Calendar No. 280

108TH CONGRESS *1st Session*	SENATE	REPORT 108–147

21st CENTURY NANOTECHNOLOGY RESEARCH AND DEVELOPMENT ACT

R E P O R T

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ON

S. 189

SEPTEMBER 15, 2003.—Ordered to be printed

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

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Mr. MCCAIN, from the Committee on Commerce, Science, and Transportation, submitted the following

R E P O R T

[To accompany S. 189]

The Committee on Commerce, Science, and Transportation, to which was referred the bill (S. 189) to authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes, having considered the same, reports favorably thereon with an amendment (in the nature of a substitute) and recommends that the bill (as amended) do pass.

PURPOSE OF THE BILL

The purpose of this legislation is to authorize appropriations for Federal nanotechnology programs for fiscal year (FY) 2004 through FY 2008, and to establish a National Nanotechnology Program (the Program) to provide guidance, investment, and coordination to Federal nanotechnology research.

BACKGROUND AND NEEDS

Nanotechnology is a newly emerging field of science where scientists and engineers are beginning to manipulate matter at the molecular and atomic level in order to develop materials and systems with revolutionary properties. A nanometer is one-billionth of a meter, or roughly 100,000 times smaller than a strand of human hair.

Nanotechnology is an inter-disciplinary field, combining all aspects of the traditional sciences. Nanotechnology requires expertise in engineering, chemistry, physics, materials science, biology, and computer science. Nanotechnology had been touted as the next Industrial Revolution, ushering in advanced materials and systems.

Advances in nanotechnology are expected to lead to groundbreaking benefits throughout industries. While much of the work done in nanotechnology involves basic research, some commercial products are already available to customers. For example, new plastic imbued with nanoparticles of clay is as hard as glass, less likely to shatter, and better at sealing in carbonation to keep drinks fresh. The textile industry has developed fabric that uses nano-hooks to attach small fibers to cotton, allowing it to effectively repel stains. Self-cleaning windows are coated with nanoparticles to prevent dirt from sticking to glass. Research is being done in nanocontainers to improve drug delivery.

There are also numerous national and homeland security applications for nanotechnology. The military is developing uniforms that can monitor soldiers' vital statistics and relay this information to command and control stations. In the war in Iraq, nano-coatings were applied on lines that feed boilers on steam-powered ships and the propulsion shafts of minesweepers.

National Nanotechnology Initiative

The National Nanotechnology Initiative (NNI) was created in 2000 with the goal of coordinating the Federal government's research and development efforts in nanotechnology. Federal support is crucial because given nanotechnology's infancy, few companies are willing to fully invest their resources since the pay-offs are so far into the future. Venture capitalists also shy away from nanotechnology for the same reasons. Universities tend not to have sufficient funds to engage in exploratory work. Only the Federal government can bridge the gap for the next decade before this research can be widely applied to commercial products. The Federal government has a history of sponsoring research that opens new frontiers that have led to a multitude of national security and commercial applications (atomic physics, space exploration and the development of the Internet). Many believe that nanotechnology is the next such frontier.

Funding for the NNI, through participating agencies, has increased from a total of $255 million in FY 1999 to $774 million in FY 2003. The Administration has requested $849 million for the NNI for FY 2004, an increase of 9.8 percent over the FY 2003 appropriated level. If Congress approves this requested increase, the funding for the NNI will have doubled since FY 2001.

The Administration recently appointed Dr. Clayton Teague as the first full-time director of the National Nanotechnology Coordination Office (NNCO). The NNCO provides day-to-day technical and administrative support to the NNI. The NNCO also supports the preparation of multi-agency planning, budget, and assessment documents. The NNCO serves as the point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, foreign organizations, and others to exchange technical and programmatic information.

"Small Wonder, Endless Frontiers"

In June 2002, the National Academy of Science (NAS) completed its review of the NNI. In its report entitled, *Small Wonders, Endless Frontiers*, the NAS found that the leadership and investment strategy established by the Nanoscale Science, Engineering, and

Technology (NSET) subcommittee of the National Science and Technology Council (NSTC) has set a positive tone for the NNI. The NNI's initial success also can be measured by the number of foreign governments that have established similar research programs. Nevertheless, the NAS review committee made a number of recommendations concerning the program, including:

- The Office of Science and Technology Policy (OSTP) should establish an independent standing nanoscience and nanotechnology advisory board to provide advice to NSET members on research investment policy, strategy, program goals, and management processes.
- NSET should develop a crisp, compelling, overarching, strategic plan.
- NNI should support long-term funding in nanoscale science and technology so it can achieve its potential and promise.
- NSET should increase multi-agency investments in research at the intersection between nanoscale technology and biology.
- NSET should create programs for the invention and development of new instruments for nanoscience.
- A special fund for Presidential grants, under OSTP management, should be created to support interagency research programs relevant to nanoscale science and technology.
- NSET should provide strong support for the development of an interdisciplinary culture for nanoscale science and technology within NNI.
- Industrial partnerships should be stimulated and nurtured, both domestically and internationally, to help accelerate the commercialization of NNI developments. NSET should create support mechanisms for coordinating and leveraging State initiatives to organize regional competitive clusters for the development of nanoscale science and technology.
- NSET should develop a new funding strategy to ensure that societal implications of nanoscale science and technology become an integral and vital component of NNI.
- NSET should develop performance metrics to assess the effectiveness of the NNI in meeting its objectives and goals.

(The entire NAS report can be found at http://www.nap.edu/catalog/10395.html)

Ethical and Health Concerns. Recently, commentators, including Michael Crichton, author of the book, *Prey*; HRH Prince Charles, the Prince of Wales; and Bill Joy, chief scientist of Sun Microsystems, have all raised concerns about nanotechnology. They all raise the specter of a "gray goo" catastrophe in which self-replicating microscopic robots the size of bacteria fill the world and wipe out humanity. Less sensational concerns also have been raised about the health and environmental effects of nanotechnology. A research group led by researchers at the National Aeronautics and Space Administration's (NASA) Johnson Space Center found in preliminary studies that inhaling vast amounts of nanotubes is dangerous. In another study, Dr. Vyvyan Howard, pathology specialist at the University of Liverpool, found that nanoscale materials are toxic, and can be easily ingested, inhaled, or absorbed.

International Competition. Despite these concerns, both the United States and its European and Asian economic competitors have begun the race to be the leader in nanotechnology. The EU has budgeted $1.2 billion for nanotechnology in 2003 and 2004. Japan is expected to invest approximately $810 million in FY 2003. South Korea and Taiwan also have established national nanoscience and nanotechnology research programs based on the NNI. The NSF found that nearly 25,000 graduates in Asian countries received doctoral degrees in engineering fields related to nanotechnology in 2000, compared with fewer than 5,000 in the United States. Also, of the 18,000 scientific articles mentioning nanotechnology in 2000, just one-third came from America.

SUMMARY OF PROVISIONS

Authorization of appropriations

S. 189, as reported, would authorize appropriations for nanoscale science and technology research and development programs at the NSF, Department of Energy, NASA, National Institutes of Health, National Institute of Standards and Technology (NIST), Environmental Protection Agency, Department of Justice, Department of Homeland Security, and Department of Agriculture. S. 189 would authorize $796 million for these programs for FY 2004 and a total of $4.7 billion for the period of FY 2004 through FY 2008.

National Nanotechnology Program

S. 189, as reported, would authorize the President to implement a National Nanotechnology Program (NNP). The program would build on the work of the NNI to provide federally funded research through the participating government agencies. The NNP would establish the goals, priorities, grand challenges, and metrics for evaluation of Federal nanotechnology research programs; invest in Federal research and development programs in nanotechnology and related sciences; and provide for the interagency coordination of Federal nanotechnology research, development, and other activities undertaken as part of the Program. The legislation would authorize the establishment of interdisciplinary nanotechnology research centers; the establishment of an American Nanotechnology Preparedness Center; and the establishment of a Center for Nanomaterials Manufacturing. The legislation also would authorize the Director of NIST to establish a center within NIST's Manufacturing Engineering Laboratory for issues relating to the commercialization of nanoscience and nanotechnology research, and act as a clearinghouse for information related to nanoscience and nanotechnology research.

Program Coordination and Management

S. 189, as reported, also would authorize the NSTC to oversee the planning, management, and coordination of the NNP. The NSTC would coordinate the budget requests of, and provide guidance to, participating departments and agencies. The legislation also would authorize the President to establish the National Nanotechnology Advisory Panel (NNAP) to advise the President and NSTC on the management, coordination, and implementation of the NNP portfolio, the components of the NNP, trends and developments in

nanotechnology, maintenance of United States leadership in this area, and the need to revise the NNP. S. 189 also retroactively would authorize the President to establish an NNCO to serve as the primary point of contact on Federal nanotechnology activities.

LEGISLATIVE HISTORY

On January 16, 2003, Senator Wyden introduced S. 189, the 21st Century Nanotechnology Research and Development Act. This legislation was co-sponsored by Senators Allen, Lieberman, Warner, Mikulski, Hollings, Landrieu, Clinton, Levin, Bayh, Hutchison, Alexander, Rockefeller, Corzine, Kerry, Lautenberg, and Cantwell.

On May 1, 2003, the full Committee conducted a hearing on S. 189. At the hearing, the witnesses included: Dr. James Murday, Chief Scientist, Acting, Office of Naval Research; Dr. James Roberto, Associate Laboratory Director for Physical Sciences, Oak Ridge National Laboratory; Dr. Clayton Teague, Director, National Nanotechnology Coordination Office; Dr. Davis Baird, Professor and Chair, Department of Philosophy, University of South Carolina; Dr. Jun Jiao, Co-Director, Center for Nanoscience and Nanotechnology; Dr. Kent A. Murphy, Founder and Chief Executive Officer, Luna Innovations; and Mr. James R. Von Ehr II, Chief Executive Officer, Zyvex Corporation.

On June 19, 2003, the Committee met in open executive session and, by a voice vote, ordered S. 189 to be reported with a substitute amendment offered by Senators Wyden, Allen, McCain, and Hollings.

ESTIMATED COSTS

In accordance with paragraph 11(a) of rule XXVI of the Standing Rules of the Senate and section 403 of the Congressional Budget Act of 1974, the Committee provides the following cost estimate, prepared by the Congressional Budget Office:

S. 189—21st Century Nanotechnology Research and Development

Summary: S. 189 would authorize appropriations for fiscal years 2004 through 2008 for the National Nanotechnology Program, comprised of various nanotechnology initiatives at nine agencies: the National Science Foundation (NSF), Department of Energy, National Aeronautics and Space Administration, National Institutes of Heath, National Institute of Standards and Technology, Environmental Protection Agency, Department of Justice, Department of Homeland Security, and the Department of Agriculture. 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 coordinate and manage the National Nanotechnology Program.

Assuming appropriation of the authorized amounts, CBO estimates that implementing this bill would cost $226 million in 2004 and a total of $3.4 billion over the 2004–2008 period. CBO estimates that enacting this bill would have no effect on direct spending or revenues.

S. 189 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 S. 189 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), 350 (agriculture), 376 (commerce and housing credit), 550 (health), and 750 (administration of justice).

	By fiscal year, in millions of dollars—					
	2003	2004	2005	2006	2007	2008
SPENDING SUBJECT TO APPROPRIATION						
Spending under current law:						
Estimated authorization level [1]	566	350	0	0	0	0
Estimated outlays	438	353	234	91	27	7
Proposed changes:						
Estimated authorization level	0	446	876	965	1,022	1,082
Estimated outlays	0	226	520	771	915	1,000
Spending under S. 189:						
Estimated authorization level	566	796	876	965	1,022	1,082
Estimated outlays	438	579	754	862	942	1,007

[1] 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 assumes 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. S. 189 would specify funding levels for each of the agencies for a total of $796 million in 2004 and a total of $4.7 billion for the 2004–2008 period. (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, but such costs would not be significant.

Intergovernmental and private-sector impact: S. 189 contains no intergovernmental or private-sector mandates as defined in UMRA and would impose no costs on state, local, or tribal governments.

Previous CBO estimate: On May 5, 2003, CBO transmitted a cost estimate for H.R. 766, the Nanotechnology Research and Development Act of 2003, as ordered reported by the House Committee on Science on May 1, 2003. The estimated cost of implementing S. 189 is higher than for H.R. 766 because the Senate bill would authorize appropriations for more agencies (nine instead of five) and for a longer period of time (through 2008 instead of 2006).

Estimate prepared by: Federal Costs: Kathleen Gramp and Jenny Lin. Impact on State, Local, and Tribal Governments: Greg Waring. Impact on the Private Sector: Jean Talarico.

Estimate approved by: Paul R. Cullinan, Chief for Human Resources Cost Estimate Unit, Budget Analysis Division.

In accordance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee provides the following evaluation of the regulatory impact of the legislation, as reported:

NUMBER OF PERSONS COVERED

The Committee believes that the bill would not subject any individuals or businesses affected by the legislation to any additional regulation.

ECONOMIC IMPACT

This legislation authorizes significant funding for research and development in nanoscale science and technology. However, it is not expected to have an adverse impact on the nation.

PRIVACY

This legislation would not have a negative impact on the personal privacy of individuals.

PAPERWORK

This legislation would not increase the paperwork requirement for private individuals or businesses.

This legislation would require the following reports—

(1) an annual report by the NSTC to the House of Representatives Committee on Science and the Senate Committee on Commerce, Science, and Transportation on the program budget for the current fiscal year for each participating agency by December 31 of such year;

(2) an annual report due at the time of the President's budget request by the NSTC to the House of Representatives Committee on Science and the Senate Committee on Commerce, Science, and Transportation on the proposed program budget for each participating agency for the next fiscal year, the progress made toward achieving the goals and priorities established for the program, an analysis of the extent to which the program has incorporated the recommendations of the Advisory Panel and American Nanotechnology Preparedness Center, and an assessment of how the agencies are using Small Business Innovative Research and Small Business Technology Transfer Research;

(3) a report, not less frequently than once every two years, by the Advisory Panel to the President, the House of Representatives Committee on Science, and the Senate Committee on Commerce, Science, and Transportation on its assessments and recommendations for ways to improve the program;

(4) a triennial review conducted by the National Research Council evaluating the program's technical success, management and coordination, and funding levels; and

(5) an annual report by the Director of the NSF describing the activities of the American Nanotechnology Preparedness Center.

SECTION-BY-SECTION ANALYSIS

Section 1. Short Title

Section 1 would cite the title as the "21st Century Nanotechnology Research and Development Act".

Section 2. National Nanotechnology Program

Subsection (a) would authorize the President to implement a National Nanotechnology Program. The Program would use the appropriate agencies, councils, and NNCO to establish goals, priorities, grand challenges, and metrics for evaluation for Federal nanotechnology research, development, and other activities. It also would fund and coordinate basic nanoscience and nanoengineering research among Federal agencies, academic laboratories, and the private sector.

Subsection (b) states that the Program's goals would include: the development of a fundamental understanding of matter that enables control and manipulation at the nanoscale; the assurance of continued United States global leadership in nanotechnology; the advancement of United States productivity and industrial competitiveness through stable, consistent, and coordinated investments in long-term nanotechnology research; the development of a network of shared facilities and centers among nanotechnology researchers; the acceleration of the deployment and application of nanotechnology to the private sector; the establishment of a program to provide education and training; and the assurance that legal, ethical, environmental and other concerns will be considered.

Subsection (c) would authorize the NSTC, or an appropriate subgroup that it designates or establishes, to oversee the planning, management, and coordination of the Program. Specifically, the NSTC, or its designated subgroup, would establish a set of broad applications of nanotechnology and development, or grand challenges, to be met by the results and activities of the program and provide for interagency coordination of the Program, including with the activities of the Department of Defense's Defense Nanotechnology Research and Development Program.

Subsection (c) also would authorize the NSTC or its designated subgroup, to develop, within 12 months after the date of enactment of this Act and to update every 4 years thereafter, a strategic plan to meet the goals and priorities of the Program and guide the activities and anticipated outcomes of the participating agencies. The strategic plan would include 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.

Additionally, this subsection would authorize the NSTC to coordinate the budget requests of each of the agencies involved in the Program with the Office of Management and Budget to ensure a balanced nanotechnology research portfolio; exchange information with academic, industry, State and local governments (including State and regional nanotechnology programs), and other appropriate groups conducting nanotechnology research; develop a plan to utilize Federal programs, such as the Small Business Innovation Research Program and the Small Business Technology Transfer Research Program; identify research areas that are not being adequately addressed by the agencies' research programs; and 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 fa-

cilities in areas of high unemployment as production engineering and research test beds.

The NSTC also would be authorized to provide for the establishment of interdisciplinary nanotechnology research centers on a merit-reviewed, competitive basis. These centers would be established in geographically diverse centers including at least one center in a State participating in the NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). The Committee encourages the participation of minority serving institutions at these centers. In addition, the Committee recognizes that societal and ethical issues related to nanotechnology research need to be considered throughout the research cycle. The Committee would encourage the interdisciplinary nanotechnology centers and the American Nanotechnology Preparedness Center to collaborate on basic research to study the societal and ethical effects of their scientific research. This research may be conducted with the participation of other centers, universities, companies, and organizations.

Subsection (d) would authorize the President to establish a NNCO with full-time staff. The NNCO would provide technical and administrative support to the NSTC and the NNAP; 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; conduct public outreach, including dissemination of findings and recommendations of the Advisory Panel; and establish an office to promote access to and early application of the technologies, innovations, and expertise derived from Program activities to Federal agencies and United States industries, including start-up companies. In conducting public outreach, the Committee encourages the NNCO to consider the use of citizen panels and other forums to improve the interaction and information dissemination between experts and the general public.

Subsection (e) would require an annual report by the NSTC to the House of Representatives Committee on Science and the Senate Committee on Commerce, Science, and Transportation on the Program budget for the current fiscal year for each participating agency by December 31 of such year. In addition, it would require an annual report due at the time of the President's budget request by the NSTC to the House of Representatives Committee on Science and the Senate Committee on Commerce, Science, and Transportation on the proposed program budget for each participating agency for the next fiscal year, the progress made toward achieving the goals and priorities established for the program, an analysis of the extent to which the program has incorporated the recommendations of the NNAP and the American Nanotechnology Preparedness Center, and an assessment of how the agencies are using Small Business Innovative Research and Small Business Technology Transfer Research.

Section 3. Advisory Panel

Subsection (a) would direct the President to establish or designate a National Nanotechnology Advisory Panel.

Subsection (b) would set criteria for the members of the NNAP. The NNAP would consist primarily of individuals who are non-Federal members and shall include representatives of academia and in-

dustry that are qualified to provide advice and information on nanotechnology research, development, demonstrations, education, technology transfer, commercial application, or societal and ethical concerns. The President would be authorized to seek and give consideration to recommendations from Congress, industry, the scientific community (including the NAS), scientific professional societies, academia, the defense community, State and local governments, regional nanotechnology programs, and other appropriate organizations.

Subsection (c) would direct the NNAP to advise the President and NSTC on matters relating to the Program, including trends and developments in nanotechnology science and engineering; progress in implementing and the need to revise the Program; the balance among the components of the Program; whether the Program component areas, priorities, and technical goals developed by the NSTC are maintaining United States leadership in nanotechnology; the management, coordination, implementation and activities of the Program; and whether societal, ethical, environmental, and workforce concerns are adequately addressed by the Program. The Committee recommends that, to the extent possible, the Panel engage relevant associations, institutes, and organizations in order to fulfill its duties as described.

Subsection (d) would require the NNAP to report, not less frequently than once every 2 fiscal years, to the President, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science on its assessments and recommendations for ways to improve the program. The first report would be submitted within 1 year after the date of enactment of this Act.

Subsection (e) would allow travel expenses for non-Federal members of the NNAP that are attending meetings or otherwise serving at the request of the head of the Panel away from their homes or regular places of business to be reimbursed.

Section 4. Triennial External Review of Nanotechnology Research and Development Program

Subsection (a) would authorize the Director of the NSF to enter into an arrangement with the National Research Council (NRC) of the NAS to conduct a triennial evaluation of the Program and report on its findings. This evaluation would include a review of the technical successes and management of the program and agency funding levels; recommendations for new goals, research areas, investment levels, policy, budget and program changes, and metrics; a review of the NNCO's efforts to promote access to and application of technologies; and an analysis of the United States international competitive position.

Subsection (b) would require the Director of the NSF to transmit upon receipt the NRC report to the Panel, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science. The first NRC report would be transmitted no later than June 10, 2005, with subsequent evaluations transmitted every 3 years thereafter.

Section 5. Authorization of Appropriations

The NSF would be authorized to carry out the Act at the following levels: $350,000,000 for FY 2004; $385,000,000 for FY 2005; $424,000,000 for FY 2006; $449,000,000 for FY 2007; and $476,000,000 for FY 2008. Of the authorized amounts, $50,000,000 would be authorized for each fiscal year for grants of up to $5,000,000 each for interdisciplinary nanotechnology research centers. This legislation also would authorize $5,000,000 from the authorized amounts for each fiscal year for the university-based American Nanotechnology Preparedness Center. The legislation also would authorize $5,000,000 from the authorized amounts for each fiscal year for the National Nanotechnology Coordination Office, and an additional $5,000,000 from the authorized amounts for each fiscal year for the Center for Nanomaterials Manufacturing.

The bill also would authorize nanotechnology programs at the DOE at the following levels: $265,000,000 for FY 2004; $292,000,000 for FY 2005; $321,000,000 for FY 2006; $340,000,000 for FY 2007; and $360,000,000 for FY 2008. Of these amounts, $25,000,000 would be authorized for use for merit-reviewed and competitively based grants to support consortia that integrate newly developed nanotechnology and microfluidic tools with systems biology, immunology, and molecular imaging. The Committee recommends that at least one such consortium shall be provided with at least $10,000,000 for each fiscal year.

The legislation also would authorize funding for the following agencies at the following levels:

ANTICIPATED FUNDING AUTHORIZED BY THE 21ST CENTURY NANOTECHNOLOGY RESEARCH AND DEVELOPMENT ACT

[In millions of dollars]

Agency	2004	2005	2006	2007	2008
NASA	31	34.1	37.5	40	42.3
NIH	70	77	85	90	95
NIST	62	68.2	75	80	84
EPA	5	5.5	6.05	6.413	6.8
Department of Justice	1	1.1	1.21	1.283	1.36
Department of Homeland Security	2	2.2	2.42	2.57	2.72
Department of Agriculture	10	11	12.1	12.83	13.6

Section 6. American Nanotechnology Preparedness Center

Subsection (a) would authorize the Director of the NSF to establish, using a merit-reviewed, competitively-based process, an 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. The American Nanotechnology Preparedness Center directly addresses the ethical and health concerns discussed in the background and needs section of this report.

Subsection (b) would authorize the Director of the NSF to work through the Center to conduct, coordinate, commission, collect, and disseminate studies on the educational, legal, workforce, societal, and ethical implications of nanotechnology, including anticipated issues and problems.

Subsection (c) would require the Director of the NSF to collect data on the anticipated size of the nanotechnology workforce need

by detailed occupation, industry, and firm characteristics. The Director also would assess the adequacy of the trained talent pool in the United States to fill such workforce needs.

Subsection (d) would require the Director of the NSF to incorporate the workforce data into a report on the Center's activities to be submitted to the President, the NSTC, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science. The Director would be required to submit the report no later than 18 months after the enactment of this bill.

Section 7. Commercialization Issues Related to Nanoscience and Nanotechnology

Subsection (a) would authorize the Director of NIST to establish a center within NIST's Manufacturing Engineering Laboratory for issues relating to the commercialization of nanoscience and nanotechnology. The program Director would conduct basic research on issues relating to the development and manufacture of nanotechnology, including metrology, reliability and quality assurance, processes control, and manufacturing best practices. In addition, the Director would consult with the National Technical Information Service and the NNCO to act as a clearinghouse for information related to commercialization of nanoscience and nanotechnology research, including information regarding activities by regional, State, and local commercial nanotechnology initiatives; transition of research, concepts, and technologies from Federal nanotechnology research into commercial and military projects; best practices by government, university, and private sector laboratories transitioning technology to commercial use; examples of ways to overcome barriers and challenges to technology deployment; and use of existing manufacturing infrastructure and workforce.

Subsection (b) would require the Director of NIST to utilize the Manufacturing Extension Partnership Program, to the extent possible, to reach small- and medium-sized manufacturing companies.

Subsection (c) would authorize the Director of the NSF to 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 activities of the Center for Nanomaterials Manufacturing shall include, but not be limited to, the development of manufacturing processes for nanostructured materials such as: nanocomposites; response-driven coatings; thin films; biomedical materials; and nanostructured materials, with emphasis on such materials in aqueous environments.

Section 8. Definitions

This section would define key terms in the Act, including "Advisory Panel", "Fundamental Research", "Nanotechnology", "Program", "Council", and "Grand Challenge".

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, the Committee states that the bill as reported would make no change to existing law.

○