



LOOKING BACK ON THE FIRST TWO YEARS
Contents

- 1 Foreword *by* Lee H. Hamilton
- 2 Introduction *by* David Rejeski
- 4 Nanotechnology: Getting It Right
- 5 Impact: Selected Key Accomplishments
- 10 Foundations for Sound Policy: Major Publications
- 14 Communicating New Ideas: Congress and Local, Federal, and International Organizations
- 20 Up for Discussion: Key Events Sponsored by the Project
- 22 Popular Resources on the Web: Inventories, Maps, Podcasts, and Newsletters
- 25 Media Outreach: Getting Nano in the "News"
- 26 Collaborations
- 27 Intern Program: Preparing a 'Nano Ready' Generation
- 28 Efforts to Reduce Our Impact on the Environment
- 29 Appendix: Additional Project Activities



FOREWORD

Advances in technology are the U.S. economy's primary fuel, driving about half of the nation's economic growth over the last six decades. From global air travel to instant wireless communication, benefits from progress in science and technology—from discovery through innovation—permeate our society and our lives. The best may be yet to come.

But no technology—no matter how rich in utility and ingenuity—is without at least some risk. Automobile emissions, medicinal side effects, radioactive waste, and global climate change are illustrative examples, spanning from individual acts to collective consequences. As technology progresses, we are challenged to learn from our past so that the fruits of our public and private investments are maximized and widely shared and that the attendant risks—known and unknown—are effectively managed.

Here, at the Woodrow Wilson International Center for Scholars, the Project on Emerging Nanotechnologies has been a strong and clear voice of reason within a technology revolution that has only begun to churn. Around the world, the equivalent of billions of dollars is being invested in efforts to marshal the almost incredible properties and behaviors of materials designed and assembled at nature's scale—at the level of atoms and molecules. Virtually every technical pursuit and every

industry stand to benefit, if government, business, and other stakeholders are wise stewards of this fast emerging technology.

Working with The Pew Charitable Trusts, the Project on Emerging Nanotechnologies has proved to be an effective link between the world of exciting new ideas and possibilities and the world of policy, promoting and facilitating productive exchanges of information and knowledge. In its first two years, the Project's staff—under the extraordinary leadership of David Rejeski—and their many collaborators from industry, academia, and government have motivated and enabled steps to ensure that, as new nanoscale materials and devices are developed, potential health and environmental risks are anticipated, understood, and managed. Realizing the tremendous promise of nanotechnology requires us to proceed further along this path toward the twin goals of effective oversight and commercialization.

Lee H. Hamilton
President and Director, Woodrow Wilson
International Center for Scholars



INTRODUCTION

Prospects for the future of nanotechnology can boggle the mind, with anticipated benefits and risks potentially impacting numerous sectors of the economy and many aspects of society. It is estimated that governments, corporations, and venture capitalists spent \$12 billion worldwide on nanotechnology research and development in 2006. At an increasing clip, businesses are translating this research into the first generation of nanotech products. Entries in our Consumer Products Inventory have more than doubled from 2006 and 2007, to more than 500 products from companies in 20 countries. However, the most exciting—and, potentially, the most economically and socially valuable—applications lie farther out on the horizon.

Success in realizing the diverse anticipated benefits of nanotechnology—literally, from cures for cancer to cheap, clean energy—is not assured. For nanotechnology to flourish, the United States must develop the risk management tools and oversight approaches that enable responsible development, encourage commercialization, and earn the trust of consumers worldwide. In nanotechnology, we find an unprecedented opportunity to do things differently, to develop a social contract between the public and the scientific community that is built on openness and trust. This is a policy and leadership challenge of utmost importance.

Since the Project on Emerging Nanotechnologies began in April 2005, we have become one of the most widely recognized national and international forums

for raising and addressing scientific, policy, and foresight issues spawned by this fast emerging and diversifying area of technology. Our partnership with the Wilson Center and The Pew Charitable Trusts has been an inclusive undertaking, engaging government, business, nongovernmental organizations, and the public in a constructive policy debate over safe and sustainable nanotechnologies.

This report reviews the Project's major activities, key contributions, and most significant impacts over its first two years. Our primary goal has been to facilitate dialogue, cooperation, and sound decision-making in a complex and fast-changing technological landscape. Nanotechnology has the potential to deliver wave after wave of opportunity for much of this new century. However, policy and organizational decisions made in both the public and private sectors over the next several years will largely set the course for nanotechnology commercialization. These will determine how wisely and how fully our nation, our world, and our planet will realize nanotechnology's enormous promise and how successfully we will minimize its risks and avert unintended negative consequences.

A handwritten signature in brown ink that reads "David Rejeski".

David Rejeski
Director, Project on Emerging Nanotechnologies



Nanotechnology: Getting It Right

Literally and figuratively, nanotechnology is about superlatives. It is science and engineering practiced at superlatively small scales—at the level of atoms and molecules. In turn, this exceptional set of still-improving capabilities has engendered almost matchless expectations, conveyed as the “next industrial revolution” or as the “dawn of a new age” in technology. With previews like these, it is no surprise that research on nanotechnology and development of its prospective applications are taking

WHAT IS NANOTECHNOLOGY? Nanotechnology is the ability to design and make things with dimensions usually between 1 and 100 nanometers. A nanometer is one billionth of a meter.



STRAND OF DNA = 2.5 NANOMETERS WIDE



RED BLOOD CELL = 7,000 NANOMETERS WIDE



NEXT-GENERATION TRANSISTOR = 45 NANOMETERS WIDE



A HUMAN HAIR = 80,000 NANOMETERS WIDE



VIRUS = ROUGHLY 100 NANOMETERS WIDE



FLEA = ROUGHLY 1 MILLION NANOMETERS WIDE

place on a global stage, sparking intense competition among businesses and nations. In the United States alone, government and industry investment in nanotechnology topped \$4 billion in 2006.

What is nanotechnology? Nanotechnology is the ability to design and make things with dimensions usually between 1 and 100 nanometers. A nanometer is one billionth of a meter; a red blood cell is about 7,000 nanometers across; and a flea is roughly 1 mil-

lion nanometers wide. The “nanoscale” lies between the domain of individual atoms and our everyday world, where the properties of materials—like strength or conductivity—stem from the collective behavior of trillions of atoms. When built and assembled at the nanoscale, materials often flout the rules of the macroscopic world and behave in ways that defy our everyday experience. Exotic properties and behaviors arise. For example: a “nanotube” of carbon is a hundred times stronger than steel, yet six times lighter; nanoparticles of gold change color and become red; and at the nanoscale, aluminum can be highly explosive.

Around the world, an estimated 20,000 researchers are furthering efforts to develop products and applications that exploit such exotic properties and behaviors. Already, there are more than 500 manufacturer-identified consumer products based on nanotechnology. Ranging from stain-resistant textiles to new medicines, these represent just the tip of the nanotechnology iceberg. Next-generation “nano” products may truly astound, presenting opportunities to help solve vexing problems, from cancer to shortages of clean water.

Yet, unconventional behaviors and properties exhibited at the nanoscale also challenge our understanding of what makes something harmful. Today, efforts to identify, understand, and manage potential environmental, health, and safety risks of engineered nanoscale materials are lagging behind the rush toward commercialization, and the gap is increasing. Resulting uncertainty due to ineffective oversight of nanotechnology hovers as a looming threat to consumer and business confidence, which, if shaken, could undermine a tremendous technological opportunity.

IMPACT: SELECTED KEY ACCOMPLISHMENTS

The Project aims to ensure that, as nanotechnologies advance, their ever-increasing *anticipated* benefits are fully realized, while potential risks are minimized. We are committed to increasing public understanding of this extraordinarily promising technology area and to fostering the engagement of consumers and other stakeholders in policy decisions that will shape the commercialization, application, and sustainability of future nanotechnology products and processes.

We collaborate with researchers, policymakers, government agencies, businesses, non-governmental organizations, and others. With our partners, we look long-term and work to foster progress in the safe development and commercialization of nanotechnology-enabled products. These collaborations identify gaps in knowledge and regulatory processes, and they recommend strategies for responding effectively. Valued for its independent, objective knowledge and analysis, the Project on Emerging Nanotechnologies has become one of the most widely trusted—and cited—sources of information in several key areas:

- Adequacy of the nation’s regulatory system for identifying and managing potential environmental, health, and safety (EHS) risks.
- Scope and relevance of federally funded EHS research.
- Current and anticipated uses of nanotechnology in consumer products, especially in the cosmetics and food sectors.
- Public perceptions and awareness of nanotechnology.
- Descriptions of the range and diversity of U.S. nanotechnology activities, as distributed across the economy and the 50 states.

In the Project’s first year alone, staff members were invited to testify at four congressional hearings, providing information and recommendations on nanotechnology risk research, oversight, and commercialization.

PRIORITIES FOR RESEARCH

Comprehensive analyses by staff members and Project-commissioned assessments by regulatory experts clearly established the immediate need for a goal-driven risk research strategy. U.S. decision-makers—including regulators and industry and consumer groups—now lack tools and important scientific information necessary to ensure the safe development and use of nanotechnology-enabled products and processes. Some highlights of Project efforts to fill this critical gap are highlighted below:

- A Project-initiated and -developed database of EHS research projects revealed that, in 2005, only about \$10 million, or 1 percent, of the \$1 billion federal investment in nanotechnology research goes for work “highly relevant” to resolving concerns and questions about risks. Andrew D. Maynard, Ph.D., the Project’s Chief Science Advisor, called for a minimum federal investment of \$100 million over two years in targeted risk research to begin filling in knowledge gaps and to lay a strong, science-based foundation for safe nanotechnology workplaces.



“This paper should be a landmark in the history of nanotechnology research. It lays out a clear, reasonable, prioritized, consensus-based set of priorities for examining the potential environmental and health consequences of nanotechnology over the next decade and a half. This paper should eliminate any remaining excuses for inaction in this vitally important area.”

—House Science Committee Chairman Sherwood Boehlert (R-NY) and Ranking Member Bart Gordon (D-TN), citing Andrew D. Maynard’s November 2006 *Nature* article

- In late 2005, Project Director David Rejeski testified before Congress and called for an improved “systematic analysis” of the governance structure for nanotechnology and the development of a “government-wide blueprint” for federal EHS research. Subsequently, the Government Accountability Office (GAO), the investigative arm of Congress, was directed to initiate a review of the size and scope of nanotechnology-related EHS research and of the regulatory and research capacity of key agencies. The GAO study is now underway.
- In November 2006, the prestigious journal *Nature* published a widely acclaimed paper specifying key challenges toward the “safe handling of nanotechnology,” written by an international team of experts led by Andrew D. Maynard, Ph.D. The article drew attention around the world and was commended by U.S. policymakers.

EFFECTIVE OVERSIGHT

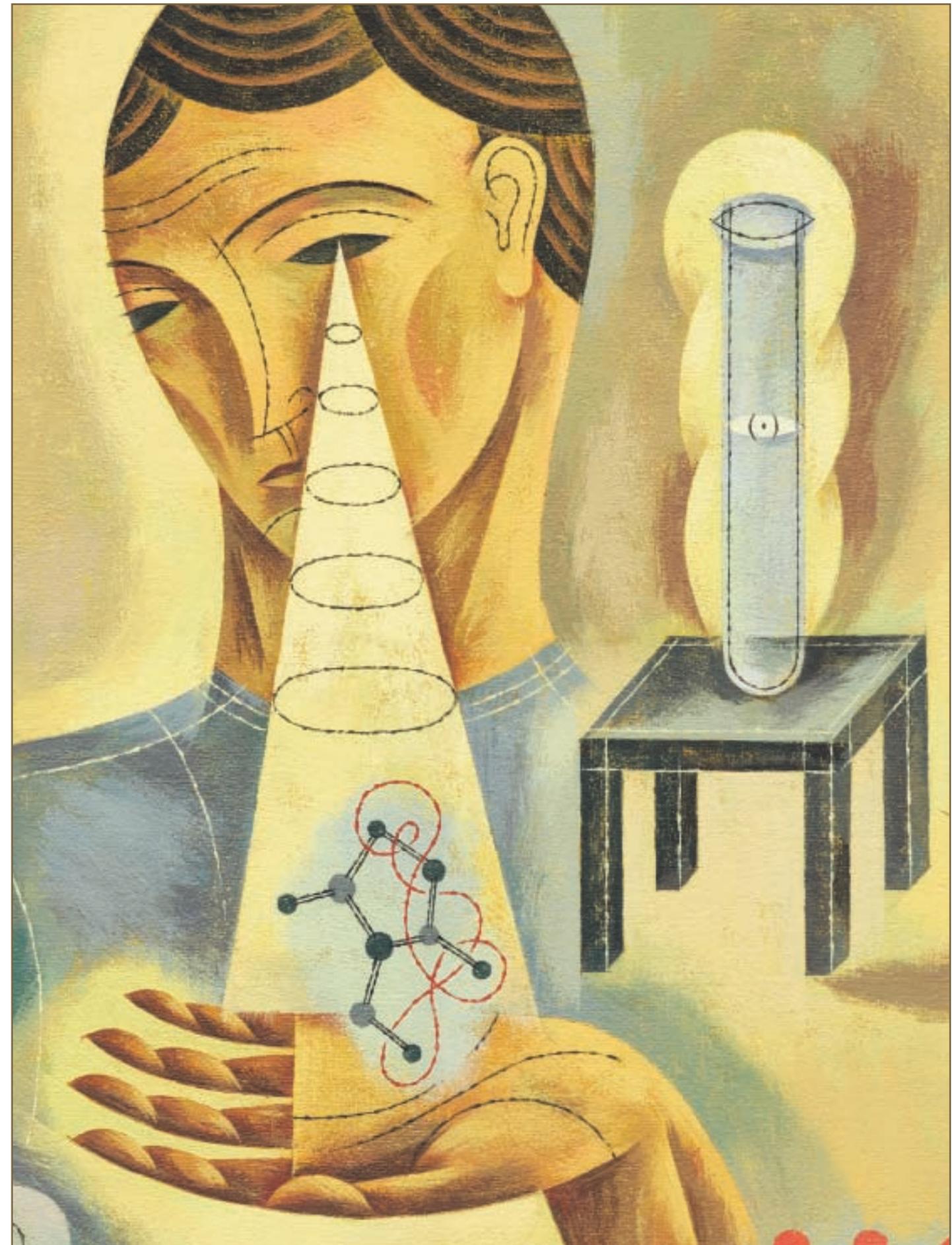
Getting nanotechnology “right” requires effective oversight—the net result of tools, strategies, and institutional relationships that government and industry can direct towards eliminating or, at least, minimizing risks. Working across sectors, the Project has motivated, initiated, facilitated, and sustained efforts toward building the regulatory structure, information requirements, worker protections, and other components of a transparent and efficient oversight system that allows the nanotechnology revolution to reach full stride. In concert, the Project has been instrumental in fostering broader awareness of prospective nanotechnology-enabled approaches to reducing waste, conserving resources, and producing “green” products.

- During its first two years, the Project commissioned and issued expert-level reviews of existing EHS regula-

tions, which included evaluating their effectiveness for managing nanotechnology-related risks. Several reviews addressed challenges specific to the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA). For example, the FDA review, *Regulating the Products of Nanotechnology: Does FDA Have the Tools It Needs?* by Michael R. Taylor, professor at the University of Maryland School of Medicine, provided the most detailed analysis to date of the agency responsible for approving new drugs and regulating 80 percent of the U.S. food supply. It highlighted deficiencies in resources, expertise, and pre-market authorities—all critical to effective oversight of nanotechnology applications in food and health care.

- To jumpstart actions toward addressing risks, the Project pursued and facilitated voluntary approaches to risk management. We helped to support the first voluntary agreement between a company (DuPont) and a non-governmental organization (NGO) (Environmental Defense). The unusual collaboration produced a pioneering voluntary standard for comprehensively documenting and communicating the steps a user should take to evaluate and address potential risks of nanoscale materials. The Project initiated similar proactive efforts with other firms, including a nanotechnology start-up and a leading manufacturer of healthcare products.

- The Project has been a world leader in advocating the concept of “Green Nano,” a strategic approach that uses nanotechnology to significantly reduce resource use and processing waste, minimize potential environmental and human health risks, and encourage replacement of existing products with new nano products that are more environmentally friendly. A series of meetings organized by the Project, including a major symposium cosponsored by the American



“Low profile is certainly not a problem for the Project on Emerging Nanotechnologies at the Wilson Center in the [United States]. Having already taken the lead in efforts to raise the profile of EHS research in the [United States] and beyond, the project published two further reports . . . *NanoFrontiers: Visions for the Future of Nanotechnology* is a lively document, which its authors hope ‘can be understood and appreciated by an audience that goes beyond the scientific community.’”

—Nature Nanotechnology, May 2007

Chemical Society (ACS), initiated and sustained an international dialogue on how to ensure that nanotechnology-enabled capabilities and applications become “instruments of sustainability.”

BETTER FORESIGHT

By regularly bringing together scientists, business representatives, and others who view the fast-changing nanotechnology landscape from different vantage points, the Project is helping to create a panoramic view of the challenges and opportunities ahead. Through a number of articles and reports, the Project has championed improving the foresight components of existing federal government nanotechnology programs—as of now, these efforts have no resources devoted to anticipating future risks or other obstacles and no structures for systematic examination of the adequacy of existing regulations for addressing nanotechnology applications on the horizon.

Yet, understanding where nanotechnology is headed, when novel products are likely to reach the market, and what risks they may pose is integral to the technology’s advance. This future intelligence is necessary to create regulatory certainty, cultivate investor confidence, build consumer trust, and excite the scientists and engineers of tomorrow. A few examples illustrate how the Project is helping to scope out the nanotechnology frontier.

- With the National Science Foundation (NSF) and the National Institutes of Health (NIH), the Project convened a two-day meeting of leading nanotechnology practitioners and visionaries. Together, these experts explored the long-term future of nanotechnologies and sometimes astonishing anticipated applications in areas such as medicine, energy, and water. The resulting report, *NanoFrontiers: Visions for the Future of Nanotechnology*, provided an intriguing

summary of prospects distilled for lay audiences. Distributed internationally via the World Wide Web, the release of the free report also served to launch a series of continuing efforts—Project-produced NanoFrontiers podcasts and newsletters—intended to excite and educate the general public about nanotechnology’s ever-increasing list of prospective applications and benefits. Through audio and print, the Project is encouraging and enabling thousands of people to contemplate the future of nanotechnology.

- The Project undertook the first forward-looking analysis of where, when, and how nanotechnology-based food and food-related applications may impact workers and consumers. This report, *Nanotechnology in Agriculture and Food Production: Anticipated Applications*, and its associated database for the first time analyzed the publicly available data on federally funded research projects in agriculture and food (agrifood) nanotechnology, supplemented with data from the U.S. Patent and Trademark Office (PTO).
- We identified and reported the status of all experimental, nanotechnology-enabled medical products in the FDA’s pipeline, providing widely cited information about prospective healthcare uses and their anticipated entry dates into the market.

AWARENESS AND ENGAGEMENT

As nanotechnology progresses, scientists and engineers are creating novel applications that have the potential to transform everything from manufacturing to medicine to energy production. Whether an expert, policy maker, or ‘average’ citizen, it is becoming increasingly important to understand the prospects for nanotechnology.

Communicating research on nanotechnology risks and benefits outside the scientific community is challenging, but it must be part and parcel of the policy

dialogue. An educated and active public is fundamental to creating effective science and technology research and education programs, crafting wise regulatory policies, sustaining innovation, and building trust in government agencies and companies at the leading edge of the nanotechnology revolution.

If the public loses confidence in these public and private organizations, the enormous potential of nanotechnology may be squandered.

From its very beginning, the Project has provided the public with balanced and easily understood information about nanotechnology’s potential benefits, and it has actively explored new avenues for increasing—and tracking—awareness.

- Since 2005, the Project has commissioned a series of national surveys, focus groups, and experimental issue groups that address public awareness and attitudes toward nanotechnology. Collectively, this work has provided the longest sustained look at public perceptions of nanotechnology, industry, and regulatory institutions. The most recent, an online survey conducted in late 2006, found that public awareness of nanotechnology remains low. Despite government and industry investments exceeding billions of dollars annually in nanotechnology research, over 80 percent of U.S. respondents had heard “little” or “nothing at all” about nanotechnology.
- Highly-regarded and heavily-used inventories of products in nanotechnology commerce have enabled specialists and non-specialists alike to explore and to take measure of the rise and spread of nanotechnology—geographically and economically. For example, the Project’s online inventory of nanotechnology-

based consumer products, the first of its kind, more than doubled—from 212 entries to more than 500—between early 2006 and mid-2007. This international inventory has been cited in news reports and by federal and international government agencies and has been replicated in Japan and Denmark.

- In a complementary effort, the Project literally put nanotechnology on the map after building an inventory of more than 800 U.S. companies, universities, government labs, and other organizations engaged in nanotechnology-related efforts. Displayed on an interactive U.S. map, the inventory was the talk of science and technology blogs around the world when it was released. Besides location, organizations were also grouped by economic sector. The largest sectors are materials, medicine and health, and tools and instruments, while the top four nanotechnology states are California, Massachusetts, New York, and Texas (each with over 50 entries).

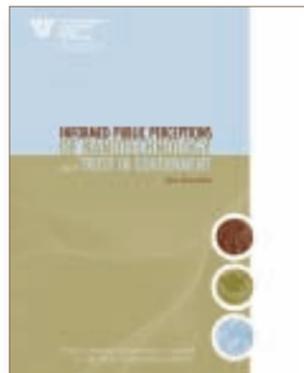


“The Wilson Center’s Project on Emerging Nanotechnologies has done a great job in its first two years providing a forum for scientific researchers and representatives from industry, labor, manufacturing, insurance, and government to gather together to discuss the benefits and challenges of nanotechnology. The Project has enabled the National Institute for Occupational Safety and Health to connect with many more nanotechnology stakeholders than we could go to on our own. Charting an intelligent course for nanotechnology development in the 21st century is off to a great start thanks to the work of the Wilson Center’s Project on Emerging Nanotechnologies.”

—Dr. John Howard, Director
National Institute for Occupational Safety and Health

FOUNDATIONS FOR SOUND POLICY: MAJOR PUBLICATIONS

The Project has quickly become a “go-to” resource for reliable information and expert analysis that government and industry need to create the right environment for nanotechnology to grow into sustainable applications and commercial products. Listed below, studies and reports commissioned and published by the Project are distributed widely and used internationally. In addition, more than 30,000 copies of these reports have been downloaded from the Project’s web site.



► Informed Public Perceptions of Nanotechnology and Trust in Government

Jane Macoubrie, Ph.D., Assistant Professor of Public and Interpersonal Communication, North Carolina State University

September 2005

This report details in-depth discussions that took place with “experimental issue groups” in Spokane, Washington; Dallas, Texas; and Cleveland, Ohio, (more than 150 people, in all) that provided an initial gauge of public perceptions of the risks and benefits of nanotechnologies. Discussions and subsequent analyses reveal a significant gap in the public’s knowledge of nanotechnology.

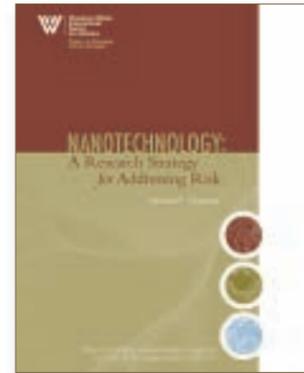
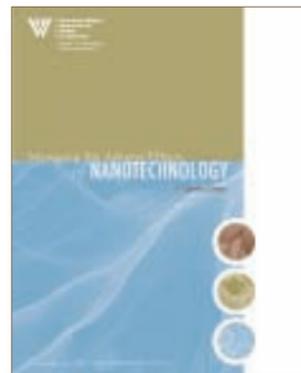
- This study also found that the public:
- anticipates major benefits from nanotechnology
 - wants to be included in technology decision-making
 - does not support a ban on nanotechnology products, and
 - expresses a high demand for effective regulation.

► Managing the Effects of Nanotechnology

J. Clarence Davies, Ph.D., Senior Fellow, Resources for the Future

January 2006

Written by one of the country’s foremost authorities on environmental research and policy, this report examines the strengths and weaknesses of the current regulatory framework for nanotechnology and calls for a new approach to nanotechnology oversight. Davies, a former assistant administrator for Policy, Planning and Evaluation at the U.S. Environmental Protection Agency, provides an overview of possible government actions to deal with potentially adverse effects of nanotechnology. This report concludes that better and more aggressive oversight and new resources will be needed to ensure that the emerging technology will progress safely and achieve its promise.



► Nanotechnology: A Research Strategy for Addressing Risk

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

July 2006

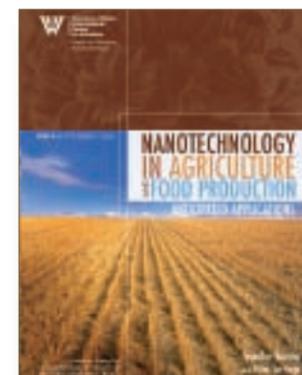
The first to propose a comprehensive framework for systematically exploring nanotechnology’s possible risks, this report recommends how this research should be prioritized and implemented—who should do what, when, and how. Maynard argues for a top-down strategic research framework within the U.S. federal government. He suggests shifting leadership to federal agencies with a clear mandate for oversight and for environmental, health, and safety research, and proposes a major increase in U.S. government spending over the next two years on highly relevant, targeted risk-based research to provide knowledge critical to effective oversight.

► Nanotechnology in Agriculture and Food Production: Anticipated Applications

Jennifer Kuzma, Ph.D., and Peter VerHage, Center for Science, Technology, and Public Policy, University of Minnesota

September 2006

Based on a review of publicly available data on federally funded research projects, supplemented with data from the U.S. Patent and Trademark Office, this report explores potential benefits and risks associated with prospective applications in agriculture and food. It has helped to initiate a much-needed dialogue among consumers, business, and government about the near- and long-term uses of—and safeguards for—nanotechnology in agriculture and food. As part of this surveying effort, the researchers developed a database of agriculture- and food-related nanotechnology research, which can be found online at www.nanotechproject.org.



► Regulating the Products of Nanotechnology: Does FDA Have the Tools It Needs?

Michael R. Taylor, J.D., Professor, University of Maryland School of Medicine

October 2006

Responsible for ensuring the safety and effectiveness of pharmaceutical products, medical devices, and about 80 percent of the U.S. food supply, the Food and Drug Administration is not “nano ready,” concludes this report written by a former FDA deputy commissioner for policy. Issued days before the FDA’s first major public meeting on nanotechnology oversight, this assessment finds that the agency’s growing responsibilities have limited its resources for nanotechnology oversight. It also identifies important gaps in legal authority that are hampering the FDA’s ability to understand and manage nanotechnology’s potential risks, especially in the areas of cosmetics and dietary supplements as well as post-market surveillance.

► Thinking Big About Things Small: Creating an Effective Oversight System for Nanotechnology

Mark Greenwood, Partner, Ropes & Gray, Washington, D.C.

March 2007

Written by a former EPA official who worked on legal issues concerning pesticides, toxic chemicals, hazardous waste management, and other topics, this report advises policymakers to focus attention on how the core assumptions that underlie today’s health and environmental regulations will translate from the macro world to the nano world. It addresses three sets of issues integral to devising the framework of an effective oversight system for nanoscale materials: 1) risk criteria (what is and is not a problem?); 2) information needs (what do we need to know to support decision making?); and 3) risk management measures (what tools should be used to manage risk?). This report stresses that these issues should be discussed now, in the early stages of commercialization. Ultimately, it cautions, regulatory confusion and delays could stifle innovation.



“[N]anotechnology can only flourish if industry and government are committed to identifying and managing the possible risks to workers, consumers, and the environment. Davies’ analysis of the federal regulatory system and recommendations should spark a necessary dialogue—among business, government and citizen groups—about how to move forward as nanotechnology develops.”

—William K. Reilly, former U.S. EPA Administrator

“The Wilson Center [*Nanotechnology: A Research Strategy for Addressing Risk*] report is an important contribution to building much needed consensus around the need for focused research into the implications, as well as the applications, of nanotechnology. We believe there is a need for a more strategically-focused federal effort devoted to studying the environmental, health, and safety dimensions of nanotechnology.”

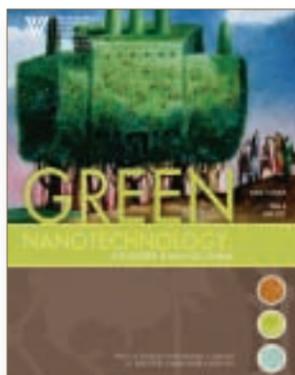
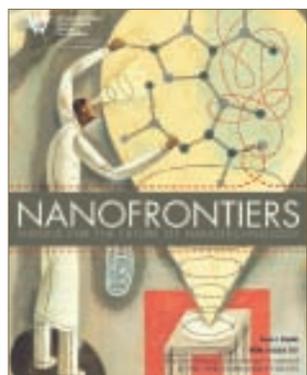
—Paolo A. Gargini, Ph.D.,
Director of Technology Strategy, Intel Corporation

► **NanoFrontiers: Visions for the Future of Nanotechnology**

Karen Schmidt, *Science Writer*

March 2007

Summarizing discussions at a novel, two-day meeting organized by the National Science Foundation, National Institutes of Health, and the Project, this report explores the tremendous long-term promise of continuing progress in nanotechnology. Synthesizing, in non-technical language, the perspectives of more than 50 scientists, engineers, ethicists, policy-makers, and other experts, this report examines compelling opportunities for widespread benefit, focusing on nanotechnology’s ability to address the “energy crisis, the need for better medical treatments, and the demand for clean water.”



► **Green Nanotechnology: It's Easier Than You Think**

Karen Schmidt, *Science Writer*

April 2007

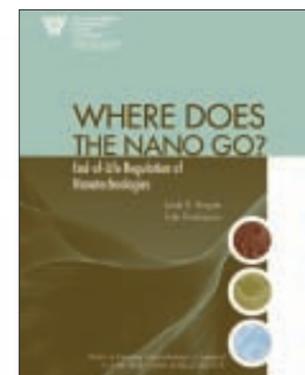
As products made with nanometer-scale materials and devices spread to more industries and markets, there is a growing opportunity and responsibility to leverage nanotechnology to reduce pollution, conserve resources, and, ultimately, build a “clean” economy. This report advises that a “strong marriage” between nanotechnology and the principles and practices of green chemistry and green engineering “holds the key to building an environmentally sustainable society in the 21st century.” It summarizes the proceedings of a national American Chemical Society symposium and four Project-hosted workshops held in 2006. Featured examples illustrate the many potentially beneficial links between nanotechnology and green chemistry and engineering, which aim to minimize environmental impacts through resource-conserving and waste-eliminating improvements in processes and products.

► **EPA and Nanotechnology: Oversight for the 21st Century**

J. Clarence Davies, Ph.D., *Senior Fellow, Resources for the Future*

May 2007

This report provides a thorough analysis of how nanotechnology can serve as a catalyst for change in the EPA and in existing regulatory frameworks. It identifies major areas that require transformation within the agency—including science, program integration, personnel, international activities, and program evaluation. In addition, Davies’ report spells out more than 25 steps that EPA, Congress, the President, the U.S. National Nanotechnology Initiative (NNI) and the nanotechnology industry as a whole should take to improve the oversight of nanotechnology. Taken as a whole, this report is an agenda for creating a regulatory system appropriate for nanotechnology and other 21st century technologies and for ensuring that society is prepared as technology advances.



► **Where Does the Nano Go? End-of-Life Regulation of Nanotechnologies**

Linda K. Breggin, *Senior Attorney, and John Pendergrass, Senior Attorney, Environmental Law Institute*

July 2007

This report contains a comprehensive analysis of two key EPA laws that regulate end-of-life management of nanotechnology: the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), also known as the Superfund statute. It is valuable input into discussions on how various forms of nanomaterials will be handled at the end of their intended use, and how the regulatory system will treat such materials at various stages of their life cycle.

Partnering to Build Understanding, Bridge Divides

The Project acts in a variety of ways to further the dialogue on policy steps toward ensuring that nanotechnology will fully deliver on its promise. We often help to build collaborations that span sectoral boundaries, tap into needed sources of expertise, or engage different stakeholder groups to think collectively about nanotechnology-related topics of shared interest. The Project’s “value added” may be in the form of seed funding, technical assistance, or provision of a neutral forum for exchanges of ideas and viewpoints.

Policy-related contributions that result from this behind-the-scenes support range from better communication between organizations to timely, important additions to the nanotechnology literature. Two examples follow:

Nanotechnology and Life Cycle Assessment: A Systems Approach to Nanotechnology and the Environment (March 2007)

- A team of U.S. and European experts concluded that life cycle assessment (LCA)—a cradle-to-grave look at the health and environmental impact of a material, chemical, or product—is an essential tool for ensuring the safe, responsible, and sustainable commercialization of nanotechnology. This report was jointly issued in Europe and the United States. The Project’s visiting scientist Barbara Karn, Ph.D., on loan from the U.S. EPA, played a key organizational role.

Green Nanotechnology: Why We Need a Green Nano Award & How to Make it Happen (June 2007)

- Written by Paul Anastas and Julie Zimmerman of the Yale Center for Green Chemistry & Engineering, this paper explores possible pathways to developing and launching a green nano award program. The Project presented this paper at the 11th Annual Green Chemistry & Engineering Conference as a way to start the dialogue on how an award could stimulate innovation and bring more visibility (recognition, funding, and knowledge) to green nanotechnology.

A more detailed list of influential publications and articles written by members of the Project or others working in affiliation with it is included in the appendix of this report.

COMMUNICATING NEW IDEAS: CONGRESS AND FEDERAL, LOCAL, AND INTERNATIONAL ORGANIZATIONS

Even for specialists, keeping up with new developments in nanotechnology and their implications is a continual challenge. The field's horizon is vast—intriguing new research results are announced almost daily and perspectives on their significance can vary greatly. The Project has taken the initiative in reaching out to policymakers, regulators, and their staffs; communicating the results of its expert-level analyses of nanotechnology-related issues; and distilling the practical relevance of the latest progress, especially in the realm of the environment, health, and safety. Communication with congressional committees and federal agencies is two-way. The Project has earned its reputation as a trusted source of impartial and highly useful information, and this reputation has spread around the world.



INVITED TESTIMONIES

U.S. House of Representatives Committee on Science

Hearing on: "Environmental and Safety Impacts of Nanotechnology: What Research is Needed?"

November 17, 2005

David Rejeski, Director, Project on Emerging Nanotechnologies

"... We need a systemic analysis across agency statutes and programs, across agencies, and across the international landscape, which looks at regulations, voluntary programs, information-based strategies and state and local ordinances and asks the question: 'Will these measures work not just today but in 5 or 10 years?'. . . We could be surprised in unpleasant ways, either by the technology itself or by people who mishandle, mislabel, or misuse the technology, so we need to anticipate, plan for, and rehearse possible scenarios for misuse or accidents. . . We need a beefed up and visible federal face for nanotechnologies sending a coherent message to the public and industry. . . This is not about creating an additional bureaucracy; it is about creating coherence and the capacity to manage an exceedingly complex enterprise of national importance. . ."

U.S. Senate Committee on Commerce, Science, and Transportation

Hearing on: "Developments in Nanotechnology"

February 15, 2006

J. Clarence Davies, Ph.D., Senior Fellow, Resources for the Future

"... Existing laws and regulatory programs are inadequate for dealing with the possible adverse effects of nanotechnology. Failure to develop a better system could leave the public unprotected, the government struggling to apply existing laws to a technology for which they were not designed, and industry exposed to the possibility of public backlash, loss of markets, and potential financial liabilities. Nanotechnology holds great promise for a better life. If it is to fulfill this promise, we must openly face the issues of whether the technology has adverse effects, what these effects are, and what kind of a regulatory system can prevent adverse effects from occurring. . ."

U.S. Senate Committee on Commerce, Science, and Transportation Subcommittee on Trade, Tourism, and Economic Development

Hearing on: "Promoting Economic Development Opportunities Through Nano Commercialization"

May 4, 2006

David Rejeski, Director, Project on Emerging Nanotechnologies

"... For commercialization to succeed, we need an oversight system that is transparent, efficient, and predictable. We do not have that now. Companies are often confused about the regulatory intentions of the government, investors insecure, and the public suspicious. Short of new legislation, which must be seriously considered, there is much more government and industry can do to provide adequate oversight on emerging products. . ."

U.S. House of Representatives Committee on Science

Hearing on: "Research on Environmental and Safety Impacts of Nanotechnology: What are the Federal Agencies Doing?"

September 21, 2006

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

"... [T]he relevant agencies are under pressure, because they are under-resourced and struggling without adequate leadership or broad strategic direction. I see no evidence of foresight; of the government looking longer-term to identify emerging risks that may appear as nanotechnology becomes more complex and converges with biotechnology. Without better foresight, there is little hope that the government will be positioned to underpin regulation with good science, or provide solid answers to questions that the public will inevitably raise about the risks of nanotechnologies. . ."



“We found the Woodrow Wilson Centre report *Nanotechnology: A Research Strategy for Addressing Risk* to be a very helpful contribution to international discussions on research needs...and we are particularly supportive of the way in which work has been divided into two categories of short and longer term. . .Many views are shared between the proposals of the Woodrow Wilson report and our own.”

—Department for Environment, Food and Rural Affairs (Defra), London, U.K.

PROJECT-ORGANIZED BRIEFINGS FOR HILL STAFF

Nanotechnology: The Next Big Thing (Russell Senate Office Building)

Honorary Hosts: Senator Ron Wyden (D-OR), Representative Bart Gordon (D-TN), Senator Richard Burr (R-NC), Representative Ralph Hall (R-TX) – Co-chairs of the Congressional Nanotechnology Caucus

March 5, 2007

Speakers:

- **Mark A. Ratner**, Ph.D., Professor of Chemistry and Director, Institute of Nanotechnology & Nanofabrication, Northwestern University; Co-author, *Nanotechnology: A Gentle Introduction to the Next Big Idea*
- **Celia Merzbacher**, Ph.D., Assistant Director for Technology Research & Development, Office of Science & Technology Policy, Executive Office of the President
- **David Rejeski**, Director, Project on Emerging Nanotechnologies

Perspectives on Nanotechnology: Business, Government, and Public Health (Dirksen Senate Office Building)

May 30, 2007

Speakers:

- **Andrew D. Maynard**, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies
- **Sean Murdock**, Executive Director, NanoBusiness Alliance
- **Jennifer Sass**, Ph.D., Senior Scientist, Natural Resources Defense Council
- **J. Clarence Davies**, Ph.D., Senior Advisor, Project on Emerging Nanotechnologies, and Senior Fellow, Resources for the Future

ANALYSIS AND ADVICE FOR FEDERAL AGENCIES

National Aeronautics and Space Administration (NASA)

Nanotechnology: Overview and Relevance to Occupational Health

October 21, 2005

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

Department of Energy (DOE)

Nanotechnology: The Current State of Affairs

March 14, 2006

Andrew D. Maynard Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

National Nanotechnology Initiative National Science and Technology Council, Committee on Technology Subcommittee on Nanoscale Science, Engineering and Technology (NSET)

Nanotechnology and Human Health Impact: A Framework for Strategic Research?

July 18, 2006

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

Food and Drug Administration Public Meeting on FDA-Regulated Products Containing Nanotechnology Materials

October 10, 2006

David Rejeski, Director, Project on Emerging Nanotechnologies

Michael R. Taylor, Senior Advisor, Project on Emerging Nanotechnologies

Environmental Protection Agency

Public Meeting on Risk Management Practices for Nanoscale Materials

October 19, 2006

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

David Rejeski, Director, Project on Emerging Nanotechnologies

National Nanotechnology Initiative

Public Meeting on Research Needs and Priorities Related to the Environmental, Health, and Safety Aspects of Engineered Nanoscale Materials

January 4, 2007

Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies

David Rejeski, Director, Project on Emerging Nanotechnologies



“If the United States and the rest of the world are to realize the full potential of nanotechnology there is a need for a comprehensive assessment of the strengths and impacts of it. The Wilson Center’s Project on Emerging Nanotechnologies has stimulated that assessment and encouraged various organizations to clearly address issues of impact. There is need for this contribution to continue.”

—Paul Schulte, Ph.D., Director of the Education and Information Division and Head of the Nanotechnology Research Center, National Institute for Occupational Safety and Health

RESPONDING LOCALLY

Berkeley, California

David Rejeski, the Project’s director, provided a response to the Berkeley City Council nanotechnology regulation in *The San Francisco Chronicle*: “The lack of information about what’s going on tends to breed a lot of suspicion and mistrust...it’s in the interests of companies and research labs to open up.”

Cambridge, Massachusetts

David Rejeski has been appointed to a 17-member Advisory Board to the City of Cambridge Department of Public Health to review potential regulations of nanotechnology.

RESPONDING INTERNATIONALLY

United Nations (UN)

Nanotechnology & Developing Countries: Issues for Global Governance, background paper

submitted to Kofi A. Annan, UN Secretary-General.

February 16, 2006

United Kingdom (U.K.) Council for Science and Technology

The Project was invited to comment on the U.K. Government’s response to the Royal Society and Royal Academy of Engineering report, *Nanoscience and Nanotechnologies: Opportunities and Uncertainties*.

September 28, 2006

Nanotechnology in China

Evan S. Michelson, a Project research associate, was selected as a National Science Foundation Young Scholar to participate in the United States-China Forum on Science and Technology Policy in Beijing, China, and conduct research on the transnational nanotechnology governance challenges facing the United States and China.

October 15–17, 2006

Hong Kong Department of Labor

Andrew D. Maynard, Ph.D., the Project’s chief science advisor, was invited to brief Hong Kong Department of Labor officials on nanotechnology and the specific challenges of assessing and managing occupational safety and health.

February 4–10, 2007

Royal Commission on Environmental Pollution

The Project was invited to comment on the U.K. Royal Commission study on the environmental effects of novel materials and applications.

July 20, 2007

Organization for Economic Cooperation and Development (OECD)

The Project has worked in cooperation with the OECD in the development of a worldwide inventory of environmental, health, and safety risk research.

March 21, 2007

UP FOR DISCUSSION: KEY EVENTS SPONSORED BY THE PROJECT

All things “nano” are up for discussion at Project-sponsored events—from opportunities for improving health in developing countries using nanotechnology to visions of a space elevator constructed with “nanotubes.” In all, the Project organized and hosted more than 30 workshops, panel discussions, and briefings that featured nanotechnology experts as well as other specialists and authorities from academia, industry, and government. Intriguing topics, high-caliber speakers, and spirited question-and-answer sessions account for the standing-room-only audiences that most Project events now attract. Usually held in intimate settings that encourage discussion, these events have drawn several thousand participants. Many more people “sit in” via simultaneous webcasts, which are also archived for later viewing. To add to the online experience, speakers’ presentation materials are posted for downloading in advance of webcasts. Shown here is a sampling of events.



LAUNCH OF THE PROJECT ON EMERGING NANOTECHNOLOGIES

SEPTEMBER 26, 2005

Rebecca W. Rimel, president and CEO of The Pew Charitable Trusts, and Lee Hamilton, president and director of the Woodrow Wilson International Center for Scholars, announce the formation of the Project on Emerging Nanotechnologies, a joint initiative between the two organizations. “Given the national and international investments in nanotechnologies and their potential to drive future economic growth, it is crucial that all parties effectively anticipate and address both their merits and risks,” Hamilton, shown here, told an audience of about 100 people at the Project’s launch.



WORKING CONFERENCE ON ENGINEERED NANOTECHNOLOGIES

APRIL 6–7, 2006

Partnering with Rice University, the International Council on Nanotechnology (ICON), and Environmental Defense, the Project convened more than two dozen international experts in toxicology, molecular biology, and other critical fields to examine potential human health hazards posed by engineered nanomaterials and to recommend approaches to testing and regulatory oversight.



NANOTECHNOLOGY OVERSIGHT AND RISK: IT’S YOUR BUSINESS

JUNE 12, 2006

At an event cosponsored by the Project and the MIT-Stanford-UC Berkeley Nanotechnology Forum at Stanford University, a panel of experts tackled issues pertaining to national and international oversight and regulation of nanotechnology. Among the questions addressed: Where is there already agreement among nations, and where are there likely differences? What role will international organizations play? Panelists were Julia A. Moore, Project deputy director; Lynn Bergeson, director of Bergeson & Campbell, PC (Washington, D.C.); Elizabeth Surkovic, Department for Environment, Food and Rural Affairs (Defra; London, U.K.); and Anthony Waitz, managing partner of Quantum Insight (Menlo Park, California).



PUBLIC AWARENESS OF NANOTECHNOLOGY: WHAT DO AMERICANS KNOW? WHO DO THEY TRUST?

SEPTEMBER 19, 2006

What do Americans know about nanotechnology? Geoffrey Garin, president of Peter D. Hart Research Associates, presents results from a national awareness and trust barometer poll, as well as two complementary focus groups of adult women, on nanotechnology and the government. The research was commissioned by the Project, the only organization systematically tracking public understanding and awareness of nanotechnology.



USING NANOTECHNOLOGY TO IMPROVE HEALTH IN DEVELOPING COUNTRIES: PROMISES AND HOPE

FEBRUARY 27, 2007

Peter Singer, Ph.D., senior scientist at the McLaughlin-Rotman Centre for Global Health and professor of medicine at the University of Toronto, describes how nanotechnology can be used to improve health in developing countries at an event cosponsored by the Project and the Wilson Center’s Global Health Initiative. He was joined by Andrew D. Maynard, Ph.D., the Project’s chief science advisor, and representatives from the National Cancer Institute (NCI) and the U.S. Agency for International Development (USAID).

NANOTECHNOLOGY & THE MEDIA: REALITIES & RISK

DECEMBER 14, 2005

Sharon M. Friedman, director of the Science & Environmental Writing Program, Lehigh University, reviews results of her research on how nanotechnology is covered in the media. Shown, from left to right, are Professor Friedman; Julia A. Moore, Project deputy director; and Evan S. Michelson, Project research associate.



TAKING NANOTECHNOLOGY TO MARKET: ONE COMPANY’S STRATEGY

JUNE 29, 2006

Barry Park, Ph.D., chief operating officer of Oxonica, an international supplier of nanomaterials that is headquartered in the United Kingdom, describes the challenges of moving nanotechnology from laboratory to store shelves; how to use nanotechnology to add value to products and to shift competitive dynamics; and what responsible development of nanotechnology means to a company.



NANOTECHNOLOGY’S PAST, PRESENT, AND FUTURE: A CONGRESSIONAL PERSPECTIVE

APRIL 16, 2007

Sherwood Boehlert (R-NY), a recently retired 12-term Congressman from upstate New York and former chair of the House Science Committee speaks about the beginnings of the National Nanotechnology Initiative and the future of nanotechnology.

NANOFRONTIERS WORKSHOP

FEBRUARY 9–10, 2006

In collaboration with the National Science Foundation and the National Institutes of Health, the Project organized and hosted a two-day brainstorming session for more than 50 leading scientists, engineers, ethicists, policymakers, and other experts to explore the diverse field’s long-term prospects—what many anticipate to be “the next industrial revolution.” Summarized in a well-received and widely distributed report, *NanoFrontiers: Visions for the Future of Nanotechnology*, the workshop has helped to stimulate broader discussion of the goals and the vision for nanotechnology in both scientific and public realms. Among the participants were Dr. Mihail C. Roco, senior advisor for nanotechnology at the NSF, and chair of the U.S. National Nanotechnology Initiative, National Science, Engineering, and Technology Council’s Subcommittee on Nanoscale Science, Engineering, and Technology (NSET), and Dr. Elias A. Zerhouni, director of the NIH.



GREEN NANOTECHNOLOGY POLICY: OPPORTUNITIES & CHOICES

MAY 24, 2006

To broaden and deepen interest in opportunities to use nanotechnology to benefit the environment, the Project initiated its “GreenNano” series, which is aimed at advancing the development of clean, environmentally sustainable products and processes using nanotechnology. The effort was led by Barbara Karn, Ph.D., on detail from the U.S. Environmental Protection Agency (EPA). Aided by Project staff, Karn organized a variety of popular “GreenNano” workshops, including the one shown here.



ENVIRONMENTAL DEFENSE AND DUPONT TO JOINTLY LAUNCH NANO RISK FRAMEWORK

JUNE 21, 2007

Environmental Defense and DuPont jointly launch their Nano Risk Framework, a tool for evaluating and addressing the potential risks of nanoscale materials. Speaking to a packed auditorium, executives from both organizations discussed the impetus for forming the partnership and the rationale for developing a guidance document for responsible use of engineered nanoscale materials. Here, Terry Medley, global regulatory affairs director at DuPont, and Scott Walsh, project manager of the Corporate Partnerships Program at Environmental Defense, describe the Nano Risk Framework to audience members.

POPULAR RESOURCES ON THE WEB: INVENTORIES, MAPS, PODCASTS, AND NEWSLETTERS

The Project maintains an independent web presence at www.nanotechproject.org. This site has served as a cornerstone for the Project's mission to effectively disseminate information and results to a broad range of stakeholders and audiences. The vast majority of Project initiatives, proceedings, and results are available on the site. All printed publications are available electronically in the widely used Adobe Portable Document Format (PDF), and a variety of additional multimedia offerings are available including: static and interactive inventories, archived event videos, unique audio and video short productions, and image resources.

Traffic has grown dramatically since the website's launch in late November 2005. Volume is up 3000% since the initial launch, with over one million hits¹ in the first five months of 2007 alone. Currently, roughly 2,000 unique users visit the site daily, spending an average of 35 minutes. There have been over 30,000 downloads of major publications in the "PEN #" Series.

Interactive inventories have been the most significant traffic draw to the Project's website, with the largest individual proportion of volume attributed to the Consumer Products Inventory.

Following are brief descriptions of some of the popular resources available at www.nanotechproject.org.

CONSUMER PRODUCTS INVENTORY

This is the first publicly available online inventory of nanotechnology-based consumer products. The inventory is an essential resource for consumers, citizens, policymakers, and others who are interested in learning about how nanotechnology is entering the marketplace. It is meant to be international and expanding, and, since its release in March 2006, the inventory has more than doubled—from 212 entries to over 500—in less than eighteen months. The

inventory has been cited in news reports and by federal and international government agencies and has been replicated in Japan and Denmark.

NANOTECHNOLOGY ENVIRONMENTAL, HEALTH, AND SAFETY IMPLICATIONS RESEARCH INVENTORY

This inventory catalogs global government-funded research into the EHS implications of nanotechnology. While not comprehensive, it is designed to serve as a resource for researchers, policymakers, and others engaged in ensuring the success of nanotechnologies through understanding and reducing potential risks. It also includes some research projects supported by industry, foundations, and others.

PUTTING NANOTECHNOLOGY ON THE MAP

This Google-based mashup shows the location, accurate to 3-digit zip code, of companies, universities, government labs, and organizations acknowledging work with nanotechnology and found through a search of publicly available data. Analysis accompanying the map ranks states and "Nano Metros" regions according to the number of entries in each area. Top sectors for nanotechnology work were also determined by looking at each company's area of research and classifying it by one of six sectors. More information can be found online at www.nanotechproject.org.



MEDICAL PRODUCT INVENTORY

To better understand current and future applications of nanotechnology in various fields of medicine, the Project has developed this inventory, comprised of two separate resources, to track nanotechnology-related

"Through its inventory of nano-products and its work on environmental nano research, the Wilson Center's Project on Emerging Nanotechnologies has provided invaluable resources not only to the community of scholars studying nanotechnologies as social phenomena but also to the broader social and political community, which is trying to come to grips with an emerging technology with vast potential."

—David Guston, Ph.D., Director,
Center for Nanotechnology in Society, Arizona State University

medical developments. The first of these resources is a list of medical drugs, delivery systems, diagnostic tests, and devices that have already been commercialized and that are available for use. The second of these resources are two timelines that illustrate estimated commercialization time frames for a select set of nanotechnology drugs, delivery systems, diagnostic tests and devices that are currently being developed—from applications that are in early stage development to applications that are already in latter stages of clinical trials.

AGRICULTURE AND FOOD (AGRIFOOD) NANOTECHNOLOGY INVENTORY

Jennifer Kuzma, Ph.D., and Peter VerHage, from the University of Minnesota's Center for Science, Technology, and Public Policy (CSTPP), looked at publicly available data on current U.S. government-funded research projects in agrifood nanotechnology and open information from the U.S. Patent and Trademark Office (PTO) to produce one of the first analyses of the current level and nature of the federal agrifood nanotechnology research portfolio, estimates on possible areas and timeframes for commercialization, and an early look at potential benefits and risks. Available online at www.nanotechproject.org, this database contains over 160 research agrifood projects.

NANOFRONTIERS PODCASTS AND NEWSLETTERS

In conjunction with the *NanoFrontiers: Visions for the Future of Nanotechnology* report, the Project has launched this series of NanoFrontiers newsletters and podcasts focused on progress toward exciting applications on the horizons of nanotechnology. Intended to encourage broader public understanding of nanotechnology, both will be avail-

able regularly on the Project's website. The podcasts have been prepared by freelance science writer Karen Schmidt.

The Project also maintains a microsite within the Wilson Center's web space at www.wilsoncenter.org/nano. The site serves primarily as the portal for live and archived webcasts as well as a dragnet for individuals trolling the Wilson Center's site for science and technology-related content.

Webcast audiences are typically 60 percent United States based, with the remaining 40 percent largely from Europe, Asia, and Latin America. While live webcast participation is roughly proportional to physical attendance, the over 100 hours of archived offerings accumulate the most views over time.

Starting from scratch in late 2005, the Project's website has matured into a major e-reference point for nanotechnology. Electronic syndication and distribution has allowed the Project to leverage its impact across a far broader range of stakeholders than would otherwise be possible.

A redesign of the website is forthcoming. Stay tuned!

TOP 5 REPORTS DOWNLOADED

1. *Nanotechnology: A Research Strategy for Addressing Risk*; Andrew D. Maynard, Ph.D., Chief Science Advisor, Project on Emerging Nanotechnologies; July 2006
2. *Managing the Effects of Nanotechnology*; J. Clarence Davies, Ph.D., Senior Fellow, Resources for the Future; January 2006
3. *Nanotechnology in Agriculture and Food Production: Anticipated Applications*; Jennifer Kuzma, Ph.D., and Peter VerHage, Center for Science, Technology, and Public Policy, University of Minnesota; September 2006
4. *NanoFrontiers: Visions for the Future of Nanotechnology*; Karen Schmidt, Science Writer; March 2007
5. *Regulating the Products of Nanotechnology: Does FDA Have the Tools it Needs?*; Michael R. Taylor, Professor, University of Maryland School of Medicine; October 2006



1. Excluding web crawlers





MEDIA OUTREACH: GETTING NANO IN THE "NEWS"

From the *New York Times* to the *Los Angeles Times* and from radio's *All Things Considered* to television's *Nightly Business Report*, the Project's experts and its reports are often in the news, helping to inform public, policy, and specialist audiences. Diligent in supplying the media with reliable expert information that is easy to understand, the Project is, in the view of the prestigious journal *Nature Nanotechnology*, in the "lead in efforts to raise the profile of EHS [environmental, health, and safety] research in the US and beyond." Stories on Project reports and events and interviews with Project staff and consultants have been featured in more than 25 TV and radio programs, 290 print stories, and 750 web stories. Coverage is often international in scope.

Over its first two years, news from the Project has resulted in a monthly average of nearly 50 print, broadcast, or web-distributed stories (not including multiple pick-ups, or repeats, of items issued by the Associated Press, Reuters, or other wire services). Project staff and consultants have been interviewed or appeared as guests

on more than 25 television and radio broadcasts, ranging from the local nightly news in New York and San Francisco to call-in programs on National Public Radio. Story lines also have been diverse—business angles, nano-enhanced sunscreens and cosmetic products, potential environmental risks, and more.

The Project's effectiveness in reaching diverse audiences is exemplified by the coverage it has received in a wide variety of large-circulation magazines. The spectrum spans from *Discover* and *Consumer Reports* to *Alternative Medicine* and *Allure*, a women's beauty magazine. Similarly, the Project's credibility and its reputation as an authoritative source of information on nanotechnology has resulted in high-profile "op-ed" articles in prestigious newspapers such as *The Boston Globe* and the *International Herald Tribune*. In addition, Project-developed databases on nanotechnology products, EHS research, and organizations have quickly become essential resources for reporters throughout the United States and around the world.

MEDIA APPEARANCES INCLUDED:

The Project's nanotechnology and policy experts have been featured in more than 25 TV and radio programs. Here, Chief Science Advisor Andrew Maynard comments on the use of silver nanoparticles as antibacterial agents in cleaning and household products. The story aired on several stations, including Cincinnati's ABC affiliate.



insights from Project Director David Rejeski and Chief Science Advisor Andrew Maynard. It also highlights the Project's on-line Consumer Products Inventory.

—**Alternative Medicine**, May 2006

"The more we know about nanomaterials' risks, the more we worry about what we don't know," says physicist Andrew Maynard, chief science adviser for the Project on Emerging Nanotechnologies . . ."

—**Consumer Reports**, June 2007



Former Environmental Protection Agency Administrator William Ruckelshaus teamed with Project Senior Advisor J. Clarence Davies on this op-ed piece calling for EPA to "develop a research and regulatory framework for nanotechnology that helps us achieve its promise . . ."



—**The Boston Globe**, July 7, 2007

The May 2006 issue of *Alternative Medicine* concludes, "We really don't know enough about nanotechnology to declare whether it is reasonably safe or not." The article features



"But coping with nanotechnology will be a daunting challenge for the agency, according to a report last week by a former senior FDA official, whose report was sponsored by the Pew Charitable Trusts and Woodrow

Wilson International Center for Scholars . . ."

—**New York Times**, Oct. 10, 2006



COLLABORATIONS

The following is a partial list of organizations, institutions, and individuals that the Project has worked with on some of its most important activities.

Center for Nanotechnology in Society-Arizona State University

Center for Nanotechnology in Society-University of California at Santa Barbara

Dupont Corporation

EcoArray

Embry Research and Communications, Inc.

Environmental Defense

Environmental Law Institute

Environmental Protection Agency

ICF Consulting Group, Inc.

Innovest Strategic Value Advisors

Institute of Occupational Medicine

International Life Sciences Institute

International Society for Industrial Ecology

Johnson & Johnson

Karen Schmidt

Luna Innovations, Inc.

Meridian Institute

Nanofilm

NanoScience Exchange

National Resources Defense Council

National Science Foundation

National Institutes of Health

National Institute of Occupational Safety and Health

Peter D. Hart Research Associates

Resources for the Future

Ropes and Gray

University of Maryland

University of Massachusetts at Lowell

Yale Law School

Yale School of Forestry and Environmental Studies

Yale University

INTERN PROGRAM: PREPARING A 'NANO READY' GENERATION

Achieving the ultimate goal of ensuring that the potential benefits of nanotechnology will sprout and flourish while possible environmental, health, and safety (EHS) risks are minimized requires preparing a new generation of engaged policymakers and scientists. In two years, the Project has supported the research of 18 graduate and undergraduate students from eight U.S. universities and one Danish institution. The students' contributions include analyses of risk perception and communication, surveys of nanotechnology start-up businesses, an inventory of commercial and consumer products that incorporate silver nanomaterials, and an assessment of nanotechnology-enabled medical devices and drugs in the market or in the development pipeline. Project interns and their research contributions are listed below.

Natalie Chin, University of Maryland

- Created Medical Product Inventory

Shilpa Deshpande, University of Virginia

- Researched nanotechnology oversight mechanisms

Emma Fauss, University of Virginia

- Developed an inventory of nanosilver consumer and commercial applications

Marc Gellman, University of North Carolina

- Identified global producers of titanium dioxide
- Researched the regulation of cosmetic companies marketing products containing nanoparticles by the Food and Drug Administration (FDA)

Philip Gorman, Rice University

- Interviewed researchers, engineers and business-people working on green nanotechnology and wrote a report outlining the opportunities and obstacles affecting the green nanotechnology industry

Steffen Foss Hansen, Technical University of Denmark

- Interviewed stakeholders about their criteria for evaluating different regulatory options
- Investigated how to apply the lessons of the past to nanotechnology
- Worked on how to overcome the challenges of dealing with emerging technologies

Andrew Larson, George Washington University

- Researched life cycle assessment (LCA) in the European Union

Alex Lee, University of Virginia

- Researched nanotechnology and patent pools

Deanna Lekas, Yale School of Forestry &

Environmental Studies

- Identified and reviewed LCA studies that had been performed on nano-based products as compared to conventional products
- Performed a preliminary substance flow analysis of carbon nanotubes
- Surveyed nanotech startups in Connecticut and New York on concerns and information needs to proactively deal with EHS issues; and reviewed literature on environmental management efforts by small and medium-sized enterprises and applied those lessons to small nanotech firms

Jessica Lin, University of Michigan

- Looked at nanotechnology in the hydrogen economy

Patrick Polischuk, George Washington University

- Updated the Consumer Product Inventory and Environmental, Health, and Safety Research Inventory
- Researched the application of distributed sensor networks to water quality trading systems
- Assessed the utility of an Environmental Protection Agency presence in *Second Life*
- Worked toward making the Wilson Center carbon neutral

(continued from page 31)

Daniel Ray, University of Michigan

- Worked on radio-frequency identification product development and development of contact database

Jessica Rushing, George Washington University

- Looked at nanotechnology and cosmetics

Joe Russo, University of Pennsylvania

- Researched nanotechnology in China

Sara Smiley Smith, Yale University

- Contributed to the Hart Research study
- Analyzed the Health Effects Institute model
- Researched nanotechnology risk perception and risk communication

Ahson Wardak, University of Virginia

- Analyzed the present regulatory structure for nanotechnology using LCA

- Compiled an inventory of active grants on environmental implications of nanotechnology
- Researched patent pools

Louise Yeung, George Washington University

- Compiled an inventory of national nanotechnology initiatives in developing countries
- Performed research and wrote sections of the NanoFrontiers newsletters
- Calculated data for the Wilson Center carbon neutral project

Kent York, George Washington University

- Researched and collected data for the Green Nanotechnology Applications and Implications database

EFFORTS TO REDUCE OUR IMPACT ON THE ENVIRONMENT

As part of our overarching goal to protect people and the environment from harm, the Project has sought to reduce its impact on climate change. The Project recognizes that its activities contribute to the rising global greenhouse gas emission levels, and has committed to trying to reduce these levels and mitigate their impact. In addition to carrying out internal energy and waste conservation efforts, the Project estimated and offset its carbon footprint for activities during 2006. For more information, please visit: www.nanotechproject.org/117.

APPENDIX: ADDITIONAL PROJECT ACTIVITIES

Below is a selection of key presentations and publications by current and former Project on Emerging Nanotechnologies staff.

DAVID REJESKI PRESENTATIONS

"A Small Green Revolution," CleanTech Venture Forum, Washington, DC, 10/06/2005

"Nanotech: Rolling to Market," Environmental Protection Agency Nanotech Grantees Meeting, Washington, DC, 10/26/2005

"Nanotech: The Next Small Thing," George Washington University, Washington, DC, 11/09/2005

"Nanotech EH&S Research: How Much is Enough?" Department of Defense Strategic Environmental Research and Development Program Meeting, Washington, DC, 11/29/2005

"Phase I or How I Learned to Love Nanotechnology," Environment Canada, Ottawa, Canada, 03/28/2006

"Nanosafety 101 or How to Avoid the Next Little Accident," Harvard School of Public Health, Cambridge, MA, 04/27/2006

"Nanotechnology: The Novel," National Nanotechnology Initiative, Washington, DC, 05/15/2006

"Nanotechnology and Food," Food Products Association, Washington, DC, 09/18/06

"Nanotechnology and Governance," American Association for the Advancement of Science Leadership Seminar in Science and Technology Policy, Washington, DC, 11/16/06

JULIA A. MOORE PRESENTATIONS

"Nanotechnology & the Public: Duh, Yuck and Wow!" Environmental Protection Agency Workshop on Nanotechnology for Hazardous Waste Site Remediation, Washington, DC, 10/21/05

"Environmental & Societal Implications of Nanotechnology," NanoCommerce & SEMI NanoForum 2005, Chicago, IL, 11/02/05

"Nanotechnology & Food: It's a Mouthful," The Institute for Food Technologists, Washington, DC, 11/14/05

"Nanotechnology Issues Relevant to Patent and Intellectual Property Attorneys," Foley & Lardner, PPL, Washington, DC, 12/15/05

"The Promise and Perils of Medical Nanotechnology," Airlie House, VA, 01/22/06 – 01/24/06

"Nanotechnology Today and Tomorrow," U.S. Government Senior Executives Women's Group, Washington, DC, 02/06/06

"Governing at the Nanoscale," Demos, London, UK, 04/6/2006

"Nanotechnology Consumer Products," Consumers Union, Yonkers, NY, 04/27/2006

"Societal Implications of Nanomedicine," Joint U.S. State Department-European Commission Conference, Lake Como, Italy, 05/22/2006 – 05/23/2006

"Development of Responsible Nanotechnology: A U.S. Perspective," Italian Association for Industrial Research Conference, Rome, Italy, 07/03/06

"The Risk Governance of Nanotechnology: Recommendations for Managing a Global Issue," International Risk Governance Council Conference, Zurich, Switzerland, 07/06/06 – 07/07/06

"Nanotechnology: Governance Challenges," Executive Council on Diplomacy, Woodrow Wilson Center, Washington, DC, 09/08/06

"Nanotechnology & Food," Food Products Association, Washington, DC, 09/18/06

"The Public & New Technologies: Realities & Myths," Social Technologies at the Carnegie Endowment for International Peace, Washington, DC, 11/14/06

"Nanotechnology & Food," Apple Processors Association Annual Meeting, Washington, DC, 12/05/06

"Public Perceptions of Nanotechnology," Nano Bio Expo 2007, Tokyo, Japan, 02/22/07

ANDREW D. MAYNARD, PH.D. PRESENTATIONS

"Nanotechnology: Opportunities and Challenges in a Changing World," National Academies of Science, Chemical Sciences Round Table, Washington DC, 09/21/05

"Nanotechnology: Overview and Relevance to Occupational Health," National Aeronautics and Space Administration, Washington, DC, 10/21/05

"Nanotechnology and Human Health Impact. A Framework for Strategic Research?" Environmental Protection Agency Grantees Meeting, Washington, DC, 10/27/05

"Engineered Nanomaterials and Occupational Health," Society Of Toxicology Symposium on Nanotoxicology, Washington, DC, 11/02/05

"Engineered Nanomaterials: Measurement in the Occupational Setting," European Center for Ecotoxicology and Toxicology of Chemicals (ECETOC) Workshop on Nanomaterials, Barcelona, Spain, 11/07/05

"Characterizing Exposure to Airborne Nanoscale Particles," Association of Inhalation Toxicologists Annual Conference, Basel, Switzerland, 11/10/05

"Working at the Nanoscale Nanotechnology and Potential Occupational Health Risk," Keynote Presentation, Australian Institute for Occupational Hygiene (AIOH) Annual Conference, Terrigal, Australia, 12/07/05

"Assessing the Environmental Safety and Human Health Risk of Emerging Nanotechnologies," Asia Nanotechnology Forum Annual Meeting, Geelong, Australia, 12/09/05

"Nanotechnology: Environment, Safety, and Health," Academia Sinica, Taipei, Taiwan, 01/04/06

"Working at the Nanoscale: Nanotechnology and Potential Occupational Health Risk," Industrial Technology Research Institute, Taipei, Taiwan, 01/06/06

"Nanotechnology and Human Health Impact: Assessing Potential Risk," Exploring the Small World: The Role of Public Research Institutes, Tokyo, Japan, 02/01/06

"Nanotechnology: The Next Big Thing, or Much Ado About Nothing?" Robert and Floretta Austin Distinguished Lecture in Science, University of Idaho, Moscow, ID, 04/17/06

"Nanotechnology: The Next Big Thing, or Much Ado About Nothing?" Warner Lecture, British Occupational Hygiene Society Annual Meeting, Newcastle, UK, 04/25/06

"Nanotechnology, Health, and the Environment: A New Challenge for a New Era?" University of Aberdeen, UK, 05/02/06

"Nanotechnology and Potential Risk. Challenges to Measuring Exposure to Engineered Nanomaterials," Nanoscience Centre, University of Cambridge, UK, 05/05/07

"Nanotechnology and Human Health: A New Challenge for a New Era?" American Thoracic Society Annual Conference, San Diego, CA, 05/22/06

"Nanotechnology: An Introduction to the Technology, and its Environmental, Health, and Safety (EH&S) Implications," The Conference Board, Chief EH&S Officers Council Meeting, Baltimore, MD, 06/08/06

"Exposure to Nanoparticles: New Challenges to Understanding and Evaluating Potential Health Impacts," Dutch Society of Toxicology Annual Meeting, Wageningen, Netherlands, 06/14/06

"Nanotechnology and Potential Health Impact: Developing a Framework for Strategic Research," International Symposium on Nanotechnology in Environmental Protection and Pollution, Hong Kong University of Science and Technology, Hong Kong, China, 06/19/06

"Nanotechnology: Is it a Risk to Human Health?" American Society of Mechanical Engineers 4th Nano Training Boot Camp, Minneapolis, MN, 07/13/06

"Nanotechnology: Overview and Issues," North Atlantic Treaty Organization Advanced Research Workshop, Varna, Bulgaria, 08/13/06

"Nanotechnology and Human Health," Cosmetics, Toiletries, and Fragrances Association: (CTFA), Newark, NJ, 09/15/06

"Ensuring the Safety of Engineered Nanomaterials: Five Major Challenges," Technology Review Emerging Technologies Conference, Boston, MA, 09/27/06

"Nanotechnology: Addressing Potential Risks," ORC International Executive Business Issues Forum Meeting, Chicago, IL, 10/11/06

"Nanotechnology and Toxicology: Are There Reasons to be Concerned About Food and Nanotechnology Together?" Nano4Food Conference Atlanta, GA, 10/12/06

"Risks of Nanotechnology: How do We Prepare for Potentially Adverse Biological Impact?" American Society of Safety Engineers, Scottsdale, AZ, 11/17/06

"Sound Science for Safe Nanotechnology," Nanotechnology Occupational Environmental Health and Safety Conference, Cincinnati, OH, 12/06/06

"Nanotechnology Environment and Health Implications (NEHI) Working Group Public Meeting on Research Needs and Priorities," NEHI Public Meeting on Environmental, Health and Safety Research, Washington, DC, 01/04/07

"Assessing the Risks of Engineered Nanomaterials: Setting the Scene," International Council on Nanotechnology (ICON) Research Needs Meeting, Bethesda, MD, 01/09/07

"Safe Handling of Nanotechnology," NGO Consortium on Nanotechnology, Washington, DC, 01/26/07

"Nanotechnology: Why Should you Care?" Rabobank North American Agribusiness Advisory Board, Carmel, CA, 01/30/07

"Nanotechnology Benefits and Challenges," Senior Management at the Hong Kong Department of Labor, Hong Kong, China, 02/08/07

"Nanotechnology and Occupational Health," Hong Kong Labor Department Occupational Safety and Health Branch, Annual Conference, Hong Kong, China, 02/09/07

"Nanotechnology: Maximizing the Benefits, Minimizing the Risks," International Consumer Products Health and Safety Association, Orlando, FL, 03/02/07

"Nanotechnology: Maximizing the Benefits, Minimizing the Risks," California Environmental Protection Agency Department of Toxic Substances Control, Sacramento, CA, 03/08/07

"Challenges of Monitoring Exposure to Carbon Nanotubes," Society of Toxicology Meeting, Charlotte, NC, 03/26/07

"The Science of Nanotechnology and Public Health," Johns Hopkins University, Baltimore, MD, 04/10/07

"Nanoparticles from Manufacturing," Health Effects Institute Annual Conference, Chicago, IL, 04/16/07

"Nanotechnology: Science, Society and Policy," Second International Nanotoxicology Conference, Venice, Italy, 04/19/07

PUBLICATIONS

Oberdörster, G., A. Maynard, et al. (2005). "Principles for characterizing the potential human health effects from exposure to nanomaterials: elements of a screening strategy." *Part. Fiber Toxicol.* 2(8): DOI:10.1186/1743-8977-2-8.

Maynard, A. D. and E. D. Kuempel (2005). "Airborne nanostructured particles and occupational health." *Journal Of Nanoparticle Research* 7(6): 587–614.

Elder, A., R. Gelein, V. Silva, T. Feikert, L. Opanashuk, J. Carter, R. Potter, A. Maynard, Y. Ito, J. Finkelstein and G. Oberdörster (2006). "Translocation of Inhaled Ultrafine Manganese Oxide Particles to the Central Nervous System," *Environmental Health Perspective* DOI:10.1289/ehp.9030.

Maynard, A. (2006a). "Nanodollars," *New Scientist* 189(2540): 25–25.

Maynard, A. D. (2006b). "Nanotechnology: Managing the risks." *Nano Today* 1(2): 22–33.

Peters, T., W. A. Heitbrink, E. D. E., S. T. J. and A. D. Maynard (2006). "The Mapping of Fine and Ultrafine Particle Concentrations in an Engine Machining and Assembly Facility," *Annals Occupational Hygiene* 50(3): 249–257.

Tsuji, J. S., A. D. Maynard, P. C. Howard, J. T. James, C. W. Lam, D. B. Warheit and A. B. Santamaria (2006). "Research strategies for safety evaluation of nanomaterials, part IV: Risk assessment of nanoparticles," *Toxicological Sciences* 89(1): 42–50.

Maynard, A. D. (2006). *Nanotechnology: A Research Strategy for Addressing Risk*, PEN 03 Washington DC, Woodrow Wilson International Center for Scholars, Project on Emerging Nanotechnologies.

Ku, B.K., M.S. Emery, A.D. Maynard, M.R. Stolzenburg and P.H. McMurry (2006). "In Situ structure characterization of air-born carbon nanofibres by a tandem mobility-mass analysis," *Nanotechnology* 17(14): 3613–3621.

Kandlikar, M., G. Ramachandran, A. Maynard, B. Murdock and W. A. Toscano (2006). "Health risk assessment for nanoparticles: A case for using expert judgment," *Journal of Nanoparticle Research* DOI: 10.1007/s11051-006-9154-x.

Maynard, A., D. (2006). "Nanotechnology: The next big thing, or much ado about nothing?," *Annals Occupational Hygiene* DOI: 10.1093/annhyg/ mel071

Maynard, A. D., R. J. Aitken, T. Butz, V. Colvin, K. Donaldson, G. Oberdörster, M. A. Philbert, J. Ryan, A. Seaton, V. Stone, S. S. Tinkle, L. Tran, N. J. Walker and D. B. Warheit (2006a). "Safe handling of nanotechnology," *Nature* 444(16):267–269.

Maynard, A. D., B. K. Ku, M. Emery, M. Stolzenburg and P. H. McMurry (2006b). "Measuring particle size-dependent physicochemical structure in airborne single walled carbon nanotube agglomerates," *Journal of Nanoparticle Research* DOI: 10/1007/s11051-006-9164-8.

Maynard, A. D. and D. Y. H. Pui (2006). "Nanotechnology and occupational health: New technologies—new challenges," *Journal of Nanoparticle Research* DOI: 10.1007/s11051-006-9164-8.

Wallace, W. E., M. J. Keane, D. K. Murray, W. P. Chisholm, Maynard, A. D. (2007). "Nanotechnologies: Overview and issues," *Nanotechnology - Toxicological issues and environmental safety*, P. P. Simeonova and M. Luster, eds., Springer, 1–14.

Maynard, A. D. and Aitken, R. J. (2007). "Assessing exposure to airborne nanomaterials: Current abilities and future requirements," *Nanotoxicology* 1:26–41.

Ku, B. K., Maynard, A. D., Baron, P. A. and Deye, G. J. (2007). "Observation and measurement of anomalous responses in a differential mobility analyzer caused by ultrafine fibrous carbon aerosols," *Journal of Electrostatics* 65:542–548.

Maynard, A. D. and Pui, D. Y. H., eds. (2007). *Nanoparticles and Occupational Health*, Springer, Dordrecht, Netherlands.

EVAN S. MICHELSON PRESENTATIONS

"Falling Through the Cracks: Issues with Nanotechnology Oversight," The Nanotechnology/Biology Interface: Exploring New Modes of Governance, University of Minnesota, Minneapolis, MN, 09/15/05

"Inventory of Research on the Environmental, Health, & Safety Implications of Nanotechnology," Materials Research Society Fall 2005 Meeting, Boston, MA, 12/01/05

"A Nanotechnology Consumer Products Inventory" (with Julia Moore), Consumers Union, Yonkers, NY, 04/27/06

"Falling Through the Cracks? Public Perception, Risk, and the Oversight of Emerging Nanotechnologies," Institute of Electrical and Electronics Engineers International Symposium on Technology and Society, New York, NY, 06/09/06

"Nanotechnology in Society: An Overview of Public Perception and Governance Issues," The 4th New England International Nanomanufacturing Workshop, Northeastern University, Boston, MA, 06/28/06

"Nanotechnology Policy: A Practitioner's Perspective," Gordon Research Conference on Science and Technology Policy, Big Sky, MT, 08/14/06

"Nanotechnology Policy: An Analysis of Transnational Governance Issues," Young Scholars Forum, National Research Center for Science and Technology for Development, Beijing, China, 10/17/06

"Nanotechnology and Transnational Governance Issues: Looking Beyond the Science," CESDRRC, Beijing, China, 10/20/06

"Governance Issues in Nanotechnology: An Overview," IASTS Annual Meeting and Conference, Baltimore, MD, 02/02/07

"Nanotechnology and the Consumer: An Overview" (with David Rejeski), Regulations for Nanotechnology in Consumer Products Conference, Intertech Pira, Washington, DC, 02/08/07

"Options for Nanotechnology Oversight," Albany Science and Technology Law Journal Symposium on Nanotechnology, Albany, NY, 03/01/07

"A Practitioner's Perspective on Nanotechnology," University of Virginia, Charlottesville, VA, 04/20/07

PUBLICATIONS

Evan S. Michelson. "Nanotechnology and the World," *CenterPoint*, Woodrow Wilson International Center for Scholars, Washington, DC, May 2007.

Louise Yeung and Evan Michelson. "China, Nanotechnology, and the Environment," *China Environment Series*, Washington, DC: Environmental Change and Security Program, Woodrow Wilson International Center for Scholars, Issue 8: 82–84.

Evan S. Michelson. "Nanotechnology Policy: An Analysis of Transnational Governance Issues Facing the United States and China," *Proceedings of the China-US Forum on Science and Technology Policy*, February 2007: 345–358.

Evan S. Michelson and David Rejeski, "Falling Through the Cracks: Public Perception, Risk, and the Oversight of Emerging Nanotechnologies," *IEEE International Symposium on Technology and Society Conference Proceedings*, June 2006: 1–17.

Evan Michelson. "Measuring the Merger: Examining the Onset of Converging Technologies," in William Sims Bainbridge and Mihail Roco, eds., *Managing Nano-Bio-Info-Cogno Innovations: Converging Technologies in Society*, Dordrecht, The Netherlands: Springer, 2006.

Evan Michelson, "Performance Assessment in the United States: An Overview of Recent Research and Development Evaluation Trends," *Science and Public Policy*, Vol. 33, No. 8, October 2006: 546–560.

DEANNA LEKAS

PRESENTATIONS

"A Road Map to a Green Nano Award," ACS Green Chemistry & Engineering Conference, Washington, DC 06/28/07

PUBLICATIONS

Deanna Lekas. *Nanotech Startup Concerns, Information Needs, and Opportunities to Proactively Address Environmental, Health, and Social Issues: Focus on Firms in Connecticut and New York*. Washington, DC: Project on Emerging Nanotechnologies, 2006.

BARBARA KARN (Former Staff)

PRESENTATIONS

"Nanotechnology and the Environment," China Academy of Science/Ecological and Environmental Sciences, Beijing, China, 10/31/05

"Scales of Sustainability: Nanotechnology and Industrial Ecology," 2005 International Conference on the Circular Economy and Regional Sustainable Development, Hangzhou, China, 11/01/05 – 11/04/05

"Nanotechnology and the Environment: Applications, Implications, and Prevention," Department of Defense Strategic Environmental Research and Development Program Meeting, Washington, DC, 11/29/05

"Nanotechnology and the Environment: What is it? What's it Got to Do with Region 1?" EPA New England/Region 1, Boston, MA, 12/12/05

"Green Nanotechnology," Council on Chemical Research (NiChE), Orlando, FL, 02/05/06 – 2/08/06

"Green Nanotechnology," American Chemistry Council, Nanotechnology Committee, Washington, DC, 02/15/06

"Protecting Human Health and the Environment with and from Nanotechnology: The Applications and Implications of Nanotechnology," US-China Workshop on Nanotechnologies, National Science Foundation, Arlington, VA, 03/23/06 – 03/24/06

"Nanotechnology and the Environment: Environmental Benefits," Office of Solid Waste Nanotech Workshop, U.S. Environmental Protection Agency, Arlington, VA, 04/04/06

"Environmental Needs for Particle Analysis," NIST/MAS Particle Workshop 2006, Gaithersburg, MD, 04/25/06

"A Nanotechnology Primer for Consumers," Consumers Union, Yonkers, NY, 04/27/06

"Nanotechnology: Emerging Challenges for Electronics and the Environment," Electronics and the Environment Conference, San Francisco, CA, 05/07/06 – 5/11/06

"Nanotechnology: What is It; Where are We; What Should We Think About?" Environmental Law Institute Vanderbilt University, Nashville, TN, 05/19/06

"Sustainability and Nanotechnology," University of North Carolina, Chapel Hill, NC, 06/21/06

"Can Nanotechnology be Green?" National Institute for Materials Science, Tokyo, Japan, 06/26/06

"Can Sunscreen Make Me Sick... And Other Questions about Nanotechnology," Student Pugwash USA, Washington, DC, 08/04/06

"Managing Nanotechnology: Applications and Implications (A Case Study of Science Policy in the Trenches)," Gordon Research Conference on Science/Technology Policy, Big Sky, MT, 08/14/06

"National Nanotechnology: Science from the Top-Down and the Bottom-Up: Industrial Ecology, Sustainability and Nanotechnology," EPA Region V, Nanotechnology for Site Remediation Workshop, Chicago, IL, 09/06/06 – 09/08/06

"The Green Nano Initiative: A Way to Sustainable Development of Nanotechnology?" NanoEuro Nano-Regulation Meeting, St. Gallen, Switzerland, 09/12/06 – 09/14/06

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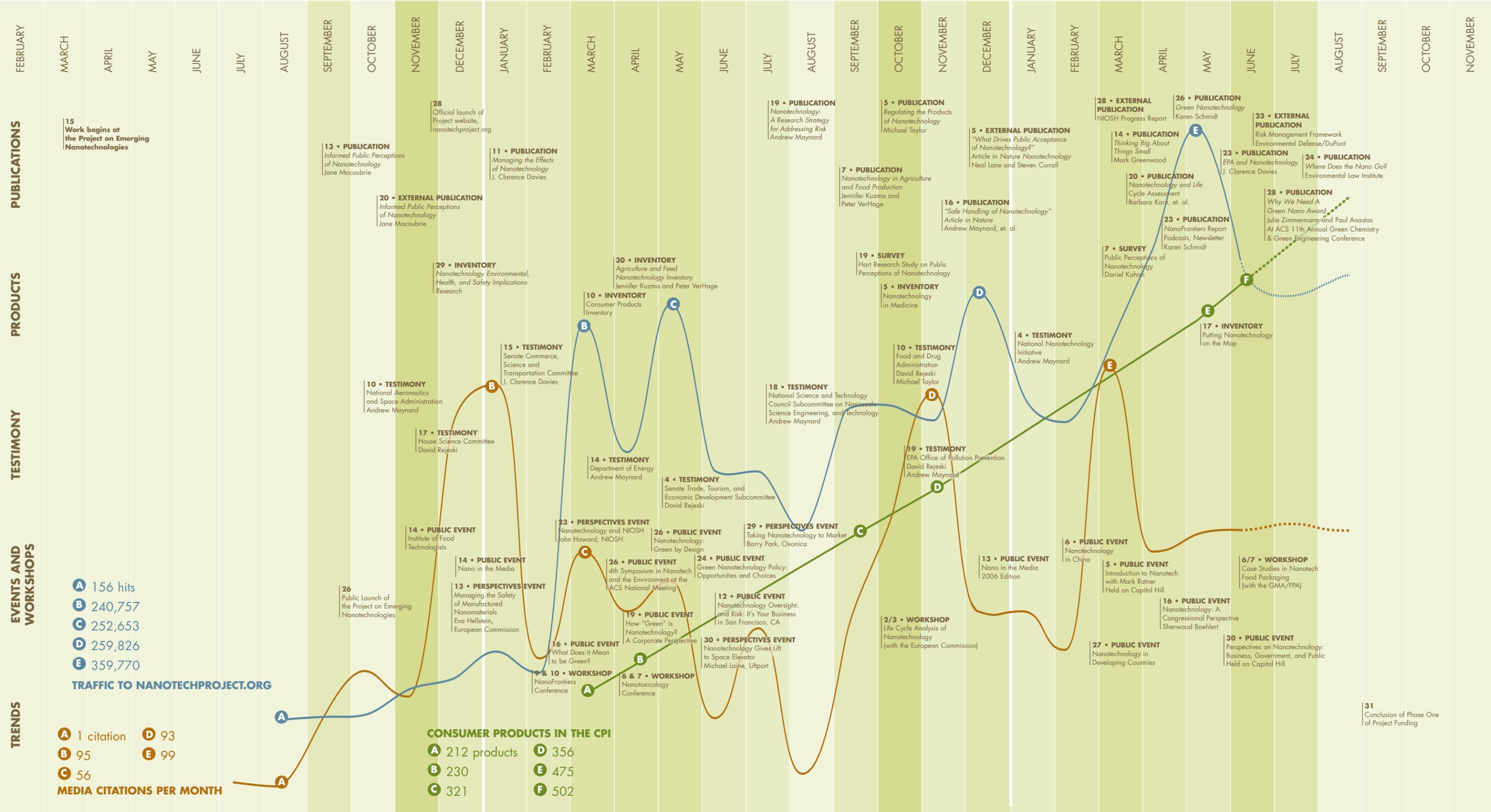
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15 Work begins at the Project on Emerging Nanotechnologies

13 PUBLICATION Informed Public Perceptions of Nanotechnology Jane Macoubrie

28 Official launch of Project website, nanotechproject.org

11 PUBLICATION Managing the Effects of Nanotechnology J. Clarence Davies

20 EXTERNAL PUBLICATION Informed Public Perceptions of Nanotechnology Jane Macoubrie

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18 TESTIMONY National Science and Technology Council Subcommittee on Nanoscale Science Engineering, and Technology Andrew Maynard

10 TESTIMONY Food and Drug Administration David Rejeski Michael Taylor

19 TESTIMONY EPA Office of Pollution Prevention David Rejeski Andrew Maynard

14 PUBLIC EVENT Institute of Food Technologists

23 PERSPECTIVES EVENT Nanotechnology and NIOSH John Howard, NIOSH

26 PUBLIC EVENT 4th Symposium in Nanotech and the Environment at the ACS National Meeting

24 PUBLIC EVENT Green Nanotechnology Policy: Opportunities and Choices

12 PUBLIC EVENT Nanotechnology Oversight: and Risk: It's Your Business I in San Francisco, CA

13 PERSPECTIVES EVENT Managing the Safety of Manufactured Nanomaterials Eva Hellstein, European Commission

16 PUBLIC EVENT What Does it Mean to be Green?

19 PUBLIC EVENT How "Green" is Nanotechnology? A Corporate Perspective

30 PERSPECTIVES EVENT Nanotechnology Gives Lift to Space Elevator Michael Laine, Liftport

9 & 10 WORKSHOP NanoFrontiers Conference

6 & 7 WORKSHOP Nanotoxicology Conference

29 PERSPECTIVES EVENT Taking Nanotechnology to Market Barry Park, Oxonica

19 SURVEY Hart Research Study on Public Perceptions of Nanotechnology

5 INVENTORY Nanotechnology in Medicine

7 PUBLICATION Nanotechnology in Agriculture and Food Production Jennifer Kuzma and Peter VerHage

16 PUBLICATION "Safe Handling of Nanotechnology" Article in Nature Andrew Maynard, et. al.

5 EXTERNAL PUBLICATION "What Drives Public Acceptance of Nanotechnology?" Article in Nature Nanotechnology Neal Lane and Steven Curral

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19 PUBLICATION Nanotechnology: A Research Strategy for Addressing Risk Andrew Maynard

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5 PUBLIC EVENT Introduction to Nanotech with Mark Ratner Held on Capitol Hill

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13 PUBLIC EVENT Nano in the Media 2006 Edition

2/3 WORKSHOP Life Cycle Analysis of Nanotechnology (with the European Commission)

5 PUBLIC EVENT Introduction to Nanotech with Mark Ratner Held on Capitol Hill

6/7 WORKSHOP Case Studies in Nanotech Food Packaging (with the GMA/FPA)

30 PUBLIC EVENT Perspectives on Nanotechnology: Business, Government, and Public Held on Capitol Hill

28 EXTERNAL PUBLICATION NIOSH Progress Report

14 PUBLICATION Thinking Big About Things Small Mark Greenwood

20 PUBLICATION Nanotechnology and Life Cycle Assessment Barbara Kari, et. al.

23 PUBLICATION NanoFrontiers Report Podcasts, Newsletter Karen Schmidt

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23 EXTERNAL PUBLICATION Risk Management Framework Environmental Defense/DuPont

23 PUBLICATION EPA and Nanotechnology J. Clarence Davies

24 PUBLICATION Where Does the Nano Go? Environmental Law Institute

28 PUBLICATION Why We Need A Green Nano Award Julie Zimmermann and Paul Anastas At ACS 11th Annual Green Chemistry & Green Engineering Conference

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PROJECT ACTIVITIES

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PROJECT STAFF

CURRENT STAFF

(counter-clockwise from top right)

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Support Assistant

Alex Parlini, Project
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Natalie Chin, Project Assistant

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Associate

Julia A. Moore, Deputy
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Evan S. Michelson, Research
Associate

FORMER STAFF

Barbara Karn, Ph.D., Former
Visiting Environmental Scientist,
Environmental Protection
Agency

MISSION STATEMENT

The **Project on Emerging Nanotechnologies**, an initiative launched by the Woodrow Wilson International Center for Scholars and The Pew Charitable Trusts in 2005, is dedicated to helping business, government and the public anticipate and manage the possible health and environmental implications of nanotechnology. As part of the Wilson Center, the Project of Emerging Nanotechnologies is a non-partisan, non-advocacy organization that collaborates with researchers, government, industry, non-governmental organizations, and others working towards the safe applications and utilization of nanotechnology.

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