President's FY 2009 Budget Request for the National Institute of Standards and Technology

Advancing Innovation for Economic Growth, Safety & Security

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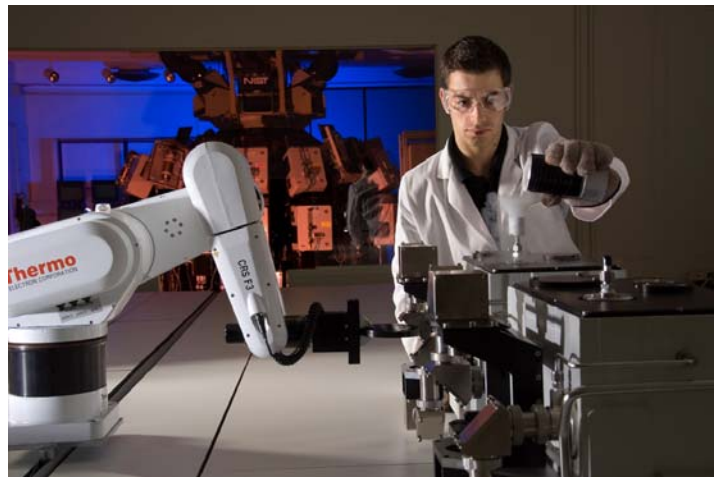
U.S. Department of Commerce

A Call to Action . . .

America COMPETES Act (P.L.110-69)

- A comprehensive strategy to keep America the most innovative nation in the world
- Authorizes American Competitiveness Initiative (ACI)-related programs at NIST, NSF, and DOE
- ACI highlighted in the President's State of the Union address
- First NIST authorization bill enacted in 12 years, the Act authorizes substantial increases in funding for basic research in physical sciences — NIST, DOE, NSF



"The only way we can hope to compete is with brains and ideas that set us above the competition—and that only comes from investments in education and R&D"

Craig Barrett, Chairman, Intel

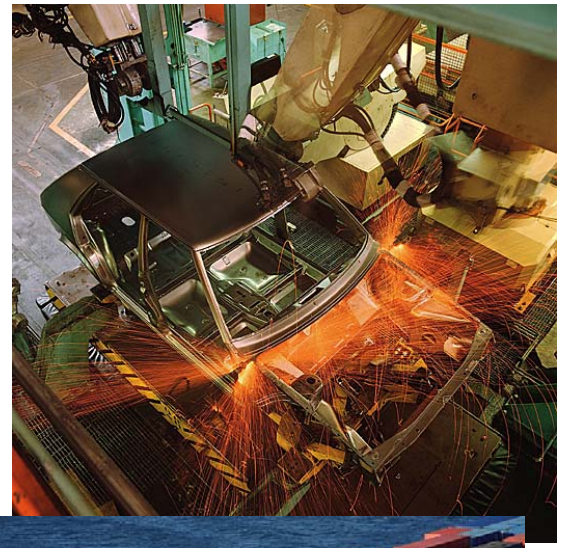
NIST infrastructure paves the way to innovation

The equivalent of research “roads and bridges” the industrial and scientific communities need to develop and commercialize new technologies

- Groundbreaking research tools that enable work in new fields — quantum information, nanotechnology, molecular bioscience
- Better measurement methods to ensure quality
- Performance measures for accurate technology comparisons
- Standards to assure fairness in trade

The result: a broad impact on everyday life

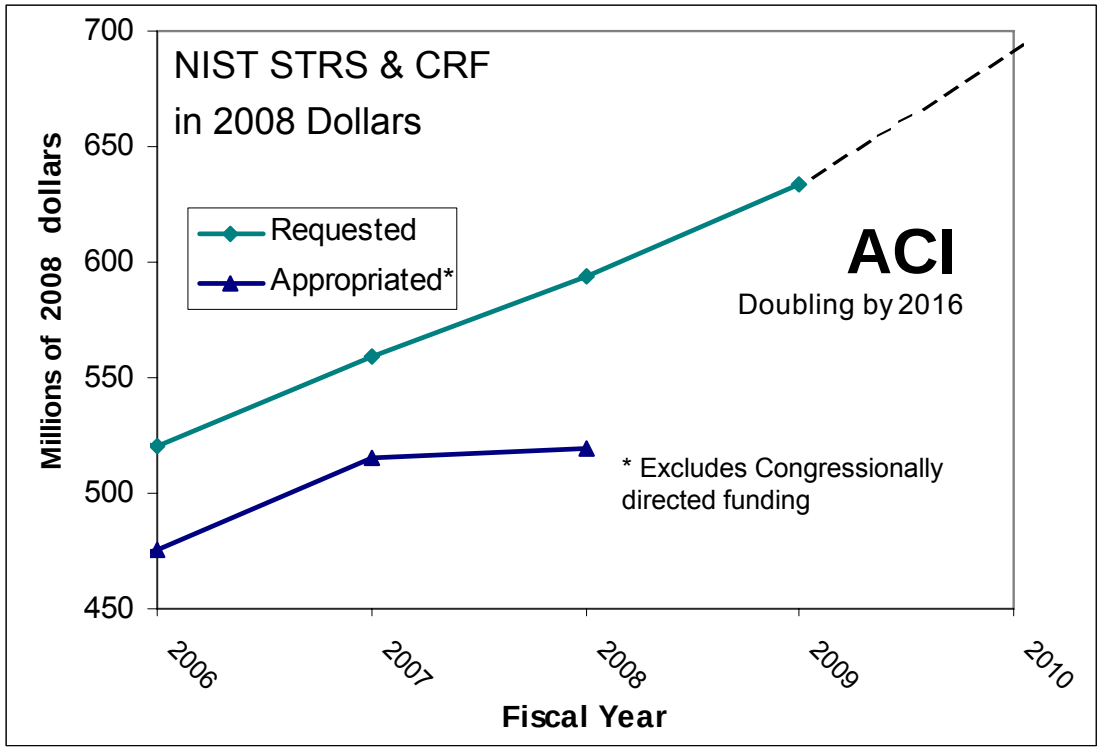
- Advancing manufacturing and services
- Helping ensure fair trade
- Improving public safety and security
- Improving quality of life



All photos © Corbis

ACI , America COMPETES – NIST has a major role

- NIST core research and facilities funding is critical to U.S. innovation,
- Both ACI and the America COMPETES Act call for substantially increased funding of NIST core research and facilities
- Increases provided in FY 2007 allowed projects to start in nanotech, neutron research, quantum science, need to sustain momentum
- FY 2008, NIST Laboratory funding cut in real dollars
  - $13.5 million short of the amount needed to cover salary increases and other anticipated costs
  - Can't fund planned projects involving an additional 300 experts in hot R&D areas needed to jump start innovation efforts
- Need to get back on the ACI doubling track



Getting Back on the Doubling Track—FY 2009 Request for NIST

(in millions of dollars)

	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Scientific & Technical Research & Services (without directed grants)	**$434.4**	**$439.6***	**$535.0**
Construction of Research Facilities	**$ 58.7**	**$ 79.2****	**$ 99.0**
(without directed projects & construction grants)	**$493.1**	**$518.8*/****	**$634.0**
NIST Core		Δ (08-09)	**= +$115.2** (+22%)
Industrial Technology Services	**$183.8** (MEP+ATP)	**$154.8** (MEP+TIP)	**$ 4.0** (MEP)
Total NIST	**$676.9**	**$673.6*/****	**$638.0**

* Does not include $0.9 million for a congressionally directed project

** Does not include $81.3 million for congressionally directed projects and competitive construction grants

Budget Request for MEP and Technology Innovation Program

President's FY 2009 budget proposes an end to federal funding of the Hollings Manufacturing Extension Partnership Program and the Technology Innovation Program (TIP)

- Very difficult decisions based on the need to fund higher priorities during tough budget times
- FY 2009 request provides $4M for federal MEP shutdown costs
- No TIP funding requested for FY 2009
- TIP phase out costs would be funded from carryover funds from FY 2008

FY 2009 President's Budget Request Increases for NIST

Includes three major areas of high priority national needs to be met by 17 NIST research and facilities initiative programs:

- Addressing urgent environment, safety, and security needs (+$26.2 million)
- Investing in strategic and rapidly advancing technologies (+$42.8 million)
- Boosting U.S. science/engineering capacity and capability (+$63.7 million)

FY 2009 President's Budget Request Increases for NIST

New initiatives are in blue italics

Addressing urgent environment, safety, and security needs (+$26.2 million)

- *Nanotechnology: Environment, Health & Safety Infrastructure*
- Climate Change Science: Measurements and Standards
- National Earthquake Hazards Reduction Program
- Disaster Resilient Structures and Communities
- Biometrics: Identifying Friend or Foe

Investing in strategic and rapidly advancing technologies (+$42.8 million)

- *Bioscience Measurements & Standards*
- Quantum Information Science
- Nanotechnology: Discovery to Manufacture
- Innovations in Measurement Science
- *Comprehensive National Cyber Security Initiative: Leap Ahead Technologies*
- *Optical Communications and Computing*
- Enabling the Use of Hydrogen as a Fuel
- Manufacturing Innovation through Supply Chain Integration

Boosting U.S. science/engineering capacity and capability (+$63.7 million)

- NIST Center for Neutron Research (NCNR) Capacity and Capability*
- Boulder Building 1 Extension: 21st Century Tools
- *JILA Building Expansion: Pushing the Scientific Frontier*
- Safety, Capacity, Maintenance and Major Repairs

***** added in FY 2009 to a previously funded initiative

Nanotechnology: Environment, Health & Safety (+$12M)

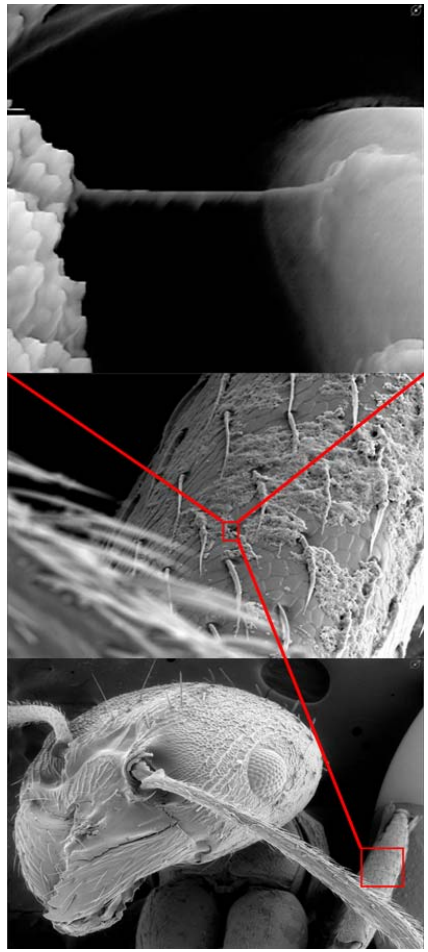
Environmental, health & safety of nanotechnology—Very little known

- Hundreds of products already contain nanoscale components
- Regulatory agencies lack basic scientific information to assess and address risks
- Industry concerned about liability

Funding increase will allow:

- Development of accurate measurement and detection methods
- Industry to exploit the tremendous economic potential of nanotech safely
- Consumers to retain confidence in nanotech products

> " NIST is ideally positioned to lead the development of characterization methods and standards, building on extensive expertise and experience in this area [of nano-EHS]." – *Woodrow Wilson International Center (2006)*



NIST image

A carbon nanotube is shown on the hair of an ant's leg

Climate Change Science: Measurements and Standards (+$5M)

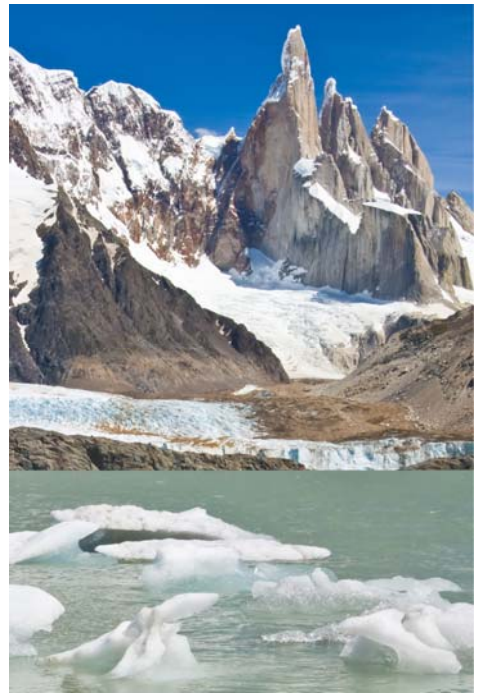
Measurements are critical to predicting climate change

Interagency Strategic Plan—2 critical gaps

- Discrepancies in measuring solar intensity
- Quantitative info on interplay of aerosols and sunlight

Initiative will help climate modelers by:

- Standardizing calibrations to reduce uncertainties in international data comparisons
- Providing new measurement methods and a properties database for aerosols



Accurately measuring the total light output from the sun can help scientists better understand and predict climate changes on Earth.

Global climate change policies potentially have large impacts on the economy. NIST can help policy makers by providing the best measurement methods and data possible for climate change science.

National Earthquake Hazards Reduction Program (+$3.3M)

Earthquakes strike without warning and can do devastating damage

- 75 million people in urban areas at moderate to high risk
- Economic value alone in these regions close to $8.6 trillion
- Single major event can cost $100 billion – $200 billion

Initiative will produce

- Updated model building codes and standards
- Tools for evaluating seismic strength of new and existing buildings
- Technical resources for structural engineers

NIST Photo

Improved measurement tools can better identify earthquake-prone buildings before they face the risk of collapse.

Disaster Resilient Structures/Communities (+$4M)

Disaster resilience depends in large measure on building codes and practices

- $1 spent on hazard mitigation saves society an average of $4

NIST and NOAA have coordinated programs

- NIST will help develop standards, decision support tools, wind prediction methods, and risk-based storm maps that will
  - Reduce risk from hurricanes, wildland-urban fires, and earthquakes
  - Create science-based tools for hazard mitigation
  - Yield short- and long-term improvement in building codes

photo courtesy FEMA

Shown above is a bridge in Mississippi destroyed by Hurricane Katrina. Risk-based storm surge maps are needed to help improve design of structures in coastal regions.

Biometrics: Identifying Friend or Foe (+$2M)

Automated tools needed to identify people

- Protect borders
- Yet allow efficient travel

NIST has decades of experience

- Assisting FBI, Homeland Security, State Department
- Managing Face Recognition Grand Challenge

Increased funding will enable

- Facial recognition for border security
- Testing for multimodal systems
- Interoperability of biometric systems
- Simultaneous facial recognition, fingerprint and iris scan technologies

Identification systems that combine two or more types of biometric data such as fingerprint, facial, and iris scans promise to bring significant improvements to border security.

Bioscience Measurement and Standards (+$10M)

Inaccurate bioscience measurements increase the cost and lower the quality of healthcare

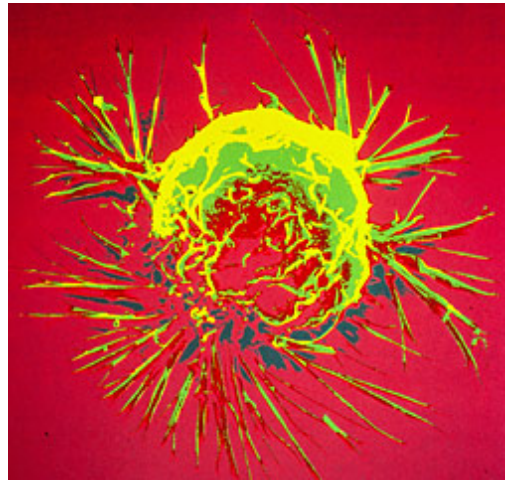
- Requires retesting, possible misdiagnosis
- Costly drug design, $1 billion per drug, 8-10 years, 8% reach market

Biopharmaceutical economics study found:

- Better measurements should reduce R&D costs for approved drugs by 25-45%
- Reduce manufacturing costs by 23%

NIST bioscience initiative will help

- Reduce errors, reduce costs, and enable innovative medical technologies
- Pave the way to personalized medicine
- Widen use of bioinformatics and modeling tools
- Enable “systems biology”—quantitative approach to disease analysis and drug design



Source: National Cancer Institute

False color image of breast cancer cell. Breast cancer alone can be linked to mutations in over 100 different genes – with no two tumors sharing the same pattern of mutations. This diversity makes treatment and management of cancer extremely difficult.

Inaccurate bioscience measurements sometimes make it hard to tell when treatments are healing or causing harm.

Quantum Information Science (+$7M)

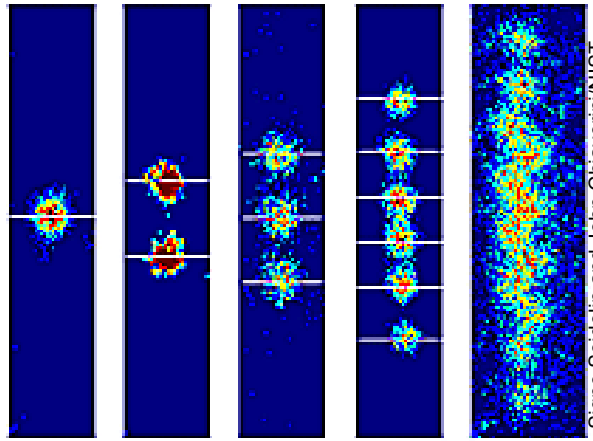
Revolutionary potential, unbreakable communications codes, and ultrapowerful computers

- Uses atoms, electrons and light particles as quantum computer “bits” or qubits

NIST is a world leader in the field

Increased funding will allow:

- Additional student training at the Joint Quantum Institute, collaboration of NIST and University of Maryland
- Development of quantum “wires” using “teleportation” and other quantum computer components
- Development of an all optical clock for ultraprecise time and frequency measurements



Signe Seidelin and John Chiaverini/NIST

Electrically charged atoms such as those in this picture may be used to build "quantum computers" that could perform information-processing tasks that are impossible with conventional computers.

Nanotechnology: From Discovery to Manufacture (+$7M)

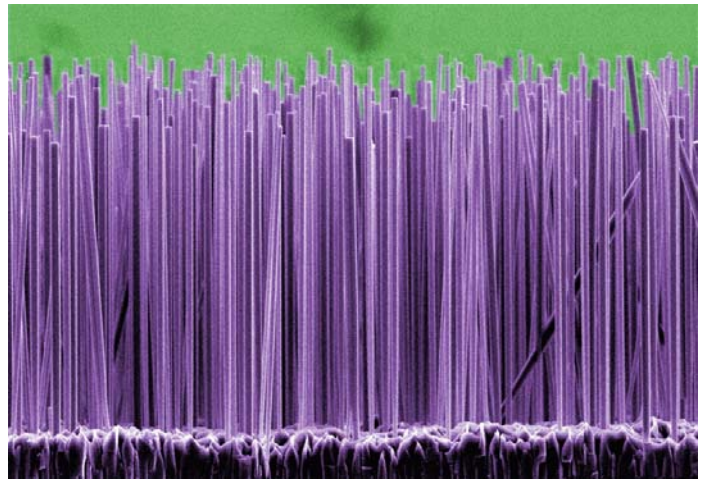
Nanoscale components, dominant factor in 21st century economy

Small size of nanoscale components requires

- Whole new measurement system
- New ways to quantify properties with accurate measures of size, shape, chemical composition, etc.

Measurement infrastructure developed with initiative funding will:

- Speed pace of nanotech research for government, industry & academia
- Accelerate commercialization
- Improve product quality
- Enable electronic chips that are faster, smaller, more efficient
- Improve manufacturing yields



Source: NIST

The semiconductor "nanowires" above are part of a project to develop measurement tools for understanding nanolasers. About 800 nanowires would fit within the thickness of a human hair.

NIST Center for Nanoscale Science and Technology

- Bridges gaps between science and production
- Nanofab user facility
- A critical resource for researchers from industry and academia

Innovations in Measurement Science (+$3M)

Program serves as an innovation incubator

High-risk, leading edge research that anticipates industry needs

Competitive, focused on multidisciplinary work aimed at innovation

Examples of past projects

- Quantum information science
- Fuel cell science
- 3D chemical imaging
- Plastic electronics

NIST researchers funded through a measurement innovation program have invented techniques to quantify the properties of new materials, such as electricity-conducting plastics, which have a wide range of potential consumer applications.

Comprehensive Cyber Security Initiative (+$5M)

U.S. economy reliant on interconnected networks

- Face ever-increasing threats
- Improving network security must be a national priority

NIST a recognized world leader in cyber security

Initiative funding will thwart attacks by

- Improved cryptographic key management
- Improved interoperability and authentication of users
- Standardization of computer security settings

Results will include

- Lower economic impact from ID theft
- Increased productivity in cyber security

Better cryptographic "key" management will lead to improved security on computer networks.

This NIST request is part of the Administration's Comprehensive National Cyber Security Initiative.

Optical Communications and Computing (+$5.8M)

High-speed communication drives the economy

Downloads much faster in other countries

- Japan, Korea, Finland—10 to 30 times faster than in U.S.
- U.S. geography/industrial structure require different technology to reach these speeds

U.S. optical networks choked with data traffic, not well synched

- Need better measurements
- Ways to redirect traffic around bottlenecks

Next generation computers may use light instead of electronics

- Need ways to measure performance, allow interconnection of devices

Better tools for measuring light can lead to faster computers and improved communications networks.

Enabling the Use of Hydrogen as a Fuel (+$4M)

Hydrogen fuel benefits

- Reduces dependence on foreign oil
- Lowers environmental impact
- Most common element on Earth

Many technical challenges ahead

- Hydrogen difficult to store/use safely
- Can embrittle metals
- Need new systems for distribution, delivery, and fair trade

NIST initiative designed to

- Develop standards for pipeline safety and reliability
- Ensure accurate fuel measures at point of sale
- Improve efficiency, durability of fuel cells

Photo courtesy of Shell

NIST expertise can lead to a solid infrastructure for zero-emission hydrogen vehicles. NIST has unique, long-term expertise in hydrogen research.

Manufacturing: Supply Chain Integration (+$1M)

Inefficient exchange of product designs and data

- Costs U.S. economy > $25 billion/year

Opportunity mirrors NIST strengths

- Standards, measurements, testing tools, neutral convener of workshops, conferences

Will foster seamless global supply chains for auto, aerospace, and construction industries

- Improve industrial efficiency/ competitiveness, especially for small manufacturers
- Create “roadmaps” for developing open standards for enterprise integration
- Develop and test standards, ensuring consistency with international standards

The U.S. automotive supply chain alone loses a billion dollars annually because of inefficient engineering data exchange.

NIST Center for Neutron Research Expansion (+$2M)

Nation's leading neutron facility

- More users than all other U.S. neutron facilities combined

Neutrons offer unique views into:

- Protein structures
- Trace chemical analysis
- Nanoelectronics
- Advanced materials

Third year of increased funding for a critical expansion program

- New world-class instruments
- Ability to serve 500 more researchers per year
- Increased operational effectiveness

The NIST Center for Neutron Research is a national user facility serving more than 2,000 researchers annually.

Boulder Laboratories: Building 1 Extension (+$43.5M)

Completion of a three-year project

- Boulder research world's best in several fields

Boulder research labs built in 1950s

- Poor air quality, vibration, temperature, and power control

Modern measurement science requires operation at the atomic scale

- Nanoscale systems—i.e. measuring forces between cells
- Ultraprecise timekeeping—critical for navigation, GPS, quantum science
- High speed, high frequency measurements for electronics and defense industries

HDR Inc.

Architectural rendering of the NIST Boulder Building 1 Extension

JILA Building Expansion (+$13M)

JILA jointly operated by NIST and University of Colorado at Boulder

- Year one of two-year construction project, total $27.5 million, CU will contribute $5 million, land, and infrastructure services
- JILA pushes the frontiers of atomic science—ultrafast, ultracold, ultrastable
- Three Nobel laureates, two Genius Awards
- Key training ground for world-class physicists

Current JILA labs severely overcrowded

JILA expansion will allow:

- Clean rooms for fundamental electronics research, cold rooms for biophysics research
- New capabilities in quantum science, biotech, energy, homeland security
- Significantly expands nation's pool of atomic, molecular and optical scientists

MacArthur fellow and NIST physicist Debbie Jin of JILA created a new state of matter known as a "fermionic condensate" with a team that included her students, Markus Greiner and Cindy Regal.

Safety, Capacity, Maintenance and Major Repairs (+$5.2M)

Aging buildings in both Gaithersburg and Boulder are threatening NIST's mission

- Built in 1950s and 1960s
- Renovation funds have not kept pace with repair needs
- Increasing failures—leaks, air handling, asbestos issues

Independent study urged increase for SCMMR to better match facilities value

Funds requested provide for:

- Ensured safety of NIST employees
- Replacement of aging mechanical and electrical systems
- Removal of hazardous materials
- Structural repairs and replacements
- Better accessibility

NIST Photo

Corroding, leaking, 40-year-old mechanical equipment in a NIST laboratory

Critical Time for U.S. Innovation and Economy

The U.S. is at an economic crossroads

- India, China, Korea, many others — investing heavily in technology, much lower wages for very skilled R&D talent
- Basic physical sciences research is an economic "seed corn" for all industrial sectors including biotechnology
- Investment in training next generation of scientists and in research facilities and capabilities will bear fruit for many years to come.
- $1 for NIST research produces $44 in benefits to U.S. economy (average of 19 economic studies)

The U.S. can choose to be a world leader in technology and innovation or be left behind

FY 2009 Budget Request Summary

The President and Congress have agreed on a strong innovation plan:

- NIST research and facilities play a critical role in advancing innovation
- Current U.S. safety, security, and quality of life is supported in many ways by past NIST accomplishments
- NIST "roads and bridges" built now enable today's innovation and tomorrow's products, services, and economic growth

The Bottom Line:
Investment in NIST research and facilities will help ensure that the U.S. continues to be the world's economic and innovation leader.