

# NATIONAL NANOTECHNOLOGY INITIATIVE

## FY 2008 BUDGET & HIGHLIGHTS

The 2008 Budget provides nearly \$1.5 billion for the National Nanotechnology Initiative (NNI), more than triple the estimated \$464 million spent in 2001. This growth in nanotechnology research and development (R&D) investments across the Federal government over the past seven years reflects the consistent, strong support of this Administration and of Congress for this program, based on its potential to expand our fundamental knowledge and to make important contributions to national priorities such as economic competitiveness, homeland and national security, and public health. A substantial portion of the funding increase in 2008 is within the agencies that are under the American Competitiveness Initiative—the National Science Foundation (NSF), Department of Energy (DOE) Office of Science, and National Institute of Standards and Technology (NIST).

Table 1 provides NNI investments in 2006–2008 for each Federal agency with a budget for nanotechnology R&D. Table 2 shows estimates for spending in environmental, health, and safety (EHS) R&D related to nanotechnology for 2006–2008. EHS R&D is research whose primary purpose is to understand and address potential risks to health and to the environment posed by nanotechnology. Table 3 lists the 2008 planned investments by agency according to program component area (PCA).

The 2008 NNI budget supports broad-ranging programs among 13 agencies. Agencies with the greatest investments are NSF, which supports fundamental research across all disciplines of science and engineering; Department of Defense (DOD), whose investments are aimed at addressing the department's national security mission; and DOE, which supports research providing a basis for new and improved energy technologies. Within the Department of Health and Human Services, programs at the National Institutes of Health (NIH) emphasize nanotechnology-based biomedical advances occurring at the intersection of biology and the physical sciences. In addition, programs at the National Institute of Occupational Safety and Health (NIOSH) address implications and applications of nanotechnology for health and safety in the workplace. Other agencies that are investing in mission-related research are the National Aeronautics and Space Administration (NASA), NIST, Environmental Protection Agency (EPA), and Departments of Agriculture (Cooperative State Research, Education, and Extension Service and Forest Service), Homeland Security (DHS), Justice, and Transportation.

### Key Points about the 2008 NNI Investments

- The 2008 NNI budget provides continued support for basic research to understand nanoscale phenomena, materials, devices, and systems. The 2007 estimates reflect the President's proposed levels, with the exception of the numbers for DOD and DHS, which are the enacted levels. Several agencies have updated their 2007 Budget levels since the release of the 2007 NNI budget supplement. Revised 2007 estimates will be published following passage of the remaining 2007 appropriations.
- EHS R&D funding in 2008 has increased 55% over the 2006 actual level. The steady growth in EHS R&D spending is expanding the capacity to do high quality research. It should be noted that the proposed \$58.6 million does not include substantial research reported under other PCAs, e.g., on instrumentation and metrology and on fundamental biological interactions upon exposure to nanomaterials, both of which will be important in the performance and interpretation of toxicological research.
- The Budget includes increases of \$30.2 million for NSF, \$80.7 million for DOE Office of Science, and \$18.7 million for NIST as compared to 2006 actual funding levels. This 20% collective increase reflects the President's commitment to double funding for key agencies supporting innovation-enabling research in the physical sciences and engineering over the next ten years, as part of the American Competitiveness Initiative.
- A more detailed Budget Supplement will be released after agencies have received appropriations for 2007.

### Highlights of Ongoing and Planned Activities

- International collaborations in non-competitive and pre-competitive areas of nanotechnology continue at an accelerated pace. In 2006, the Organization for Economic Cooperation and Development (OECD)

established a Working Party on Manufactured Nanomaterials, chaired by the United States, to address health and safety issues. With U.S. leadership, a second OECD working party is being formed under the Committee for Scientific and Technological Policy to address broader issues related to realization of the benefits of nanotechnology, including assessing economic impact, education and training, and public communication. The National Nanotechnology Coordination Office (NNCO) and NNI agencies are also collaborating with a nanotechnology research institute in Belgium to organize a workshop on public outreach and communication.

- EHS research planning continues to be a priority. The interagency Nanoscale Science, Engineering, and Technology (NSET) Subcommittee published a report prepared by its Nanotechnology Environmental and Health Implications (NEHI) Working Group entitled *Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials* in September 2006, and held a public meeting on EHS research needs and prioritization in January 2007. In the coming year, the NEHI Working Group will identify gaps in the research portfolio and work with agencies to address research priority areas. In parallel, a growing number of agencies are participating in two joint solicitations addressing potential environmental and health implications of nanotechnology. One led by EPA that is focused on environmental implications is now in its third year (DOE will join EPA and NSF in 2008). A second is a new solicitation starting in 2007, focused on human health implications, and is led by NIH's National Institute of Environmental and Health Sciences and includes participation by five other NIH institutes as well as EPA and NIOSH. In addition, EPA will initiate a new \$1.6 million research program in 2008 to identify potential uses and study nanoscale materials that are subject to the Toxic Substances Control Act.
- The NNI is developing characterization tools to stimulate innovation and support responsible development. Funding for research in instrumentation, metrology, and standards is up 64% in 2008 as compared to 2006 actual levels. An example of the ongoing activities is the Nanotechnology Characterization Lab of NIH's National Cancer Institute, which is partnering with the Food and Drug Administration (FDA) and NIST to develop characterization cascades for preclinical evaluations of nanomaterials intended for cancer therapeutics.
- The NNI continues to develop state-of-the-art facilities and infrastructure. In 2008, the fifth of five DOE Nanoscale Science Research Centers, the Center for Functional Nanomaterials at Brookhaven National Laboratory, will become fully operational. These centers provide the broad research community access to facilities, instrumentation, and expertise in support of advanced nanotechnology R&D.
- The National Nanomanufacturing Network was established in 2007 with four NSF Nanoscale Science and Engineering Centers as founding partners and will expand in 2008 to include partners from DOD-funded labs and NIST. The network is intended to catalyze the advancement of nanotechnology towards commercial manufacturing by facilitating collaboration and information-sharing among Federally sponsored researchers and partners from the private sector.
- Societal aspects of nanotechnology are being addressed through several approaches and agency-sponsored education and public engagement activities are reaching across the country. The NSET Subcommittee, with NNCO support, sponsored workshops on public participation in nanotechnology and on ethical aspects of nanotechnology. With NSF funding, the Center for Learning and Teaching at the Nanoscale and the Nanoscale Informal Science Education Network both unveiled "one-click-resource" websites complementing their growing collaborative networks, while the traveling exhibit "Too Small To See" was visited by over 350,000 children and their families in its first ninety days at Walt Disney World's Epcot Center.
- Standards are being developed to support responsible research, development, and use of nanotechnology. NNI agency representatives are engaged in a number of consensus-based standards activities and play a leadership role in the U.S. participation at the International Organization for Standardization (ISO). Together, NIST, NASA, and NIOSH are developing the first Standard Reference Material for carbon-nanotube-bearing material. Carbon nanotubes have potential use in products including electronic circuits and displays, power transmission, and ultra-lightweight composites.

<b>Table 1</b> <b>NNI Budget, 2006-2008</b> <b>(dollars in millions)</b>			
	<b>2006 Actual</b>	<b>2007 Estimate*</b>	<b>2008 Proposed</b>
NSF	359.7	373.1	389.9
DOD	423.9	417.2**	374.7
DOE	231.0	293.3	331.5
DHHS (NIH)	191.6	170.2	202.9
DOC (NIST)	77.9	89.3	96.6
NASA	50.0	25.0	24.0
EPA	4.5	8.6	10.2
USDA (CSREES)	3.9	3.9	3.0
DHHS (NIOSH)	3.8	4.6	4.6
USDA/FS	2.3	2.6	4.6
DHS	1.5	2.0	1.0
DOJ	0.3	1.4	0.9
DOT (FHWA)	0.9	0.9	0.9
<b>TOTAL</b>	<b>1,351.2</b>	<b>1,392.1</b>	<b>1,444.8</b>

<b>Table 2</b> <b>Budget for Environmental, Health, and Safety R&amp;D, 2006-2008</b> <b>(dollars in millions)</b>			
	<b>2006 Actual</b>	<b>2007 Estimate*</b>	<b>2008 Proposed</b>
NSF	21.0	25.7	28.8
DOD	1.0	1.0	1.0
DOE	0.5	0.0	3.0
DHHS (NIH)	5.2	4.6	5.7
DOC (NIST)	2.4	1.8	5.8
NASA	0.0	0.0	0.0
EPA	3.7	8.0	9.6
USDA (CSREES)	0.1	0.1	0.1
DHHS (NIOSH)	3.8	4.6	4.6
USDA/FS	0.0	0.0	0.0
DHS	0.0	0.0	0.0
DOJ	0.0	0.0	0.0
DOT (FHWA)	0.0	0.0	0.0
<b>TOTAL</b>	<b>37.7</b>	<b>45.8</b>	<b>58.6</b>

\* The 2007 Estimates reflect 2007 Budget levels, except for the Departments of Defense and Homeland Security, which are the enacted levels. Several agencies have updated their 2007 Budget levels since the release of the 2007 NNI Budget Supplement.

\*\* 2007 estimate includes about \$100 million in Congressional earmarks at DOD that are outside the NNI plan.

**Table 3**  
**Planned 2008 Agency Investments by Program Component Area**  
 (dollars in millions)

	Fundamental Phenomena & Processes	Nanomaterials	Nanoscale Devices & Systems	Instr. Research, Metrology, & Standards	Nano-manufacturing	Major Research Facilities & Instr. Acquisition	Societal Dimensions	NNI Total*
NSF	142.7	60.2	51.1	14.5	26.9	31.6	62.9	389.9
DOD	179.1	91.7	70.6	8.3	1.0	23.0	1.0	374.7
DOE	85.4	99.8	13.5	26.7	2.0	100.6	3.5	331.5
DHHS (NIH)	53.3	16.5	114.9	6.7	1.7	0.1	9.7	202.9
DOC (NIST)	27.1	8.0	13.5	26.4	11.1	4.5	6.0	96.6
NASA	1.0	12.0	10.0	0.0	1.0	0.0	0.0	24.0
EPA	0.2	0.2	0.2	0.0	0.0	0.0	9.6	10.2
USDA (CSREES)	0.4	0.8	1.5	0.0	0.1	0.0	0.2	3.0
DHHS (NIOSH)	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.6
USDA (FS)	1.7	1.5	1.0	0.2	0.2	0.0	0.0	4.6
DHS	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0
DOJ	0.0	0.0	0.1	0.8	0.0	0.0	0.0	0.9
DOT (FHWA)	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9
<b>TOTAL*</b>	<b>491.8</b>	<b>290.7</b>	<b>277.4</b>	<b>83.6</b>	<b>44.0</b>	<b>159.8</b>	<b>97.5</b>	<b>1,444.8</b>

\* Totals may not add due to rounding.

**What is Nanotechnology?**

Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers (10<sup>-9</sup> m). Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale. At this level, the physical, chemical, and biological properties of materials differ in fundamental and valuable ways from the properties of individual atoms and molecules or bulk matter. Nanotechnology R&D is directed toward understanding and creating improved materials, devices, and systems that exploit these new properties.

**What is the NNI?**

The National Nanotechnology Initiative (NNI) is a multi-agency U.S. Government program aimed at accelerating the discovery, development, and deployment of nanometer-scale science, engineering, and technology. The NNI is a program involving nanotechnology-related activities of 26 Federal agencies, 13 of which have budgets for nanotechnology research and development (R&D) in 2008, coordinated through the Nanoscale Science, Engineering, and Technology (NSET) Subcommittee of the National Science and Technology Council.

