18

Chemical Sciences in the FY 2008 Budget

Ashley Predith, J. Carl Maxwell,
Anthony Pitagno and Kathryn J. Hughes,
American Chemical Society

Chemistry is a central science that seeks to understand the composition and structure of different substances and their properties and reactions. The subdisciplines of chemistry reflect the types of substances and the kinds of enquiry used for investigating the chemistry of the physical world. Major subdisciplines are biological chemistry, inorganic chemistry, organic chemistry, materials chemistry, physical chemistry, analytical chemistry, and theoretical chemistry. Each federal agency has a unique mission, and the degree of research support in each subdiscipline varies by agency. The budget proposal for FY 2008 continues to be influenced by the President's American Competitiveness Initiative (ACI), which calls for a doubling, over 10 years, of investment in "innovation-enabling physical science and engineering research." The ACI affects the budgets of the National Science Foundation (NSF), the Department of Energy (DOE) Office of Science, and the National Institute of Standards and Technology (NIST). In the current FY 2008 budget proposal:

- Support for chemistry would increase at the National Institute of Standards and Technology through increased funding of laboratory research and construction programs;

- Support for chemistry at the National Science Foundation would increase;

- Support for chemistry at the Department of Energy would see significant increases in Administration priority areas such as hydrogen energy research and nanoscale science;

- Support for chemistry at the Department of Defense (DOD) would likely decrease with proposed decreased funding in basic and applied research;

- Support for chemistry at the National Institutes of Health (NIH) would increase slightly with proposed funding of the National Institute of General Medical Sciences (NIGMS);

- Construction continues on the Linac Coherent Light Source, and the five NanoScale Science Research Centers will be fully functional in 2008. These facilities will enable world-class research in emerging chemical fields.

Scientists in academic, government, and industry laboratories perform federally funded chemical research. The results of this research are utilized by government and leveraged by industry to develop various products and services that improve quality of life and help maintain our economic strength. Among a variety of benefits, successes in chemistry have led to effective health and pharmaceutical products, the growth and safety of our nation's food and water supply, the expansion and improvement of our energy sources, new materials for the electronics and information industries, and key technologies for national defense.

The federal government has a particularly important role in the basic chemical sciences performed largely at the university level. It is at this level and to a large extent with these funds that the nation's future chemical scientists and engineers are trained. Thus, continued federal investment in the chemical sciences is necessary in order to benefit from future chemical advances.

NATIONAL INSTITUTES OF HEALTH (NIH)

Twenty-seven institutes and centers comprise the National Institutes of Health (NIH), and each institute focuses its intramural and extramural research on addressing one type of disease. The National Institute of General Medical Studies (NIGMS) and the National Center for Research Resources (NCRR) have the unique missions of addressing fundamental medical science issues, and they are the two organizations that primarily fund basic chemistry research at NIH.

The NIGMS mission is to support basic biomedical research that will lay a foundation for advances in the diagnosis, treatment, and prevention of all diseases. The FY 2007 budget, passed by joint funding resolution, is $1.9 billion. The FY 2008 budget estimate is just $6 million more (see Table II-9). Within NIGMS, the division of Pharmacology, Physiology, and Biological Chemistry (PPBC) grants funds that focus on biochemistry research. Recent chemistry advances unveiled by NIGMS-supported researchers cover a spectrum of topics. One investigation used computer models to determine the reactions between certain pathogens that cause disease and the antibodies that protect the body. NIGMS researchers also used high intensity x-ray techniques to determine the three-dimensional structure of proteins, and another investigation determined how misshapen protein shapes contribute to development of a particular disease. The PPBC FY 2007 enacted budget was $419 million, and the fiscal year 2008 budget estimate is $421 million.

The NIH supports more than 30,000 basic and clinical researchers, and the mission of NCRR is to provide infrastructure, tools and training to help scientists engage in basic laboratory research. The fiscal year 2007 enacted budget is $1.1 billion, and the FY 2008 budget is $21 million less. NCRR funding especially useful to chemical science researchers includes Shared Instrumentation Grants, which allow for the purchase of major laboratory instruments to be shared by groups of NIH-sponsored researchers.

NATIONAL SCIENCE FOUNDATION (NSF)

The National Science Foundation seeks to support fundamental, transformative research. The focus is not on technology development, but on understanding the scientific underpinnings of chemical phenomena. Researchers funded by NSF investigate many areas of chemistry. Recent advances included developing methods to create stronger glassy materials, understanding the origin of metallic scents, using nanoparticles to suppress protein production, and demonstrating frictionless molecular motion in water.

Within NSF, the Chemistry Division of the Mathematics and Physical Sciences (MPS) Directorate is the primary supporter of the Foundation's chemistry research. Support for chemistry research can also be found in other NSF divisions including the Materials Research and Physics Division, the Molecular and Cellular Biosciences Division, the

Atmospheric Sciences and Earth Sciences Divisions, the Advanced Computational Research Division, the Chemical and Transport Systems Division, and the Office of Multidisciplinary Research

The MPS Chemistry Division supports chemical research across a wide spectrum of topics, whereas other NSF divisions support chemistry as it assists in the advancement of divisional objectives. The seven priorities for Chemistry Division in FY 2008 are:

- the Chemical Bonding Centers program that funds collaborative, cutting-edge, creative research;
- the Nanoscience, Complexity and Molecular Basis of Life Processes program that seeks to design compounds at the molecular level that could then self-assemble into a larger system with desired properties;
- the Science Beyond Moore's Law program that involves the design of single-molecule electronic devices;
- the Sustainability program that encourages the development of green technologies and green processes to synthesize chemicals;
- the Cyber-enabled Discovery and Innovation program that supports computational chemistry investigations;
- the program for Preparing the Workforce of the 21st Century that funds research for a diverse group of young investigators in areas targeted by the President's American Competitiveness Initiative; and
- the Chemical Research Instrumentation and Facilities program that invests in instruments and computational resources for research.

The FY 2008 budget request for the MPS directorate is $1.3 billion, which is an increase of 8.9 percent over the $1.2 billion FY 2007 budget (see Table II-7). Under the proposed FY 2008 budget, the chemistry division budget in the MPS Directorate would increase by 10.2 percent from the FY 2007 budget, bringing the chemistry division budget to $211 million. 45 percent of funding will go to new projects, with the balance of funding going to continuing projects and other objectives. The change reflects an increase of 7.7 percent ($12.9 million) for Research and Education Grants, 55.4 percent ($5.3 million) for Centers Programs, and 8.8 percent ($1.2 million) for Instrumentation and Facilities.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

"The mission of the Environmental Protection Agency is to protect human health and the environment." – www.epa.gov

At EPA, the Office of Research and Development (ORD) supports most of the fundamental research that plays a role in the Agency's efforts to protect public health and the environment. Because chemistry plays a central role in much of EPA's decision-making processes and in solving the nation's environmental problems, ORD engages in a great deal of chemical research. The efforts include addressing concerns about potentially harmful components of air, water, and food and the development of green chemistry and engineering approaches for less environmentally damaging processes and materials. Recent research funded by EPA used computational tools to model the toxic chemicals from their source to their environmental impact, developed a method to measure airborne nanoparticles, analyzed the formation of particulate matter, and investigated the mechanism of dioxin formation from organic materials.

The FY 2008 proposed budget is $755 million for the overall EPA Science and Technology (S&T) account, an increase of $24 million (3.3 percent) over the FY 2007 level. The main S&T programs are Air Toxics and Quality, Climate Protection Program, Enforcement, Homeland Security, Indoor Air, Pesticides Licensing, Research (Clean Air, Clean Water, Human Health and Ecosystems, Land Protection, Sustainability), Toxic Research and Prevention, and Water: Human Health Protection. The EPA's S&T account supports laboratories and programs that contribute, in many cases, to multiple goals and objectives across the whole of EPA.

DEPARTMENT OF ENERGY (DOE)

DOE supports fundamental research in the chemical sciences that seeks to foster new and improved energy technologies and to alleviate environmental impacts of energy use by increasing the scientific understanding of energy conversion. DOE credits research in chemistry for improving combustion systems that output less pollution, improving catalysts used in producing chemicals, and finding new processes for converting solar radiation. Through the Office of Science, DOE is the sole supporter of heavy-element chemistry.

Chemistry funding from DOE comes through the Office of Science, specifically from the Office of Basic Energy Sciences (BES), the Office of Advanced Scientific Computing Research (ASCR), and the Office of Biological and Environmental Research (BER). The Administration proposes a $4.4 billion budget for the Office of Science in FY 2008, a 15.8 percent increase over the final 2007 appropriation. The BES request is $1.5 billion, which is a 20 percent increase over the FY 2007 enacted budget. BER requests $532 million, an increase of 10 percent over the FY 2007 enacted budget, and ASCR requests $340 million, an increase of 20 percent over the FY 2007 enacted budget (see Table II-11).

From the Office of Basic Energy Sciences, funding for Chemical Science, Geosciences, and Energy Biosciences subprogram would increase 25.2 percent from FY 2007 to the FY 2008 request of $284 million. The subprogram manages the Combustion Research Facility at Sandia National Laboratories in Livermore, California. One of the long term goals of BES is to "understand, model, and control chemical reactivity and energy transfer processes in the gas phase, in solutions, at interfaces, and on surfaces for energy-related applications, employing lessons from inorganic and biological systems." The program also manages research on the molecular mechanisms of natural solar energy conversion. The FY 2008 budget request for this area would increase 9.5 percent to $20 million.

The FY 2008 budget continues financial support for the construction of the Linac Coherent Light Source, which will provide laser-like radiation in the x-ray region of the spectrum at a world-class facility based at Stanford Linear Accelerator Center. The light source is expected to become operational in 2009. The facility will provide 10 billion times the brightness of current coherent light sources, giving insight as never before into catalysis, chemical processes, protein folding, and molecular assembly. All five NanoScale Science Research Centers (NSRCs) at Oak Ridge, Lawrence Berkeley, Sandia, Brookhaven, and Argonne National Laboratories will be fully operational by 2008. The NSRCs are user facilities for the synthesis, processing, fabrication, and analysis of materials at the nanoscale level. They are designed to enable the nanoscale revolution by situating multiple research disciplines, multiple techniques, and a wide variety of state-of-the-art instrumentation in a single building. The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory, the world's most powerful neutron scattering

facility, will be in its second full year of operation in 2008. SNS will be the world's most powerful neutron scattering facility.

Two final important initiatives in the Office of Science budget request involve hydrogen and nanoscale funding. The Hydrogen Energy Research project requests $59.5 million, an increase of 19.0 percent over FY 2007. The FY 2008 request for Nanoscale Science Research funding is $279.5 million, a 10.1 percent increase. $3.0 million in the Biological and Environmental Research program is targeted to study environmental aspects of nanomaterials, and BER and BES will coordinate their nanoscale programs. (For more on the DOE budget, see Chapter 8.)

DEPARTMENT OF DEFENSE (DOD)

DOD supports military-relevant chemical research through the Army, Navy, and Air Force research organizations and through defense-wide research agencies such as the Defense Advanced Research Projects Agency (DARPA). Basic research funding, referred to as "6.1," is allocated for both intramural and extramural programs.

Chemistry is important in many areas of basic research at DOD. The Air Force Office of Scientific Research (AFOSR), for example, conducts programs in molecular dynamics, theoretical and polymer chemistry, and surface science. These efforts serve the needs of the Air Force for new lightweight materials, better understanding of atmospheric processes, more energetic and efficient propellants, improved corrosion prevention capabilities, and the development of improved electro-optic technologies. The military also has interest in the development of sensors to measure aerosols, bacteria, viruses, radioactive agents, and other toxins. The Naval Research Laboratory hosts an array of chemistry-related investigations from the chemistry of optical materials to data mining and marine biogeochemistry, and the Army Research Office supported $4.5 million in chemistry funding in FY 2006.

The FY 2008 budget request would decrease DOD basic research ("6.1") by 8.7 percent (to $1.4 billion; see Table II-2) and applied research ("6.2") by 18.2 percent (to $4.4 billion), which would likely decrease support for chemical research. The Defense Advanced Research Projects Agency (DARPA) basic research budget request is $153 million. (For more on the DOD budget, see Chapter 5.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST, through its intramural and extramural programs, delivers the underlying technological capabilities for areas of chemical processing and research, from nanotrace analyses and clinical testing to synthesis and catalysis. The Administration's budget would reduce total NIST funding in FY 2008 by 5.1 percent to $641 million. For NIST laboratories under Scientific and Technical Research Services (STRS), there is strong $501 million FY 2008 request, representing a 15.7 percent increase over FY 2007 final appropriations. This increase will address critical infrastructure and national security needs while supporting chemical research (see Table II-14).

NIST laboratories provide impartial expertise, test methods, and best-in-the-world calibration services that maximize efficiency, promote trade, and ensure confidence in the growing number of precision measurements needed for a variety of sectors including electronics, automotive, aerospace, food processing, and health care. The laboratories, in addition, produce standard reference materials and data needed to achieve lower detection limits and improve the quality, productivity, and efficiency of chemical measurements.

The Chemical Science and Technology Laboratory (CSTL) heads the chemistry related research at NIST, with concomitant chemistry work taking place in the Materials Science and Engineering Laboratory. CSTL will be active in developing measurements and standards for two main NIST initiatives in FY 2008: global climate change science and nanoscience. For the climate change science program, activity will include measurements of aerosols, a less well understood climate change factor than green house gases. World-class analysis of nanoscale phenomena are particular strength of CSTL, and the laboratory will continue to invest in comprehensive nanoscale facilities and analysis.

The administration's decision to eliminate funding for the Advance Technology Program (ATP) will hamper research in a variety of chemically related high-risk technologies. This is the fifth consecutive year the White House has proposed ending ATP.