Federal R&D Policy

PCAST Energy R&D Panel (1997)

"Fission's future expandability is in doubt in the United States and many other regions of the world because of concerns about high costs, reactor-accident risks, radioactive-waste management, and potential links to the spread of nuclear weapons. We believe that the potential benefits of an expanded contribution from fission in helping address the carbon dioxide challenge warrant the modest research initiative proposed here (NERI and NEPO), in order to find out whether and how improved technology could alleviate the concerns that cloud this energy option's future.

To write off fission now as some have suggested, instead of trying to fix it where it is impaired, would be imprudent in energy terms and would risk losing much U.S. influence over the safety and proliferation resistance of nuclear energy in other countries. Fission belongs in the R&D portfolio."

PCAST Recommendations on Nuclear Energy R&D

- A major extramural research program (investigator-initiated, peer reviewed, long range) (Nuclear Energy Research Initiative - NERI)
- A major research program aimed at extending the life of operating plants (Nuclear Energy Plant Optimization - NEPO)
- A high level advisory body to DOE (Nuclear Energy Research Advisory Committee - NERAC)

NERAC

Nuclear Energy Research Advisory Committee

“To provide expert, independent advice on long-range plans, priorities, and strategies in nuclear energy research to the U.S. Department of Energy”

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NUCLEAR ENERGY RESEARCH ADVISORY COMMITTEE

- Overview
- Charter
- Organization
- Long-Term R&D Plan
- Meetings
- Reports

Overview

The Nuclear Energy Research Advisory Committee (NERAC) was established on October 1, 1998, to provide independent advice to the Department of Energy (DOE) and Office of Nuclear Energy, Science and Technology (NE) on complex science and technical issues that arise in the planning, managing, and implementation of DOE's nuclear energy program. NERAC will periodically review the elements of the NE program and based on these reviews provide advice and recommendations on long-range plans, priorities, and strategies to effectively address the scientific and engineering aspects of the research and development efforts. In addition, the committee will provide advice on national policy and scientific aspects on nuclear energy research issues as requested by the Secretary of Energy or the Director, NE. The committee includes representatives from universities, industry, and national laboratories. Particular attention was paid to obtaining a diverse membership with a balance of disciplines, interests, experiences, points of view, and geography. NERAC operates in accordance with the Federal Advisory Committee Act (FACA)(Public Law 92-463), 92nd Congress, H.R. 4383' October 6, 1972) and all applicable FACA Amendments, Federal Regulations and Executive Orders.

TOP

NERAC Membership

- John Ahearne, Duke
- Tom Cochran, NRDC
- Allen Croft, Oak Ridge NL
- Marvin Fertel, Nuclear Energy Institute
- Beverly Hartline, LANL
- Bill Kastenberg, UC-Berkeley
- Dale Klein, U Texas - Austin
- Bob Long, Nuclear Stewardship
- Warren Miller, Jr., LANL
- Richard Reba, U. Chicago
- Lynn Rempke, INEEL
- Paul Robinson, Sandia NL
- Robert Socolow, Princeton
- Allen Session, Queens College
- Daniel Sullivan, NIH
- Bruce Tarter, LLNL
- John Taylor, EPRI
- Charles Till, Argonne NL
- Neal Todreas, MIT
- Joseph Comfort, Arizona State
- Maureen Crandall, ICAF
- Jose Luis Cortez, New Mexico M&T
- Tom Boulette, Worcester Polytechnic
- Jim Duderstadt, Michigan, Chair

NERAC Subcommittees

- Long Range Planning (Ahearne)
- Nuclear Science and Technology Infrastructure (D. Klein)
- Operating Nuclear Power Plant R&D (Taylor)
- Isotope Research and Production (Reba)
- Proliferation Resistant Nuclear Technologies (Taylor)
- Transmutation of Radioactive Waste (Richter)
- Blue Ribbon Committee on Nuclear Engineering (Corradini)
- Nuclear Space Propulsion (A. Klein)
- Nuclear Impact on Air Quality (Ahearne)

Nuclear Energy Research Advisory Committee
(NERAC)
Subcommittee on
Long-Term Planning for Nuclear Energy Research

Long-Term Nuclear Technology Research and Development Plan

SUMMARY

June 2000

Long-Range R&D Plan

- Basic Science and Engineering Research
- Nuclear Power
  - Advanced Fuels
  - Instrumentation and Controls
  - Technology and Economics
- Isotopes and Radiation Sources
- Space Nuclear Systems

The importance of investments in …

- New Knowledge (research)

  "Nation must restore an adequate investment in basic and applied research in nuclear energy if it is to sustain a viable U.S. nuclear power option."

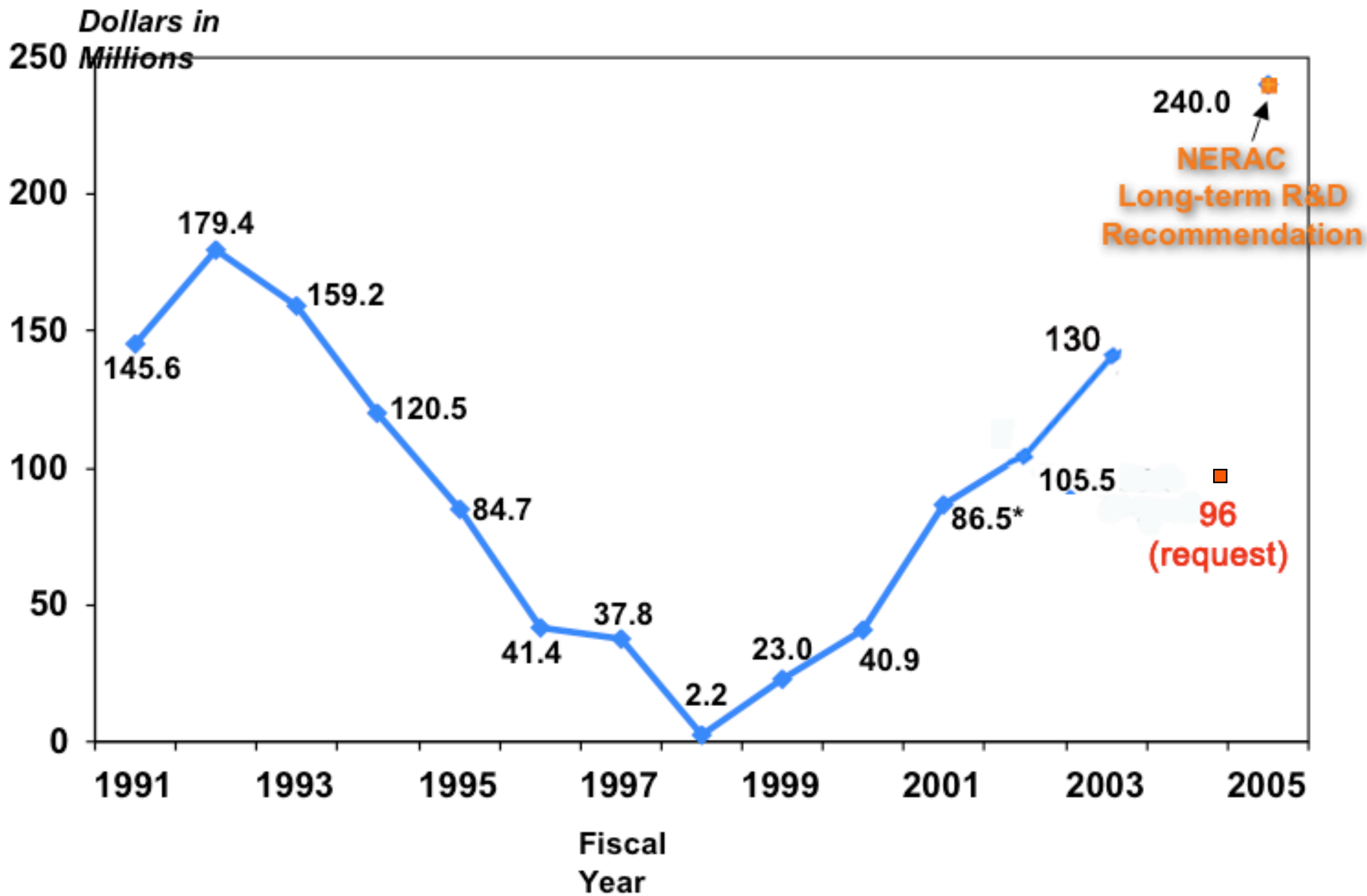
- Human Capital (education)

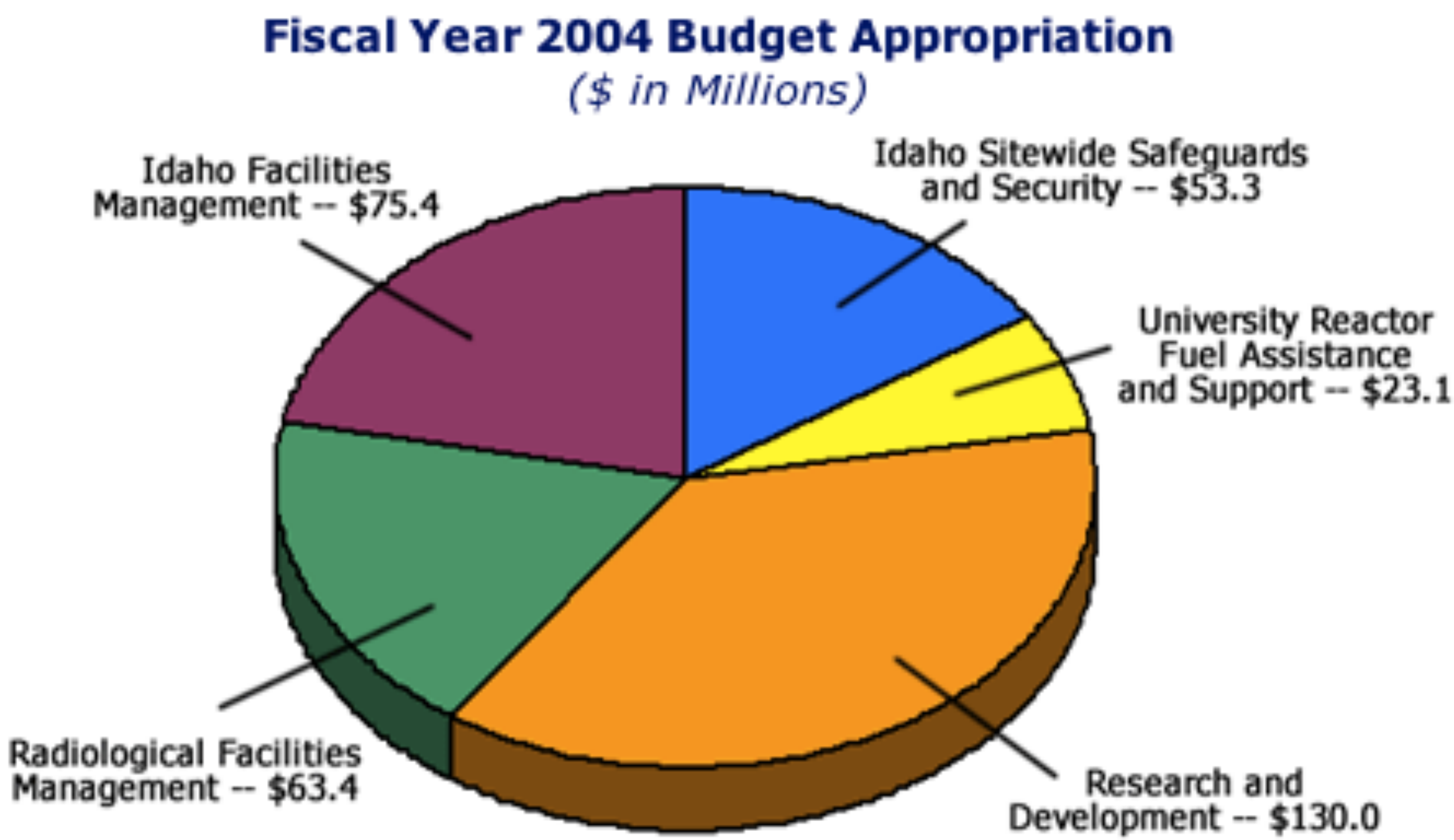
  "Perhaps the most important role for DOE/NE at the present time is to insure that the education system and its facility infrastructure are in good shape."

- Infrastructure (facilities)

  "Need for adequate DOE facilities to sustain the nuclear energy research mission (particularly reactor facilities and isotope sources)."

Research & Development Budget History

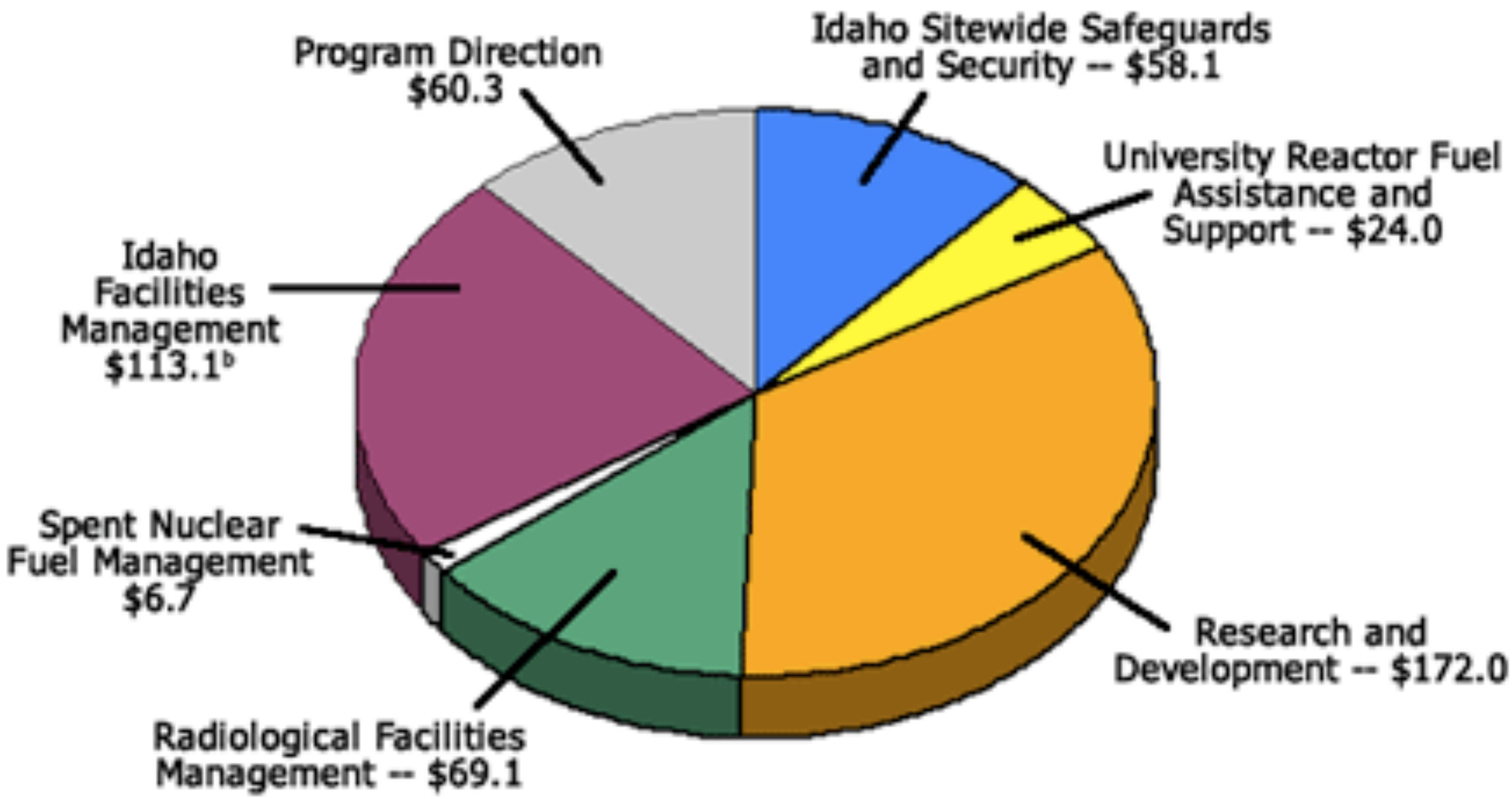




Fiscal Year 2004 Budget Appropriation
($ in Millions)
Idaho Facilities Management -- $75.4
Idaho Sitewide Safeguards and Security -- $53.3
University Reactor Fuel Assistance and Support -- $23.1
Radiological Facilities Management -- $63.4
Research and Development -- $130.0

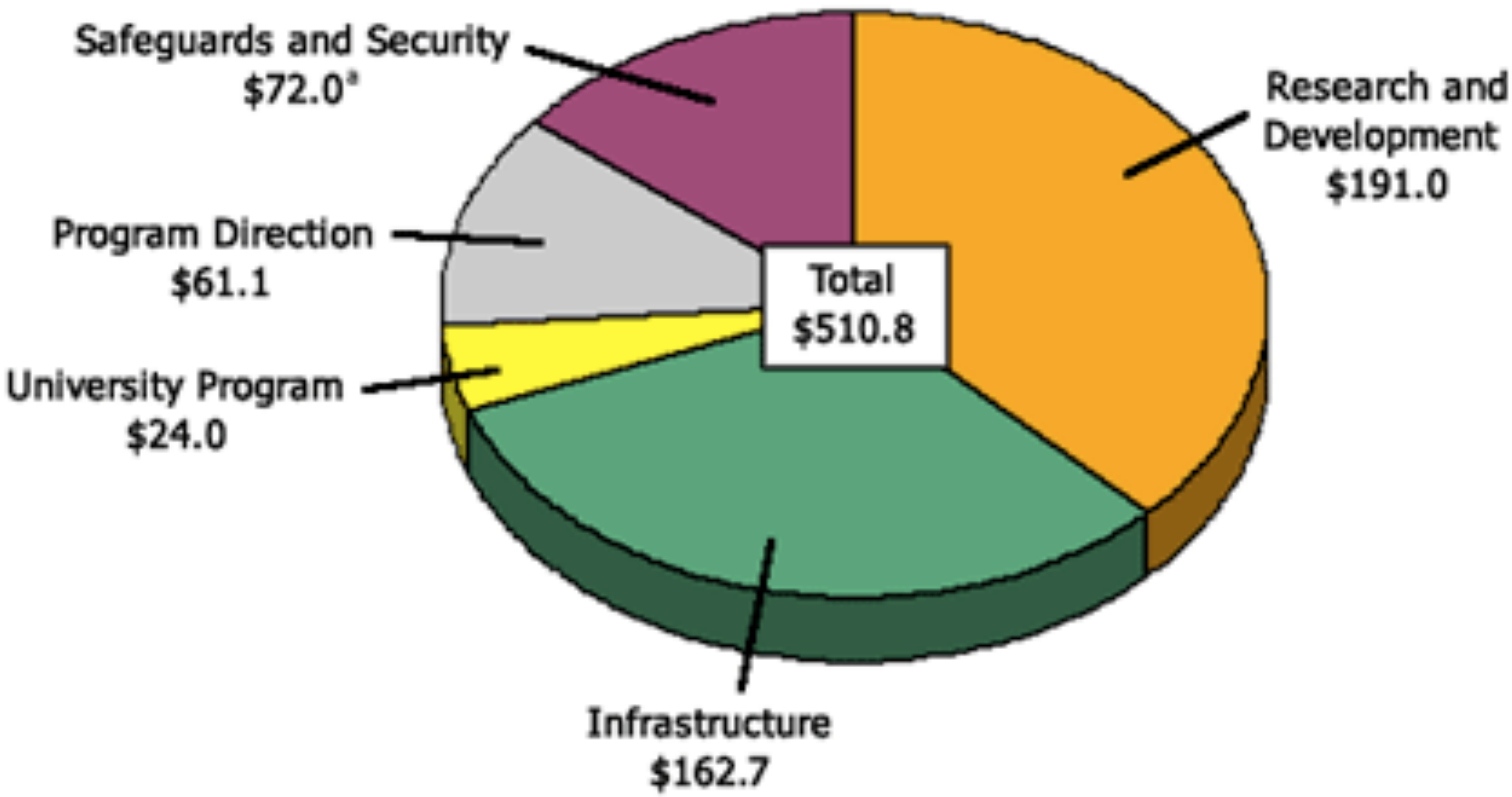
Fiscal Year 2005 Appropriation[a]

($ in Millions)



Fiscal Year 2006 Request

($ in Millions)



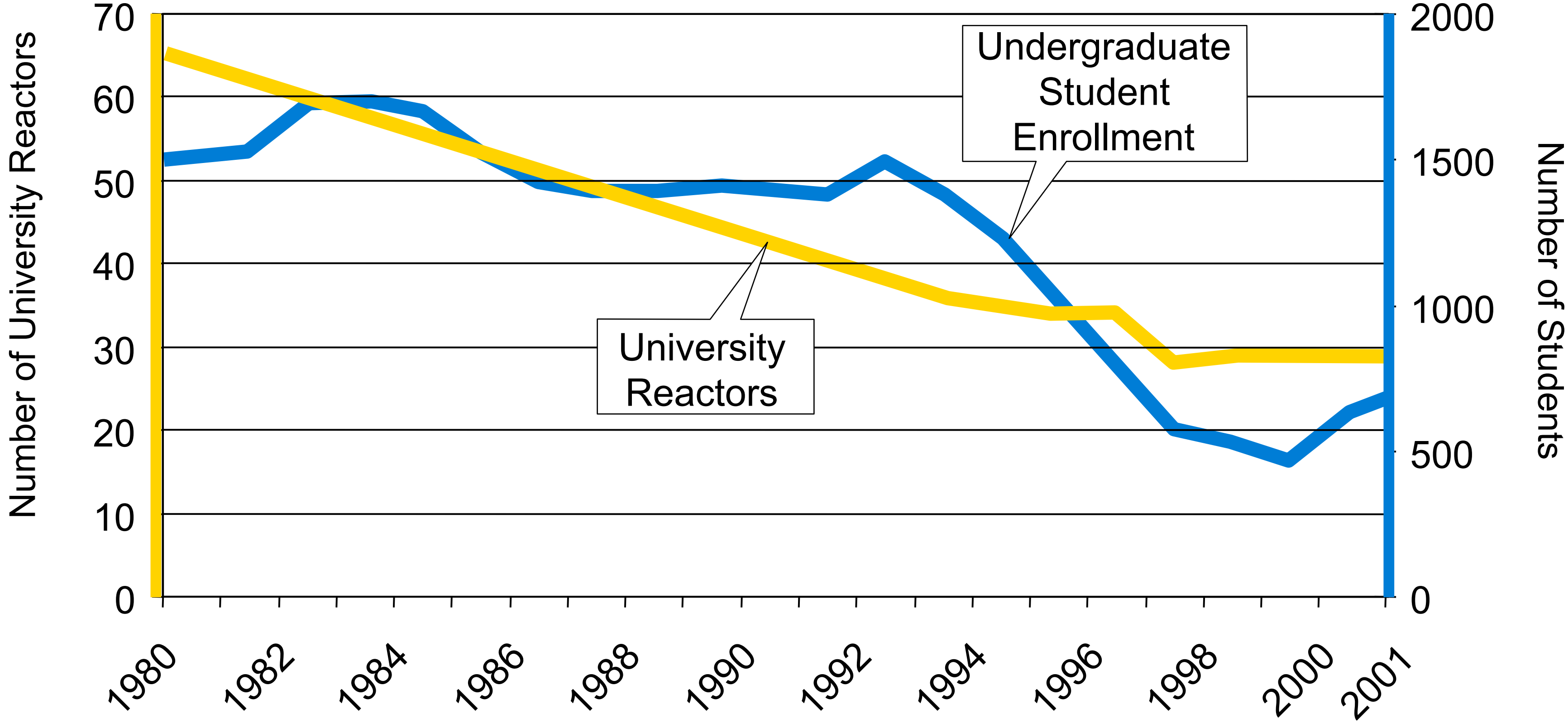
Research and Development

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56	2,944	0
Nuclear Energy Research Initiative	17,413[a]	11,000	-4,408[a]	6,592	0
Nuclear Energy Technologies	31,579[b]	20,000	-378	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940[ac]	24,000	3,744[a]	27,744	30,546
Nuclear Hydrogen Initiative	2,000[c]	6,500	-123	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287	66,713	46,254
Total, R&D	130,030	132,500	-2,508	129,992[d]	96,046

Trends In University Nuclear Engineering



NERAC Recommendations

Nuclear Energy Research Advisory Committee
(NERAC)
Subcommittee on
Long-Term Planning for Nuclear Energy Research

Long-Term Nuclear Technology Research and Development Plan

SUMMARY

June 2000

Long-Range R&D Plan

- Basic Science and Engineering Research
- Nuclear Power
  - Advanced Fuels
  - Instrumentation and Controls
  - Technology and Economics
- Isotopes and Radiation Sources
- Space Nuclear Systems

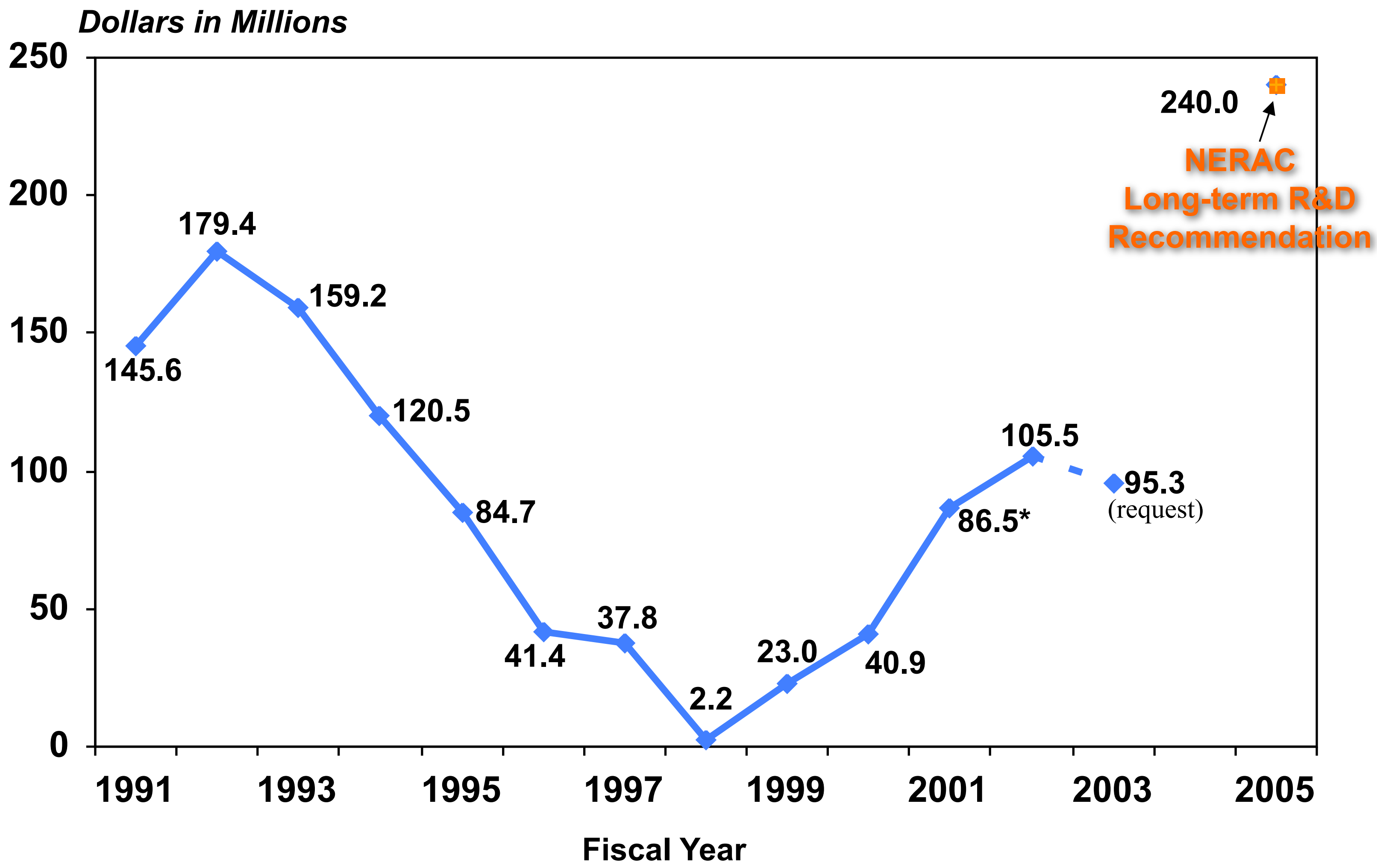
The importance of investments in …

- Ideas (research)

  "Nation must restore an adequate investment in basic and applied research in nuclear energy if it is to sustain a viable U.S. nuclear power option."

- People (education)
  - "Perhaps the most important role for DOE/NE at the present time is to insure that the education system and its facility infrastructure are in good shape."
- Tools (facilities)
  - "Need for adequate DOE facilities to sustain the nuclear energy research mission (particularly reactor facilities and isotope sources)."

Research & Development Budget History



Does not include $34 million of funding for the APT budget which was funded by DP in FY 2001.

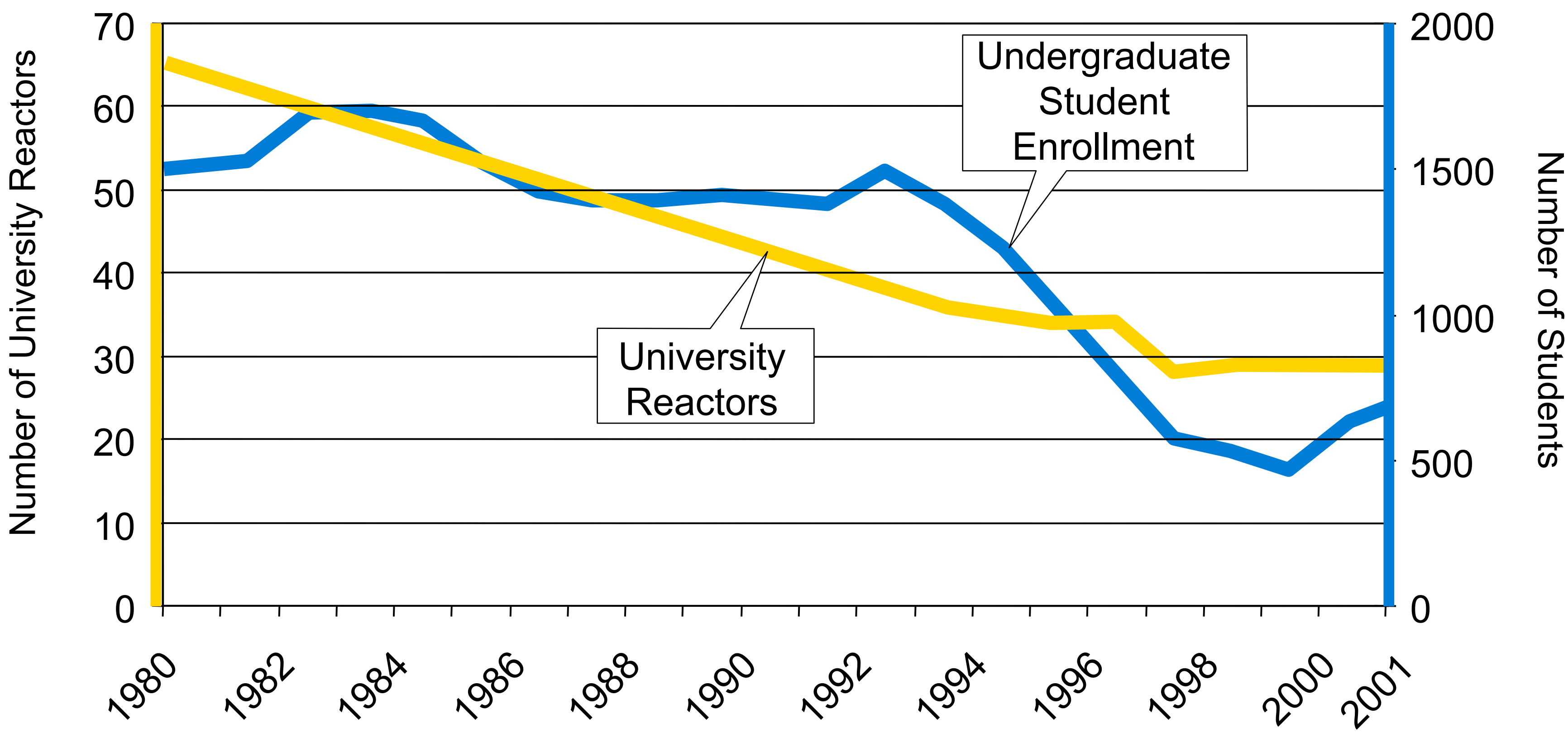
Human Resources

"Perhaps the most important role for DOE/NE in the nuclear energy area is to insure the educational system and facility infrastructure are in good health. It is important that the U.S. maintain a strong commitment to the education and training of nuclear scientists and engineers, to support a wide range of nuclear activities.

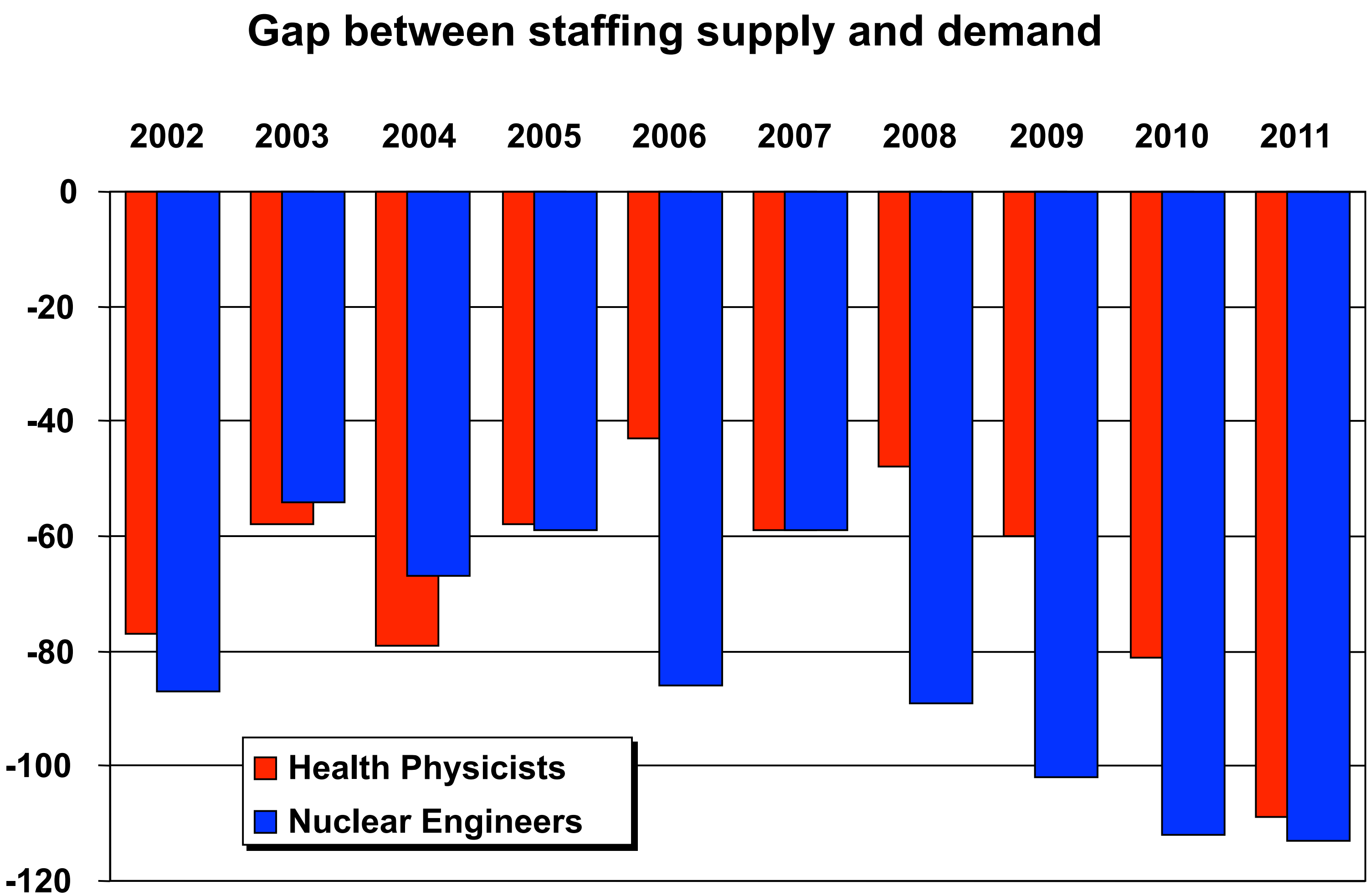
In support of these roles, one of DOE/NE's primary responsibilities is to assure the country has the supply of nuclear scientists and engineers that will be needed to provide worldwide leadership in scientific, nonproliferation, commercial, and other uses of nuclear science, technology, and materials. This leads to the need to support undergraduate and graduate students, faculty, and both university and DOE infrastructure as well as to fund long-term nuclear-related R&D that is in the national interest.

NERAC Long Range R&D Plan (May, 2000)

Trends In University Nuclear Engineering



Actual staffing gap rises to more than 100 HPs and 100 nuclear engineers by 2011



Reference:
Navigant Consulting
12-17-01

Can the pipeline be filled to support both civilian and defense nuclear energy needs?

- Numerous studies (NEI, ANS, NEDHO, …) for U.S.
- All come to the same conclusion:
  - **HUGE need for nuclear professionals**
  - **90,000 new nuclear workers needed in next 10 years**
  - **In next 10 years, need**
    - **~ 2400 new nuclear engineers**
    - **~ 1300 new health physicists**

Assessing the Capacity of the U.S. Engineering Research Enterprise

A National Academy of Engineering Study

The Context

- Demographics, globalization, technological change
- Global, knowledge-driven economy
- Out-sourcing, off-shoring, inadequate diversity
- Importance of technological innovation to economic competitiveness and national security

Dark clouds

- National Academies (COSEPUP)
- PCAST
- DOE (Vest Committee)
- National Science Board
- AAAS
- The Media

Dark clouds

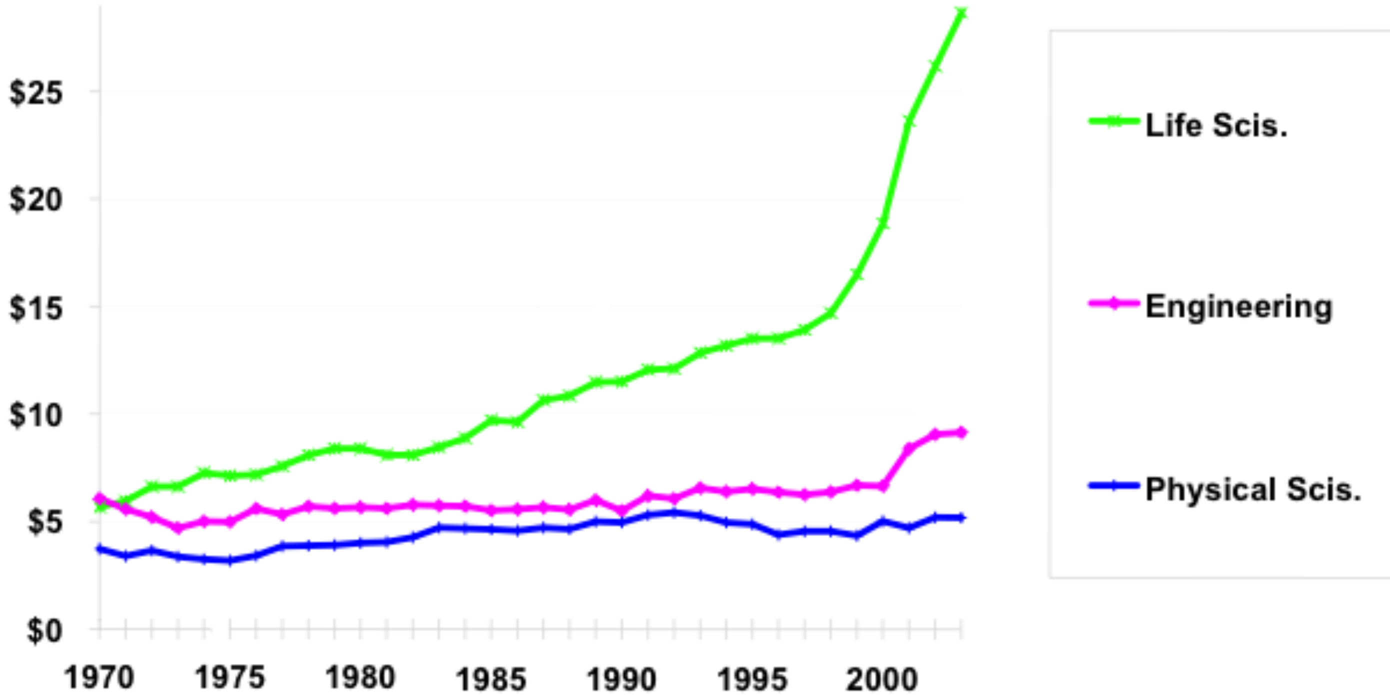
- National Academies (COSEPUP)
- PCAST
- DOE (Vest Committee)
- National Science Board
- AAAS
- The Media
- The FY2006 Budget Request

National Academies

- Massive shift of federal R&D toward biomedical sciences and away from physical sciences and engineering.
- Serious distortions are appearing in national R&D enterprise.
- Federal R&D has declined from 70% of national R&D activity in the 1970s to roughly 25% today…

Trends in Federal Research by Discipline, FY 1970-2003

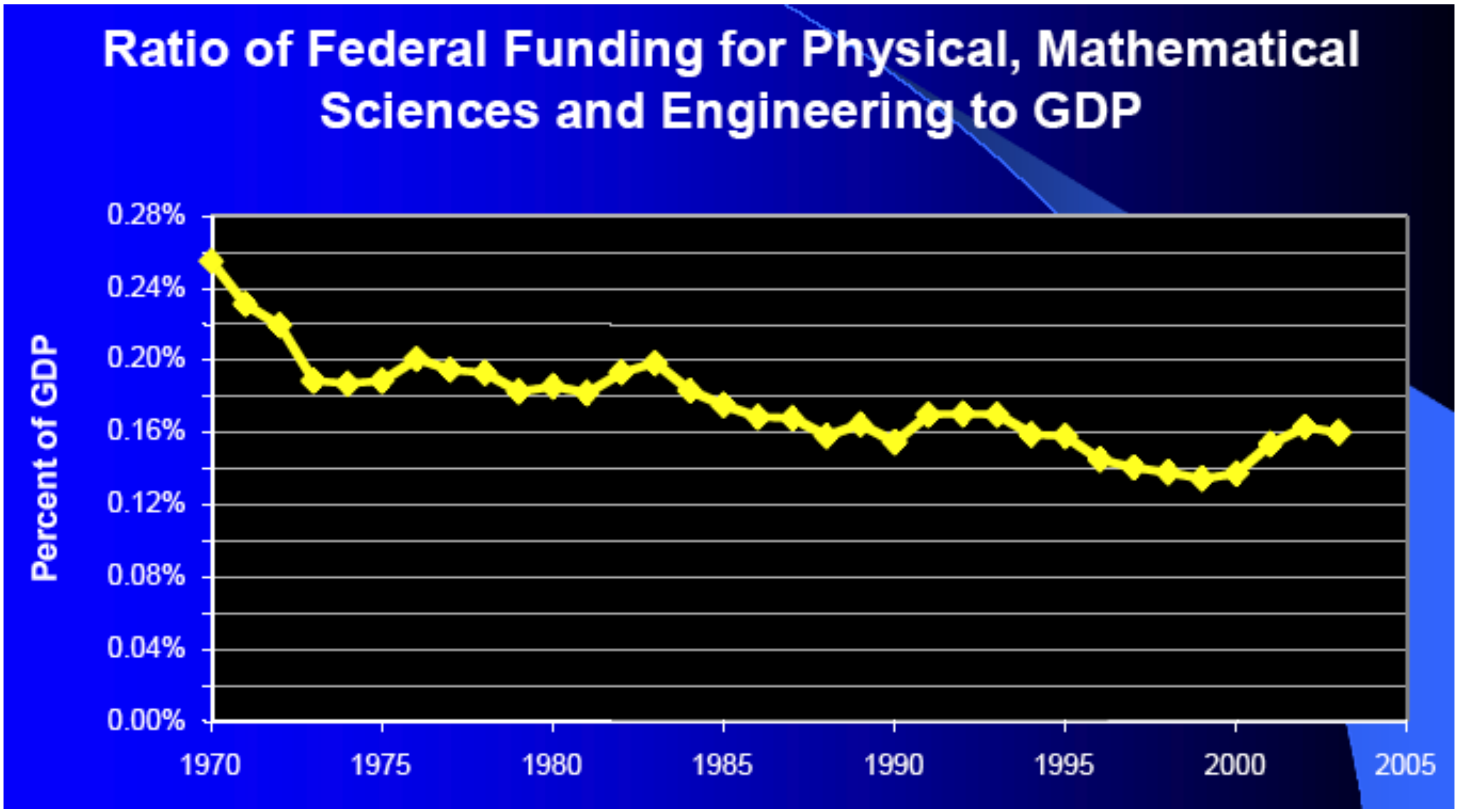
obligations in billions of constant FY 2002 dollars



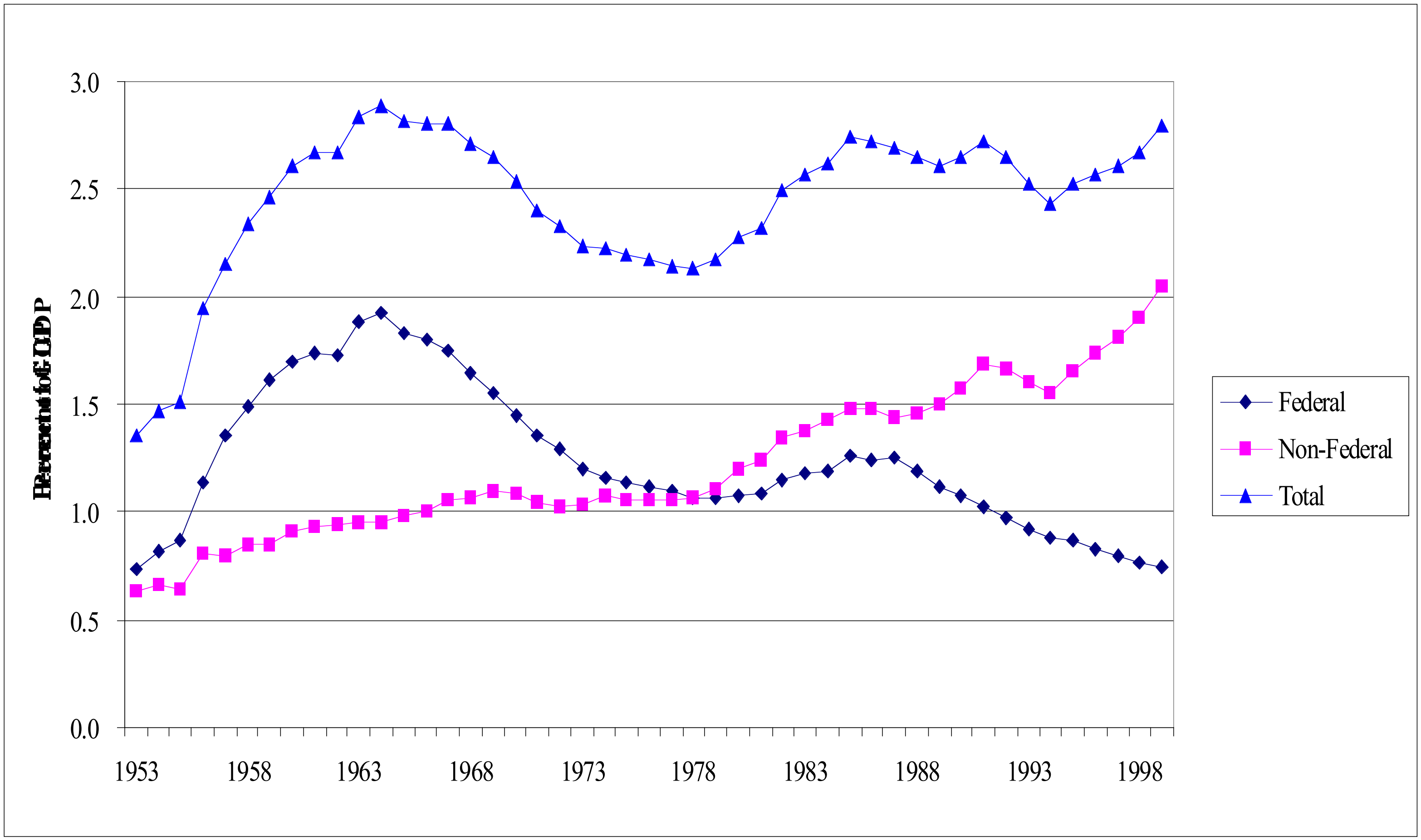
Source: National Science Foundation, *Federal Funds for Research and Development FY 2001, 2002, and 2003,* 2003. FY 2002 and 2003 data are preliminary. Constant-dollar conversions based on OMB's GDP deflators. AUGUST '03

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Another concern…



Federal vs. Non-Federal R&D



PCAST

- PCAST's studies have shown that from 1993 to 2000, federal support for the physical sciences and engineering remained relatively flat, and in some instances decreased.
- Federal support for science and engineering students enhances economic growth. Yet federal support for graduate support of students in physical science and engineering has declined significantly over the past two decades.

PCAST

- R&D "Innovation Ecosystems" critical to U.S. technological preeminence.
- Foreign inroads occurring and helped by foreign investment in R&D and S&E education.
- U.S. technological preeminence is not forever assured!

PCAST Recommendations

- Increase federal funding for physical science and engineering R&D.
- Reinvigorate a next generation “Bell Labs” model.
- Permanent R&D tax credit.
- Improve workforce skills.

DOE Science Priorities Committee

In 1970 physical science, engineering and life science each were funded at an annual level of approximately $5 billion in 2002 dollars. Today, physical science and engineering research are funded at approximately $5 billion and $8 billion, respectively. The current funding for life science is about $28 billion.

AAAS

"Federal R&D Investments Face Another Rough Year in 2006: Cuts for Many R&D Programs, Gains for Space and Homeland Security"

While the R&D portfolio of $132 billion would be essentially constant, total federal research investment ("FS&T") would drop 1.4% to $60 billion, with cuts to most R&D programs with the exception of modest increases for NASA, DHS, and NSF.

Particularly hard-hit by the proposed 21% cut in DOD and 4.5% cut in DOE research programs would be physical science and engineering research.

Pentagon Redirects Its Research Dollars

J. Emilio Flores for The New York Times

Leonard Kleinrock of U.C.L.A. declined Darpa money when he learned that his assistants had to be American citizens.

By JOHN MARKOFF

Published: April 2, 2005

SAN FRANCISCO, April 1 - The Defense Advanced Research Projects Agency at the Pentagon - which has long underwritten open-ended "blue sky" research by the nation's best computer scientists - is sharply cutting such spending at universities, researchers say, in favor of financing more classified work and narrowly defined projects that promise a more immediate payoff.

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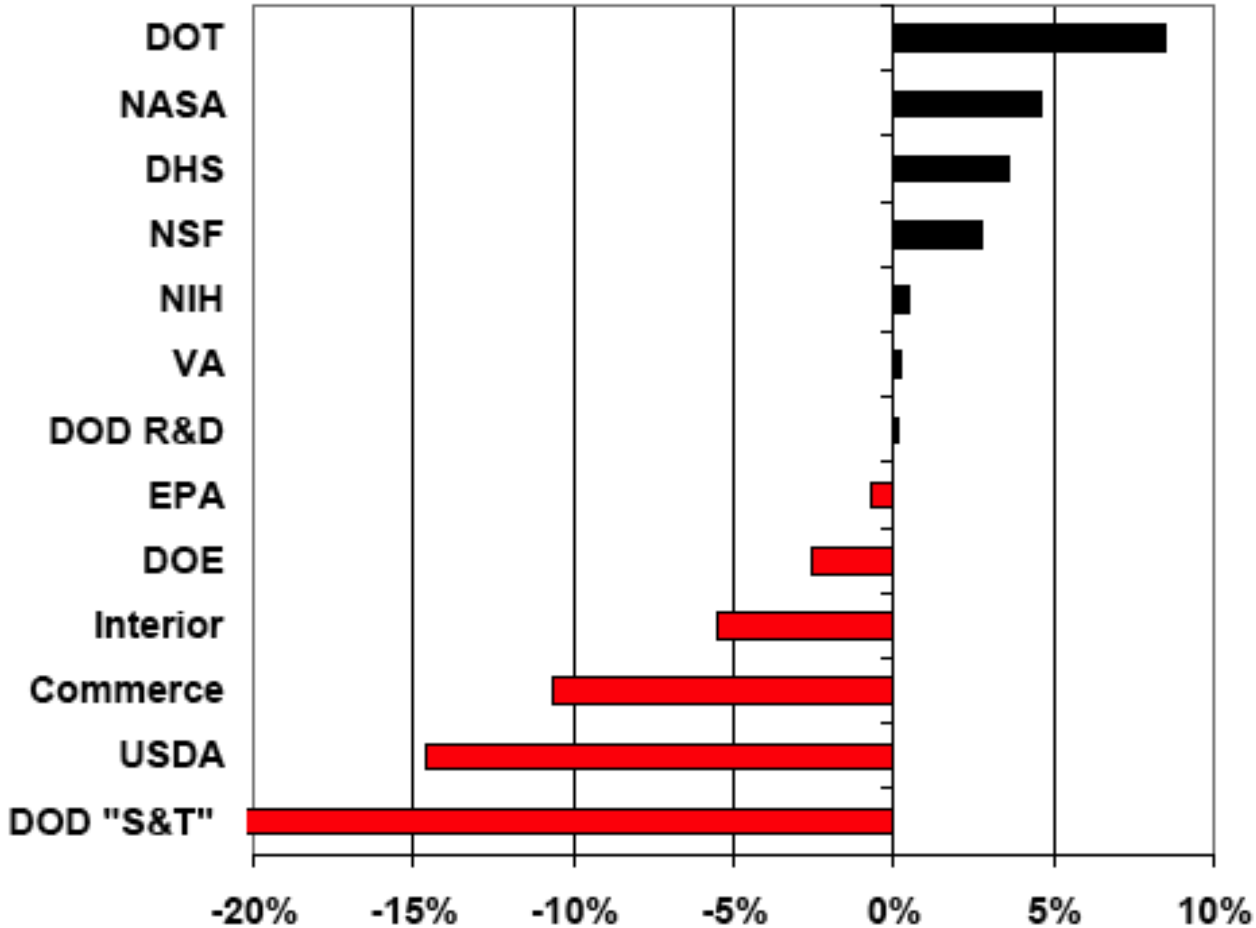
FY 2006 R&D Request

Percent Change from FY 2005



Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2006.

DOD "S&T" = DOD R&D in "6.1" through "6.3" categories plus medical research.

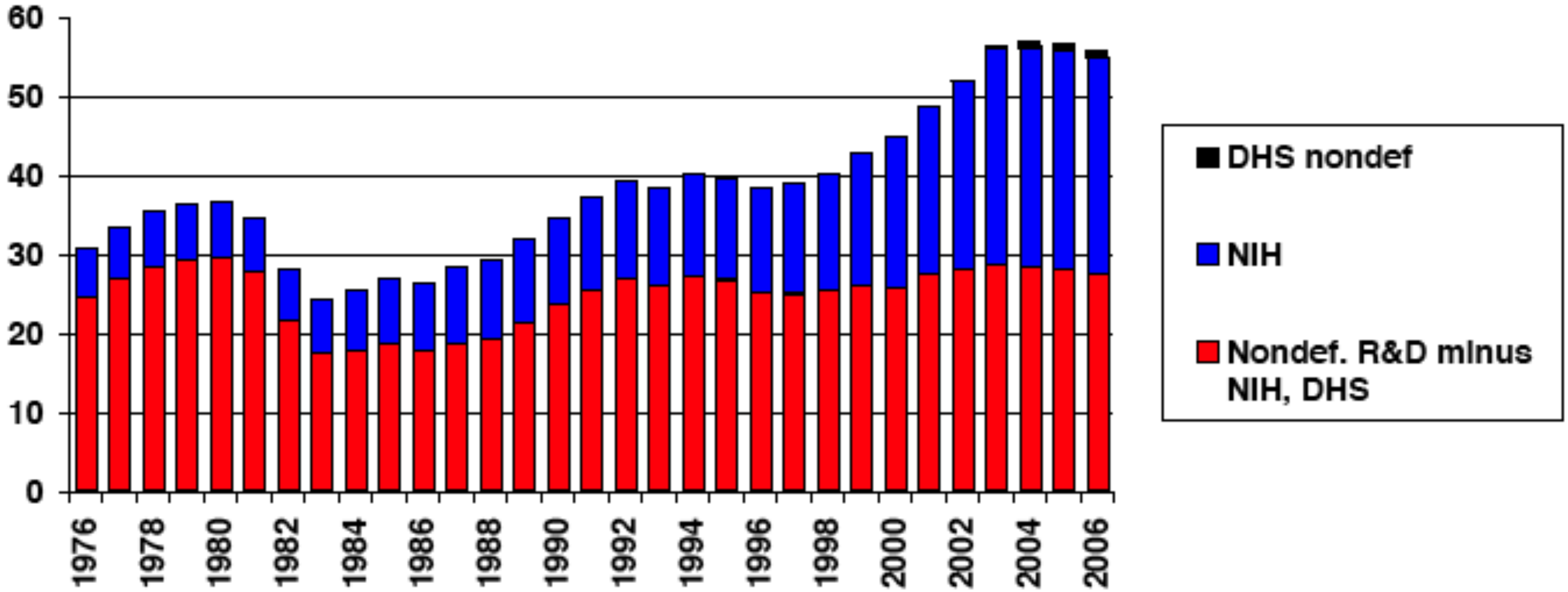
AAAS

Some FY2006 Datapoints

- NSF(+2.4%), but most of this is a fund transfer from the Coast Guard to operate ice breakers.
- DOE Office of Science (- 4.5%)
- NASA: Universe (-0.1%), Earth-Sun (-4.3%; Aero (-5.9%); Ed (-23%); Exploration Systems (+ 17.9%)
- DOD: 6.1-6.2-6.3 (- 21%)

Selected Trends in Nondefense R&D, FY 1976-2006

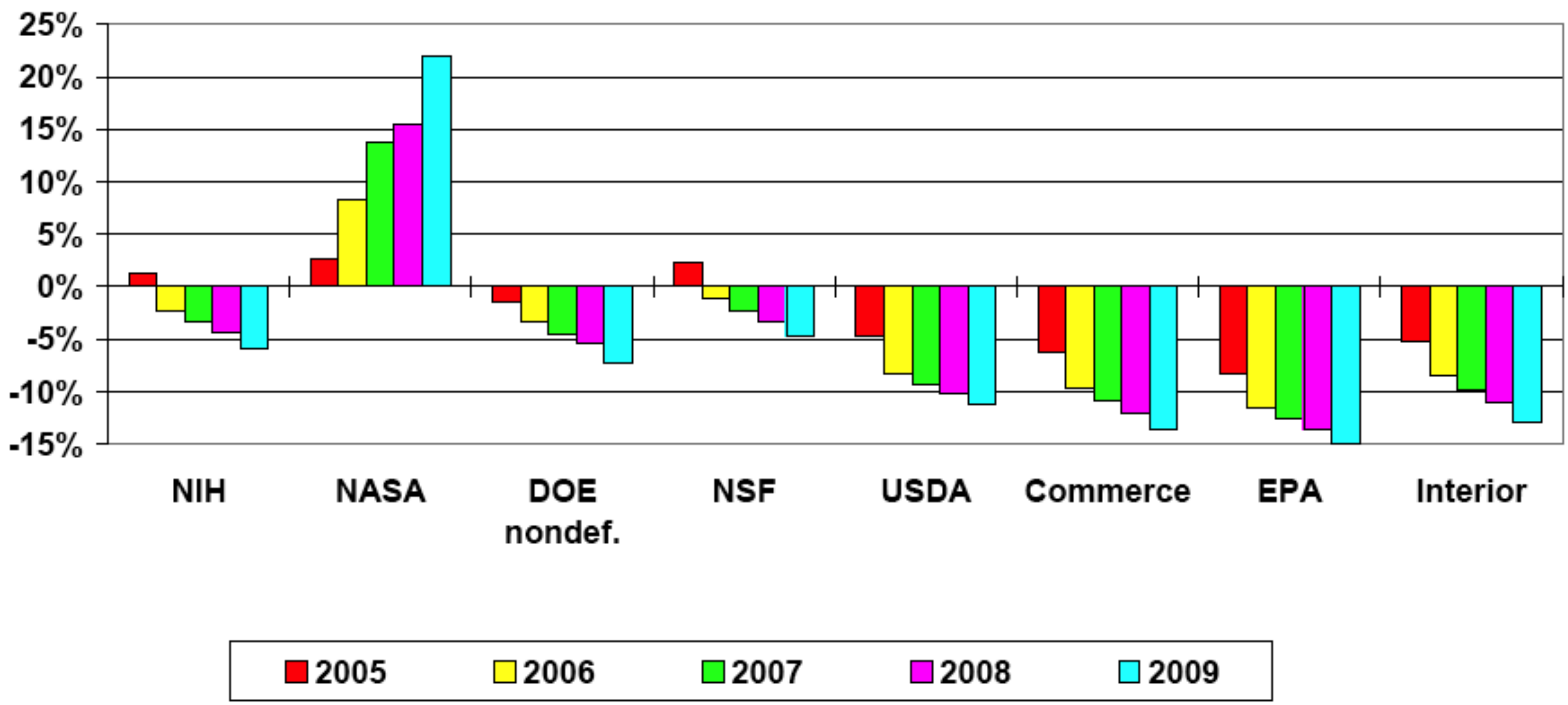
In billions of constant FY 2005 dollars



Source: AAAS analyses of R&D in *AAAS Reports VIII-XXX.* FY 2006 figures are President's request. R&D includes conduct of R&D and R&D facilities.

Projected Nondefense R&D in the President's Budget, FY 2004-2009

% change from FY 2004 funding level in constant dollars



Source: AAAS analysis *Projected Effects of President's FY 2005 Budget on Nondefense R&D*

AAAS

The Media: A Gathering Storm

- William Broad: “The US has started to lose its worldwide dominance in critical areas of science and innovation. Europe and Asia are making large investments in physical science and engineering research, while the US has been obsessed with biomedical research to the neglect of other areas.”
- Tom Friedman: “The US is not graduating the volume of scientists and engineers, we do not have a lock on the new ideas, and we are either flat-lining or cutting back our investments in physical science and engineering. We are losing our competitive edge vis-à-vis China, India, and other Asian tigers.”

Industry: Craig Barrett (Intel)

“The U.S. is not graduating the volume of scientists and engineers, we do not have a lock on the infrastructure, we do not have a lock on the new ideas, and we are either flat-lining, or in real dollars cutting back, our investments in physical science and engineering.

The only crisis the U.S. thinks it is in today is the war on terrorism. It’s not!”

NAE Committee

Assessing the Capacity of the U.S. Engineering Research Enterprise

Charge

To conduct a "fast-track" evaluation of

- 1) the past and potential impact of the U.S. engineering research enterprise on the nation's economy, quality of life, security, and global leadership; and
- 2) the adequacy of public and private investment to sustain U.S. preeminence in basic engineering research.

NAE Committee

- James J. Duderstadt
- Erich Bloch
- Ray M. Bowen
- Barry Horowitz
- Lee L. Huntsman
- James Johnson
- Kristina M. Johnson
- Linda Katehi
- David C. Mowery
- Cherry A. Murray
- Malcolm R. O'Neill
- George Scalise
- Ernie Smerdon
- Robert F. Sproull
- David Wormley
- Proctor P. Reid

The Process

- 2004: Hearings and development of preliminary findings and recommendations
- January 1, 2005: Release of a public draft report (reviewed) for comment from the engineering community
- March 2005: Utilize feedback to redraft report (again for review)
- April 2005: Publication of final report.

Premise

- Leadership in innovation is essential to U.S. economic prosperity and national security.
- Pre-eminence in technological innovation requires leadership in all aspects of engineering: research, education, and practice.

Council on Competitiveness

National Innovation

National Innovation Initiative

NII Working Group Web Portal

Vision

Innovation fosters the new ideas, technologies, and processes that lead to better jobs, higher wages and a higher standard of living. For advanced industrial nations no longer able to compete on cost, the capacity to innovate is the most critical element in sustaining competitiveness.

The United States stands apart from the rest of the world in its record of sustained innovation over decades, across industries, and through economic cycles. Why? What has made the United States an engine of innovation? A number of structural and economic advantages help explain this performance, including:

- Ready access to natural resources and labor
- The skills and work ethic of American workers
- Strong capital markets, a long tradition of the rule of law, a deep commitment to property rights, and a culture that encourages and rewards risk-takers
- A unique system of cooperation and collaboration among the federal government, national and military labs, private-sector R&D efforts, research universities and entrepreneurs

News

October 1, 2004
NII Co-Chairs Share Innovation Vision with BusinessWeek

September 30, 2004
Associated Press -- National Innovation Initiative heads expect recommendations to set agenda

September 30, 2004
Professional science master's can fill gaps in federal scientific workforce, Sloan's Teitelbaum says

August 16, 2004
American Physical Society -- Workforce Issues Dominate Policy Briefing

July 30, 2004
California Computer News -- Innovate America...

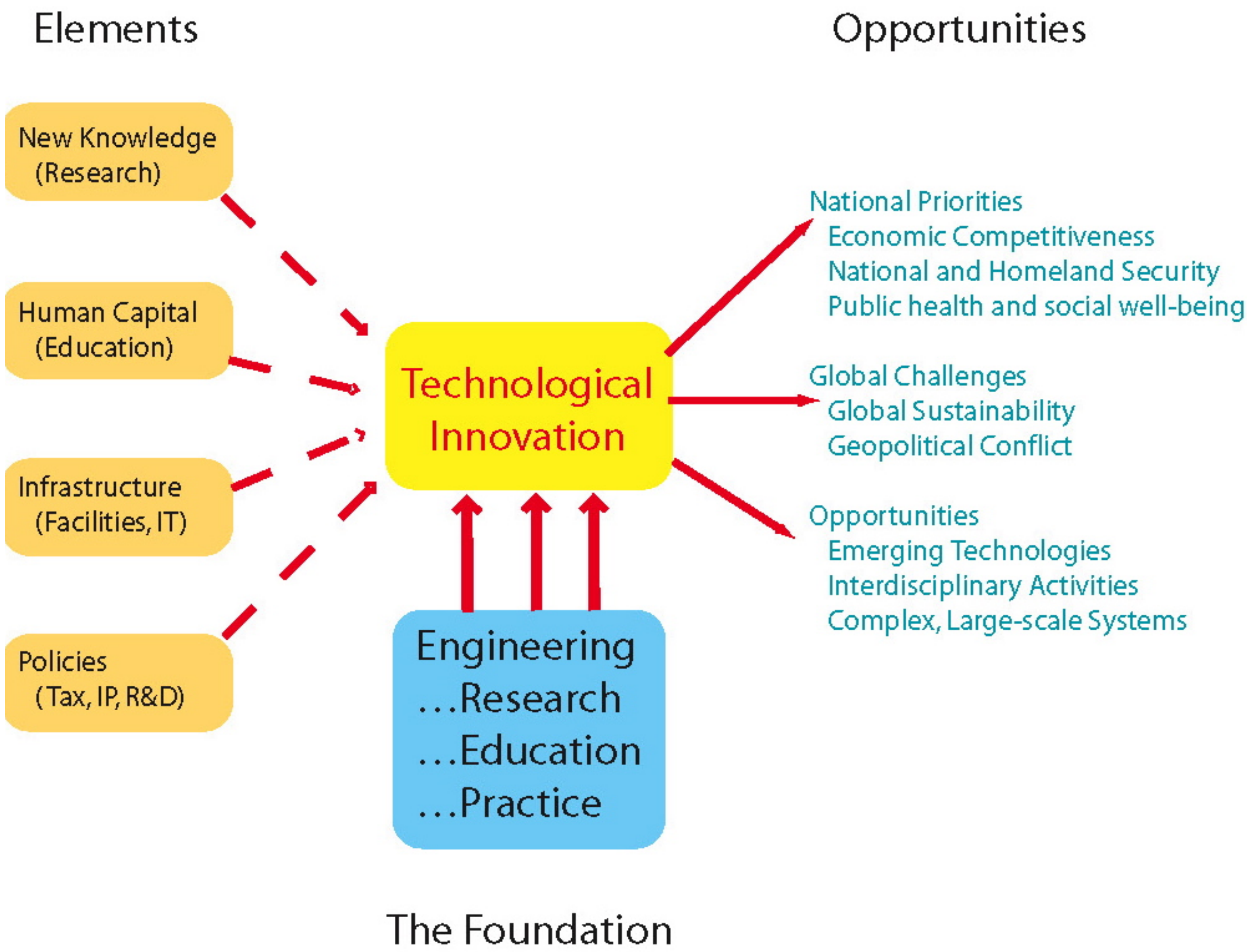
July 22, 2004
Council On

National Innovation Initiative: Resolution

- Innovation will be the single most important factor in determining America's success throughout the 21st century.
- America's challenge is to unleash its innovation capacity to drive productivity, standard of living and leadership in global markets.
- For the past 25 years we have optimized our organizations for efficiency and quality. Over the next quarter century, we must optimize our entire society for innovation.

The Ingredients of Innovation

- The U.S. culture–a diverse population, democratic values, free market practices– provide a fertile environment for innovation.
- But history has show that significant public investments is necessary to produce key ingredients for technological innovation:
  - New knowledge (research)
  - Human capital (education)
  - Infrastructure (physical, cyber)
  - Policies (tax, intellectual property)



Elements
Opportunities
New Knowledge (Research)
Human Capital (Education)
Infrastructure (Facilities, IT)
Policies (Tax, IP, R&D)
Technological Innovation
Engineering …Research …Education …Practice
The Foundation
National Priorities
Economic Competitiveness
National and Homeland Security
Public health and social well-being
Global Challenges
Global Sustainability
Geopolitical Conflict
Opportunities
Emerging Technologies
Interdisciplinary Activities
Complex, Large-scale Systems

Note:

- The roles of the federal government is essential!
- Corporations invest primarily in applied research tied to next generation product.
- The federal government supports most long-term research.
- And universities play a key role in basic research, supported primarily by the federal government.

Findings

- In a global knowledge-driven economy, technological innovation is critical to economic competitiveness, the quality of life, and national security.
- Leadership in engineering research, education, and practice is a prerequisite to global leadership in technological innovation.

Findings (continued)

- U.S. leadership in technological innovation is seriously threatened by the accelerating pace of discovery, investments by other nations in R&D and technical workforce development, and an increasingly competitive global economy.
- Federal investment in engineering and physical science research has been stagnant for three decades. Long term research critical to innovation has not been adequately funded.

Findings (continued)

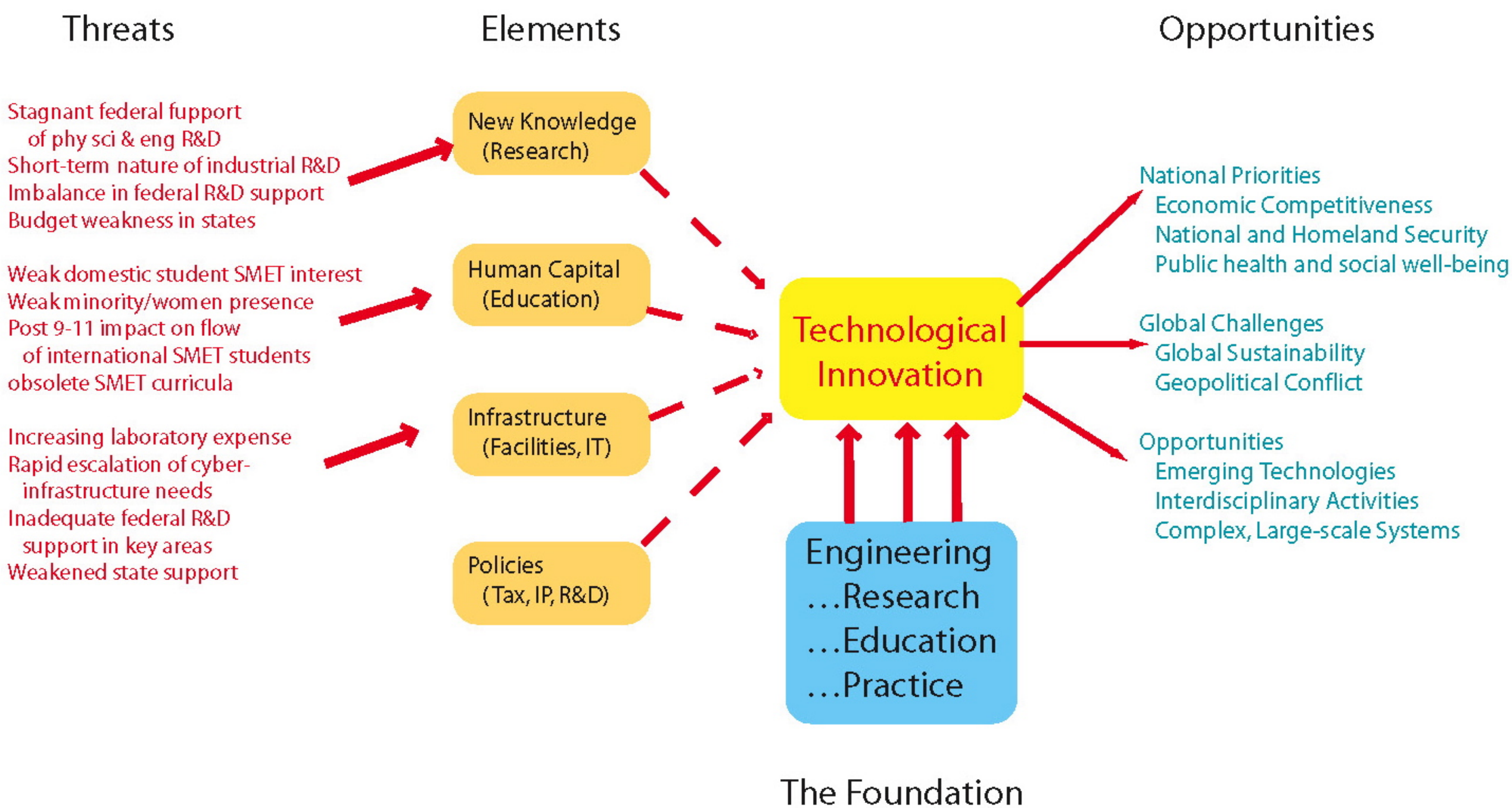
- Currently, most support for engineering research comes from federal mission agencies and NSF. Since NSF is uniquely situated to catalyze change in engineering research, education, and practice and to head a buildup of long-term fundamental engineering research at the nation’s universities, it is especially important for linking basic engineering research and education to fundamental scientific discoveries in physical, natural, and social sciences.

Findings (continued)

- The current federally funded R&D portfolio is inadequate to ensure national leadership in research areas of key strategic interest to the nation (e.g., national defense, homeland security, and the economic competitiveness of American industry).
- Although industry today accounts for almost 75% of the nation's R&D, its capacity to conduct long-term scientific and engineering research has been constrained by near-term financial earnings pressures and restructured markets.

Findings (continued)

- The changing nature of technological innovation–more rapid, global, systemic, and interdisciplinary–will require changes in engineering research, education, and practice.
- A technically skilled workforce is essential to an innovation-driven nation. This will likely require more U.S. citizens educated in engineering–particularly women and underrepresented minorities. It will also require that the U.S. retain the capacity to attract talented scientists and engineers from throughout the world.


Threats
Elements
Opportunities
Stagnant federal fupport
of phy sci & eng R&D
Short-term nature of industrial R&D
Imbalance in federal R&D support
Budget weakness in states
Weak domestic student SMET interest
Weak minority/women presence
Post 9-11 impact on flow
of international SMET students
obsolete SMET curricula
Increasing laboratory expense
Rapid escalation of cyber-
infrastructure needs
Inadequate federal R&D
support in key areas
Weakened state support
New Knowledge
(Research)
Human Capital
(Education)
Infrastructure
(Facilities, IT)
Policies
(Tax, IP, R&D)
Technological
Innovation
Engineering
...Research
...Education
...Practice
The Foundation
National Priorities
Economic Competitiveness
National and Homeland Security
Public health and social well-being
Global Challenges
Global Sustainability
Geopolitical Conflict
Opportunities
Emerging Technologies
Interdisciplinary Activities
Complex, Large-scale Systems

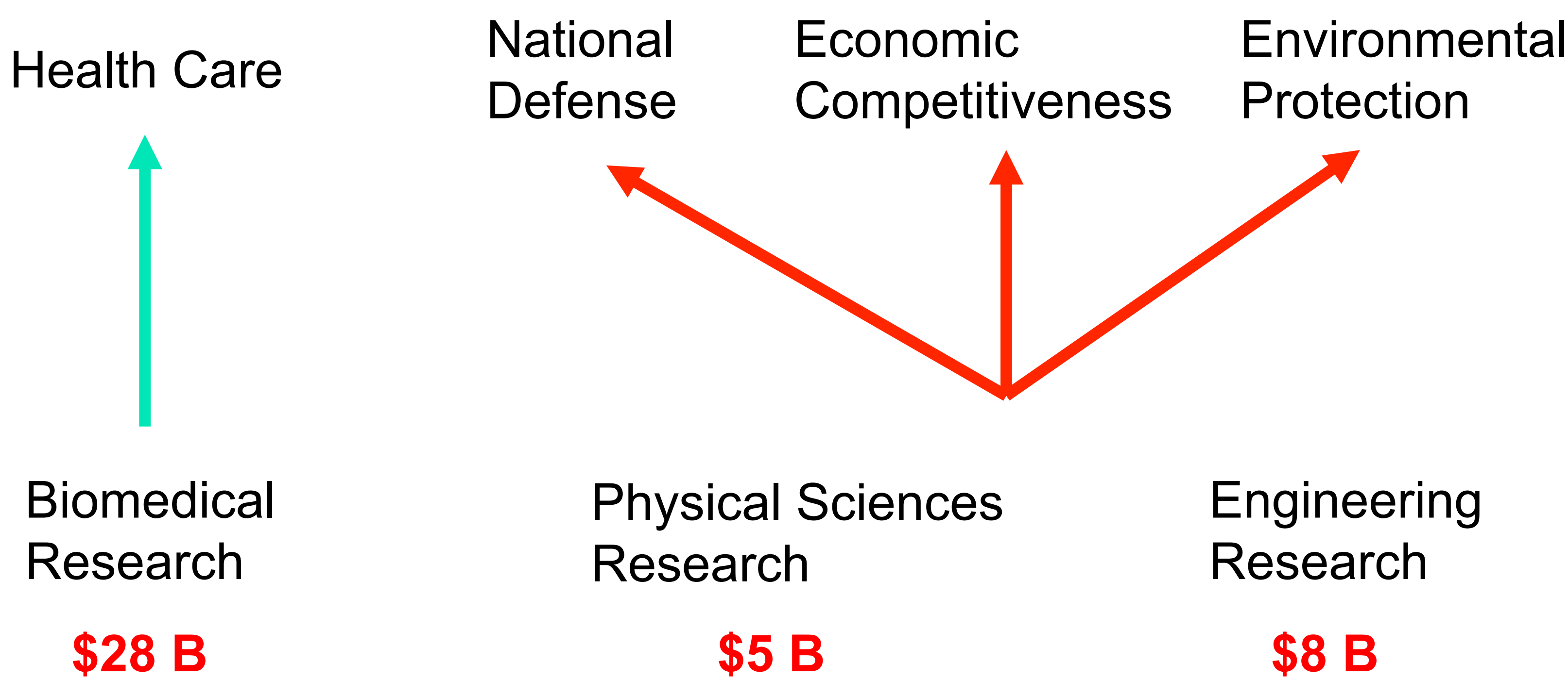
Recommendations

- Balancing Federal R&D Portfolio
- Re-establishing Basic Engineering Research As A Priority of Industry
- Strengthening Linkages Between Industry and Research Universities
- Human Capital
- Discovery-Innovation Institutes

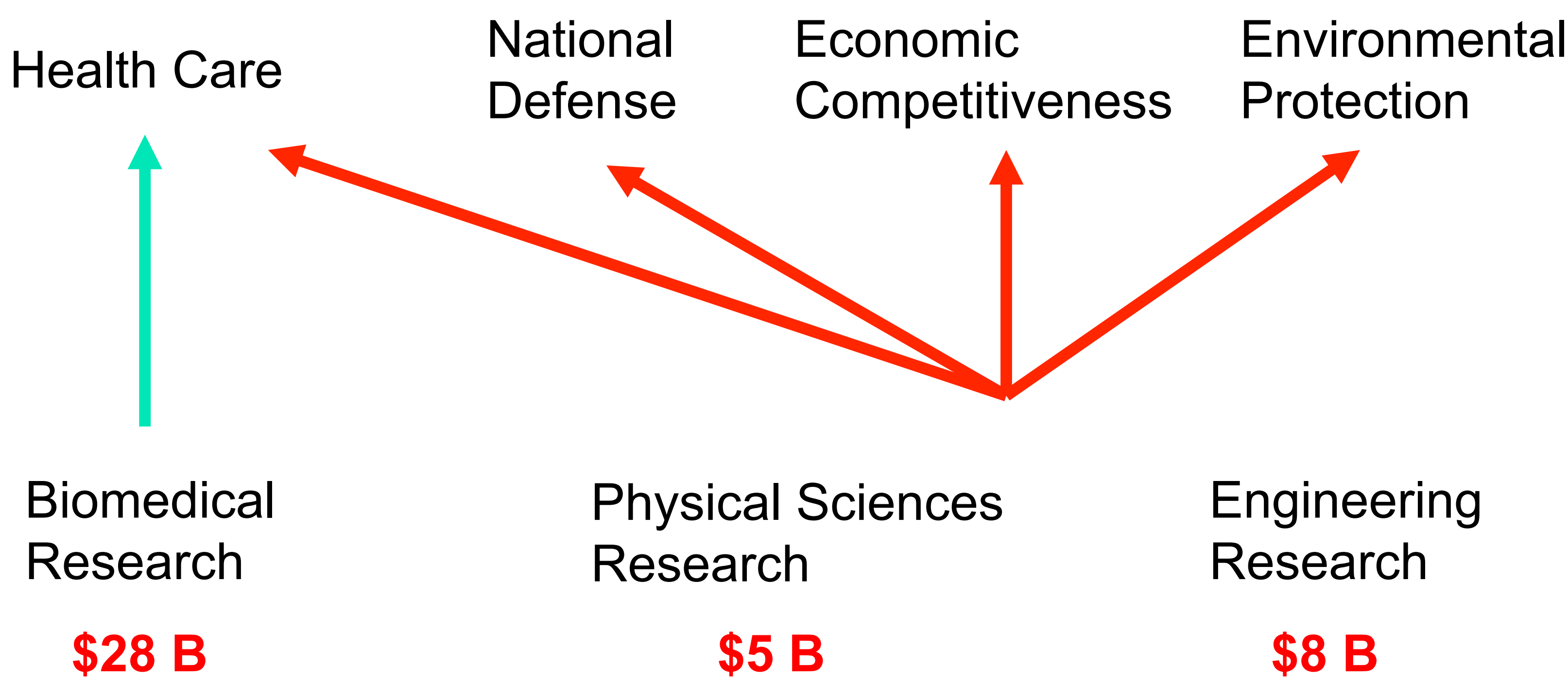
Balancing Federal R&D Portfolio

The Committee strongly recommends a rebalancing of the federal R&D portfolio by increasing the funding of research in physical science and engineering to levels sufficient to support the nation’s most urgent priorities such as national defense, homeland security, economic competitiveness, and energy security.

Federal R&D for National Priorities



Federal R&D for National Priorities



Rebalancing (continued)

This might occur through additional investments in research in these areas, for example, by moving ahead with the earlier Congressional authorization to double the budget of the National Science Foundation; or by reallocation within the existing federal R&D budget to achieve a better balance among disciplines and agencies; or by establishing a mandate through authorization language for increased support of research in physical science and engineering on the part of well-funded agencies such as NIH, DOD, DOE, and NASA, as necessary to sustain their overall research objectives).

Basic Research in Industry

The federal government should consider a broad series of actions to establish strong incentives for American companies to conduct long-term engineering research, including tax incentives, intellectual property policies, relaxation of anti-trust constraints on research consortia, and jointly funded industry-university-government laboratory partnerships.

Industry-University Linkages

Sustaining the nation's leadership in technological innovation requires far more robust ties between American industry and research universities. Recommended actions include: joint initiatives such as the Discovery-Innovation Institutes; federal efforts to streamline and standardize intellectual property policies; programs to support industry scientists and engineers as visiting faculty and the placement of advanced graduate and postdoctoral students in corporate R&D laboratories.

Graduate Scientists and Engineers

The nation should secure an adequate flow of next generation scientists and engineers through a major federal fellowship-traineeship program in key strategic areas (e.g, energy, info-nano-bio, knowledge services), similar to that created by the National Defense Education Act. Immigration policies and practices should be streamlined to restore the flow of talented students, scientists, and engineers from around the world into American universities and industry.

Diversity

The highest priority should be given by all elements of the engineering community and its stakeholders – industry, government, higher education, professional societies–to mount and sustain effective efforts to attract women and underrepresented minorities into engineering careers. This will likely require a very significant increase in investments from both the public and private sector, but it is also clearly key to sustaining both the capacity and quality of our nation’s scientific and engineering workforce.

Strengthening the Engineering Profession

The recent NAE report, *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*, includes recommendations intended to improve engineering curricula; attract and retain a diverse cadre of students majoring in engineering with the tools and creativity necessary to succeed in the future innovation-driven U.S. economy; and to create mechanisms to strengthen the profession of engineering through well-designed graduate engineering programs. This committee endorses these recommendations and urges participation by the full engineering community to meet the challenges of *Engineer 2020.*

Infrastructure

Federal and state governments and industry (through tax incentives) should invest more resources in upgrading and expanding laboratories, equipment, information technologies, and other infrastructural needs of research universities to ensure that the national capacity to conduct world-class engineering research is sufficient to address the technical challenges that lie ahead.

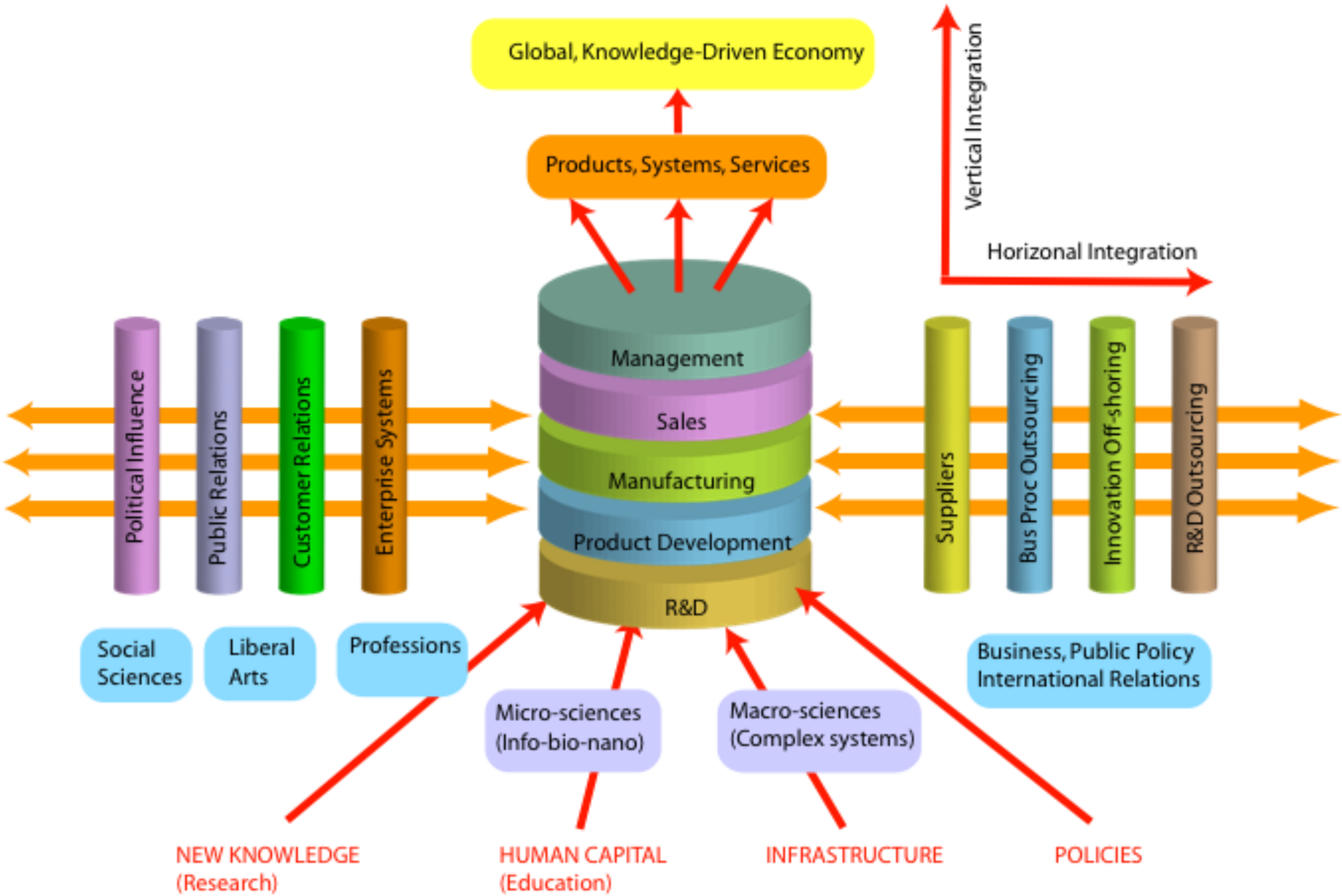
One More Recommendation…

One More Recommendation

Discovery-Innovation Institutes

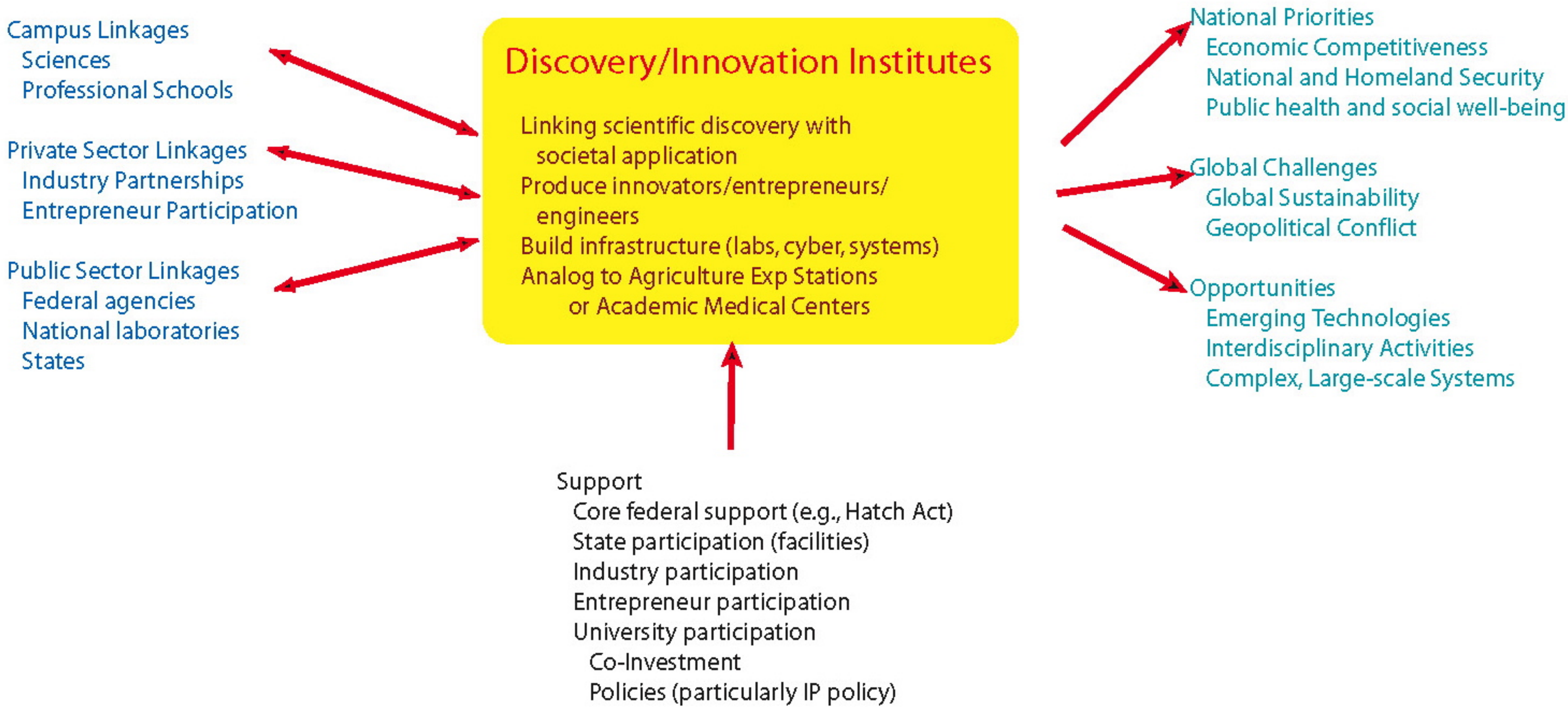
U.S. Leadership in Innovation will Require Changes

- In the way research is prioritized, funded, and conducted.
- In the education of engineers and scientists.
- In policies and legal structures such as intellectual property.
- In strategies to maximize contributions from institutions (universities, CR&D, federal agencies, national laboratories)


Global, Knowledge-Driven Economy
Products, Systems, Services
Vertical Integration
Horizonal Integration
Management
Sales
Manufacturing
Product Development
R&D
Political Influence
Public Relations
Customer Relations
Enterprise Systems
Suppliers
Bus Proc Outsourcing
Innovation Off-shoring
R&D Outsourcing
Social Sciences
Liberal Arts
Professions
Business, Public Policy International Relations
Micro-sciences (Info-bio-nano)
Macro-sciences (Complex systems)
NEW KNOWLEDGE (Research)
HUMAN CAPITAL (Education)
INFRASTRUCTURE
POLICIES

Discovery Innovation Institutes

To address the challenge of maintaining the nation's leadership in technological innovation, the committee is convinced that a bold, transformative initiative is required. To this end, we recommend the establishment of multidisciplinary Discovery-Innovation Institutes on university campuses designed to perform the engineering research that links fundamental scientific discovery with the technological innovation to create the products, processes, and services needed by society.


Discovery/Innovation Institutes
Linking scientific discovery with societal application
Produce innovators/entrepreneurs/ engineers
Build infrastructure (labs, cyber, systems)
Analog to Agriculture Exp Stations or Academic Medical Centers
Campus Linkages
Sciences
Professional Schools
Private Sector Linkages
Industry Partnerships
Entrepreneur Participation
Public Sector Linkages
Federal agencies
National laboratories
States
National Priorities
Economic Competitiveness
National and Homeland Security
Public health and social well-being
Global Challenges
Global Sustainability
Geopolitical Conflict
Opportunities
Emerging Technologies
Interdisciplinary Activities
Complex, Large-scale Systems
Support
Core federal support (e.g., Hatch Act)
State participation (facilities)
Industry participation
Entrepreneur participation
University participation
Co-Investment
Policies (particularly IP policy)

Discovery-Innovation Institutes

- Like agricultural experiment stations, they would be responsive to societal priorities.
- Like academic medical centers they would bring together research, education, and practice.
- Like CR&D laboratories, they would link fundamental discoveries with the engineering research necessary to yield innovative products, services, and systems, but while also educating the next generation technical workforce.

[Environmental Stewardship and Natural Resources Policy and Management](#) (4.7 MB, PDF) Environmental stewardship and natural resources policy and management is one of five target areas driving the MAES research agenda over the next decade. It is a broad area, encompassing land use, air quality, soil conservation, waste management, landscape ecology, ecosystem management and water research. In this issue of Futures, we highlight just a small fraction of the MAES research being done in these areas.

The MAES is conducting a national search for a director. For more information, please visit the **MAES Director Search** web page.

MICHIGAN AGRICULTURAL EXPERIMENT STATION
Michigan State University

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- **MAES Scientists Honored at Founders' Day Celebration**
- **MAES Welcomes New Scientist**
- **U.S.-Canada Forestry Symposium to Address Trade**
- **March Water Policy Workshops Focus on River Science and Drinking Water**
- **Understanding Pesticides in Tree Fruit Is Topic of March Workshop**
- **Food and Agriculture Entrepreneur Workshops Offered Across Michigan**
- **MAES Research Contributes to Launch of New Bean Products**
- **MAES Scientists Awarded $1 Million for Swine Research**

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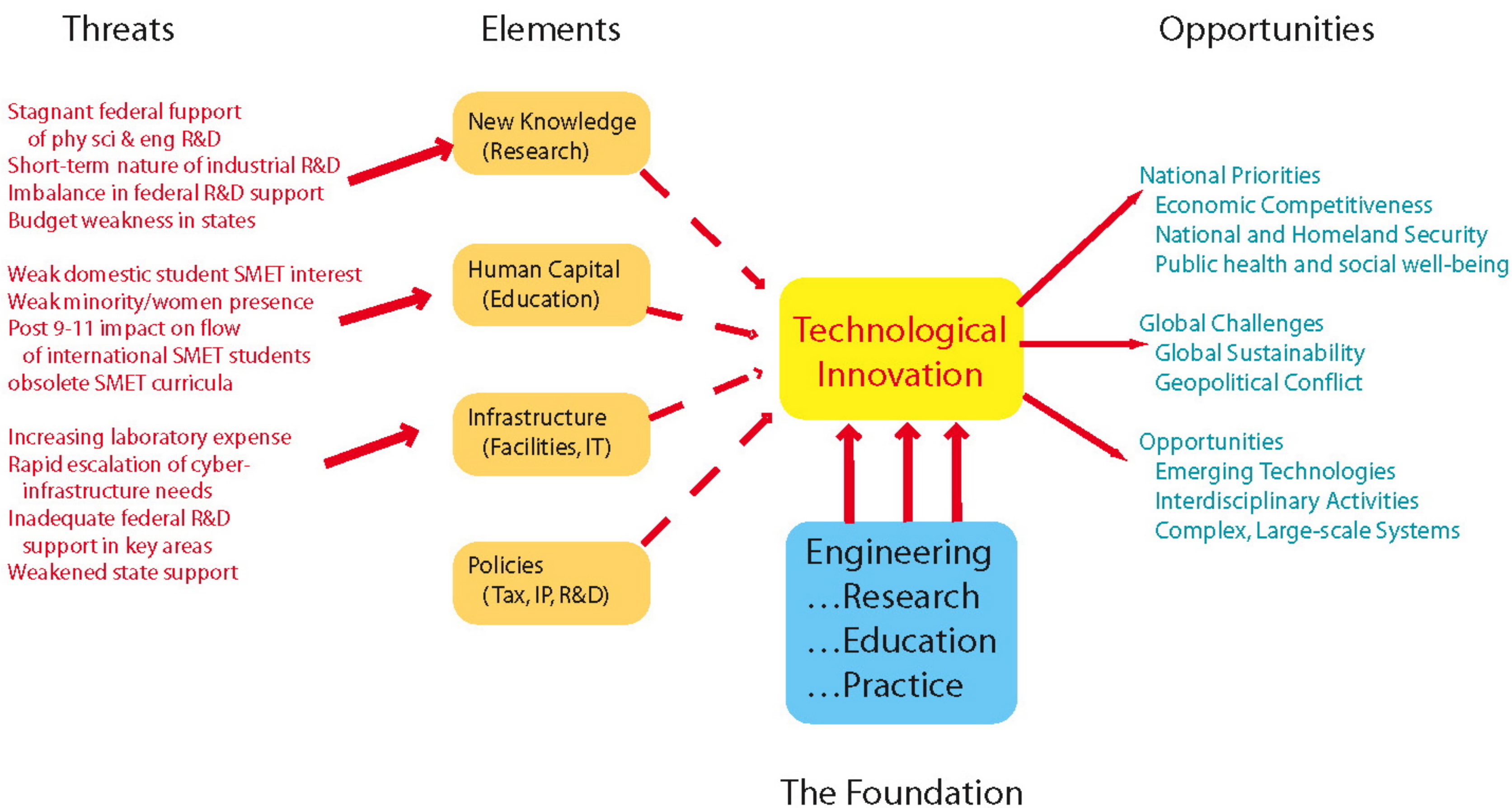
Discovery-Innovation Institutes

- Although primarily associated with engineering schools, DIIs would partner with other professional schools (e.g., business, medicine, law) and academic disciplines.
- To ensure the necessary transformative impact, the DII program should be funded at levels comparable to other major federal initiatives such as biomedicine and manned spaceflight, e.g., building to several billion dollars per year and distributed broadly through an interagency competitive grants program.

In summary

- DIIs would be engines of innovation that would transform institutions, policy, and culture and enable our nation to solve critical problems and maintain leadership in a global, knowledge-driven society.
- The DII proposal is designed to illustrate the bold character and significant funding level we believe are necessary to secure the nation's leadership in technological innovation.



Threats
Elements
Opportunities
Stagnant federal fupport
of phy sci & eng R&D
Short-term nature of industrial R&D
Imbalance in federal R&D support
Budget weakness in states
Weak domestic student SMET interest
Weak minority/women presence
Post 9-11 impact on flow
of international SMET students
obsolete SMET curricula
Increasing laboratory expense
Rapid escalation of cyber-
infrastructure needs
Inadequate federal R&D
support in key areas
Weakened state support
New Knowledge
(Research)
Human Capital
(Education)
Infrastructure
(Facilities, IT)
Policies
(Tax, IP, R&D)
Technological
Innovation
Engineering
...Research
...Education
...Practice
The Foundation
National Priorities
Economic Competitiveness
National and Homeland Security
Public health and social well-being
Global Challenges
Global Sustainability
Geopolitical Conflict
Opportunities
Emerging Technologies
Interdisciplinary Activities
Complex, Large-scale Systems

How can Congress help?

- Resist efforts to cut federal R&D in physical science and engineering still further (e.g., FY2006 cuts planned for DOD 6.1-6.3, DOE Science, NASA Science, etc.)
- Provide appropriations to achieve authorization target of doubling the NSF budget.
- Enact a 21st Century National Education Defense Act for graduate student support (e.g., DOD).
- Provide tax incentives and regulatory relief to encourage basic research in industry.
- Launch a major interagency initiative to fund Discovery-Innovation Institutes.