



Role of the National Nanotechnology Initiative in the Safe and Responsible Development of Nanotechnology

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NNI Vision

A future in which the ability to understand and control matter at the nanoscale leads to *a revolution in technology and industry that benefits society.*

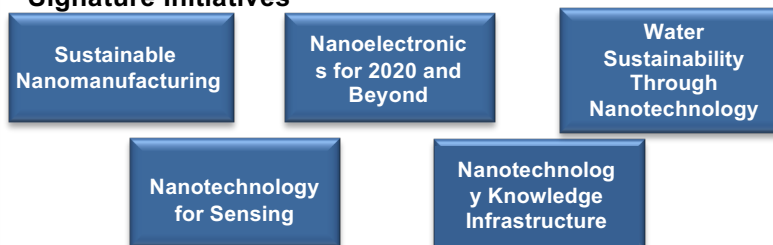


The National Nanotechnology Initiative (NNI)

- Established in 2000 by President Bill Clinton, signed into law by President Bush in 2003
- Intent of the NNI is to provide a framework for member agencies to work together to:
 - Advance world-class nanotechnology research
 - Foster the transfer of technologies into products for commercial and public benefit
 - Develop and sustain educational resources, a skilled workforce and the supporting infrastructure and tools to advance nanotechnology
 - Support the responsible development of nanotechnology
- The NNI is a coordinated initiative not a distinct funding program



Signature Initiatives



R&D 100

Snapshot of Nanotechnology Landscape

Lux Research, February 2016

Worldwide governments, corporations and VCs invested **\$18.1 billion in 2014** (8% increase over 2010)

- The **U.S. contributed 33%** of this amount – leads in government and corporate spending
- Corporate spending in the US in 2014 was \$4.0 billion, government spending was \$1.67 billion

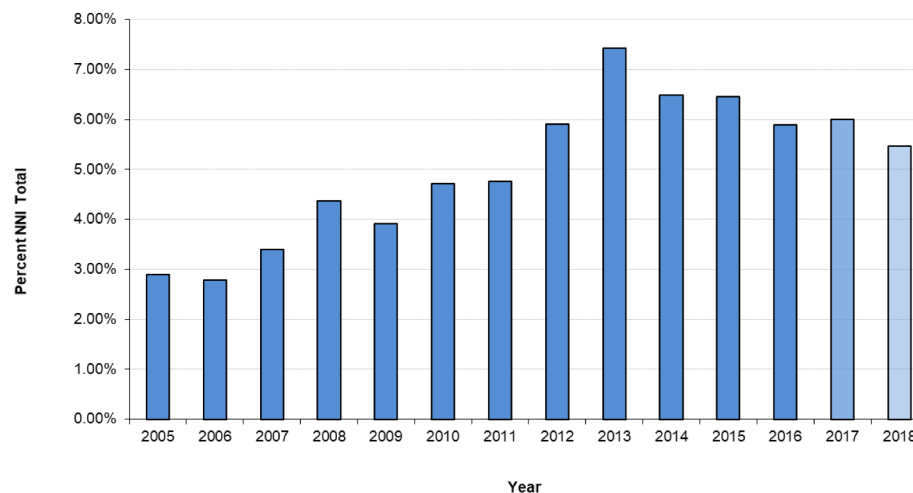
Global value of nano-enabled products is predicted to reach \$3.7 trillion by 2018.

- The **revenue** from nano-enabled products globally grew from \$339 billion in 2010 to **\$1.6 trillion in 2014**.
- US revenues grew from \$109M to \$370M
- The **revenue** from nanomaterials increased 35% over 2012 to \$2.12 billion in 2014

NNI EHS Priorities

- Federal agencies continue to target and accelerate nanoEHS research by
 - Prioritizing nanomaterials
 - Establishing standard measurements, terminology, nomenclature, and assay methods
 - Developing informatics and predictive modeling tools
 - Stratifying knowledge for risk assessment
 - Partnering to achieve the NNI EHS research goals, both domestically and internationally

NNI EHS Funding, Percent of NNI Total
2005-2018



Notes:

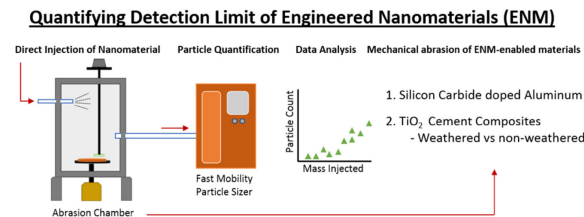
- This includes PCA 5 – narrowly defined EHS research – only. Additional EHS-related research is included in Nanotechnology Signature Initiatives (NSIs, PCA 1). EHS funding under PCAs 1 and 5 combined totals ~10%.
- Lighter shades for 2017 and 2018 indicate estimated and requested figures, respectively.

NEHI Working Group

- Coordinates Federal research and development directed at understanding the environmental, health, and safety (EHS) implications of nanotechnology
- Federal R&D examples (nanomaterial occupational exposure, risk assessment)



Image credit: NIOSH (www.cdc/niosh-science-blog/category/nanotechnology)



Alberts et al. 2018 (doi.org/10.1016/j.impact.2018.02.006)

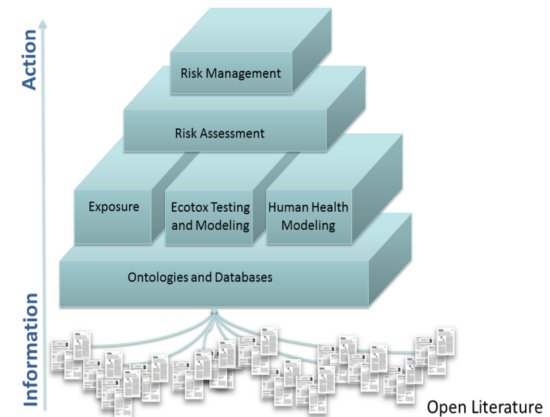


Image credit: M. Hoover (NIOSH) and C. Hendren (Duke University)

Federal Agencies Participating in NEHI

OSTP



OMB



CPSC



DOC/NIST

NIST

DO



DO



DOI/USGS



DOL/OSHA



DO



EPA



HHS/ATSD



HHS/CDC/NIOS



HHS/FDA



HHS/NIH/NCI



HHS/NIH/NIEHS



ITC



NSF



USDA/FS



USDA/NIF

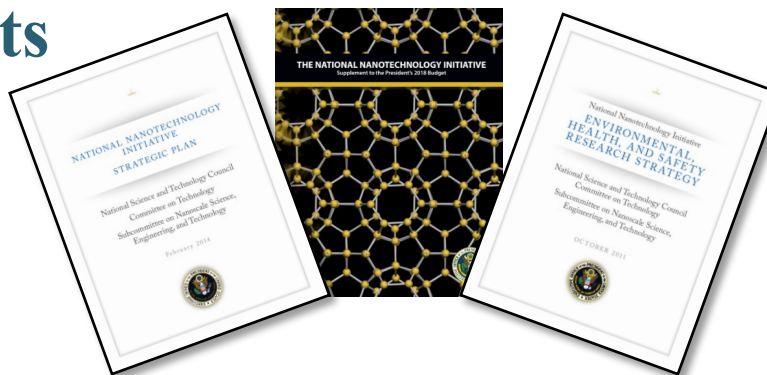


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Key NNI Documents

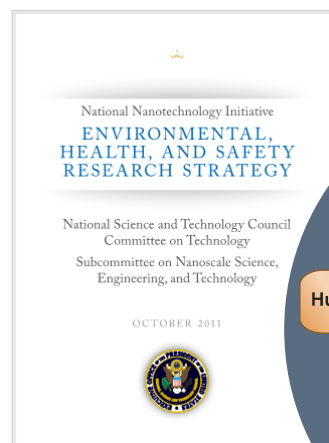
- Strategic Plans
 - Lay out a series of objectives under each NNI goal
 - Describe Program Component Areas (PCAs)
 - Define agency interests and priorities, coordination and assessment structures and mechanisms, collaborative agency activities and plans, and stakeholder input
- Annual Budget Supplements
 - Report Federal nanotechnology investments and activities
 - Serve as the annual reports of the NNI
- 2011 NNI EHS Research Strategy
 - Federal agency nanoEHS research activities, priorities, and program plans



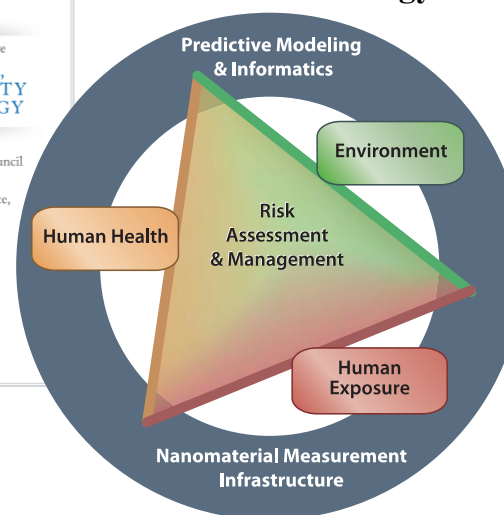
The 2011 NNI EHS Research Strategy

“A future in which responsible development of nanotechnology provides maximum benefit to the environment and to human social and economic well-being.”

- Developed jointly by the NEHI agencies
- Consistent with the objectives of NNI Goal 4
- Identified six core research areas in nanotechnology-related environmental, health, and safety
- Identified specific research needs in each core research area
- Identified overarching activities for implementation and coordination of the Strategy

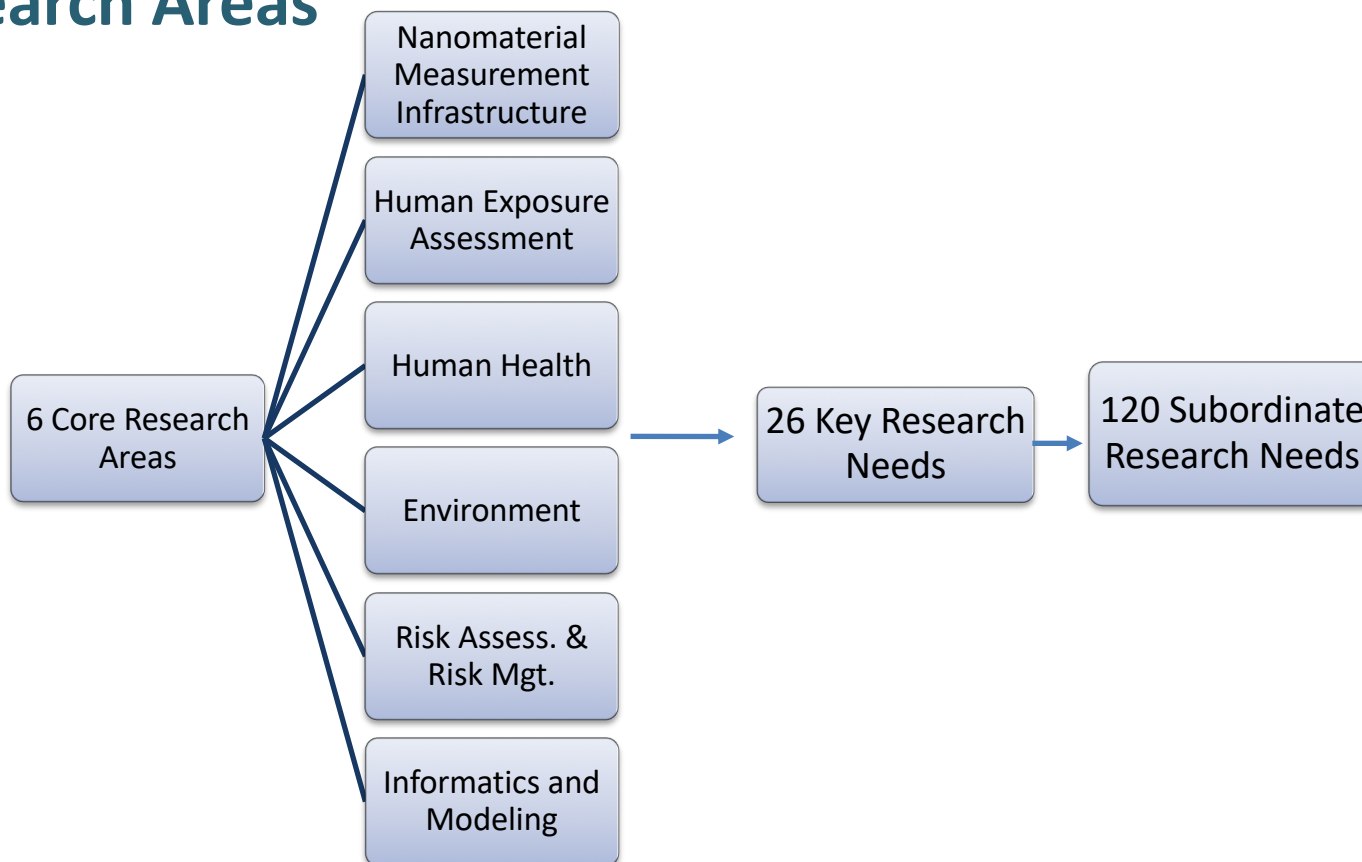
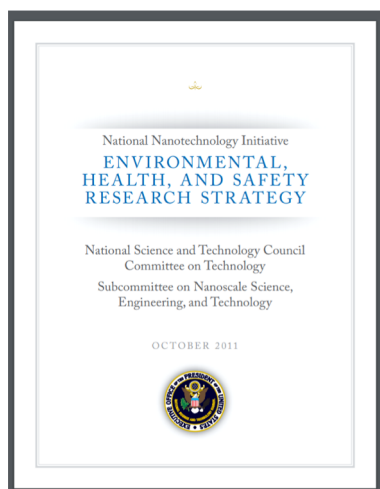


Core Research Areas in the EHS Strategy

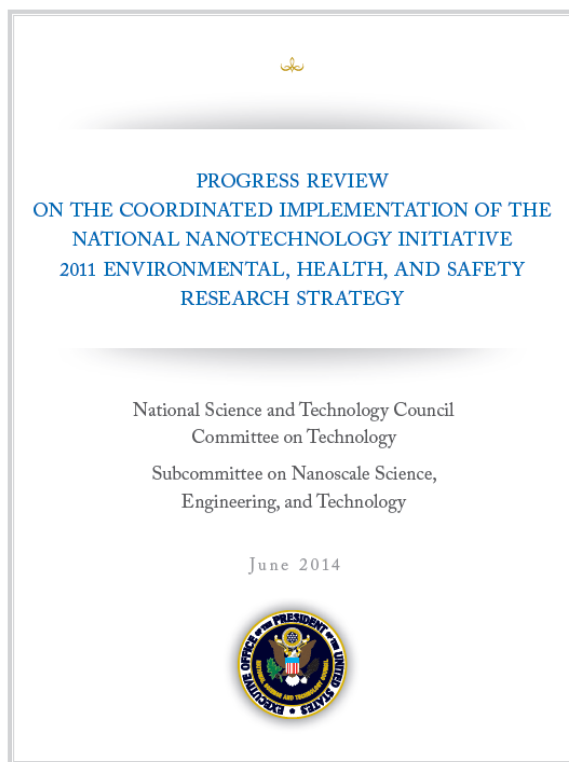


Source: Debra Kaiser, NIST. N.R. Fuller of Sayo-Art provided revised image graphics.

NNI EHS Research Areas



The 2014 NNI EHS Progress Review



- Developed jointly by the NEHI agencies
- Follows the structure of the 2011 NNI EHS Research Strategy
- Contains annotated examples of nanoEHS research activities undertaken by the NEHI agencies
- Includes intramural and extramural research from FY 2009 to FY 2012
- Demonstrates extensive coordination and collaboration among the NEHI agencies
- Is not a comprehensive review of all nanoEHS research supported by the Federal Government
- Is not a technical review of current state of progress in nanoEHS research

Guidance Documents on the Safe Use of Nanotechnologies

- NNI agencies continue to develop and disseminate guidance for the safe handling of nanomaterials.
- Example: Current Intelligence Bulletins (CIBs) are issued by NIOSH to disseminate new scientific information about occupational hazards.



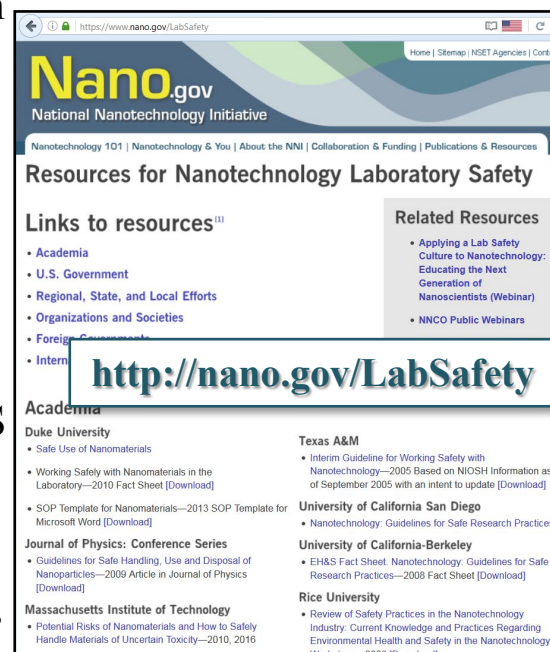
Examples of Guidance Documents Developed by NNI

Agencies

Source: NIOSH & OSHA

NNI Resources for Laboratory Safety

- Both general and specific information about laboratory safety
- Online safety courses
- Guidance documents
- Examples and templates for standard operating procedures (SOPs) and protocols
- Presentations and videos on nanoEHS safety
- Audience specific brochures
- Resources from academic, non-profit, and government sources



NEHI NanoEHS Webinar Series

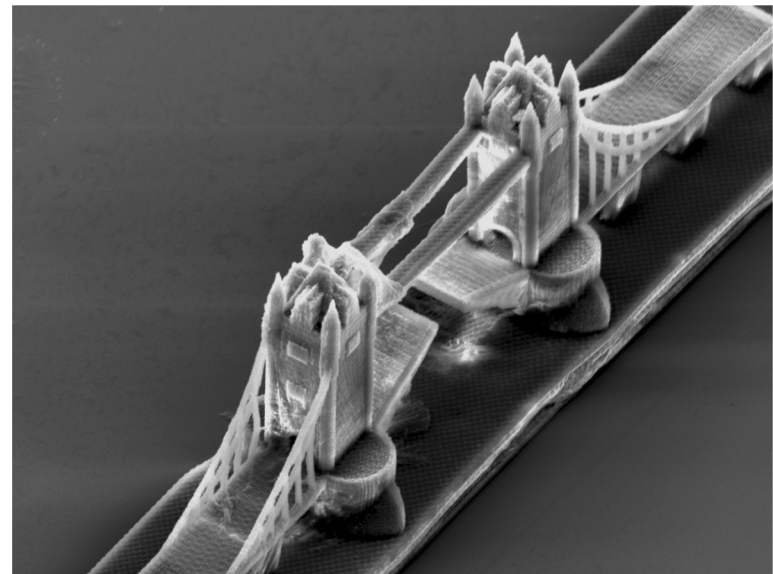
- Recent EHS Webinars
 - *An Introduction to Voluntary Standards and Their Role in Enhancing the Quality of Scientific Research*
 - *The National Nanotechnology Coordinated Infrastructure (NNCI) Nodes and Environmental Research: Examples from the Field*
- Other webinars in the Series
 - *Applying a Lab Safety Culture to Nanotechnology: Educating the Next Generation of Nanoscientists*
- See the nano.gov website for:
 - Upcoming webinars
 - Webinar archives
 - Additional information on Laboratory Safety

<http://nano.gov/nanoEHSwebinars>



us — eu
bridging nanoEHS research efforts
Communities of Research (CoRs)

- **Databases & Computational Modeling for NanoEHS**
- **Exposure through Product Life**
- **Risk Management & Control**
- **Risk Assessment**
- **Characterisation**
- **EcoToxicity**
- **Human Toxicity**



http://www.tuwien.ac.at/en/news/news_detail/article/7444/

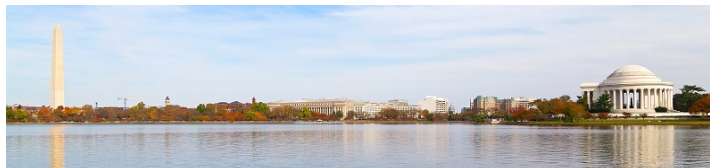
Quantifying Exposure to Engineered Nanomaterials in Consumer Products (QEEN)

- Workshop co-sponsored by CPSC and the NNI to identify knowledge gaps and technology needs in understanding effects of exposure to engineered nanomaterials to humans and the environment
- Major findings:
 - Significant progress has been made, especially over the past decade, in our ability to quantify ENM exposure
 - New characterization tools
 - Exposure assessment methodologies
 - Simulation and modeling
 - Ability to detect NPs well below known toxicity levels
 - Techniques needed for more rapidly estimating exposure risk, including alternative testing models and high throughput methods
 - Studies need to better replicate real world conditions
 - Concentrations
 - Changes to ENMs through product life cycle
 - New focus on determining biomarkers linked to disease

R&D 100



Upcoming Workshops



Highlighting advances in nanomaterial exposure science and the state of nanoEHS science

QEEN II

2nd Quantifying Exposure to Engineered
Nanomaterials in Manufactured
Products Workshop
October 9-10
www.nano.gov/qeen2



The 2018 U.S.-EU: *Bridging NanoEHS Research
Efforts* Joint Workshop
October 11-12
us-eu.org/2018-u-s-eu-workshop/