

# THE FUTURE OF THE NNI AND CRITICAL ROLE OF INFRASTRUCTURE

Branden Brough, PhD

Director, National Nanotechnology Coordination Office

October 26, 2023

NNCI Annual Conference, Stanford University



# NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

“**Just imagine**, materials with 10 times the strength of steel and only a fraction of the weight; shrinking all the information at the Library of Congress into a device the size of a sugar cube; detecting cancerous tumors that are only a few cells in size. Some of these research goals will **take 20 or more years** to achieve. But that is why -- precisely why -- as Dr. Baltimore said, there is such a **critical role for the federal government.**”

-President Bill Clinton, January 21, 2000



Today at the White House, the President signed into law the **21st Century Nanotechnology Research and Development Act**... Nanotechnology promises to be both evolutionary and revolutionary--improving and creating entirely new products and processes in areas from electronics to health care.

-White House Press Release, December 3, 2003





**NNI Vision:** A future in which the ability to understand and control matter at the nanoscale leads to ongoing revolutions in technology and industry that benefits society.

NASA

USDA/NIFA  
USDA/ARS  
USDA  
USDA/FS  
US  
OSTP  
OMB  
CPSC  
DHS

DOC/BIS  
DOC/EDA  
EDA  
U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

DOC/ITA  
DOC/NIST  
NIST

DOC/USPTO

DOD

DOE

DOEd

DOI/BSEE  
BSEE  
Bureau of Safety and Environmental Enforcement

DOI/USBR  
BUREAU OF RECLAMATION  
U.S. DEPARTMENT OF THE INTERIOR

USGS  
science for a changing world  
DOI/USGS

DOJ/NIJ

DOL/OSHA

DOS

DOT/FHWA

DOTr

EPA

HHS/BARDA

CDC  
CENTERS FOR DISEASE CONTROL AND PREVENTION

HHS/CDC/ATSDR  
HHS/CDC/NCEH

HHS/CDC/NIOSH  
NIOSH

HHS/FDA  
FDA

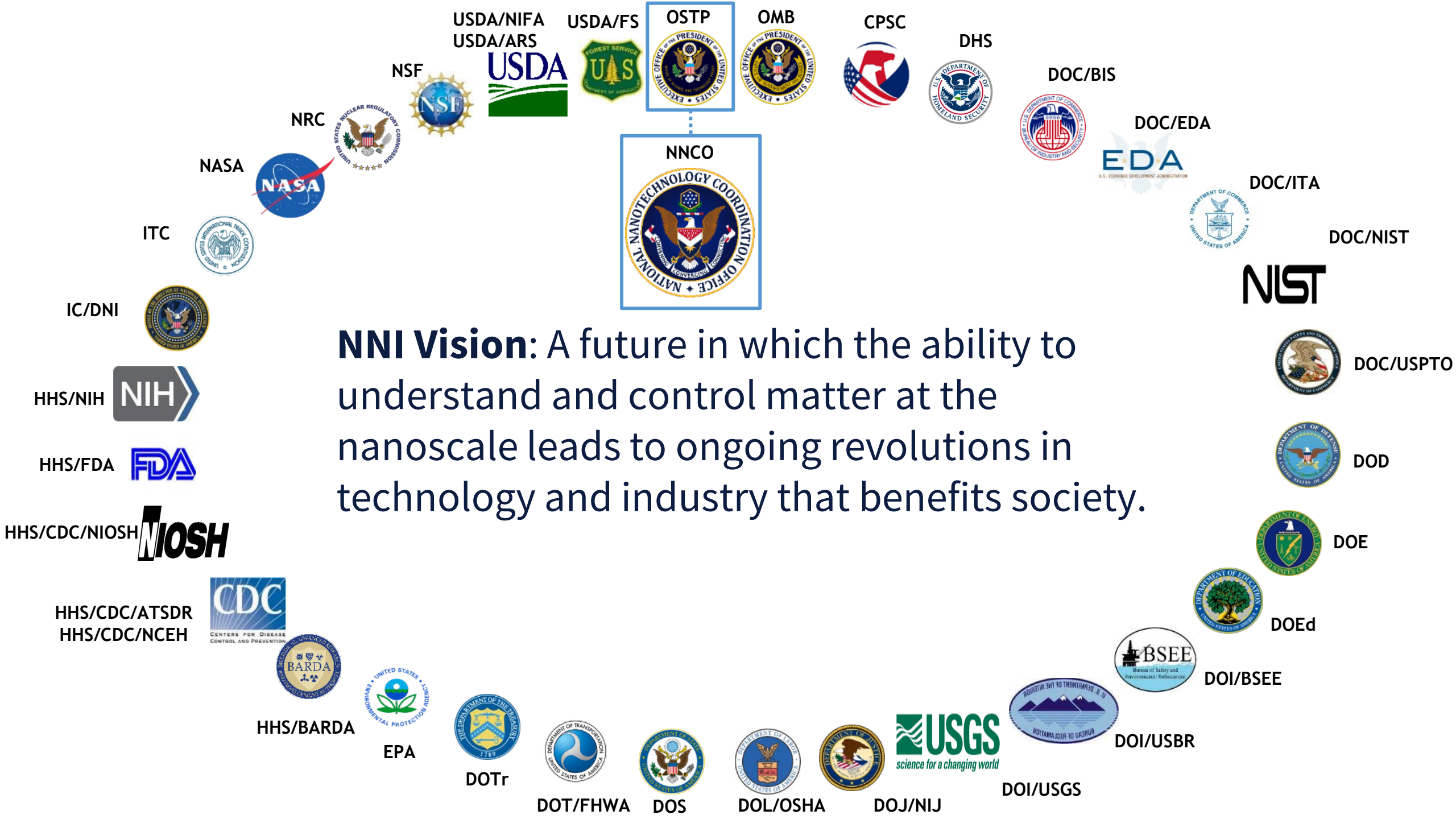
HHS/NIH  
NIH

IC/DNI

ITC

NRC  
NUCLEAR REGULATORY COMMISSION

ITC  
INTERNATIONAL TRADE COMMISSION



**NNI Vision:** A future in which the ability to understand and control matter at the nanoscale leads to ongoing revolutions in technology and industry that benefits society.

# 2021 NNI STRATEGIC PLAN

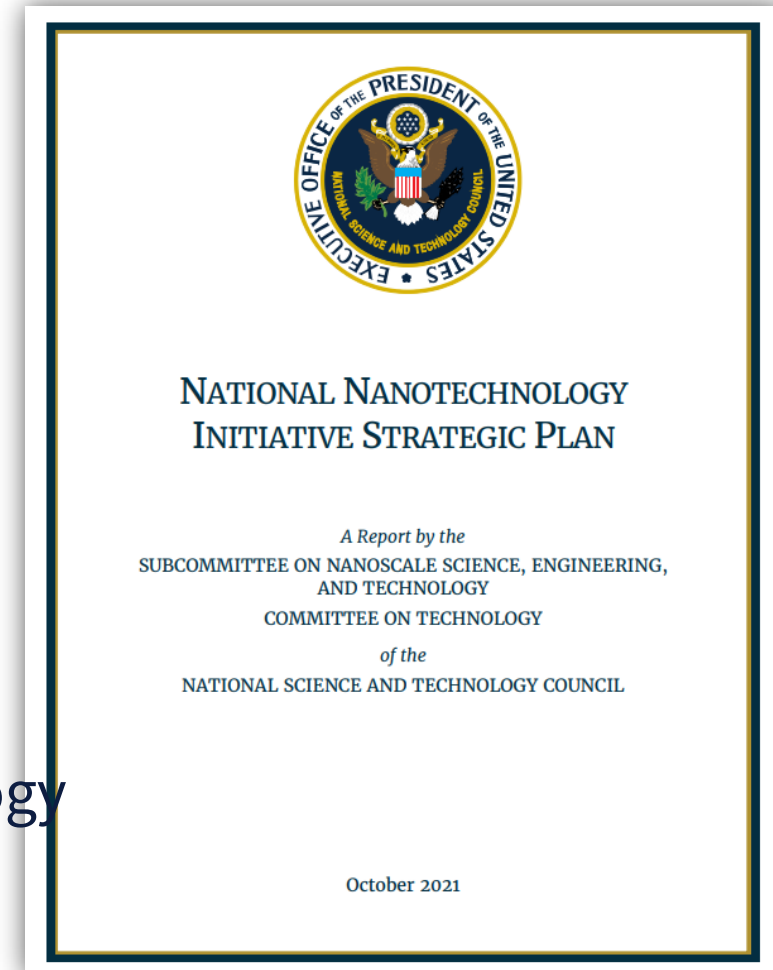
**Goal 1:** Ensure that the United States remains a world leader in nanotechnology research and development

**Goal 2:** Promote commercialization of nanotechnology R&D

**Goal 3:** Provide the infrastructure to sustainably support nanotechnology research, development, and deployment

**Goal 4:** Engage the public and expand the nanotechnology workforce

**Goal 5:** Ensure the responsible development of nanotechnology



# BIDEN-HARRIS ADMINISTRATION R&D PRIORITIES (AND NNI OPPORTUNITIES)

- Advance trustworthy AI technology
- Lead the world in maintaining global security and stability
- Step up to the global challenge of meeting the climate crisis
- Achieve better health outcomes for every person
- Reduce barriers and inequities
- Bolster the R&D and industrial innovation
- Strengthen, advance, and use America's unparalleled research



EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20503



August 17, 2023

M-23-20

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: SHALANDA D. YOUNG *Shalanda D. Young*  
DIRECTOR  
OFFICE OF MANAGEMENT AND BUDGET

ARATI PRABHAKAR *Arati Prabhakar*  
DIRECTOR  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Multi-Agency Research and Development Priorities for the FY 2025 Budget

Our Nation has immense aspirations today: achieving robust health and ample opportunity for each person in every community; overcoming the climate crisis by reimagining our infrastructure, restoring our relationship with nature, and securing environmental justice; sustaining global security and stability; building a competitive economy that creates good-paying jobs; realizing the benefits of artificial intelligence while managing its risks; and fostering a strong, resilient, and thriving democracy. The purpose of public science, technology, and innovation is to open doors to make these aspirations possible.

Because Federal research and development (R&D) is integral to the just, vibrant, and ambitious future that America seeks, President Biden is prioritizing R&D funding and mobilizing America's powerful R&D ecosystem. To make its vital contribution to our future, federal R&D must sustain America's leadership position in science and technology. It must take aim at and achieve bold, barely feasible goals. Federal R&D must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not traditionally benefited from R&D—from K-12 education and workforce training to construction and traffic safety.

This memorandum outlines the Administration's multi-agency R&D priorities for formulating fiscal year (FY) 2025 Budget submissions to the Office of Management and Budget (OMB). These priorities should be addressed within the FY 2025 Budget guidance levels provided by OMB. Clear choices will be required given constrained discretionary funding caps. Agency budget submissions should include an addendum that details how each request level addresses these priorities. Agencies engaged in complementary activities are expected to consult with one another during the budget formulation process to maximize impact by coordinating resources and avoiding unnecessary

# THE CHIPS AND SCIENCE ACT

- Provides appropriations to improve U.S. competitiveness in semiconductor/microelectronics manufacturing, research, and education/workforce (DOC, incl. NIST, DOD, NSF, State)
- Authorizes broad research and development activities (DOE, NIST, NSF, NASA, more)



# BIDEN-HARRIS ADMINISTRATION R&D PRIORITIES (AND NNI OPPORTUNITIES)

- Advance trustworthy AI technology
- Lead the world in maintaining global security and stability
- Step up to the global challenge of meeting the climate crisis
- Achieve better health outcomes for every person
- Reduce barriers and inequities
- Bolster the R&D and industrial innovation
- Strengthen, advance, and use America's unparalleled research



EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20503



August 17, 2023

M-23-20

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: SHALANDA D. YOUNG *Shalanda D. Young*  
DIRECTOR  
OFFICE OF MANAGEMENT AND BUDGET

ARATI PRABHAKAR *Arati Prabhakar*  
DIRECTOR  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Multi-Agency Research and Development Priorities for the FY 2025 Budget

Our Nation has immense aspirations today: achieving robust health and ample opportunity for each person in every community; overcoming the climate crisis by reimagining our infrastructure, restoring our relationship with nature, and securing environmental justice; sustaining global security and stability; building a competitive economy that creates good-paying jobs; realizing the benefits of artificial intelligence while managing its risks; and fostering a strong, resilient, and thriving democracy. The purpose of public science, technology, and innovation is to open doors to make these aspirations possible.

Because Federal research and development (R&D) is integral to the just, vibrant, and ambitious future that America seeks, President Biden is prioritizing R&D funding and mobilizing America's powerful R&D ecosystem. To make its vital contribution to our future, federal R&D must sustain America's leadership position in science and technology. It must take aim at and achieve bold, barely feasible goals. Federal R&D must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not traditionally benefited from R&D—from K-12 education and workforce training to construction and traffic safety.

This memorandum outlines the Administration's multi-agency R&D priorities for formulating fiscal year (FY) 2025 Budget submissions to the Office of Management and Budget (OMB). These priorities should be addressed within the FY 2025 Budget guidance levels provided by OMB. Clear choices will be required given constrained discretionary funding caps. Agency budget submissions should include an addendum that details how each request level addresses these priorities. Agencies engaged in complementary activities are expected to consult with one another during the budget formulation process to maximize impact by coordinating resources and avoiding unnecessary



# BIDEN-HARRIS ADMINISTRATION R&D PRIORITIES (AND NNI OPPORTUNITIES)

- Advance trustworthy AI technology
- Lead the world in maintaining global security and stability

Step up to the global challenge of meeting the climate crisis

- Achieve better health outcomes for every person
- Reduce barriers and inequities
- Bolster the R&D and industrial innovation
- Strengthen, advance, and use America's unparalleled research



EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20503



August 17, 2023

M-23-20

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: SHALANDA D. YOUNG *Shalanda D. Young*  
DIRECTOR  
OFFICE OF MANAGEMENT AND BUDGET

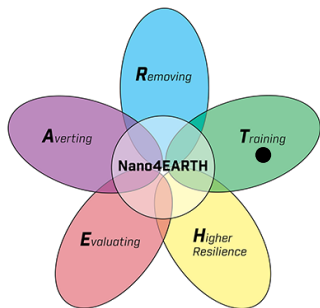
ARATI PRABHAKAR *Arati Prabhakar*  
DIRECTOR  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

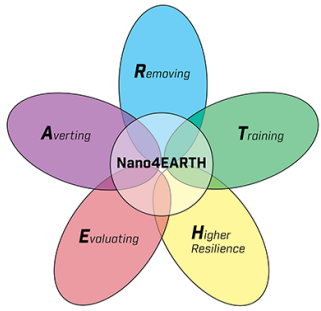
SUBJECT: Multi-Agency Research and Development Priorities for the FY 2025 Budget

Our Nation has immense aspirations today: achieving robust health and ample opportunity for each person in every community; overcoming the climate crisis by reimagining our infrastructure, restoring our relationship with nature, and securing environmental justice; sustaining global security and stability; building a competitive economy that creates good-paying jobs; realizing the benefits of artificial intelligence while managing its risks; and fostering a strong, resilient, and thriving democracy. The purpose of public science, technology, and innovation is to open doors to make these aspirations possible.

Because Federal research and development (R&D) is integral to the just, vibrant, and ambitious future that America seeks, President Biden is prioritizing R&D funding and mobilizing America's powerful R&D ecosystem. To make its vital contribution to our future, federal R&D must sustain America's leadership position in science and technology. It must take aim at and achieve bold, barely feasible goals. Federal R&D must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not traditionally benefited from R&D—from K-12 education and workforce training to construction and traffic safety.

This memorandum outlines the Administration's multi-agency R&D priorities for formulating fiscal year (FY) 2025 Budget submissions to the Office of Management and Budget (OMB). These priorities should be addressed within the FY 2025 Budget guidance levels provided by OMB. Clear choices will be required given constrained discretionary funding caps. Agency budget submissions should include an addendum that details how each request level addresses these priorities. Agencies engaged in complementary activities are expected to consult with one another during the budget formulation process to maximize impact by coordinating resources and avoiding unnecessary





# Nano4EARTH

Accelerating nanotechnology solutions  
to overcome climate change

- Kick-off Workshop (Jan. 24-25)
- Roundtable discussions
  - Interfaces + (July 6)
  - Batteries (Sept. 26)
  - GHG Capture (Nov. 2)
  - Catalysts (Jan: TBD)
- Perspective article (tentatively Nature Nanotech)
- Podcast
- TechConnect session
- Report
- Community led events



JANUARY 26, 2023

## Readout of Nano4EARTH Kick-off Workshop

 [OSTP](#) [NEWS & UPDATES](#) [PRESS RELEASES](#)

The White House Office of Science and Technology Policy (OSTP) and the National Nanotechnology Initiative (NNI) [recently announced Nano4EARTH](#), a National Nanotechnology Challenge to develop technologies and industries that advance the Biden-Harris Administration's commitment to tackling the climate crisis. To energize a wide-ranging community and build a foundation for the challenge, the National Nanotechnology Coordination Office (NNCO) organized the [Nano4EARTH Kick-off Workshop](#) in late January. More than 400 people across sectors, with diverse expertise and perspectives, participated in the event.

Discussions focused on identifying nanotechnologies that are poised to have an impact on climate change in four years or less, in addition to sharing resources available to address barriers to entrepreneurship and technology adoption. Goals and metrics to maintain momentum throughout the challenge were also identified. New connections and networks spanning federal agencies, non-federal organizations, and industry were created and several examples of collaborations and events centered on nanotechnology and

# BIDEN-HARRIS ADMINISTRATION R&D PRIORITIES (AND NNI OPPORTUNITIES)

- Advance trustworthy AI technology
- Lead the world in maintaining global security and stability
- Step up to the global challenge of meeting the climate crisis
- Achieve better health outcomes for every person
- Reduce barriers and inequities
- Bolster the R&D and industrial innovation
- Strengthen, advance, and use America's unparalleled research



EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20503



August 17, 2023

M-23-20

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: SHALANDA D. YOUNG *Shalanda D. Young*  
DIRECTOR  
OFFICE OF MANAGEMENT AND BUDGET

ARATI PRABHAKAR *Arati Prabhakar*  
DIRECTOR  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Multi-Agency Research and Development Priorities for the FY 2025 Budget

Our Nation has immense aspirations today: achieving robust health and ample opportunity for each person in every community; overcoming the climate crisis by reimagining our infrastructure, restoring our relationship with nature, and securing environmental justice; sustaining global security and stability; building a competitive economy that creates good-paying jobs; realizing the benefits of artificial intelligence while managing its risks; and fostering a strong, resilient, and thriving democracy. The purpose of public science, technology, and innovation is to open doors to make these aspirations possible.

Because Federal research and development (R&D) is integral to the just, vibrant, and ambitious future that America seeks, President Biden is prioritizing R&D funding and mobilizing America's powerful R&D ecosystem. To make its vital contribution to our future, federal R&D must sustain America's leadership position in science and technology. It must take aim at and achieve bold, barely feasible goals. Federal R&D must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not traditionally benefited from R&D—from K-12 education and workforce training to construction and traffic safety.

This memorandum outlines the Administration's multi-agency R&D priorities for formulating fiscal year (FY) 2025 Budget submissions to the Office of Management and Budget (OMB). These priorities should be addressed within the FY 2025 Budget guidance levels provided by OMB. Clear choices will be required given constrained discretionary funding caps. Agency budget submissions should include an addendum that details how each request level addresses these priorities. Agencies engaged in complementary activities are expected to consult with one another during the budget formulation process to maximize impact by coordinating resources and avoiding unnecessary

# BIDEN-HARRIS ADMINISTRATION R&D PRIORITIES (AND NNI OPPORTUNITIES)

- Advance trustworthy AI technology
  - Lead the world in maintaining global security and stability
  - Step up to the global challenge of meeting the climate crisis
  - Achieve better health outcomes for every person
- Reduce barriers and inequities
  - Bolster the R&D and industrial innovation
  - Strengthen, advance, and use America's unparalleled research



EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20503



August 17, 2023

M-23-20

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: SHALANDA D. YOUNG *Shalanda D. Young*  
DIRECTOR  
OFFICE OF MANAGEMENT AND BUDGET

ARATI PRABHAKAR *Arati Prabhakar*  
DIRECTOR  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Multi-Agency Research and Development Priorities for the FY 2025 Budget

Our Nation has immense aspirations today: achieving robust health and ample opportunity for each person in every community; overcoming the climate crisis by reimagining our infrastructure, restoring our relationship with nature, and securing environmental justice; sustaining global security and stability; building a competitive economy that creates good-paying jobs; realizing the benefits of artificial intelligence while managing its risks; and fostering a strong, resilient, and thriving democracy. The purpose of public science, technology, and innovation is to open doors to make these aspirations possible.

Because Federal research and development (R&D) is integral to the just, vibrant, and ambitious future that America seeks, President Biden is prioritizing R&D funding and mobilizing America's powerful R&D ecosystem. To make its vital contribution to our future, federal R&D must sustain America's leadership position in science and technology. It must take aim at and achieve bold, barely feasible goals. Federal R&D must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not traditionally benefited from R&D—from K-12 education and workforce training to construction and traffic safety.

This memorandum outlines the Administration's multi-agency R&D priorities for formulating fiscal year (FY) 2025 Budget submissions to the Office of Management and Budget (OMB). These priorities should be addressed within the FY 2025 Budget guidance levels provided by OMB. Clear choices will be required given constrained discretionary funding caps. Agency budget submissions should include an addendum that details how each request level addresses these priorities. Agencies engaged in complementary activities are expected to consult with one another during the budget formulation process to maximize impact by coordinating resources and avoiding unnecessary

# NANOTECHNOLOGY INFRASTRUCTURE LEADERS SUMMIT

## SEPTEMBER 11, 2023

- Meeting of leaders from 35 different shared research infrastructure organizations
- Goals
  - Create a network of networks
  - Identify opportunities that would benefit users and centers
  - Catalyze collaborations

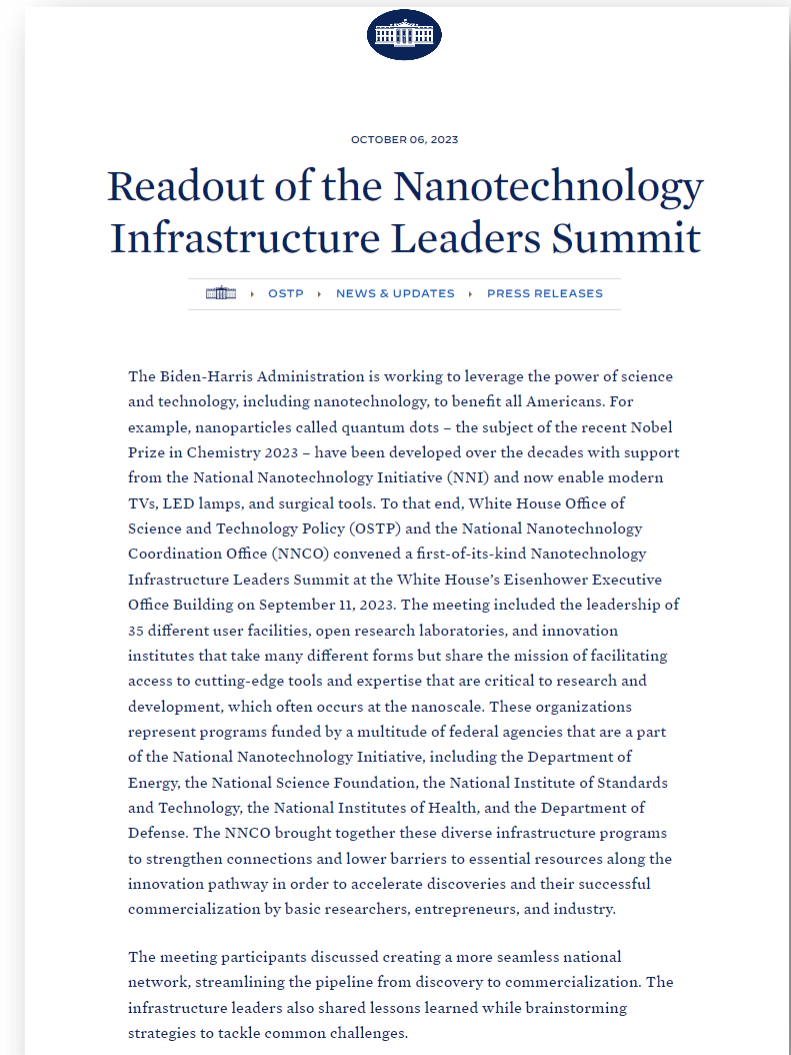


# NANOTECHNOLOGY INFRASTRUCTURE LEADERS SUMMIT

## SEPTEMBER 11, 2023

Common themes of the discussions were:

- Despite different operating models, there are opportunities to **share best practices** across organizations.
- Better **collaboration and communication** can also help bridge basic science and applied research and manufacturing.
- **Broad understanding** of the breadth and diversity of the nation's shared infrastructure by researchers, entrepreneurs, and industry is required in order to realize the full potential of the network.



# NASEM REVIEW OF THE NNI

- Analyze the composition of the science and engineering community currently being served by the nation's nanotechnology R&D infrastructure.
  - Explore trends, opportunities, and emerging use cases
  - Explore how geography, organization type, career stage, project focus area, and other factors influence awareness, access, and opportunity. The metrics used to track and evaluate success may also be considered.
- Identify barriers to use for communities who are not fully engaging with nanotechnology R&D infrastructure.
  - Examples: awareness, interaction models, peer review models, financial and travel logistics, remote access resources, IP and contractual agreements, opportunities to enhance data and resource sharing, and approaches to incentivizing use.
  - Recommend possible improvements to assist in achieving equitable and impactful national engagement in, and use of, existing infrastructure.



# PCAST REPORT

- Nanotechnology research is critical to U.S. innovation and needs to continue
- Nanotech has proven value: microelectronics, mRNA vaccines, next gen energy tech, myriad other materials
- 3,700 companies that identify as nanotech enterprises generated \$42B in revenue and employed 171,000 workers in 2017; Many more companies employ nanotech as part of their broader business portfolio, making total value to the US economy substantial



---

REPORT TO THE PRESIDENT AND TO CONGRESS  
The Seventh Assessment of the  
National Nanotechnology Initiative

---

Executive Office of the President  
President's Council of Advisors on  
Science and Technology

August 2023





# PCAST REPORT

“The ingenuity of scientists and engineers in the United States and the leadership of the federal government across five administrations nurtured an emerging technology into an established advanced technology that continues to provide solutions to American and global challenges.

“The National Nanotechnology Initiative (NNI) was a driving force behind these accomplishments.”



---

REPORT TO THE PRESIDENT AND TO CONGRESS  
The Seventh Assessment of the  
National Nanotechnology Initiative

---

Executive Office of the President  
President's Council of Advisors on  
Science and Technology

August 2023



# PCAST REPORT

## Recommendations

1. ...sunset or substantially revise the 21st Century Nanotechnology R&D Act.
2. ...the NSET Subcommittee to continue leadership for Federal coordination of nanotechnology strategic planning, implementation, and outreach.
3. ...enhance experiential learning programs for nanotechnology students and scientists to become the collaborative, multi-disciplinary workforce needed for nanotechnology and other advanced technologies.



---

REPORT TO THE PRESIDENT AND TO CONGRESS  
The Seventh Assessment of the  
National Nanotechnology Initiative

---

Executive Office of the President  
President's Council of Advisors on  
Science and Technology

August 2023



# DOE BESAC CHARGE

## DECEMBER 2022

- What has been the impact of the NSRCs? Consider scientific productivity, instrumentation advances, user community, contributions to national priorities, including energy technologies, and other metrics. What aspects of these facilities are “world-leading”?
- How are the collective NSRCs synergistic? What are the unique scientific roles?
- The initial vision for the NSRCs included synergies with the other user facilities at each of the laboratories. Has this vision been realized? What future directions are most promising?
- What are the best practices and opportunities for enhancement in the NSRC outreach activities to ensure a diverse user community?
- How should the NSRCs evolve to better serve the nation and user research?



# NANOEHS RESEARCH STRATEGY

Strategy document originally was published in 2011; ~100 citations

- Human exposure assessment
- Informatics and modeling
- Human health
- Environment
- Risk assessment and risk management
- Nanomaterial Measurement Infrastructure
- Ethical, Legal and Social Implications

RFI: Spring 2023

Public Meeting: May 31-June 1

Final draft to be released this fall





# Enabling the Nanotechnology Revolution: *Celebrating the 20th Anniversary of the 21st Century Nanotechnology Research and Development Act*

**March 5, 9-5, National Academies**

[www.nano.gov/anniversarysymposium](http://www.nano.gov/anniversarysymposium)



**Ilke Arslan**  
Argonne National  
Laboratory



**Theresa Dankovich**  
Folia Materials



**Ali Beskok**  
Southern Methodist  
University



**Doyle Edwards**  
Brewer Science



**Bob Ehrmann**  
Pennsylvania State  
University  
(tentative)



**LaMar Hill**  
NY CREATES  
(tentative)



**Cheryl Kerfeld**  
Michigan State  
University, LBNL



**Kei Koizumi**  
Office of Science  
and Technology  
Policy



**Rick Schneider**  
Google  
(tentative)



**Mihail C. Roco**  
National Science  
Foundation



**Reginald Rogers**  
University of  
Missouri, Columbia



**Mikkel Thomas**  
Georgia Institute of  
Technology



**Jameson Wetmore**  
Arizona State  
University



**Denis Wirtz**  
Johns Hopkins  
University



**Miguel José Yacamán**  
Northern Arizona  
University



**Hannah Zierden**  
University of  
Maryland



# Enabling the Nanotechnology Revolution: *Celebrating the 20th Anniversary of the 21st Century Nanotechnology Research and Development Act*

March 5, 9-5, National Academies

[www.nano.gov/anniversarysymposium](http://www.nano.gov/anniversarysymposium)

## Featured Speakers



**Arati Prabhakar**  
Chief Science  
Advisor to  
President Biden;  
OSTP Director



**Neal Lane**  
Rice University;  
Former Science  
Advisor to  
President Clinton  
and OSTP Director



**Ron Wyden**  
U.S. Senator  
from Oregon



**Chad Mirkin**  
Northwestern University



**Kate Rubins**  
NASA Astronaut  
(tentative)



**Maxx Arguilla**  
University of  
California, Irvine



**Jennifer Dionne**  
Stanford  
University



**Saniya LeBlanc**  
George Washington  
University (tentative)



**Register Today!**

# JOIN THE CONVERSATION!

## Engage

- Webinars and Workshops
- Respond to Requests For Information (RFI)
- Share news and highlights
- Contact the NNCO: [info@nnco.nano.gov](mailto:info@nnco.nano.gov)

## Follow Social Media

 [www.nano.gov](http://www.nano.gov)

 @NNInanonews

 National Nanotechnology Initiative

 NanoTube - The National Nanotechnology Initiative



# SUMMARY

- The NNI is evolving but the future looks bright
- The NNI is well aligned with the nation's R&D priorities
- Shared Infrastructure/User Facilities are central to the NNI
- CHIPS/microelectronics is a significant driver but not the only priority
- User facilities can uniquely reduce barriers and inequities
- Expanding the network through coordination is critical and impactful
- Continue to be involved in the broader NNI community





# THANK YOU

Branden Brough, PhD  
Director, National Nanotechnology Coordination Office

<http://www.nano.gov/>  
[bbrough@nnco.nano.gov](mailto:bbrough@nnco.nano.gov)

