonstrate coordination with other agencies of their investments in instrumentation, upgrades and user programs at national scientific user facilities.

Within discovery-oriented physical science investments, priority will be given to those projects and programs that are demonstrably well coordinated with related programs in other agencies and countries. Examples of well coordinated, inter-agency investments in the discovery-oriented sciences are described in the interagency working group report, *A 21st Century Frontier for Discovery: The Physics of the Universe*.

Understanding Complex Biological Systems

New biotechnological tools are giving researchers unprecedented access to data on DNA sequences, and RNA and protein expression, thus opening new avenues for research into the

functional implications of gene expression. Agencies should target investments toward the development of a deeper understanding of complex biological systems through collaborations among physical, computational, behavioral, social and biological researchers and engineers. Scientific and technological breakthroughs in revealing biochemical processes are expected in diverse areas at scales ranging from the sub-molecular to the systems level. The rapidly developing methods and capabilities of the behavioral and social sciences can have significant impact on national security, health and education. Social science research is relevant to prevention and treatment of infectious disease (plant, animal and human), and to inherently complex areas such as obesity, environmental management, and the neural basis of behavior. Obesity research should be a priority area for interagency coordination. Data sharing across platforms and disciplines is important for all these complex issues, and should be given higher priority in agency programs.

Energy and Environment

The Administration's energy and environment research initiatives are critical for achieving sustained economic growth while ensuring national energy security and a healthy environment.

Global earth observations support research in a wide range of sciences important for society. The *U.S. Strategic Plan for an Integrated Earth Observations System* (IEOS) provides guidance for agencies contributing to these efforts. Agencies should focus on near-term opportunities to pilot integrated observing systems, such as those that contribute to natural hazards assessment and disaster warnings. Agencies also should work through the NSTC U.S. Group on Earth Observations Subcommittee to ensure continued coordination and implementation of the U.S. Strategic Plan and continued strong U.S. leadership in the international community.

Investments in global climate change science and technology continue to improve our understanding of climate variability and change, provide the basis for sound long-term climate policy decision-making, and enable the development of energy efficient technologies. Agencies should implement the 2003 "*Strategic Plan for the U.S. Climate Change Science Program*" and focus on the topics described in the 2003 "*U.S. Climate Change Technology Program: Research and Current Activities*."

Agencies are encouraged to implement activities outlined in the Administration's 2004 U.S. Ocean Action Plan, developed in response to the U.S. Commission on Ocean Policy. These activities included the development of an Ocean Research Priorities Plan and Implementation Strategy and the integration of U.S. ocean observing efforts into the Global Earth Observation System of Systems.

The ability to measure, monitor and forecast U.S. and global supplies of fresh water is important because agencies are developing a coordinated, multi-year plan through the NSTC to improve research to understand the processes that control water availability and quality, and to collect and make available the data needed to ensure an adequate water supply for the future. Significant progress on this plan, including stakeholder input, is expected during the next two years.

In support of the President's Hydrogen Fuel Initiative, agency efforts should address the critical technology barriers of on-board hydrogen storage density, hydrogen production cost, and fuel cell cost, as well as distributed production and delivery systems. R&D should focus on novel materials for fuel cells and hydrogen storage (including nanostructured materials), durable and

inexpensive catalysts, and hydrogen production from renewable energy, nuclear energy, biological and electrochemical processes, and fossil fuels with carbon sequestration.

Research and Development Investment Criteria

The President's Management Agenda directs agencies to use the R&D investment criteria to improve investment decisions for and management of their R&D programs. Under this initiative, three primary criteria apply to all R&D programs:

1. Relevance;
2. Quality; and
3. Performance.

Industry-relevant applied R&D must meet additional criteria. The specific activities that programs should undertake to demonstrate fulfillment of the R&D investment criteria are described in a previous year's memorandum, which is available at:

http://www.whitehouse.gov/omb/memoranda/m03-15.pdf

Many of these specific activities have been incorporated into the Program Assessment Rating Tool (PART) that has been tailored for R&D programs. Agencies should use the criteria as broad guidelines that apply at all levels of Federally funded R&D efforts, and they should use the PART as the instrument to periodically evaluate fulfillment of the criteria at the program level.

The R&D criteria have benefited from four years of working with agencies, other stakeholders, and experts in assessment, to build on the best of existing R&D planning and assessment practices. The R&D investment criteria continue to:

- Provide tools for programs, agencies, and policy makers to select, plan, and manage R&D programs effectively, to increase the productivity of the Federal R&D portfolio and the return on taxpayer investment;
- Help convey the Administration's expectations for proper program management;
- Set standards for information to be monitored and provided in program plans and budget justifications; and
- Ultimately improve public understanding of the potential benefits and effectiveness of the federal investment in R&D.