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[Report No. 108–147]

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

IN THE SENATE OF THE UNITED STATES

JANUARY 16, 2003

Mr. WYDEN (for himself, Mr. ALLEN, Mr. LIEBERMAN, Mr. WARNER, Ms. MIKULSKI, Mr. HOLLINGS, Ms. LANDRIEU, Mrs. CLINTON, Mr. LEVIN, Mr. BAYH, Mrs. HUTCHISON, Mr. ALEXANDER, Mr. ROCKEFELLER, Mr. CORZINE, Mr. KERRY, Mr. LAUTENBERG, Ms. CANTWELL, and Mr. BAUCUS) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

SEPTEMBER 15, 2003

Reported by Mr. MCCAIN with an amendment

[Strike out all after the enacting clause and insert the part printed in italic]

A BILL

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''21st Century Nanotechnology Research and Development Act''.

SEC. 2. FINDINGS.

The Congress makes the following findings:

(1) The emerging fields of nanoscience and nanoengineering (collectively, ''nanotechnology''), in which matter is manipulated at the atomic level (i.e., atom-by-atom or molecule-by-molecule) in order to build materials, machines, and devices with novel properties or functions, are leading to unprecedented scientific and technological opportunities that will benefit society by changing the way many things are designed and made.

(2) Long-term nanoscale research and development leading to potential breakthroughs in areas such as materials and manufacturing, electronics, medicine and healthcare, environment, energy, chemicals, biotechnology, agriculture, information technology, and national security could be as significant as the combined influences of microelectronics, biotechnology, and information technology on the 20th century. Nanotechnology could lead to things such as—

(A) new generations of electronics where the entire collection of the Library of Congress is stored on devices the size of a sugar cube;

(B) manufacturing that requires less material, pollutes less, and is embedded with sophisticated sensors that will internally detect signs of weakness and automatically respond by releasing chemicals that will prevent damage;

(C) prosthetic and medical implants whose surfaces are molecularly designed to interact with the cells of the body;

(D) materials with an unprecedented combination of strength, toughness, and lightness that will enable land, sea, air, and space vehicles to become lighter and more fuel efficient;

(E) selective membranes that can fish out specific toxic or valuable particles from industrial waste or that can inexpensively desalinate sea water; and

(F) tiny robotic spacecraft that will cost less, consume very little power, adapt to unexpected environments, change its capabilities as needed, and be completely autonomous.

(3) Long-term, high-risk research is necessary to create breakthroughs in technology. Such research requires government funding since the benefits are too distant or uncertain for industry alone to support. Current Federal investments in nanotechnology research and development are not grounded in any specifically authorized statutory

foundation. As a result, there is a risk that future funding for long-term, innovative research will be tentative and subject to instability which could threaten to hinder future United States technological and economic growth.

(4) The Federal government can play an important role in the development of nanotechnology, as this science is still in its infancy, and it will take many years of sustained investment for this field to achieve maturity.

(5) Many foreign countries, companies and scientists believe that nanotechnology will be the leading technology of the 21st century and are investing heavily into its research. According to a study of international nanotechnology research efforts sponsored by the National Science and Technology Council, the United States is at risk of falling behind its international competitors, including Japan, South Korea, and Europe if it fails to sustain broad based funding in nanotechnology. The United States cannot afford to fall behind our competitors if we want to maintain our economic strength.

(6) Advances in nanotechnology stemming from Federal investments in fundamental research and subsequent private sector development likely will create technologies that support the work and improve the efficiency of the Federal government, and contribute significantly to the efforts of the government's mission agencies.

(7) According to various estimates, including those of the National Science Foundation, the market for nanotech products and services in the United States alone could reach over $1 trillion later this century.

(8) Nanotechnology will evolve from modern advances in chemical, physical, biological, engineering, medical, and materials research, and will contribute to cross-disciplinary training of the 21st century science and technology workforce.

(9) Mastering nanotechnology will require a unique skill set for scientists and engineers that combine chemistry, physics, material science, and information science. Funding in these critical areas has been flat for many years and as a result fewer young people are electing to go into these areas in graduate schools throughout the United States. This will have to reverse if we hope to develop the next generation of skilled workers with multidisciplinary perspectives necessary for the development of nanotechnology.

(10) Research on nanotechnology creates unprecedented capabilities to alter ourselves and our environment and will give rise to a host of novel social, ethical, philosophical, and legal issues. To appropriately address these issues will require wide reflection and guidance that are responsive to the realities of the science, as well as addi-

tional research to predict, understand, and alleviate anticipated problems.

(11) Nanotechnology will provide structures to enable the revolutionary concept of quantum computing, which uses quantum mechanical properties to do calculation. Quantum computing permits a small number of atoms to potentially store and process enormous amounts of information. Just 300 interacting atoms in a quantum computer could store as much information as a classical electronic computer that uses all the particles in the universe, and today's complex encryption algorithms, which would take today's best super computer 20 billion years, could be cracked in 30 minutes.

(12) The Executive Branch has previously established a National Nanotechnology Initiative to coordinate Federal nanotechnology research and development programs. This initiative has contributed significantly to the development of nanotechnology. Authorizing legislation can serve to establish new technology goals and research directions, improve agency coordination and oversight mechanisms, help ensure optimal returns to investment, and simplify reporting, budgeting, and planning processes for the Executive Branch and the Congress.

(13) The private sector technology innovations that grow from fundamental nanotechnology research are de-

pendent on a haphazard, expensive, and generally inefficient technology transition path. Strategies for accelerating the transition of fundamental knowledge and innovations in commercial products or to support mission agencies should be explored, developed, and when appropriate, executed.

(14) Existing data on the societal, ethical, educational, legal, and workforce implications and issues related to nanotechnology are lacking. To help decision-makers and affected parties better anticipate issues likely to arise with the onset and maturation of nanotechnology, research and studies on these issues must be conducted and disseminated.

(15) Many States and regions have begun nanotechnology programs. These programs have developed expertise, particularly with regard to providing infrastructure and preparing the nanotechnology workforce. The Federal nanotechnology program should leverage these existing State and local institutions to best provide a coordinated and comprehensive nanotechnology research portfolio.

(16) In ''Small Wonders, Endless Frontiers'' the National Academy of Sciences' National Research Council recommends increased investment in nanotechnology, particularly at the intersection of nanotechnology and biology.

Such investments will allow significant advancements in biotechnology and medicine.

SEC. 3. PURPOSE.

It is the purpose of this Act to authorize a coordinated inter-agency program that will support long-term nanoscale research and development leading to potential breakthroughs in areas such as materials and manufacturing, nanoelectronics, medicine and healthcare, environment, energy, chemicals, biotechnology, agriculture, information technology, and national and homeland security.

SEC. 4. NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.

(a) NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.—The President shall establish a National Nanotechnology Research Program. Through appropriate agencies, councils, and the National Coordination Office, the program shall—

(1) establish the goals, priorities, grand challenges, and metrics for evaluation for Federal nanotechnology research, development, and other activities;

(2) invest in Federal research and development programs in nanotechnology and related sciences to achieve those goals; and

(3) provide for interagency coordination of Federal nanotechnology research, development, and other activities undertaken pursuant to the program.

(b) GOALS OF THE NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.—The goals of the program are as follows:

(1) The coordination of long-term fundamental nanoscience and engineering research to build a fundamental understanding of matter enabling control and manipulation at the nanoscale.

(2) The assurance of continued United States global leadership in nanotechnology to meet national goals and to support national economic, health, national security, educational, and scientific interests.

(3) The advancement of United States productivity and industrial competitiveness through stable, consistent, and coordinated investments in long-term scientific and engineering research in nanotechnology.

(4) The development of a network of shared academic facilities and technology centers, including State supported centers, that will play a critical role in accomplishing the other goals of the program, foster partnerships, and develop and utilize next generation scientific tools.

(5) The development of enabling infrastructural technologies that United States industry can use to commercialize new discoveries and innovations in nanoscience.

(6) The acceleration of the deployment and transition of advanced and experimental nanotechnology and concepts into the private sector.

(7) The establishment of a program designed to provide effective education and training for the next generation of researchers and professionals skilled in the multidisciplinary perspectives necessary for nanotechnology.

(8) To ensure that philosophical, ethical, and other societal concerns will be considered alongside the development of nanotechnology.

(c) RESEARCH AND DEVELOPMENT AREAS.—Through its participating agencies, the National Nanotechnology Research Program shall develop, fund, and manage Federal research programs in the following areas:

(1) LONG-TERM FUNDAMENTAL RESEARCH.—The program shall undertake long-term basic nanoscience and engineering research that focuses on fundamental understanding and synthesis of nanometer-size building blocks with potential for

breakthroughs in areas such as materials and manufacturing, nanoelectronics, medicine and healthcare, environment, energy, chemical and pharmaceuticals industries, biotechnology and agriculture, computation and information technology, and national security. Funds made available from the appropriate agencies under this paragraph shall be used—

(A) to provide awards of less than $1,000,000 each to single investigators and small groups to provide sustained support to individual investigators and small groups conducting fundamental, innovative research; and

(B) to fund fundamental research and the development of university-industry-laboratory and interagency (including State-led) partnerships.

(2) GRAND CHALLENGES.—The program shall support grand challenges that are essential for the advancement of the field and interdisciplinary research and education teams, including multidisciplinary nanotechnology research centers, that work on major long-term objectives. This funding area will fund, through participating agencies, interdisciplinary research and education teams that aim to

achieve major, long-term objectives, such as the following:

(A) Nanomaterials by design which are stronger, lighter, harder, self-repairing, and safer.

(B) Nanoelectronics, optoelectronics, and magnetics.

(C) Healthcare applications.

(D) Nanoscale processes and environment.

(E) Energy and energy conservation.

(F) Microspacecraft.

(G) Bio-nanodevices for detection and mitigation of biothreats to humans.

(H) Economical, efficient, and safe transportation.

(I) National and homeland security.

(J) Other appropriate challenges.

(3) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTERS.—The Program, through the appropriate agencies, shall fund, on a competitive merit reviewed basis, research centers in the range of $3,000,000 to $5,000,000 per year each for 5 years. A grant under this paragraph to a center may be renewed for 1 5-year term on the basis of that center's performance, determined after a review. The

program, through its participating agencies, shall encourage research networking among centers and researchers and require access to facilities to both academia and industry. The centers shall assist in reaching other initiative priorities, including fundamental research, grand challenges, education, development and utilization of specific research tools, and promoting partnerships with industry. To the greatest extent possible, agencies participating in the program shall establish geographically diverse centers including at least one center in a State participating in the National Science Foundation's (NSF) Experimental Program, to Stimulate Competitive Research (EPSCoR), established under section 113 of the NSF Authorization Act of 1988 (42 U.S.C. 1862(g)) and shall encourage the participation of minority serving institutions at these centers.

(4) RESEARCH INFRASTRUCTURE.—The program, through its participating agencies, shall ensure adequate research infrastructure and equipment for rapid progress on program goals, including the employment of underutilized manufacturing facilities in areas of high unemployment as production engineering and research testbeds for micron-scale technologies. Major research equipment and instrumen-

tation shall be an eligible funding purpose under the program.

(5) SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—The Director of the National Science Foundation shall establish a new Center for Societal, Ethical, Educational, Legal, and Workforce Issues Related to Nanotechnology at $5,000,000 per year to encourage, conduct, coordinate, commission, collect, and disseminate research on the societal, ethical, educational, legal, and workforce issues related to nanotechnology. The Center shall also conduct studies and provide input and assistance to the Director of the National Science Foundation in completing the annual report required under paragraph 7(b)(3) of this Act.

(6) TRANSITION OF TECHNOLOGY.—The program, through its participating agencies, shall ensure cooperation and collaboration with United States industry in all relevant research efforts and develop mechanisms to assure prompt technology transition.

(7) GAP FUNDING.—The program shall address research areas identified by the Council under section 5(a)(9) of this Act through a program of com-

petitive grants to be awarded in such areas by the Director of the National Science Foundation using the Foundation's funds and any funds contributed to the Foundation by other participating agencies for this purpose. Such grants may be made to government or non-government awardees. Where appropriate, such grants may encourage interagency partnerships or leverage the expertise of State-supported nanotechnology programs.

SEC. 5. PROGRAM COORDINATION AND MANAGEMENT.

(a) IN GENERAL.—The National Science and Technology Council shall oversee the planning, management, and coordination of the Federal nanotechnology research and development program. The Council, itself or through an appropriate subgroup it designates or establishes, shall—

(1) establish a set of broad applications of nanotechnology research and development, or grand challenges, to be met by the results and activities of the program, based on national needs;

(2) submit to the Congress through the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science, an annual report, along with the Presi-

dent's annual budget request, describing the implementation of the program under section 4;

(3) provide for interagency coordination of the program, including with the Department of Defense;

(4) coordinate the budget requests of each of the agencies involved in the program with the Office of Management and Budget to ensure that a balanced research portfolio is maintained in order to ensure the appropriate level of research effort;

(5) provide guidance each year to the participating departments and agencies concerning the preparation of appropriations requests for activities related to the program;

(6) consult with academic, industry, State and local government (including State and regional nanotechnology programs), and other appropriate groups conducting research on and using nanotechnology;

(7) establish an Information Services and Applications Council to promote access to and early application of the technologies, innovations, and expertise derived from nanotechnology research and development program activities to agency missions and systems across the Federal government, and to United States industry;

(8) in cooperation with the Advisory Panel established under subsection (b), develop and apply measurements using appropriate metrics for evaluating program performance and progress toward goals; and

(9) identify research areas which are not being adequately addressed by the agencies' current research programs.

(b) PRESIDENT'S NANOTECHNOLOGY ADVISORY PANEL.—

(1) ESTABLISHMENT.—The President shall establish a National Nanotechnology Advisory Panel.

(2) SELECTION PROCEDURES.—The President shall establish procedures for the selection of individuals not employed by the Federal government who are qualified in the science of nanotechnology and other appropriate fields and may, pursuant to such procedures, select up to 20 individuals, one of whom shall be designated Chairman, to serve on the Advisory Panel. Selection of individuals for the Advisory Panel shall be based solely on established records of distinguished fundamental and applied scientific service, and the panel shall contain a reasonable cross-section of views and expertise, including those regarding the societal, ethical, educational, legal,

and workforce issues related to nanotechnology. In selecting individuals to serve on the Advisory Panel, the President shall seek and give due consideration to recommendations from the Congress, industry, the scientific community (including the National Academy of Sciences), scientific professional societies, academia, the defense community, the education community, State and local governments, and other appropriate organizations.

(3) MEETINGS.—The Advisory Panel shall meet no less than twice annually, at such times and places as may be designated by the Chairman in consultation with the National Nanotechnology Coordination Office established under subsection 5(c) of this Act.

(4) DUTIES.—The Advisory Panel shall advise the President and the National Science and Technology Council, and inform the Congress, on matters relating to the National Nanotechnology Program, including goals, roles, and objectives within the program, its capabilities and research needs, guidance on achieving major objectives, and establishing and measuring performance goals using appropriate metrics. The Advisory Panel shall issue an annual report, containing the information required by subsection (d) of this section, to the President, the

Council, the heads of each agency involved in the program, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science, on or before September 30 of each year.

(c) NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.—The President shall establish a National Nanotechnology Coordination Office, with full-time staff, to provide day-to-day technical and administrative support to the Council and the Advisory Panel, and to be the point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, State nanotechnology programs, and others to exchange technical and programmatic information. The Office shall promote full coordination of research efforts between agencies, scientific disciplines, and United States industry.

(d) PROGRAM PLANS AND REPORTS.—

(1) ANNUAL EVALUATION OF NANOTECHNOLOGY RESEARCH DEVELOPMENT PROGRAM.—The report by the Advisory Panel, required pursuant to subsection (b)(4), shall include—

(A) a review of the program's technical success in achieving the stated goals and grand

challenges according to the metrics established by the program and Advisory Panel;

(B) a review of the program's management and coordination;

(C) a review of the funding levels by each agency for the program's activities and their ability to achieve the program's stated goals and grand challenges;

(D) a review of the balance in the program's portfolio and components across agencies and disciplines;

(E) an assessment of the degree of participation in the program by minority serving institutions and institutions located in States participating in NSF's EPSCoR program;

(F) a review of policy issues resulting from advancements in nanotechnology and its effects on the scientific enterprise, commerce, workforce, competitiveness, national security, medicine, and government operations;

(G) recommendations for new program goals and grand challenges;

(H) recommendations for new research areas, partnerships, coordination and management mechanisms, or programs to be estab-

lished to achieve the program's stated goals and grand challenges;

(I) recommendations for new investments by each participating agency in each program funding area for the 5-year period following the delivery of the report;

(J) reviews and recommendations regarding other issues deemed pertinent or specified by the panel; and

(K) a technology transition study which includes an evaluation of the Federal nanotechnology research and development program's success in transitioning its research, technologies, and concepts into commercial and military products, including—

(i) examples of successful transition of research, technologies, and concepts from the Federal nanotechnology research and development program into commercial and military products;

(ii) best practices of universities, government, and industry in promoting efficient and rapid technology transition in the nanotechnology sector;

(iii) barriers to efficient technology transition in the nanotechnology sector, including, but not limited to, standards, pace of technological change, qualification and testing of research products, intellectual property issues, and Federal funding; and

(iv) recommendations for government sponsored activities to promote rapid technology transition in the nanotechnology sector.

(2) OFFICE OF MANAGEMENT AND BUDGET REVIEW.—

(A) BUDGET REQUEST REVIEW.—Each Federal agency and department participating in the program shall, as part of its annual request for appropriations, submit information to the Office of Management and Budget including—

(i) each element of its nanotechnology research and development activities that contributes directly to the program or benefits from the program;

(ii) the portion of its request for appropriations that is allocated to each such element; and

(iii) the portion of its request for appropriations that is allocated to each program funding area.

(B) OMB REVIEW AND ALLOCATION STATEMENT.—The Office of Management and Budget shall review the information provided under subparagraph (A) in light of the goals, priorities, grand challenges, and agency and departmental responsibilities set forth in the annual report of the Council under paragraph (3), and shall include in the President's annual budget estimate, a statement delineating the amount and portion of each appropriate agency's or department's annual budget estimate relating to its activities undertaken pursuant to the program.

(3) ANNUAL NSTC REPORT TO CONGRESS ON THE NANOTECHNOLOGY RESEARCH DEVELOPMENT PROGRAM.—The National Science and Technology Council shall submit an annual report to the Congress that—

(A) includes a detailed description of the goals, grand challenges, and program funding areas established by the President for the program;

(B) sets forth the relevant programs and activities, for the fiscal year with respect to which the budget submission applies, of each Federal agency and department, participating in the program, as well as such other agencies and departments as the President or the Director considers appropriate;

(C) describes the levels of Federal funding for the fiscal year during which such report is submitted, and the levels proposed for the fiscal year with respect to which the budget submission applies, for each of the program funding areas of the program;

(D) describes the levels of Federal funding for each agency and department participating in the program and each program funding area for the fiscal year during which such report is submitted, and the levels proposed for the fiscal year with respect to which the budget submission applies, and compare these levels to the most recent recommendations of the Advisory Panel and the external review of the program;

(E) describes coordination and partnership activities with State, local, international, and private sector efforts in nanotechnology re-

search and development, and how they support the goals of the program;

(F) describes mechanisms and efforts used by the program to assist in the transition of innovative concepts and technologies from Federally funded programs into the commercial sector, and successes in these transition activities;

(G) describes coordination between the military and civilian portions, as well as the life science and non-life science portions, of the program in technology development, supporting the goals of the program, and supporting the mission needs of the departments and agencies involved;

(H) analyzes the progress made toward achieving the goals, priorities, and grand challenges designated for the program according to the metrics established by the program and the Advisory Panel, and

(I) recommends new mechanisms of coordination, program funding areas, partnerships, or activities necessary to achieve the goals, priorities, and grand challenges established for the program.

(4) TRIENNIAL EXTERNAL REVIEW OF NANOTECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM.—

(A) IN GENERAL.—The Director of the National Science Foundation shall enter into an arrangement with the National Research Council of the National Academy of Sciences to conduct a triennial evaluation of the Federal nanotechnology research and development program, including—

(i) a review of the technical success of the program in achieving the stated goals and grand challenges under the metrics established by the program and the nanotechnology Advisory Panel, and under other appropriate measurements;

(ii) a review of the program's management and coordination across agencies and disciplines;

(iii) a review of the funding levels by each agency for the program's activities and their ability with such funding to achieve the program's stated goals and grand challenges;

(iv) recommendations for new or revised program goals and grand challenges;

(v) recommendations for new research areas, partnerships, coordination and management mechanisms, or programs to be established to achieve the program's stated goals and grand challenges;

(vi) recommendations for investment levels in light of goals by each participating agency in each program funding area for the 5-year period following the delivery of the report;

(vii) recommendations on policy, program, and budget changes with respect to nanotechnology research and development activities;

(viii) recommendations for improved metrics to evaluate the success of the program in accomplishing its stated goals;

(ix) a review of the performance of the Information Services and Applications Council and its efforts to promote access to and early application of the technologies, innovations, and expertise derived from program activities to agency missions

and systems across the Federal government and to United States industry; and

(x) an analysis of the relative position of the United States compared to other nations with respect to nanotechnology research and development, including the identification of any critical research areas where the United States should be the world leader to best achieve the goals of the program.

(B) EVALUATION TO BE TRANSMITTED TO CONGRESS.—The Director of the National Science Foundation shall transmit the results of any evaluation for which it made arrangements under subparagraph (A) to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Science upon receipt. The first such evaluation shall be transmitted no later than June 10, 2005, with subsequent evaluations transmitted to the Committees every 3 years thereafter.

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

(a) NATIONAL SCIENCE FOUNDATION.—

(1) GENERAL AUTHORIZATION.—There are authorized to be appropriated to the Director of the National Science Foundation to carry out the Director's responsibilities under this Act $346,150,000 for fiscal year 2004.

(2) SPECIFIC ALLOCATIONS.—

(A) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTERS.—Of the amounts described in paragraph (1), $50,000,000 for fiscal year 2004, shall be available for grants of up to $5,000,000 each for multidisciplinary nanotechnology research centers.

(B) CENTER FOR SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—Of the sums authorized for the National Science Foundation each fiscal year, $5,000,000 shall be used to establish a university-based Center for Societal, Ethical, Educational, Legal, and Workforce Issues Related to Nanotechnology.

(C) NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.—Of the sums authorized for the National Science Foundation each fiscal year, $5,000,000 shall be used for the activities of the Nanotechnology Coordination Office.

(D) GAP FUNDING.—Of the sums authorized for the National Science Foundation each fiscal year, $5,000,000 shall be for use in competitive grants as described in section 4(c)(7) of this Act.

(b) DEPARTMENT OF ENERGY.—There are authorized to be appropriated to the Secretary of Energy to carry out the Secretary's responsibilities under this Act $160,195,000 for fiscal year 2004.

(c) NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.—There are authorized to be appropriated to the Administrator of the National Aeronautics and Space Administration to carry out the Administrator's responsibilities under this Act $58,650,000 for fiscal year 2004.

(d) NATIONAL INSTITUTES OF HEALTH.—There are authorized to be appropriated to the Director of the National Institutes to carry out the Director's responsibilities under this Act $49,680,000 for fiscal year 2004.

(e) NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY.—There are authorized to be appropriated to the Director of the National Institute of Standards and Technology to carry out the Director's responsibilities under this Act $50,600,000 for fiscal year 2004.

(f) ENVIRONMENTAL PROTECTION AGENCY.—There are authorized to be appropriated to the Administrator of

the Environmental Protection Agency to carry out the Administrator's responsibilities under this Act $5,750,000 for fiscal year 2004.

(g) DEPARTMENT OF JUSTICE.—There are authorized to be appropriated to the Director of the National Institute of Justice to carry out the Director's responsibilities under this Act $1,610,000 for fiscal year 2004.

(h) DEPARTMENT OF TRANSPORTATION.—There are authorized to be appropriated to the Secretary of Transportation to carry out the Secretary's responsibilities under this Act $2,300,000 for fiscal year 2004.

(i) DEPARTMENT OF AGRICULTURE.—There are authorized to be appropriated to the Secretary of Agriculture to carry out the Secretary's responsibilities under this Act $2,870,000 for fiscal year 2004.

SEC. 7. SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.

(a) STUDIES.—The Director of the National Science Foundation shall encourage, conduct, coordinate, commission, collect, and disseminate studies on the societal, ethical, educational, and workforce implications of nanotechnology through the Center for Societal, Ethical, Educational, Legal, and Workforce Issues established under section 4(c)(5). The studies shall identify antici-

pated issues and problems, as well as provide recommendations for preventing or addressing such issues and problems.

(b) DATA COLLECTION.—The Director of the National Science Foundation shall collect data on the size of the anticipated nanotechnology workforce need by detailed occupation, industry, and firm characteristics, and assess the adequacy of the trained talent pool in the United States to fill such workforce needs.

(c) ANNUAL REPORT.—The Director of the National Science Foundation shall compile the studies required by paragraph (2) and, with the assistance of the Center for Societal, Ethical, Educational, Legal, and Workforce Issues Related to Nanotechnology established under section 4(c)(5) of this Act, shall complete a report that includes a description of the Center's activities, which shall be submitted to the President, the Council, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science not later than 18 months after the date of enactment of this Act.

SEC. 8. DEFINITIONS.

In this Act:

(1) ADVISORY PANEL.—The term ''Advisory Panel'' means the President's National Nanotechnology Panel.

(2) FUNDAMENTAL RESEARCH.—The term ''fundamental research'' means research that builds a fundamental understanding and leads to discoveries of the phenomena, processes, and tools necessary to control and manipulate matter at the nanoscale.

(3) GRAND CHALLENGE.—The term ''grand challenge'' means a fundamental problem in science or engineering, with broad economic and scientific impact, whose solution will require the application of nanotechnology.

(4) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTER.—The term ''interdisciplinary nanotechnology research center'' means a group of 6 or more researchers collaborating across scientific and engineering disciplines on large-scale long-term research projects that will significantly advance the science supporting the development of nanotechnology or the use of nanotechnology in addressing scientific issues of national importance, consistent with the goals set forth in section 4(b).

~~(5) NANOTECHNOLOGY.—The term ''nanotechnology'' means the ability to work at the molecular level, atom-by-atom, to create large structures with fundamentally new molecular organization.~~

~~(6) PROGRAM.—The term ''program'' means the national nanotechnology research program established under section 4.~~

~~(7) RESEARCH INFRASTRUCTURE.—The term ''research infrastructure'' means the measurement science, instrumentation, modeling and simulation, and user facilities needed to develop a flexible and enabling infrastructure so that United States industry can rapidly commercialize new discoveries in nanotechnology.~~

SECTION 1. SHORT TITLE.

This Act may be cited as the ''21st Century Nanotechnology Research and Development Act''.

SEC. 2. NATIONAL NANOTECHNOLOGY PROGRAM.

(a) NATIONAL NANOTECHNOLOGY PROGRAM.—The President shall implement a National Nanotechnology Program. Through appropriate agencies, councils, and the National Nanotechnology Coordination Office established in subsection (d), the Program shall—

(1) Establish the goals, priorities, grand challenges, and metrics for evaluation for Federal nanotechnology research, development, and other activities;

(2) Invest in Federal research and development programs in nanotechnology and related sciences to achieve those goals; and

(3) Provide for interagency coordination of Federal nanotechnology research, development, and other activities undertaken pursuant to the Program.

(b) GOALS.—The goals of the National Nanotechnology Program shall include:

(1) Developing a fundamental understanding of matter that enables control and manipulation at the nanoscale.

(2) Ensuring United States global leadership in the development and application of nanotechnology.

(3) Advancing the United States productivity and industrial competitiveness through stable, consistent, and coordinated investments in long-term scientific and engineering research in nanotechnology.

(4) Developing a network of shared facilities and centers to foster partnerships among researchers in nanotechnology.

(5) Accelerating the deployment and application in the private sector, including startup companies, of nanoscale-related research and development.

(6) Providing effective education and training for researchers and professionals skilled in the multidisciplinary perspectives necessary for nanotechnology so that a true interdisciplinary research culture for nanoscale science, engineering, and technology can emerge.

(7) Ensuring that ethical, legal, environmental, and other appropriate societal concerns are considered during the development of nanotechnology, including safer sustainable nanoscience products and processing.

(c) PROGRAM MANAGEMENT.—The National Science and Technology Council shall oversee the planning, management, and coordination of the National Nanotechnology Program. The Council, itself or through an appropriate subgroup it designates or establishes, shall—

(1) establish a set of broad applications of nanotechnology research and development, or grand challenges, to be met by the results and activities of the Program, based on national needs;

(2) provide for interagency coordination of the Program, including with the activities of the Defense Nanotechnology Research and Development Program

established under section 246 of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314);

(3) develop, within 12 months after the date of enactment of this Act, and update every 4 years thereafter, a strategic plan to meet the goals and priorities established under subsection (b) and to guide the activities and anticipated outcomes of the participating agencies, including a description of how the Program will move results out of the laboratory and into application for the benefit of society, support for long-term funding for multidisciplinary research and development in technology, and dedication of funding for interagency nanotechnology projects;

(4) coordinate the budget requests of each of the agencies involved in the Program with the Office of Management and Budget to ensure that a balanced nanotechnology research portfolio is maintained in order to ensure the appropriate level of research effort;

(5) exchange information with academic, industry, State and local government (including State and regional nanotechnology programs), and other appropriate groups conducting research on and using nanotechnology;

(6) 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)(5);

(7) identify research areas that are not being adequately addressed by the agencies' current research programs;

(8) encourage progress on Program goals through the utilization of existing manufacturing facilities and industrial infrastructures such as, but not limited to, the employment of underutilized manufacturing facilities in areas of high unemployment as production engineering and research testbeds; and

(9) provide for, on a merit-reviewed, competitive basis, interdisciplinary nanotechnology research centers, which to the greatest extent possible, shall be established in geographically diverse centers including at least one center in a State participating in the National Science Foundation's (NSF) Experimental Program to Stimulate Competitive Research (EPSCoR), established under section 113 of the NSF Authorization Act of 1988 (42 U.S.C. 1862(g)) and shall encourage the participation of minority serving institutions at these centers.

(d) PROGRAM COORDINATION.—The President shall establish a National Nanotechnology Coordination Office, with full-time staff, which shall—

(1) provide technical and administrative support to the Council and the Advisory Panel;

(2) serve as the point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, State nanotechnology programs, interested citizen groups, and others to exchange technical and programmatic information;

(3) conduct public outreach, including dissemination of findings and recommendations of the Advisory Panel, as appropriate; and

(4) establish an office to promote access to and early application of the technologies, innovations, and expertise derived from Program activities to agency missions and systems across the Federal Government, and to United States industry, including startup companies.

(e) ANNUAL REPORT.—The Council shall prepare an annual report, to be submitted to the House of Representatives Committee on Science and the Senate Committee on Commerce, Science, and Transportation 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 subsection (b)(7), which shall be submitted by December 31st of such year;

(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 subsection (b)(7);

(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 Panel and the Center, established in section 7 of this Act; and

(5) an assessment of how Federal agencies are implementing the plan described in section (c)(7), and a description of the amount of Small Business Innovative Research and Small Business Technology Transfer Research funds supporting the plan.

SEC. 3. ADVISORY PANEL.

(a) IN GENERAL.—The President shall establish or designate a National Nanotechnology Advisory Panel.

(b) QUALIFICATIONS.—The Panel established or designated by the President under subsection (a) shall consist primarily of individuals who are non-Federal members and shall include representatives of academia and industry. Members of such Panel shall be qualified to provide advice and information on nanotechnology research, development, demonstrations, education, technology transfer, commercial application, or societal and ethical concerns. In selecting or designating an Advisory Panel, the President may also seek and give consideration to recommendations from the Congress, industry, the scientific community (including the National Academy of Sciences), scientific professional societies, academia, the defense community, State and local governments, regional nanotechnology programs, and other appropriate organizations.

(c) DUTIES.—The Panel shall advise the President and the Council on matters relating to the Program, including assessing—

(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 Council are helping to maintain United States leadership in nanotechnology;

(6) the management, coordination, implementation, and activities of the Program; and

(7) whether societal, ethical, environmental, and workforce concerns are adequately addressed by the Program.

(d) REPORTS.—The Advisory Panel shall report, not less frequently than once every 2 fiscal years, to the President, the Senate Committee on Commerce, Science, and Technology, and the House of Representatives Committee on Science on its assessments under subsection (c) and its recommendations for ways to improve the Program. The first report under this subsection shall be submitted within 1 year after the date of enactment of this Act.

(e) TRAVEL EXPENSES OF NON-FEDERAL MEMBERS.—Non-Federal members of the Panel, while attending meetings of the Panel or while otherwise serving at the request of the head of the Panel away from their homes or regular places of business, may be allowed travel expenses,

including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code, for individuals in the Government serving without pay. Nothing in this subsection shall be construed to prohibit members of the Panel who are officers or employees of the United States from being allowed travel expenses, including per diem in lieu of subsistence, in accordance with existing law.

SEC. 4. TRIENNIAL EXTERNAL REVIEW OF NANOTECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The Director of the National Science Foundation shall enter into an arrangement with the National Research Council of the National Academy of Sciences to conduct a triennial evaluation of the National Nanotechnology Program, including—

(1) a review of the technical success of the Program in achieving the stated goals under the metrics established by the Program and the Advisory Panel, and under other appropriate measurements;

(2) a review of the Program's management and coordination across agencies and disciplines;

(3) a review of the funding levels by each agency for the Program's activities and their ability with such funding to achieve the Program's stated goals;

(4) recommendations for new or revised Program goals;

(5) recommendations for new research areas, partnerships, coordination and management mechanisms, or programs to be established to achieve the Program's stated goals;

(6) recommendations for investment levels by each participating agency in each Program funding area for the 5-year period following the delivery of the report;

(7) recommendations on policy, program, and budget changes with respect to nanotechnology research and development activities;

(8) recommendations for improved metrics to evaluate the success of the Program in accomplishing its stated goals;

(9) a review of the performance of the National Nanotechnology Coordination Office and its efforts to promote access to and early application of the technologies, innovations, and expertise derived from program activities to agency missions and systems across the Federal Government and to United States industry; and

(10) an analysis of the relative position of the United States compared to other nations with respect

to nanotechnology research and development, including the identification of any critical research areas where the United States should be the world leader to best achieve the goals of the Program.

(b) EVALUATION TO BE TRANSMITTED TO CONGRESS.—The Director of the National Science Foundation shall transmit the results of any evaluation for which it made arrangements under subsection (a) to the Advisory Panel, the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Science upon receipt. The first such evaluation shall be transmitted no later than June 10, 2005, with subsequent evaluations transmitted to the Committees every 3 years thereafter.

SEC. 5. AUTHORIZATION OF APPROPRIATIONS.

(a) NATIONAL SCIENCE FOUNDATION.—

(1) IN GENERAL.—There are authorized to be appropriated to the Director of the National Science Foundation to carry out the Director's responsibilities under this Act—

(A) $350,000,000 for fiscal year 2004;

(B) $385,000,000 for fiscal year 2005;

(C) $424,000,000 for fiscal year 2006;

(D) $449,000,000 for fiscal year 2007; and

(E) $476,000,000 for fiscal year 2008.

(2) SPECIFIC ALLOCATIONS.—

(A) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTERS.—Of the amounts authorized by paragraph (1) for each fiscal year, $50,000,000 for each fiscal year shall be available for grants of up to $5,000,000 each for multidisciplinary nanotechnology research centers.

(B) AMERICAN NANOTECHNOLOGY PREPAREDNESS CENTER.—Of the amounts authorized by paragraph (1) for each fiscal year, $5,000,000 shall be used to establish and maintain a university-based American Nanotechnology Preparedness Center.

(C) NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.— Of the sums authorized by paragraph (1) for each fiscal year, $5,000,000 shall be used for the activities of the Nanotechnology Coordination Office.

(D) MANUFACTURING TECHNOLOGIES FOR NANOMATERIALS.—Of the sums authorized by paragraph (1) for each fiscal year, $5,000,000 shall be used for the activities of the Center for Nanomaterials Manufacturing.

(b) DEPARTMENT OF ENERGY.—

(1) IN GENERAL.—There are authorized to be appropriated to the Secretary of Energy to carry out the Secretary's responsibilities under this Act—

(A) $265,000,000 for fiscal year 2004;

(B) $292,000,000 for fiscal year 2005;

(C) $321,000,000 for fiscal year 2006;

(D) $340,000,000 for fiscal year 2007; and

(E) $360,000,000 for fiscal year 2008.

(2) ALLOCATION.—Of the sums authorized by paragraph (1) for each fiscal year, $25,000,000 shall be used on a merit-reviewed and competitive basis to support consortia that integrate newly developed nanotechnology and microfluidic tools with systems biology, immunology, and molecular imaging, of which at least 1 such consortium shall be provided with at least $10,000,000 for each fiscal year.

(c) NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.—There are authorized to be appropriated to the Administrator of the National Aeronautics and Space Administration to carry out the Administrator's responsibilities under this Act—

(1) $31,000,000 for fiscal year 2004;

(2) $34,100,000 for fiscal year 2005;

(3) $37,500,000 for fiscal year 2006;

(4) $40,000,000 for fiscal year 2007; and

(5) $42,300,000 for fiscal year 2008.

(d) NATIONAL INSTITUTES OF HEALTH.—There are authorized to be appropriated to the Director of the National Institutes to carry out the Director's responsibilities under this Act—

(1) $70,000,000 for fiscal year 2004;

(2) $77,000,000 for fiscal year 2005;

(3) $85,000,000 for fiscal year 2006;

(4) $90,000,000 for fiscal year 2007; and

(5) $95,000,000 for fiscal year 2008.

(e) NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY.—There are authorized to be appropriated to the Director of the National Institute of Standards and Technology to carry out the Director's responsibilities under this Act—

(1) $62,000,000 for fiscal year 2004;

(2) $68,200,000 for fiscal year 2005;

(3) $75,000,000 for fiscal year 2006;

(4) $80,000,000 for fiscal year 2007; and

(5) $84,000,000 for fiscal year 2008.

(f) ENVIRONMENTAL PROTECTION AGENCY.—There are authorized to be appropriated to the Administrator of the Environmental Protection Agency to carry out the Administrator's responsibilities under this Act—

(1) $5,000,000 for fiscal year 2004;

(2) $5,500,000 for fiscal year 2005;

(3) $6,050,000 for fiscal year 2006;

(4) $6,413,000 for fiscal year 2007; and

(5) $6,800,000 for fiscal year 2008.

(g) DEPARTMENT OF JUSTICE.—There are authorized to be appropriated to the Director of the National Institute of Justice to carry out the Director's responsibilities under this Act—

(1) $1,000,000 for fiscal year 2004;

(2) $1,100,000 for fiscal year 2005;

(3) $1,210,000 for fiscal year 2006;

(4) $1,283,000 for fiscal year 2007; and

(5) $1,360,000 for fiscal year 2008.

(h) DEPARTMENT OF HOMELAND SECURITY.—There are authorized to be appropriated to the Secretary of Homeland Security to carry out the Secretary's responsibilities under this Act—

(1) $2,000,000 for fiscal year 2004;

(2) $2,200,000 for fiscal year 2005;

(3) $2,420,000 for fiscal year 2006;

(4) $2,570,000 for fiscal year 2007; and

(5) $2,720,000 for fiscal year 2008.

(i) DEPARTMENT OF AGRICULTURE.—There are authorized to be appropriated to the Secretary of Agriculture

to carry out the Secretary's responsibilities under this Act—

(1) $10,000,000 for fiscal year 2004;

(2) $11,000,000 for fiscal year 2005;

(3) $12,100,000 for fiscal year 2006;

(4) $12,830,000 for fiscal year 2007; and

(5) $13,600,000 for fiscal year 2008.

SEC. 6. AMERICAN NANOTECHNOLOGY PREPAREDNESS CENTER.

(a) IN GENERAL.—The Director of the National Science Foundation shall, on a merit-reviewed and competitive basis, establish a new American Nanotechnology Preparedness Center to encourage, conduct, coordinate, commission, collect, and disseminate research on the educational, legal, workforce, societal, and ethical issues related to nanotechnology.

(b) STUDIES.—The Director of the National Science Foundation, through the Center, shall conduct, coordinate, commission, collect, and disseminate studies on the educational, legal, workforce, societal, and ethical implications of nanotechnology. The studies shall identify anticipated issues and problems, as well as provide recommendations for preventing or addressing such issues and problems.

(c) WORKFORCE DATA.—The Director of the National Science Foundation shall collect data on the size of the an-

ticipated nanotechnology workforce need by detailed occupation, industry, and firm characteristics, and assess the adequacy of the trained talent pool in the United States to fill such workforce needs.

(d) ANNUAL REPORT.—The Director of the National Science Foundation shall compile the studies required by paragraph (b) and, with the assistance of the Center, shall complete a report that includes a description of the Center's activities, which shall be submitted to the President, the Council, the Advisory Panel, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science not later than 18 months after the date of enactment of this Act.

SEC. 7. COMMERCIALIZATION ISSUES RELATED TO NANOSCIENCE AND NANOTECHNOLOGY.

(a) IN GENERAL.—The Director of the National Institute of Standards and Technology shall establish a center within NIST's Manufacturing Engineering Laboratory for issues relating to the commercialization of nanoscience and nanotechnology research. The program shall—

(1) conduct basic research on issues related to the development and manufacture of nanotechnology including—

(A) metrology;

(B) reliability and quality assurance;

(C) processes control; and

(D) manufacturing best practices; and

(2) in consultation with the National Technical Information Service and the National Nanotechnology Coordination Office, act as a clearinghouse for information related to commercialization of nanoscience and nanotechnology research, including—

(A) information relating activities by regional, state, and local commercial nanotechnology initiatives;

(B) transition of research, technologies, and concepts from Federal nanotechnology research and development programs into commercial and military products;

(C) best practices by government, university and private sector laboratories transitioning technology to commercial use;

(D) examples of ways to overcome barriers and challenges to technology deployment; and

(E) use of existing manufacturing infrastructure and workforce.

(b) USE OF MANUFACTURING EXTENSION PARTNERSHIP PROGRAM.—The Director of the National Institute of Standards and Technology shall utilize the manufacturing

extension partnership program to the extent possible to reach small and medium sized manufacturing companies.

(c) MANUFACTURING TECHNOLOGIES FOR NANOMATERIALS.—The Director of the National Science Foundation shall establish, on a merit-reviewed, competitive basis, a new Center for Nanomaterials Manufacturing to encourage the development and transfer of technologies for the manufacture of nanomaterials. The Center will encourage, conduct, coordinate, commission, collect, and disseminate research on new manufacturing technologies for materials with unprecedented combinations of strength, toughness, lightness, flame resistance, and membrane separation characteristics, and develop mechanisms to transfer such manufacturing technologies to United States industries.

SEC. 8. DEFINITIONS.

In this Act:

(1) ADVISORY PANEL.—The term "Advisory Panel" means the President's National Nanotechnology Panel established or designated under section 3.

(2) FUNDAMENTAL RESEARCH.—The term "fundamental research" means research that builds a fundamental understanding and leads to discoveries of

the phenomena, processes, and tools necessary to control and manipulate matter at the nanoscale.

(3) NANOTECHNOLOGY.—The term "nanotechnology" means the ability to work at the molecular level, atom-by-atom, to create large structures with fundamentally new molecular organization.

(4) PROGRAM.—The term "Program" means the National Nanotechnology Program established under section 2.

(5) COUNCIL.—The term "Council" means the National Science and Technology Council or an appropriate subgroup designated by the Council under section 2(c).

(6) GRAND CHALLENGE.—The term "grand challenge" means a fundamental problem in science or engineering, with broad potential economic and scientific impact, the solution to which will require the application of nanotechnology research.

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108TH CONGRESS
1ST SESSION

S. 189

[Report No. 108–147]

A BILL

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

SEPTEMBER 15, 2003

Reported with an amendment