

NANOTECHNOLOGY RESEARCH AND DEVELOPMENT ACT  
OF 2003

MAY 6, 2003.—Committed to the Committee of the Whole House on the State of the  
Union and ordered to be printed

Mr. BOEHLERT, from the Committee on Science,  
submitted the following

R E P O R T

together with

ADDITIONAL VIEW

[To accompany H.R. 766]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, to whom was referred the bill (H.R. 766) to provide for a National Nanotechnology Research and Development Program, and for other purposes, having considered the same, report favorably thereon with an amendment and recommend that the bill as amended do pass.

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## I. AMENDMENT

The amendment is as follows:

Strike all after the enacting clause and insert the following:

### SECTION 1. SHORT TITLE.

This Act may be cited as the “Nanotechnology Research and Development Act of 2003”.

### SEC. 2. DEFINITIONS.

In this Act—

(1) the term “advanced technology user facility” means a nanotechnology research and development facility supported, in whole or in part, by Federal funds that is open to all United States researchers on a competitive, merit-reviewed basis;

(2) the term “Advisory Committee” means the advisory committee established or designated under section 5;

(3) the term “Director” means the Director of the Office of Science and Technology Policy;

(4) the term “Interagency Committee” means the interagency committee established under section 3(c);

(5) the term “nanotechnology” means science and engineering aimed at creating materials, devices, and systems at the atomic and molecular level;

(6) the term “Program” means the National Nanotechnology Research and Development Program described in section 3; and

(7) the term “program component area” means a major subject area established under section 3(c)(2) under which is grouped related individual projects and activities carried out under the Program.

### SEC. 3. NATIONAL NANOTECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The President shall implement a National Nanotechnology Research and Development Program to promote Federal nanotechnology research, development, demonstration, education, technology transfer, and commercial application activities as necessary to ensure continued United States leadership in nanotechnology research and development and to ensure effective coordination of nanotechnology research and development across Federal agencies.

(b) PROGRAM ACTIVITIES.—The activities of the Program shall be designed to—

(1) provide sustained support for nanotechnology research and development through—

(A) grants to individual investigators and interdisciplinary teams of investigators;

(B) establishment of advanced technology user facilities; and

(C) establishment of interdisciplinary research centers, which shall—

(i) network with each other to foster the exchange of technical information and best practices;

(ii) involve academic institutions or national laboratories and other partners, which may include States and industry;

(iii) make use of existing expertise in nanotechnology in their regions and nationally;

(iv) make use of ongoing research and development at the micrometer scale to support their work in nanotechnology; and

(v) be capable of accelerating the commercial application of nanotechnology innovations in the private sector;

(2) ensure that solicitation and evaluation of proposals under the Program encourage interdisciplinary research;

(3) expand education and training of undergraduate and graduate students in interdisciplinary nanotechnology science and engineering;

(4) accelerate the commercial application of nanotechnology innovations in the private sector;

(5) ensure that societal and ethical concerns, including environmental concerns and the potential implications of human performance enhancement and the possible development of nonhuman intelligence, will be addressed as the technology is developed by—

(A) establishing a research program to identify societal and ethical concerns related to nanotechnology, and ensuring that the results of such research are widely disseminated;

(B) insofar as possible, integrating research on societal and ethical concerns with nanotechnology research and development, and ensuring that advances in nanotechnology bring about improvements in quality of life for all Americans; and

(C) requiring that interdisciplinary research centers under paragraph (1)(C) include activities that address societal and ethical concerns; and

(6) include to the maximum extent practicable diverse institutions, including Historically Black Colleges and Universities and those serving large proportions of Hispanics, Native Americans, Asian-Pacific Americans, or other underrepresented populations.

(c) **INTERAGENCY COMMITTEE.**—The President shall establish or designate an interagency committee on nanotechnology research and development, which shall include representatives from the Office of Science and Technology Policy, the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, the Environmental Protection Agency, and any other agency that the President may designate. The Director shall select a chairperson from among the members of the Interagency Committee. The Interagency Committee, which shall also include a representative from the Office of Management and Budget, shall oversee the planning, management, and coordination of the Program. The Interagency Committee shall—

(1) establish goals and priorities for the Program;

(2) establish program component areas, with specific priorities and technical goals, that reflect the goals and priorities established for the Program;

(3) develop, within 6 months after the date of enactment of this Act, and update annually, a strategic plan to meet the goals and priorities established under paragraph (1) and to guide the activities of the program component areas established under paragraph (2);

(4) propose a coordinated interagency budget for the Program that will ensure the maintenance of a balanced nanotechnology research portfolio and ensure that each agency and each program component area is allocated the level of funding required to meet the goals and priorities established for the Program;

(5) develop a plan to utilize Federal programs, such as the Small Business Innovation Research Program and the Small Business Technology Transfer Research Program, in support of the goal stated in subsection (b)(4); and

(6) in carrying out its responsibilities under paragraphs (1) through (5), take into consideration the recommendations of the Advisory Committee and the views of academic, State, industry, and other appropriate groups conducting research on and using nanotechnology.

#### **SEC. 4. ANNUAL REPORT.**

The chairperson of the Interagency Committee shall prepare an annual report, to be submitted to the Committee on Science of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate at the time of the President's budget request to Congress, that includes—

(1) the Program budget, for the current fiscal year, for each agency that participates in the Program, including a breakout of spending for the development and acquisition of research facilities and instrumentation, for each program component area, and for all activities pursuant to section 3(b)(5);

(2) the proposed Program budget, for the next fiscal year, for each agency that participates in the Program, including a breakout of spending for the development and acquisition of research facilities and instrumentation, for each program component area, and for all activities pursuant to section 3(b)(5);

(3) an analysis of the progress made toward achieving the goals and priorities established for the Program;

(4) an analysis of the extent to which the Program has incorporated the recommendations of the Advisory Committee; and

(5) an assessment of how Federal agencies are implementing the plan described in section 3(c)(5), and a description of the amount of Small Business Innovative Research and Small Business Technology Transfer Research funds supporting the plan.

#### **SEC. 5. ADVISORY COMMITTEE.**

(a) **IN GENERAL.**—The President shall establish or designate an advisory committee on nanotechnology consisting of non-Federal members, including representatives of research and academic institutions and industry, who are qualified to provide advice and information on nanotechnology research, development, demonstration, education, technology transfer, commercial application, and societal and ethical concerns. The recommendations of the Advisory Committee shall be considered by Federal agencies in implementing the Program.

(b) **ASSESSMENT.**—The Advisory Committee shall assess—

- (1) trends and developments in nanotechnology science and engineering;
- (2) progress made in implementing the Program;
- (3) the need to revise the Program;
- (4) the balance among the components of the Program, including funding levels for the program component areas;
- (5) whether the program component areas, priorities, and technical goals developed by the Interagency Committee are helping to maintain United States leadership in nanotechnology;
- (6) the management, coordination, implementation, and activities of the Program; and
- (7) whether societal and ethical concerns are adequately addressed by the Program.

(c) **REPORTS.**—The Advisory Committee shall report not less frequently than once every 2 fiscal years to the President on its findings of the assessment carried out under subsection (b), its recommendations for ways to improve the Program, and the concerns assessed under subsection (b)(7). The first report shall be due within 1 year after the date of enactment of this Act.

(d) **FEDERAL ADVISORY COMMITTEE ACT APPLICATION.**—Section 14 of the Federal Advisory Committee Act shall not apply to the Advisory Committee.

**SEC. 6. NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.**

The President shall establish a National Nanotechnology Coordination Office, with full-time staff, which shall—

- (1) provide technical and administrative support to the Interagency Committee and the Advisory Committee;
- (2) serve as a point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, and others to exchange technical and programmatic information; and
- (3) conduct public outreach, including dissemination of findings and recommendations of the Interagency Committee and the Advisory Committee, as appropriate.

**SEC. 7. AUTHORIZATION OF APPROPRIATIONS.**

(a) **NATIONAL SCIENCE FOUNDATION.**—There are authorized to be appropriated to the National Science Foundation for carrying out this Act—

- (1) \$350,000,000 for fiscal year 2004;
- (2) \$385,000,000 for fiscal year 2005; and
- (3) \$424,000,000 for fiscal year 2006.

(b) **DEPARTMENT OF ENERGY.**—There are authorized to be appropriated to the Secretary of Energy for carrying out this Act—

- (1) \$265,000,000 for fiscal year 2004;
- (2) \$292,000,000 for fiscal year 2005; and
- (3) \$322,000,000 for fiscal year 2006.

(c) **NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.**—There are authorized to be appropriated to the National Aeronautics and Space Administration for carrying out this Act—

- (1) \$31,000,000 for fiscal year 2004;
- (2) \$34,000,000 for fiscal year 2005; and
- (3) \$37,000,000 for fiscal year 2006.

(d) **NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY.**—There are authorized to be appropriated to the National Institute of Standards and Technology for carrying out this Act—

- (1) \$62,000,000 for fiscal year 2004;
- (2) \$68,000,000 for fiscal year 2005; and
- (3) \$75,000,000 for fiscal year 2006.

(e) **ENVIRONMENTAL PROTECTION AGENCY.**—There are authorized to be appropriated to the Environmental Protection Agency for carrying out this Act—

- (1) \$5,000,000 for fiscal year 2004;
- (2) \$5,500,000 for fiscal year 2005; and
- (3) \$6,000,000 for fiscal year 2006.

**SEC. 8. EXTERNAL REVIEW OF THE NATIONAL NANOTECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM.**

(a) **IN GENERAL.**—Not later than 6 months after the date of enactment of this Act, the Director shall enter into an agreement with the National Academy of Sciences to conduct periodic reviews of the Program. The reviews shall be conducted once every 3 years during the 10-year period following the enactment of this Act. The reviews shall include—

- (1) an evaluation of the technical achievements of the Program;
- (2) recommendations for changes in the Program;

(3) an evaluation of the relative position of the United States with respect to other nations in nanotechnology research and development;

(4) an evaluation of the Program's success in transferring technology to the private sector;

(5) an evaluation of whether the Program has been successful in fostering interdisciplinary research and development; and

(6) an evaluation of the extent to which the Program has adequately considered societal and ethical concerns.

(b) **STUDY ON MOLECULAR MANUFACTURING.**—Not later than 3 years after the date of enactment of this Act a review shall be conducted in accordance with subsection (a) that includes a study to determine the technical feasibility of the manufacture of materials and devices at the molecular scale. The study shall—

(1) examine the current state of the technology for enabling molecular manufacturing;

(2) determine the key scientific and technical barriers to achieving molecular manufacturing;

(3) review current and planned research activities that are relevant to advancing the prospects for molecular manufacturing; and

(4) develop, insofar as possible, a consensus on whether molecular manufacturing is technically feasible, and if found to be feasible—

(A) the estimated timeframe in which molecular manufacturing may be possible on a commercial scale; and

(B) recommendations for a research agenda necessary to achieve this result.

(c) **STUDY ON SAFE NANOTECHNOLOGY.**—Not later than 6 years after the date of enactment of this Act a review shall be conducted in accordance with subsection (a) that includes a study to assess the need for standards, guidelines, or strategies for ensuring the development of safe nanotechnology, including those applicable to—

(1) self-replicating nanoscale machines or devices;

(2) the release of such machines or devices in natural environments;

(3) distribution of molecular manufacturing development;

(4) encryption;

(5) the development of defensive technologies;

(6) the use of nanotechnology as human brain extenders; and

(7) the use of nanotechnology in developing artificial intelligence.

**SEC. 9. SCIENCE AND TECHNOLOGY GRADUATE SCHOLARSHIP PROGRAMS.**

(a) **ESTABLISHMENT OF PROGRAMS.**—

(1) **IN GENERAL.**—The agency heads shall each establish within their respective departments and agencies a Science and Technology Graduate Scholarship Program to award scholarships to individuals that is designed to recruit and prepare students for careers in the Federal Government that require engineering, scientific, and technical training.

(2) **COMPETITIVE PROCESS.**—Individuals shall be selected to receive scholarships under this section through a competitive process primarily on the basis of academic merit, with consideration given to financial need and the goal of promoting the participation of individuals identified in section 33 or 34 of the Science and Engineering Equal Opportunities Act (42 U.S.C. 1885a or 1885b).

(3) **SERVICE AGREEMENTS.**—To carry out the Programs the agency heads shall enter into contractual agreements with individuals selected under paragraph (2) under which the individuals agree to serve as full-time employees of the Federal Government, for the period described in subsection (f)(1), in positions needed by the Federal Government and for which the individuals are qualified, in exchange for receiving a scholarship.

(b) **SCHOLARSHIP ELIGIBILITY.**—In order to be eligible to participate in a Program, an individual must—

(1) be enrolled or accepted for enrollment as a full-time student at an institution of higher education in an academic field or discipline described in a list made available under subsection (d);

(2) be a United States citizen or permanent resident; and

(3) at the time of the initial scholarship award, not be a Federal employee as defined in section 2105 of title 5 of the United States Code.

(c) **APPLICATION REQUIRED.**—An individual seeking a scholarship under this section shall submit an application to an agency head at such time, in such manner, and containing such information, agreements, or assurances as the agency head may require.

(d) **ELIGIBLE ACADEMIC PROGRAMS.**—The agency heads shall each make publicly available a list of academic programs and fields of study for which scholarships

under their department's or agency's Program may be utilized, and shall update the list as necessary.

(e) SCHOLARSHIP REQUIREMENT.—

(1) IN GENERAL.—Agency heads may provide scholarships under their department's or agency's Program for an academic year if the individual applying for the scholarship has submitted to the agency head, as part of the application required under subsection (c), a proposed academic program leading to a degree in a program or field of study on a list made available under subsection (d).

(2) DURATION OF ELIGIBILITY.—An individual may not receive a scholarship under this section for more than 4 academic years, unless an agency head grants a waiver.

(3) SCHOLARSHIP AMOUNT.—The dollar amount of a scholarship under this section for an academic year shall be determined under regulations issued by the agency heads, but shall in no case exceed the cost of attendance.

(4) AUTHORIZED USES.—A scholarship provided under this section may be expended for tuition, fees, and other authorized expenses as established by the agency heads by regulation.

(5) CONTRACTS REGARDING DIRECT PAYMENTS TO INSTITUTIONS.—Each agency head may enter into a contractual agreement with an institution of higher education under which the amounts provided for a scholarship under this section for tuition, fees, and other authorized expenses are paid directly to the institution with respect to which the scholarship is provided.

(f) PERIOD OF OBLIGATED SERVICE.—

(1) DURATION OF SERVICE.—The period of service for which an individual shall be obligated to serve as an employee of the Federal Government is, except as provided in subsection (h)(2), 24 months for each academic year for which a scholarship under this section is provided.

(2) SCHEDULE FOR SERVICE.—(A) Except as provided in subparagraph (B), obligated service under paragraph (1) shall begin not later than 60 days after the individual obtains the educational degree for which the scholarship was provided.

(B) An agency head may defer the obligation of an individual to provide a period of service under paragraph (1) if the agency head determines that such a deferral is appropriate. The agency head shall prescribe the terms and conditions under which a service obligation may be deferred through regulation.

(g) PENALTIES FOR BREACH OF SCHOLARSHIP AGREEMENT.—

(1) FAILURE TO COMPLETE ACADEMIC TRAINING.—Scholarship recipients who fail to maintain a high level of academic standing, as defined by the appropriate agency head by regulation, who are dismissed from their educational institutions for disciplinary reasons, or who voluntarily terminate academic training before graduation from the educational program for which the scholarship was awarded, shall be in breach of their contractual agreement and, in lieu of any service obligation arising under such agreement, shall be liable to the United States for repayment within 1 year after the date of default of all scholarship funds paid to them and to the institution of higher education on their behalf under the agreement, except as provided in subsection (h)(2). The repayment period may be extended by the agency head when determined to be necessary, as established by regulation.

(2) FAILURE TO BEGIN OR COMPLETE THE SERVICE OBLIGATION OR MEET THE TERMS AND CONDITIONS OF DEFERMENT.—Scholarship recipients who, for any reason, fail to begin or complete their service obligation after completion of academic training, or fail to comply with the terms and conditions of deferment established by the appropriate agency head pursuant to subsection (f)(2)(B), shall be in breach of their contractual agreement. When recipients breach their agreements for the reasons stated in the preceding sentence, the recipient shall be liable to the United States for an amount equal to—

(A) the total amount of scholarships received by such individual under this section; plus

(B) the interest on the amounts of such awards which would be payable if at the time the awards were received they were loans bearing interest at the maximum legal prevailing rate, as determined by the Treasurer of the United States,

multiplied by 3.

(h) WAIVER OR SUSPENSION OF OBLIGATION.—

(1) DEATH OF INDIVIDUAL.—Any obligation of an individual incurred under a Program (or a contractual agreement thereunder) for service or payment shall be canceled upon the death of the individual.

(2) IMPOSSIBILITY OR EXTREME HARDSHIP.—The agency heads shall by regulation provide for the partial or total waiver or suspension of any obligation of

service or payment incurred by an individual under their department's or agency's Program (or a contractual agreement thereunder) whenever compliance by the individual is impossible or would involve extreme hardship to the individual, or if enforcement of such obligation with respect to the individual would be contrary to the best interests of the Government.

(i) DEFINITIONS.—In this section the following definitions apply:

(1) AGENCY HEAD.—The term “agency head” means the Director of the National Science Foundation, the Secretary of Energy, the Administrator of the National Aeronautics and Space Administration, the Director of the National Institute of Standards and Technology, or the Administrator of the Environmental Protection Agency.

(2) COST OF ATTENDANCE.—The term “cost of attendance” has the meaning given that term in section 472 of the Higher Education Act of 1965 (20 U.S.C. 1087*ll*).

(3) INSTITUTION OF HIGHER EDUCATION.—The term “institution of higher education” has the meaning given that term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).

(4) PROGRAM.—The term “Program” means a Science and Technology Graduate Scholarship Program established under this section.

## II. PURPOSE OF THE BILL

The purpose of the bill is to provide for a National Nanotechnology Research and Development Program, and to authorize funding for this program at the National Science Foundation (NSF), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), the National Institute of Standards and Technology (NIST), and the Environmental Protection Agency (EPA).

## III. BACKGROUND AND NEED FOR THE LEGISLATION

Nanotechnology is the science of manipulating and characterizing matter at the atomic and molecular level. It is one of the most promising and exciting fields of science today, involving a multitude of science and engineering disciplines, with widespread applications in electronics, advanced materials, medicine, and information technology. For example, nanotechnology likely represents the future of information processing and storage, as computer chips and magnetic disk drive components will increasingly depend on nanotechnology innovations. A variety of nanotechnology products are already in development or on the market, and experts agree that more revolutionary products will emerge from nanotechnology research currently underway. Large companies are investing in nanotechnology development programs, and many small start-up companies have been founded to develop new technologies and new products based on breakthroughs in our understanding of materials at the atomic and molecular level.

The promise of nanotechnology to accelerate technological change has prompted some to advise caution about pursuing rapid innovation without some understanding of where it might lead us. The research community should be prepared to respond to legitimate questions about the consequences of new products based on nanotechnology. For example, one of the more salient concerns is the possible environmental or health impact of nanotechnology materials. Nanoscale particles, or nanoparticles, because of their small size, may readily enter living systems with potentially toxic results. While few comprehensive studies have been completed, early research suggests that some common nanotechnology materials may be biologically inert and thus pose little threat. Nonetheless, new

materials can interact with the environment or with living systems in unexpected ways. Studies of the environmental impacts as well as of societal and ethical questions associated with the adoption of these new technologies will be needed.

The National Nanotechnology Initiative (NNI) is a research initiative involving 10 federal agencies—one of the President’s most significant new commitments to continued U.S. leadership in science and technology. The initiative has grown rapidly from an initial budget request of \$464 million in fiscal year 2001 to the \$849 million requested for fiscal year 2004. In 2002, the National Academy of Sciences conducted a review<sup>1</sup> of the program and spoke favorably of the quality of the research and the opportunities for rapid technological innovation. However, the review raised several concerns and made a number of recommendations, including:

- Establish an independent advisory board,
- Develop a strategic plan,
- Effect greater interagency coordination,
- Promote interdisciplinary nanotechnology R&D, and
- Address potential societal and ethical concerns.

This Act addresses all of these issues with the program as raised by the National Academy of Sciences and other outside experts. In addition, by authorizing a federal nanotechnology research and development (R&D) program in statute, the act assures stable, long-term support for these programs. The Act also sets up review and oversight mechanisms to assure that new funds are used in the most effective manner possible.

#### IV. SUMMARY OF HEARINGS

On March 19, 2003, the Committee on Science held a hearing to examine the current state of federal nanotechnology research and development (R&D) activities, consider the needs in nanotechnology for interdisciplinary research and education and for greater interagency coordination, and learn about the potential for future economic growth associated with nanotechnology developments. Witnesses provided comments on and recommendations for additions to H.R. 766, The Nanotechnology Research and Development Act of 2003, introduced by Chairman Boehlert and Rep. Honda on February 13, 2003. The Committee heard testimony from Senator Allen and Senator Wyden, on S. 189, The 21st Century Nanotechnology Research and Development Act, the Senate companion to H.R. 766. The Committee also heard testimony from the Associate Director for Technology at the Office of Science and Technology Policy, nanotechnology researchers from IBM, Cornell University, and Oak Ridge National Laboratory, and a venture capital expert from JP Morgan Partners. Witnesses addressed the need for technology transfer mechanisms to allow the United States to translate its global advantage in nanotechnology research into new products and commercial leadership and the importance of education efforts by the nanotechnology community to increase public understanding of nanotechnology as well as to interest the next generation of scientists in nanotechnology-related fields.

<sup>1</sup>Small Wonders, Endless Frontiers: A Review of the National Nanotechnology Initiative, National Academy Press, Washington, DC, 2002.

On April 9, 2003, the Committee on Science held a hearing to examine the societal implications of nanotechnology, to learn about concerns about existing and potential applications of nanotechnology, and to consider how research and debate on societal, ethical, and environmental concerns could be integrated into the research and development process. Witnesses provided comments on and recommendations for additions to H.R. 766, The Nanotechnology Research and Development Act of 2003. The Committee heard testimony from the executive director of the Center for Biological and Environmental Nanotechnology at Rice University, a professor of political science at Rensselaer Polytechnic Institute, the president of the Foresight Institute, and the author of *The Age of Intelligent Machines*. Witnesses addressed the need to involve the public in the debate on future applications of nanotechnology and stressed the importance of integrating research on new technologies with research on the concerns about the new technologies, so that questions about technologies' implications can be tackled early and that ethical and environmental researchers can focus on the most technically feasible scenarios.

#### V. COMMITTEE ACTIONS

On February 13, 2003, Science Committee Chairman Sherwood Boehlert and Rep. Michael Honda introduced H.R. 766, The Nanotechnology Research and Development Act of 2003, a bill to provide for a National Nanotechnology Research and Development Program.

The Full Committee on Science met on Thursday, May 1, 2003, to consider the bill.

- An amendment was offered by Chairman Boehlert, which made technical changes to the bill and added provisions (1) increasing the authorization levels for nanotechnology programs at the Department of Energy (DOE) to match the numbers authorized in H.R. 6, and (2) granting the Administration the flexibility to designate an existing Presidential Advisory Committee to serve as the Advisory Committee on Nanotechnology. The amendment was adopted by a rollcall vote (Y-22; N-19).

COMMITTEE ON SCIENCE - ROLL CALL - 108<sup>th</sup> CONGRESS

DATE: *5/1/03* SUBJECT: *Manager's Amendment to H.R. 766*

Rm.	Phone	Member	Yes	No	Not Voting	Present	Absent
2246	53665	Mr. Boehlert, R-NY	✓				
2231	54236	Mr. Lamar Smith, R-TX	✓				
2466	52011	Mr. Weldon, R-PA					
2338	52415	Mr. Rohrabacher, R-CA	✓				
2109	52002	Mr. Barton, R-TX	✓				
2201	51986	Mr. Calvert, R-CA	✓				
2305	56276	Mr. Nick Smith, R-MI	✓				
2412	52721	Mr. Bartlett, R-MD	✓				
1714	53831	Mr. Ehlers, R-MI	✓				
425	52472	Mr. Gutknecht, R-MN	✓				
2443	52006	Mr. Nethercutt, R-WA	✓				
2342	55565	Mr. Lucas, R-OK	✓				
1213	53515	Mrs. Biggert, R-IL	✓				
2245	55311	Mr. Gilchrest, R-MD	✓				
117	52561	Mr. Akin, R-MO	✓				
1229	52371	Mr. Johnson, R-IL	✓				
1508	52565	Ms. Hart, R-PA	✓				
114	52211	Mr. Sullivan, R-OK	✓				
307	56365	Mr. Forbes, R-VA	✓				
1118	52931	Mr. Gingrey, R-GA	✓				
124	50453	Mr. Bishop, R-UT	✓				
1721	57772	Mr. Burgess, R-TX	✓				
315	54931	Mr. Bonner, R-AL	✓				
323	52706	Mr. Feeney, R-FL	✓				
		Vacancy					
2405	56673	Mr. Hall, D-TX				✓	
2304	54231	Mr. Gordon, D-TN		✓			
2454	55661	Mr. Costello, D-IL		✓			
1511	58885	Ms. Johnson, D-TX		✓			
2263	55161	Ms. Woolsey, D-CA		✓			
405	56565	Mr. Lampson, D-TX		✓			
1005	52265	Mr. Larson, D-CT		✓			
115	52161	Mr. Udall, D-CO		✓			
1023	50855	Mr. Wu, D-OR		✓			
1713	52631	Mr. Honda, D-CA		✓			
216	57508	Mr. Bell, D-TX		✓			
1505	53032	Mr. Miller, D-NC		✓			
504	56831	Mr. Davis, D-TN		✓			
2435	53816	Ms. Jackson-Lee, D-TX		✓			
102	53072	Ms. Lofgren, D-CA		✓			
1030	55911	Mr. Sherman, D-CA		✓			
1421	53536	Mr. Baird, D-WA		✓			
431	52865	Mr. Moore, D-KS		✓			
1122	56616	Mr. Weiner, D-NY		✓			
410	53011	Mr. Matheson, D-UT		✓			
503	56131	Mr. Cardoza, D-CA		✓			
		Vacancy					
TOTAL			22	19			

Attest: *Virginia A. Scrimin* (Clerk)

- An amendment was offered by Mr. Smith of Michigan, Ms. Hart, Mr. Wu, and Mr. Matheson to require interdisciplinary research centers to exchange technical information and best practices; to partner with States and industry; to make use of existing expertise in their regions and of ongoing micrometer-scale R&D; and to accelerate commercialization of nanotechnology. The amendment was adopted by a voice vote.
- An amendment was offered by Ms. Jackson-Lee and Mr. Wu to ensure that the Program will include the Nation's colleges and universities serving under-represented minorities. The amendment was adopted by a voice vote.
- An amendment was offered by Ms. Jackson-Lee to ensure that research on nanotechnology brings about improvements that benefit all Americans. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Sherman to clarify that research on societal and ethical concerns includes study of environmental concerns and the implications of possible development of non-human intelligence. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Bell to ensure that interdisciplinary research centers include activities that address societal and ethical concerns. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Sherman and Mr. Bell to require that the annual report include budget information on spending for research programs on societal and ethical concerns. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Matheson to require that the annual report include budget information on spending for development and acquisition of research facilities and instrumentation. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Honda to require that the Interagency Committee develop a plan for using Federal programs, such as the Small Business Innovation Research (SBIR) Program and the Small Business Technology Transfer Research (STTR) Program, in support of commercialization of nanotechnology and that the annual report include an assessment of the implementation of the plan and a report on the amount of SBIR and STTR funds supporting the plan. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Wu to require that the external review of the National Nanotechnology Research and Development Program by the National Academy of Sciences include, not less than three years after the enactment of the act, a study on the technical feasibility of the manufacture of materials and devices at the molecular scale. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Sherman to require that the external review of the National Nanotechnology Research and Development Program by the National Academy of Sciences include, not less than six years after the enactment of the act, a study that assesses the need for standards, guidelines, or strategies for ensuring the development of safe nanotechnology. The amendment was adopted by a voice vote.
- An amendment was offered by Mr. Rohrabacher to add a new section to the bill that authorizes the Science and Technology Graduate Scholarships Programs and requires the heads of the Na-

tional Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, and the Environmental Protection Agency to award scholarships on a competitive basis, designed to recruit and prepare graduate students for careers in the federal government that require engineering, scientific, and technical training. Individuals who receive scholarships are required to serve as full-time employees of the federal government for two years for each year of scholarship funding received. An amendment was offered by Mr. Wu to the amendment by Mr. Rohrabacher to extend scholarship eligibility to permanent residents and was adopted by a voice vote. The amendment by Mr. Rohrabacher was adopted, as amended, by a voice vote.

- An amendment was offered by Mr. Honda to specify in greater detail the qualifications required of members of the Advisory Committee. A unanimous consent request to withdraw the amendment was agreed to.

- An amendment was offered by Ms. Johnson of Texas to require that the Advisory Committee convene citizen panels of nonscientific and nontechnical experts to consider and make recommendations on the societal and ethical concerns arising from the development of nanotechnology. The amendment was defeated by a voice vote.

- An amendment was offered by Mr. Honda to authorize appropriations for nanotechnology research and development within the Advanced Technology Program in the Department of Commerce. A unanimous consent request to withdraw the amendment was agreed to.

- An amendment was offered by Mr. Sherman and Mr. Bell to require that not less than five percent of the total appropriations be set aside for research on societal and ethical implications of nanotechnology. The amendment was defeated by a voice vote.

- An amendment was offered by Ms. Jackson-Lee to require the Technology Administration of the Department of Commerce to sponsor seminars on nanotechnology hubs and State-led nanotechnology initiatives and to maintain an electronic archive of best practices for promoting and developing nanotechnology hubs and State-led initiatives. A unanimous consent request to withdraw the amendment was agreed to.

- An amendment was offered by Mr. Baird to support funding for the application of nanotechnology to systems biology. A unanimous consent request to withdraw the amendment was agreed to.

Mr. Gordon moved that the Committee favorably report the bill, H.R. 766, as amended, to the House with the recommendation that the bill as amended do pass, and that the staff be instructed to make technical and conforming changes to the bill as amended and prepare the legislative report and that the Chairman take all necessary steps to bring the bill before the House for consideration. With a quorum present, the motion was agreed to by a voice vote.

#### VI. SUMMARY OF MAJOR PROVISIONS OF THE BILL

- Requires the implementation of a National Nanotechnology Research and Development Program to promote Federal nanotechnology research, development, demonstration, education, technology transfer, and commercial application activities. Requires grants to individual investigators and interdisciplinary teams of in-

investigators and the establishment of interdisciplinary research centers and advanced technology user facilities. Requires expansion of education and training of undergraduate and graduate students in interdisciplinary nanotechnology science and engineering and acceleration of the commercial application of nanotechnology innovations in the private sector.

- Authorizes appropriations for NSF of \$350,000,000 for FY 2004, \$385,000,000 for FY 2005, and \$424,000,000 for FY 2006. Authorizes appropriations for DOE of \$265,000,000 for FY 2004, \$292,000,000 for FY 2005, and \$322,000,000 for FY 2006. Authorizes appropriations for NASA of \$31,000,000 for FY 2004, \$34,000,000 for FY 2005, and \$37,000,000 for FY 2006. Authorizes appropriations for NIST of \$62,000,000 for FY 2004, \$68,000,000 for FY 2005, and \$75,000,000 for FY 2006. Authorizes appropriations for EPA of \$5,000,000 for FY 2004, \$5,500,000 for FY 2005, and \$6,000,000 for FY 2006.

- Requires that research is conducted to identify societal and ethical concerns related to nanotechnology. Requires that such research be integrated with nanotechnology research and development.

- Requires the establishment of an interagency committee to oversee the planning, management, and coordination of the National Nanotechnology Research and Development Program. Requires the interagency committee to establish goals and priorities for the Program, and to develop and update annually a strategic plan to meet these goals and priorities.

- Requires the chairperson of the interagency committee to submit an annual report to Congress containing the current and proposed Program budget for each agency and for each program component area and an analysis of the progress made toward achieving the Program goals and priorities.

- Requires the President to establish or designate an Advisory Committee to assess overall trends in nanotechnology and to review the conduct and impact of the Program. Requires the Advisory Committee to report not less frequently than once every 2 fiscal years.

- Requires the establishment of a National Nanotechnology Coordination Office to provide technical and administrative support to the Interagency Committee and the Advisory Committee and to conduct public outreach.

- Requires the Director of the Office of Science and Technology Policy to have the National Academy of Sciences conduct periodic reviews of the Program (once every 3 years during the 10-year period following the enactment of this Act).

- Establishes a Science and Technology Graduate Scholarship program at the agencies authorized in this Act. Requires individuals who receive scholarships to serve as full-time employees of the federal government for two years for each year of scholarship funding received.

## VII. SECTION-BY-SECTION ANALYSIS (BY TITLE AND SECTION)

### *Sec. 1. Short title*

“Nanotechnology Research and Development Act of 2003.”

*Sec. 2. Definitions*

Defines terms used in the text.

*Sec. 3. National Nanotechnology Research and Development Program*

Establishes an interagency R&D program to promote and coordinate Federal nanotechnology research, development, demonstration, education, technology transfer, and commercial application activities. The program will provide sustained support for interdisciplinary nanotechnology R&D through grants to researchers and through the establishment of interdisciplinary research centers and advanced technology user facilities.

Establishes a research program to identify societal and ethical concerns related to nanotechnology and requires that such research be integrated into nanotechnology R&D programs insofar as possible.

Establishes an interagency committee, composed of representatives of participating Federal agencies, as well as representatives from the Office of Science and Technology Policy and the Office of Management and Budget, to oversee the planning, management, and coordination of all Federal nanotechnology R&D activities. Requires the Interagency Committee to establish goals and priorities, establish program component areas to implement those goals and priorities, develop a strategic plan to be updated annually, propose a coordinated interagency budget for Federal nanotechnology R&D, and develop a plan for using Federal programs in support of commercialization of nanotechnology.

*Sec. 4. Annual report*

Requires the chairperson of the interagency committee to submit an annual report, at the time of the President's budget request to Congress, describing Federal nanotechnology budgets and activities for the current fiscal year, and what is proposed for the next fiscal year, by agency and by program component area; also requires current and next fiscal year budget information on funds for research on societal and ethical concerns and for development and acquisition of research facilities and instrumentation. Requires that the report include an analysis of the progress made toward achieving the goals and priorities established for Federal nanotechnology R&D, and the extent to which the program incorporates the recommendations of the Advisory Committee (established in sec. 5). Requires that the report include an assessment of the implementation of the plan for using Federal programs in support of commercialization of nanotechnology (required in Sec. 3) and a report on the amount of Small Business Innovation Research Program and the Small Business Technology Transfer Research Program funds supporting the plan.

*Sec. 5. Advisory committee*

Establishes or designates a Presidentially-appointed advisory committee, consisting of non-Federal experts, to conduct a broad assessment of Federal nanotechnology R&D activities and issue a biennial report.

*Sec. 6. National Nanotechnology Coordination Office*

Establishes a National Nanotechnology Coordination Office with full-time staff to provide technical and administrative support to the Interagency Committee and the Advisory Committee, to serve as a point of contact for outside groups, and to conduct public outreach.

*Sec. 7. Authorization of appropriations*

Authorizes appropriations for nanotechnology R&D programs at the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, and the Environmental Protection Agency.

[In millions of dollars]

Agency	FY04	FY05	FY06
NSF .....	350	385	424
DOE .....	265	292	322
NASA .....	31	34	37
NIST .....	62	68	75
EPA .....	5	5.5	6
Total .....	713	784.5	864

*Sec. 8. External review of the National Nanotechnology Research and Development Program*

Requires the Director of the Office of Science and Technology Policy to contract with the National Academy of Sciences to conduct a triennial review of Federal nanotechnology R&D programs including technical progress, managerial effectiveness, and adequacy in addressing societal and ethical concerns. Requires a study within three years on the technical feasibility of the manufacture of materials and devices at the molecular scale and within six years on an assessment of the need for standards, guidelines, or strategies for ensuring the development of safe nanotechnology.

*Sec. 9. Science and Technology Graduate Scholarship Program*

Authorizes the Director of the National Science Foundation, the Secretary of Energy, the Administrator of the National Aeronautics and Space Administration, the Director of the National Institute of Standards and Technology, and the Administrator of the Environmental Protection Agency to establish, within their respective departments and agencies, a Science and Technology Graduate Scholarship Program to award scholarships to individuals designed to recruit and prepare undergraduate and graduate students for careers in the federal government that require scientific and technical training. Individuals who receive scholarships are required to serve as full-time employees of the federal government for two years for each year of scholarship funding received.

VIII. COMMITTEE VIEWS

*The Potential of nanotechnology*

The Committee believes that nanotechnology, the science of manipulating and characterizing matter at the atomic and molecular level, is one of the most promising and exciting fields of science

today. Nanotechnology involves a multitude of science and engineering disciplines, with widespread applications in electronics, advanced materials, medicine, and information technology. For example, nanotechnology likely represents the future of information processing and storage, as computer chips and magnetic disk drive components will increasingly depend on nanotechnology innovations.

The National Nanotechnology Initiative (NNI), a research initiative involving 10 federal agencies, has grown rapidly from an initial budget request of \$464 million in fiscal year 2001 to the \$849 million requested for fiscal year 2004. In 2002, the National Academy of Sciences conducted a review<sup>2</sup> of the program and spoke favorably of the quality of the research and the opportunities for rapid technological innovation. The Committee believes that the research and development supported by the NNI is laying the groundwork for the eventual introduction of a wide variety of new products and applications. Some of the near-term applications, such as ultraviolet-light blocking sunscreens, are already in the marketplace, while longer-term possibilities, such as new cancer treatments, are still at the stage of promising laboratory results.

#### *Technology transfer*

The Committee believes that the United States is the global leader in innovative, cross-disciplinary nanotechnology research and development activities. However, to fully realize the economic and societal benefits of nanotechnology, ideas and knowledge must be translated into products and applications. The Committee has heard that other countries are very active in nanotechnology, particularly in supporting the development and commercialization phases of nanotechnology. The Committee believes that it will be important for private industry to be involved in nanotechnology research and development programs. Having industrial partners in research programs allows scientists early access to critical sources of information on to what sort of technologies and research programs would be most attractive and useful for industry and to lay the groundwork for efficient commercialization.

The Committee recognizes that there are a number of Federal programs and efforts that are directed towards facilitating technology transfer. The Act directs the Interagency Committee to develop and report on a plan for utilizing the relevant Federal programs, such as the Small Business Innovation Research (SBIR) Program and the Small Business Technology Transfer Research (SBTTR) Program, to encourage acceleration of commercialization of nanotechnology. The Committee also recognizes the importance of other outreach efforts related to technology transfer, such as work by the Technology Administration of the Department of Commerce promoting technology-led economic development. The Committee encourages the Department to continue these efforts by sponsoring a series of seminars on developing nanotechnology hubs and State-led nanotechnology initiatives, which bring together researchers, government officials, corporations, start-ups, and other interested parties; and by maintaining an electronic archive of best

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<sup>2</sup>Small Wonders, Endless Frontiers: A Review of the National Nanotechnology Initiative, National Academy Press, Washington, DC, 20002.

practices for promoting and developing nanotechnology hubs and State-led initiatives.

The Committee is aware of, and encourages, numerous ongoing efforts in which companies and universities are working together on research that could lead to new products, including research that could lead to unique biosensing materials and devices.

*Concerns about the societal, environmental, and ethical implications of nanotechnology*

The Committee anticipates that many benefits will be realized as new materials and products emerge through the pursuit of nanotechnology research. However, past experience demonstrated that new technologies can produce unintended, negative consequences. Recent experience with public debates about biotechnology indicate the public's recognition that new knowledge and technological pursuits carry risks as well as benefits. These debates also express the desire of the public for serious consideration of these risks and benefits.

The scientific community has recognized that the promise of nanotechnology to accelerate technological change requires caution about pursuing rapid innovation without some understanding of where it might lead us. The National Academy of Sciences review noted that the social and economic consequences of nanotechnology promise to be diverse, difficult to anticipate, and sometimes disruptive. The increasing rate of innovation associated with nanotechnology developments, coupled with advances in biotechnology and information technology, has "the potential to compress the time from discovery to full deployment, thereby shortening the time society has to adjust to these changes. Speculation about unintended consequences of nanotechnology, some of it informed, but a lot of it wildly uninformed, has already captured the imagination and, to some extent, the fear of the general public."<sup>3</sup>

The Committee believes that the National Nanotechnology Research and Development Program should include measured consideration of environmental, societal and economic, and ethical implications of nanotechnology. A number of significant questions—such as those about the toxicological properties of nanomaterials, about changing workforce needs for new manufacturing modes, about the appropriateness of nano-enabled health and capability enhancements—exist and should be studied. The Committee emphasizes the importance of tackling these questions early, so that potential negative consequences of nanotechnology can be averted. The research program in societal and ethical concerns is analogous to the Ethical, Legal, and Social Implications (ELSI) Research Program that has been a part of the Human Genome Project since 1990.

The Committee stresses the importance of integrating research on environmental, societal, and ethical implications with nanotechnology research and development programs to ensure that the feasibility of scenarios under study are taken into account and that results of the environmental, societal, and ethical research influences the direction of ongoing nanotechnology research and development of commercial applications.

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<sup>3</sup>Small Wonders, Endless Frontiers: A Review of the National Nanotechnology Initiative, National Academy Press, Washington, DC, 20002. Page 31.

The Committee recognizes that the National Science Foundation has increased its efforts to attract proposals that include a societal implications dimension and to involve NSF's Directorate for Social, Behavioral, and Economic Sciences in proposal review. The Committee strongly encourages continued efforts at all agencies to integrate social science research and health-related research into the nanotechnology research and development activities. A better understanding of how technical and social systems affect one another will support smoother commercialization and adoption not only of nanotechnology applications but also of other future technologies.

Many varied predictions have been made about the long-term impact of nanotechnology on society and on human capabilities. The Committee feels that the research on societal and ethical concerns should include efforts to educate the public regarding the societal and ethical issues and to invite public input; studies designed to forecast future, long-term developments in nanotechnology and identify the societal and ethical questions raised by such possible developments; efforts to address the societal and ethical concerns raised by technologies which may create entities with intelligence surpassing that of the average human today; and efforts to address the societal and ethical concerns raised by molecular engineering and molecular assembly technologies. The Committee believes that an important part of such research programs is assuring that the results of the research are widely disseminated. Therefore, Section 3(b)(5) is designed to include efforts to educate and involve the public on the societal and ethical issues raised by nanotechnology including, but not limited to, the conduct of public forums. Public support for nanotechnology research and development and public acceptance of the products derived from it will be enhanced through proactive, reasoned consideration of the potential impacts of the new materials and technologies.

The Committee has specified that the annual report on the Program include a funding breakout, by agency and for the current and following fiscal years, of all activities that are related to societal and ethical concerns in accordance with section 3(b)(5) of the bill. This requirement reflects the Committee's strong interest in the way the Program addresses societal and ethical concerns of nanotechnology and in the level of resources that are allocated for this purpose. The Committee expects the annual report to include a description of the nature of the activities being supported and how the activities relate to overall Program objectives. The Committee also expects the report to describe how the Program is complying with the requirement to integrate research on societal and ethical concerns with research and development efforts to advance nanotechnology. In particular, the report should indicate how the goals and objectives of the Program are influenced by the outcomes of societal and ethical activities being supported.

#### *The interdisciplinary nature of nanotechnology*

Just as nanotechnology applications have the potential to revolutionize the technologies available in many areas, such as healthcare, telecommunications, and homeland defense, achieving these breakthroughs will require input from many scientific and engineering fields. In nanotechnology, many different disciplines are converging—biology, physics, chemistry, materials science, me-

chanical engineering, and electrical engineering, to name several. The Committee recognizes that standard, discipline-based models of research and education, will not support rapid advancement in nanoscience and engineering, nor will they provide the next generation of nano-researchers. The Act authorizes sustained support for interdisciplinary nanotechnology research and development through grants to researchers and through the establishment of interdisciplinary research centers and advanced technology user facilities. The bill requires the activities of the National Nanotechnology Research and Development Program to ensure that solicitation and evaluation of proposals under the Program encourage interdisciplinary research. The Committee strongly encourages the use of new and creative approaches to bridging cultural and technical gaps between researchers in different fields and to providing educational experiences that allow students to be exposed to nanotechnology early and to receive degrees that reflect the collaborative and technical skills needed for careers in nanotechnology research and development.

One example of the potential benefits of interdisciplinary research can be seen in the area of "bio-nanotechnology." The Committee believes that the application of nanotechnology to the field of systems biology is of great importance and strongly recommends investment and research to achieve integration of these disciplines. Systems biology analyzes all of the elements in a system rather than an individual cell, gene or protein. By applying nanotechnology to systems biology, it will be possible to achieve ultra-rapid diagnostic results, by analyzing on a molecular level the signatures of thousands of genes and proteins. This will lead to the advancement of predictive medicine generating revolutions in the prevention, diagnosis and treatment of disease. The Committee believes this acceleration of the medical field necessitates further study of integration of nanotechnology and systems biology and expects adequate resources to be allocated for reaching this goal.

#### *Interagency coordination of nanotechnology research*

The National Nanotechnology Initiative includes 10 federal agencies. Each agency has its own mission and supports and provides progress in nanotechnology research and development in a different way. The Committee believes that this multi-pronged approach is effective, and the federal nanotechnology effort is indeed more than the sum of its parts. However, to reduce redundancy and ensure that important areas do not fall through the gaps, the Committee believes that more meaningful interagency coordination and collaboration is required.

The Act establishes in statute an interagency committee to oversee the planning, management, and coordination of all federal nanotechnology research and development activities, establish goals and priorities, establish program component areas to implement those goals and priorities, develop a strategic plan to be updated annually, consult widely with stakeholders, and propose a coordinated interagency budget for federal nanotechnology research and development. The Committee believes that the Nanotechnology Research and Development Program would benefit from the development of a crisp, compelling, overarching strategic plan that articulates short- (1 to 5 years), medium- (6 to 10 years), and long-

range (beyond 10 years) goals and objectives, emphasizing goals that move results out of the laboratory and into the service of society. The Act places representatives from the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, and the Environmental Protection Agency on the interagency committee, and the Committee expects that the President will include the other agencies involved in the National Nanotechnology Initiative on the interagency committee, as these agencies also have a key role to play in the federal performance and support of nanotechnology research and development.

The Committee also believes that a dedicated office is necessary to provide support for the interagency committee and the advisory committee, to serve as a point of contact for outside groups, and to conduct public outreach.

*External input into the Nanotechnology Research and Development Program*

The Committee recognizes the complexity of the proposed nanotechnology research and development activities—the Program will involve cross-disciplinary research, multi-agency programs, technology transfer, and societal implications. The Committee believes, as did the National Academy of Sciences review, that an independent advisory committee could provide useful external perspectives to the administration and the agencies regarding the goals, priorities, and implementation and the administration of the Program.

Whether the requirement of Section 5 of the bill for an advisory committee is met by establishing a new entity or by assigning the responsibility to an existing one, the Committee expects the advisory committee to have members with a wide variety of expertise and perspectives on nanotechnology research, development, and demonstration, on the Program's strategic plan, and on the execution of the Program. In addition, the range of expertise encompassed by the advisory committee should allow it to assess the education, technology transfer, commercial application, and societal and ethical research aspects of the Program.

The Committee expects the advisory committee, if designated to be an existing committee with broader responsibilities than the Program, to devote sustained attention to the Program over the entire life of the Program and at the level of intensity necessary to carry out the comprehensive assessment requirements specified in section 5(b) of the bill.

The Committee also believes that regular external assessment of the Program will be valuable, and therefore the Act authorizes periodic review by the National Academy of Sciences of the Program, including of the technical progress, effectiveness of technology transfer, ability to foster interdisciplinary research and development, and adequacy in addressing societal and ethical concerns. The Committee recognizes that reviews in these areas, like the other authorized studies on molecular manufacturing and safe nanotechnology, may be best conducted as individual studies by separate National Academy of Sciences panels. Therefore, the Committee believes that the triennial review required by Section 8 can consist of a collection of individual National Academy of Sciences

reports grouped together, as long as all the review topics required by the Act are covered in the collection and all of the reviews in the included reports were conducted within 3 years of the release of the triennial review.

*Science and technology scholarships*

The Committee is concerned about the ability of the federal government to attract and retain the trained personnel it needs to fill positions that require a high level of scientific and technical skill. The Act contains a provision that the Committee intends and expects to result in the award of scholarships for talented young scientists pursuing degrees in scientific and technical disciplines of importance to the government. Students participating in this program will receive scholarships in exchange for a commitment to serve in a federal government position upon completion of their degrees. The Committee believes that this program will provide an important tool for recruiting talented young scientists to government service, particularly in agencies, such as the National Aeronautics and Space Administration and the Patent and Trademark Office, that have positions demanding a high degree of scientific or technical literacy.

IX. COST ESTIMATE

A cost estimate and comparison prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act of 1974 has been timely submitted to the Committee on Science prior to the filing of this report and is included in Section X of this report pursuant to House Rule XIII, clause 3(c)(3).

H.R. 766 does not contain new budget authority, credit authority, or changes in revenues or tax expenditures. Assuming that the sums authorized under the bill are appropriated, H.R. 766 does authorize additional discretionary spending, as described in the Congressional Budget Office report on the bill, which is contained in Section X of this report.

X. CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

U.S. CONGRESS,  
CONGRESSIONAL BUDGET OFFICE,  
*Washington, DC, May 5, 2003.*

Hon. SHERWOOD L. BOEHLERT,  
*Chairman, Committee on Science,  
House of Representatives, Washington, DC.*

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 766, the Nanotechnology Research and Development Act of 2003.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Kathleen Gramp.

Sincerely,

BARRY B. ANDERSON  
(For Douglas Holtz-Eakin, Director.)

Enclosure.

*H.R. 766—Nanotechnology Research and Development Act of 2003*

Summary: H.R. 766 would authorize appropriations for fiscal years 2004 through 2006 for various nanotechnology initiatives at five agencies: the National Science Foundation (NSF), Department of Energy, National Aeronautics and Space Administration, National Institute of Standards and Technology, and Environmental Protection Agency. These programs, which involve technologies that manipulate matter at the atomic level, would be overseen by both external and intergovernmental committees. The bill also would direct the Office of Science and Technology Policy (OSTP) to fund several studies by the National Academy of Sciences (NAS) over the next 10 years.

Assuming appropriation of the authorized amounts, CBO estimates that implementing this bill would cost a total of \$1.9 billion over the 2004–2008 period. CBO estimates that enacting this bill would have no effect on direct spending or revenues.

H.R. 766 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA) and would impose no costs on state, local, or tribal governments.

Estimated cost to the Federal Government: The estimated budgetary impact of H.R. 766 is shown in the following table. The costs of this legislation fall within budget functions 250 (general science, space, and technology), 300 (natural resources and the environment), and 376 (commerce and housing credit).

	By fiscal year, in millions of dollars—					
	2003	2004	2005	2006	2007	2008
SPENDING SUBJECT TO APPROPRIATION						
Spending under current law:						
Estimated authorization level <sup>1</sup> .....	497	350	0	0	0	0
Estimated outlays .....	412	350	233	89	26	7
Proposed changes:						
Estimated authorization level .....	0	364	785	865	1	1
Estimated outlays .....	0	200	450	686	465	130
Spending under H.R. 766:						
Estimated authorization level .....	497	714	785	865	1	1
Estimated outlays .....	412	550	683	775	491	137

<sup>1</sup>The 2003 level reflects agencies' estimates of the amount appropriated for nanotechnology programs that year. The 2004 level is the amount authorized to be appropriated for NSF's nanotechnology program under current law.

Basis of estimate: For this estimate, CBO estimates that the amounts authorized will be appropriated each year and that outlays will occur at rates similar to those of existing research and development programs. H.R. 766 would specify funding levels for each of the agencies, totaling \$713 million in 2004, \$785 million in 2005, and \$864 million in 2006. (The \$350 million specified for NSF's program for 2004 is not included in the table as a proposed change because that amount has already been authorized under current law.) The amounts specified in the bill would not cover costs associated with the external advisory functions and studies. Based on information from OSTP and NAS, CBO estimates that those activities would cost an average of about \$700,000 annually.

Intergovernmental and private-sector impact: H.R. 766 contains no intergovernmental or private-sector mandates as defined in UMRA and would impose no costs on state, local, or tribal governments.

Estimate prepared by: Federal costs: Kathleen Gramp; impact on state, local, and tribal governments: Greg Waring; impact on the private sector: Jean Talarico.

Estimate approved by: Peter H. Fontaine, Deputy Assistant Director for Budget Analysis.

#### XI. COMPLIANCE WITH PUBLIC LAW 104-4 (UNFUNDED MANDATES)

H.R. 766 contains no unfunded mandates.

#### XII. COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

The Committee on Science's oversight findings and recommendations are reflected in the body of this report.

#### XIII. STATEMENT ON GENERAL PERFORMANCE GOALS AND OBJECTIVES

Pursuant to clause (3)(c) of House rule XIII, the goals of H.R. 766 are to establish a National Nanotechnology Research and Development Program; to authorize appropriations for NSF, DOE, NASA, NIST, and EPA to carry out the Program; to establish an inter-agency committee to oversee the planning, management, and coordination of the Program; to establish an advisory committee on nanotechnology and a National Nanotechnology Coordination Office; to provide for external reviews of the Program by the National Academy of Sciences; and to establish a Science and Technology Graduate Scholarships Program to recruit and prepare students for careers in the Federal government that require scientific and technical training.

#### XIV. CONSTITUTIONAL AUTHORITY STATEMENT

Article I, section 8 of the Constitution of the United States grants Congress the authority to enact H.R. 766.

#### XV. FEDERAL ADVISORY COMMITTEE STATEMENT

The functions of the advisory committee required by H.R. 766 could be performed by one or more agencies or by enlarging the mandate of another existing advisory committee.

#### XVI. CONGRESSIONAL ACCOUNTABILITY ACT

The Committee finds that H.R. 766 does not relate to the terms and conditions of employment or access to public services or accommodations within the meaning of section 102(b)(3) of the Congressional Accountability Act (Public Law 104-1).

#### XVII. STATEMENT ON PREEMPTION OF STATE, LOCAL, OR TRIBAL LAW

This bill is not intended to preempt any state, local, or tribal law.

#### XVIII. CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

This legislation does not amend any existing Federal statute.

#### XIX. COMMITTEE RECOMMENDATIONS

On May 1, 2003, a quorum being present, the Committee on Science favorably reported H.R. 766, The Nanotechnology Research and Development Act of 2003, by a voice vote, and recommended its enactment.

XX. ADDITIONAL VIEW

One of the primary goals of this Act is to provide opportunities for expanded university research in the area of nanotechnology. I strongly support such efforts and expect that funding of the interdisciplinary research centers will be allocated to a broad range of universities engaged in nanotechnology research, particularly universities located in regions with a concentration of high-technology companies and which provide educational opportunities to underserved and minority students. Portland State University's Center for Nanoscience and Nanotechnology, which focuses on the development of carbon nanotubes and nanowires as a new generation of electron field emitters, the creation of building blocks for nano-electronic devices, and the preparation of future scientists and engineers with advanced nanoscience knowledge and the state-of-the-art instrumentation skills, is conducting particularly interesting research on such sciences and would serve as a strong example of an interdisciplinary research center.

DAVID WU.

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