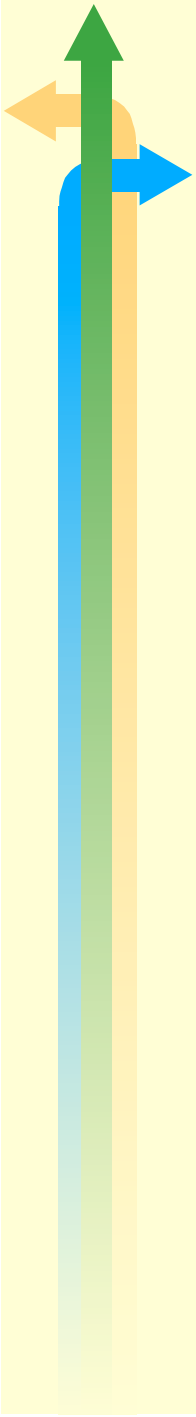


Federal Research Policy and the Future of the American Research University

Jim Duderstadt
The Scientific Club
March 16, 2000

The Issues

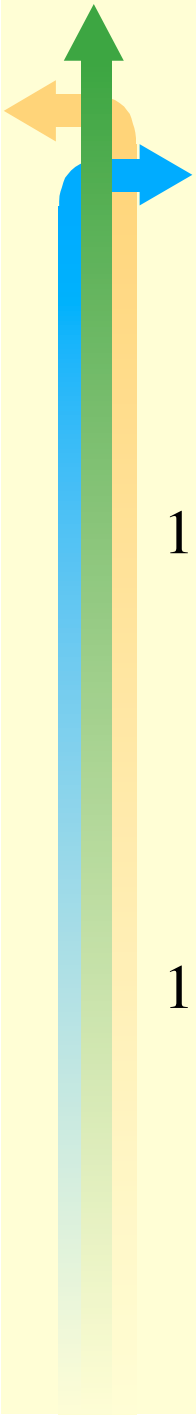
- The nature of federally-sponsored research
  - Basic vs. applied research
  - Curiosity-driven vs. strategic research
  - Newtonian vs. Baconian vs. Jeffersonian research
- A question of balance
  - Biomedical sciences vs. everything else…
  - Federal vs. corporate vs. foundation research

The Issues (continued)

- The impact on the university
  - Research >> teaching >> service >> citizenship
  - "a holding company for research entrepreneurs"
- The future of the American research university
  - The decline and fall of federally sponsored research
  - The Research University, Inc.
  - The core-in-cloud model

Some background

- Member, National Science Board (1984-1996)
  - Chair (1990-1994)
- Councilor,NAE (1994-2000)
- Member, NAS Committee on Science, Engineering,
  - And Public Policy (COSEPUP) (1997-2003)
  - Chair, FS&T Steering Group
- Chair, NAS Task Force on Information Technology
  - and the Future of the Research University
- Other: Chair, DOE Nuclear Energy Research Advisory Com
  - Chair, NRC Committee on Scholarship in Digital Age
  - Chair, Triana Review Committee



In the beginning...

1945: *Science, the Endless Frontier*, Vanevar Bush

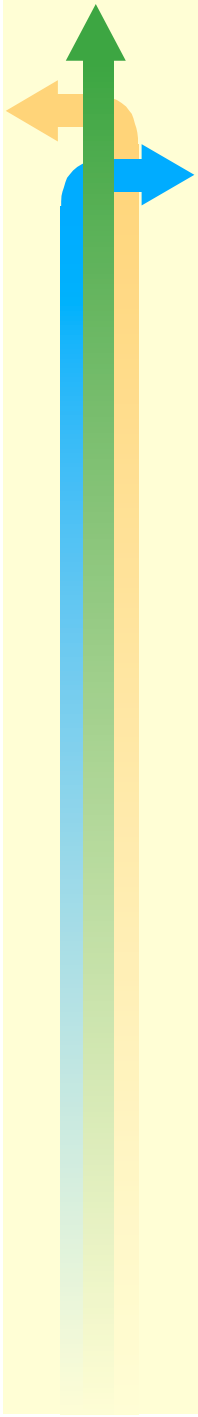
The government-university research partnership

The National Science Foundation

The National Science Board

1950s -->

The evolution of the “research university”

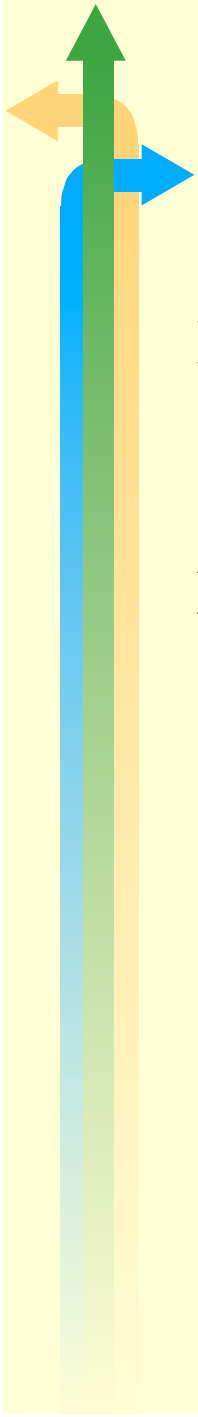


Government-University Research Partnership

Bush Report: “Since health, well-being, and security are proper concerns of government, scientific progress is, and must be, of vital interest to government.”

Key features:

- Merit-determined, peer-reviewed research grants
- Investigator initiated
- Freedom of inquiry
- Single-investigator grant model



Federal Research Agencies

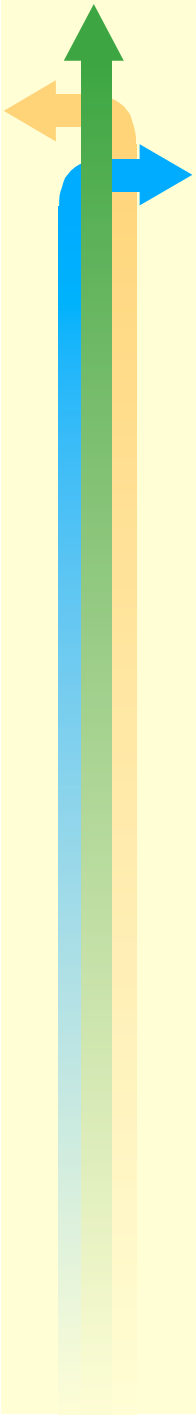
Basic Research Agencies:

- National Science Foundation ($3.4 B)
- National Institutes of Health ($17.7 B)

Mission Agencies:

- Department of Defense ($7.5 B)
- Department of Energy ($6.7 B)
- National Aeronautics and Space Administration ($9.8B)
- Department of Commerce ($1.1 B)
- Department of Agriculture ($1.8 B)
- Department of Education ($0.3 B)
- Other Agencies ($3 B)

(FY2001 FS&T Budget: Total $53.7 B)



The Process (for FY2001)

May-August, 1999: Agencies develop funding requests

September-January 2000: OMB assembles request

February, 2000: President presents budget request

March, 2000-September 2000: Congress develops appropriation budgets through committee structures

October-November 2000: Conference Committees

November-December 2000: President signs bills

The Players

- White House: PCAST, OSTP, OMB
- Congress:
  - Authorization committees
  - Appropriation committees
- Lobbyists
  - Scientific societies
  - Higher education
  - Special interests
  - The “marching army”

How are priorities really set?

Changing nature of social needs?

- Military security (Cold War) --> health care (aging population)

Federal policy?

- (Sputnik, RANN, 21st Century Research Fund)

Congressional appropriation process?

- Committee structure (e.g., HUD-Ind Agencies)
- Lobbyists (earmarks)

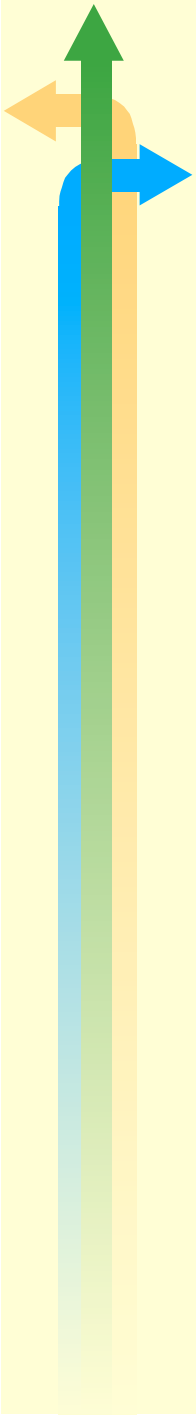
The Press Report (1995)

NAS/NAE/IOM Report:

Allocating Federal Funds for Science and Technology

Goals:

- Make the research funding allocation process more coherent, systematic, and comprehensive
- Allocate funds to best people and best projects.
- Ensure that sound scientific and technical advice guides allocation process.
- Improve federal management of R&D activities.



Operational Elements of the Press Report

- Develop an alternative to the federal "R&D" budget category than more accurately measures spending on generating new knowledge: "The Federal Science and Technology budget" (FS&T)
- Propose a guiding principle for making resource allocation decisions in federally-sponsored research

Key Concept:
The Federal Science and Technology Budget

The FS&T budget reflects the real federal investment in the creation of new knowledge and technologies and excludes activities such as the testing and evaluation of new weapons systems.

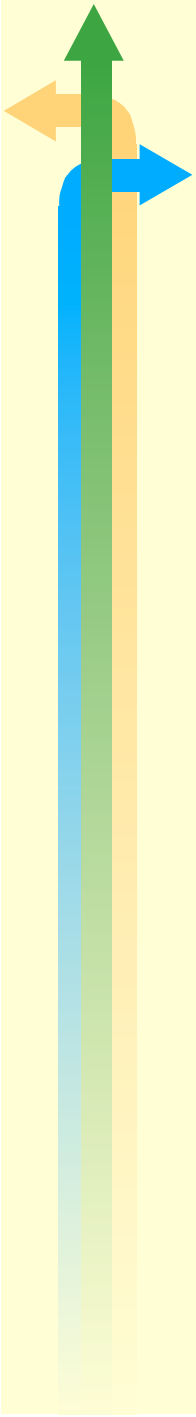
For example, in FY2001:

Total Federal R&D Budget: $85.4 B

Total Federal FS&T Budget: $53.7 B

FS&T Budget includes

- Civilian and noncivilian research budgets for all agencies (including “6.1” and “6.2” at DOD)
- Development budget for all agencies except DOD and DOE. For the development of the later two agencies, only DOD “6.3” and the equivalent activities of the DOE atomic-energy defense program are included in the FS&T budget
- R&D facilities and major capital equipment for R&D



Principle for Allocation of Federal Research Funding

1. The United States should be among the leaders in all major fields of science and technology.

2. The United States should be the absolute leader in key science and technology areas of major importance.

Examples:

- U.S. should be absolute leader in biotech, infotech
- U.S. should be among leaders in high energy physics

Role of COSEPUP

- Annual FS&T Analysis
- Developing methodology to do international benchmarking in various disciplines (e.g., materials science, mathematics, immunology)
- Working with federal government to include benchmarking in application of Government Performance Results Act (GPRA) to research programs of federal agencies

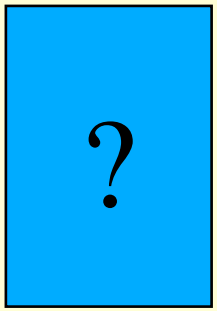
FS&T Guidance Group (COSEPUP)

- Provide an impact assessment of aggregate FS&T trends each spring (with AAAS)
- To seek guidance from both the research community and policy makers about key issues of concern.
- To analyze in more detail such issues in targeted COSEPUP or NRC studies.
- Guidance Group Overseeing this Activity: Jim Duderstadt (chair), Millie Dresselhaus, Guy Stever, Marye Anne Fox, Phillip Griffiths, Lew Branscomb, Anita Jones, Ruby Hearn

FS&T Reports to date

1999

2000



2001

2002

2003

FY2001 FS&T Report currently in

NRC Report Review Process

Example: FY2001

- Federal R&D Budget: **$85.4 B**
- FS&T Budget: **$53.7 B**
- 21st Century Research Fund: **$42.9 B**

21st Century Research Fund

- Centerpiece of the President's R&D investment strategy.
- Similar in concept to an integrated FS&T budget with the inclusion of DOD basic and applied research.
- Differs with FS&T budget across all agencies in terms of the level of funding and the activities funded. For example, the 21st Century Research Fund does not include DOD "6.3" or DOE's atomic weapons programs.

Some Comparisons

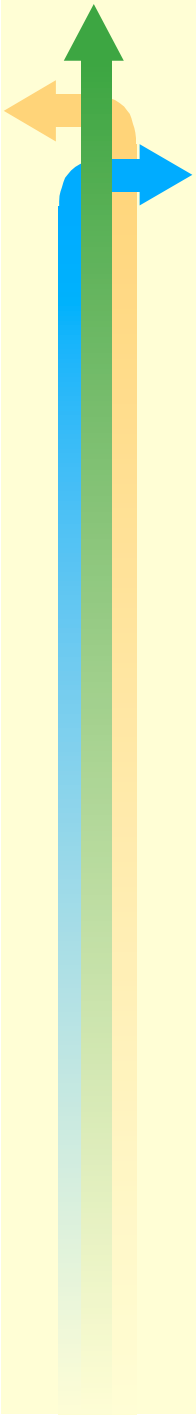
Agency	21st Century Research Fund*	FS&T	R&D
Dept. of Defense	**4,362**	**7,543**	**38,576**
Basic and applied research (6.1-6.2)	4,362	4,362	4,362
Advanced technology development (6.3)	--	3,182	3,182
Test, evaluation, and other	--	--	31,032
Dept. of Health & Human Services	**18,813**	**19,087**	**19,087**
National Institutes of Health	18,813	18,094	18,094
Other HHS programs	--	993	993
National Aeronautics and Space Administration	**5,165**	**10,040**	**10,040**
Space, Earth, and Life and Microgravity Sciences	4,107	4,107	4,107
Aerospace Technology	1,058	1,193	1,193
Other Science, Aeronautics, and Technology	--	629	629
Human Space Flight and Mission Support	--	4,111	4,111
Dept. of Energy	**4,221**	**6,819**	**7,655**
Solar and Renewable Energy R&D	410	376	376
Nuclear Energy R&D	--	92	92
Fossil Energy R&D	--	293	293
Energy Conservation	660	465	465
Science Programs	3,151	2,969	2,969
Atomic Energy Defense Activities	--	2,749	3,405
Radioactive Waste Management	--	40	40
National Science Foundation	**4,572**	**3,431**	**3,431**
Research and Related Activities	3,541	3,180	3,180
Major Research Equipment	139	139	139
Education and Human Resources	729	112	112
Salaries, Expenses, and Inspector General	164	0	0
Dept. of Agriculture	**1,649**	**1,828**	**1,828**
Dept. of Commerce	**862**	**1,148**	**1,148**
Dept. of the Interior	**895**	**590**	**590**
Dept. of Transportation	**899**	**778**	**778**
Environmental Protection Agency	**758**	**679**	**679**
Education	**379**	**271**	**271**
Veterans' Affairs	**321**	**655**	**655**
All Others	**--**	**597**	**597**
TOTAL	**42,895**	**53,402**	**85,335**

Source: OMB, *Budget of the U.S. Government FY 2001* and AAAS, Table II-1.

TABLE A-4 Cross-Cutting National Science and Technology Council Initiatives, President's FY 2001 Budget (millions of constant FY 2000 dollars)

				Percent Change	
	1999 Actual	2000 Est.	2001 Budget	FY 1999-FY 2000	FY 2000-FY 2001
Nanotechnology Initiative	251	270	485	7.7%	79.7%
Information Technology R&D	1,320	1,721	2,270	30.3%	31.9%
Clean Energy: Biobased Products and Bioenergy	198	196	283	-1.0%	44.6%
Climate Change Technology Initiative	1,036	1,099	1,404	6.1%	27.7%
Partnership for a New Generation of Vehicles	239	226	250	-5.2%	10.6%
Integrated Science for Ecosystem Challenges	639	657	732	2.8%	11.5%
U.S. Global Change Res. Program	1,682	1,701	1,706	1.1%	0.3%
Interagency Education Research Initiative	30	38	49	24.8%	29.0%
Critical Infrastructure Prot. R&D	457	461	594	0.9%	28.9%
Weapons of Mass Destruction Preparedness R&D	325	473	491	45.6%	3.8%

Source: U.S. Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2001*.



FY 2001 Observations (preliminary)

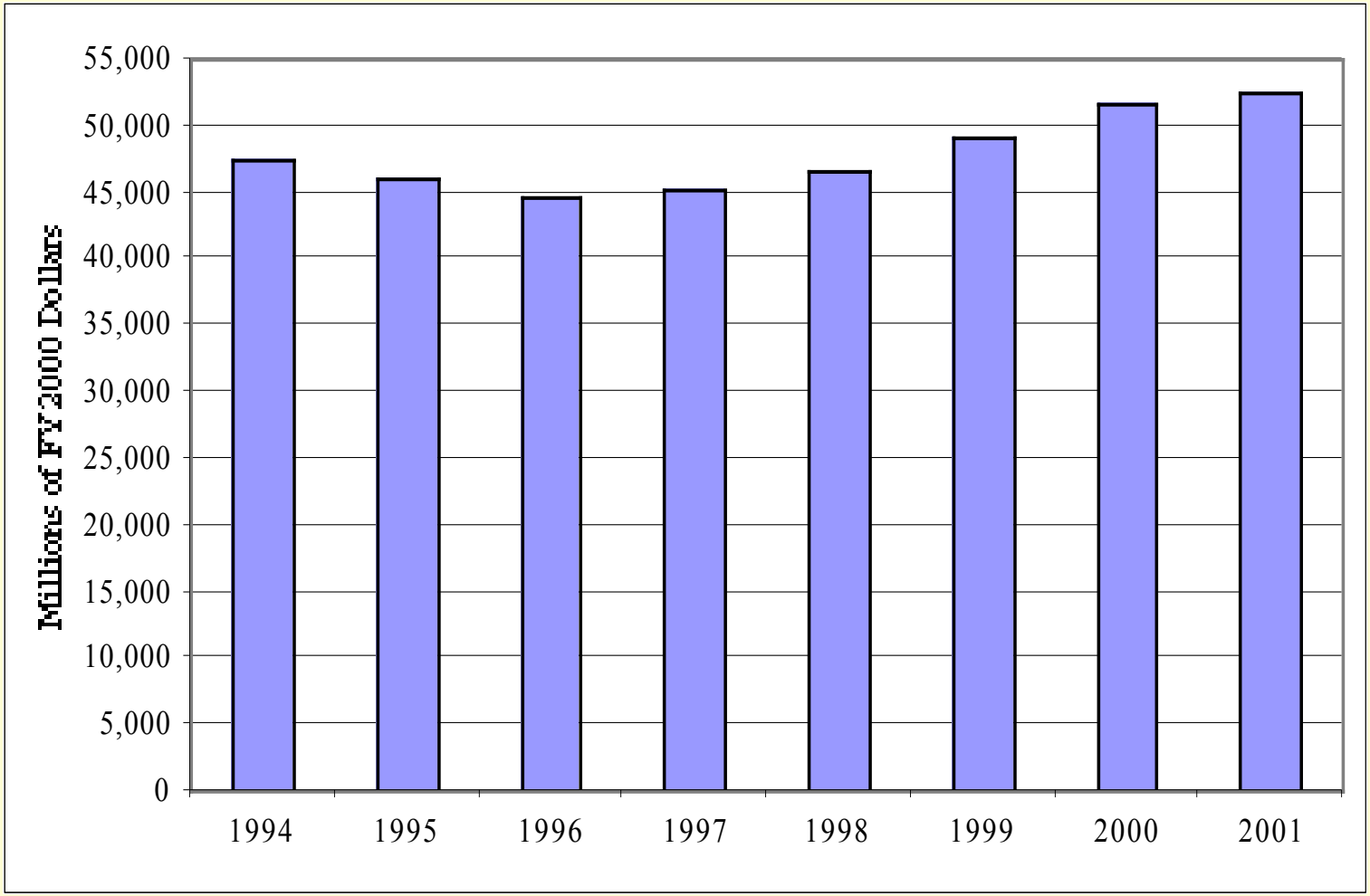
1. FS&T budget dropped significantly in early 1990s and has only recovered in past two years.

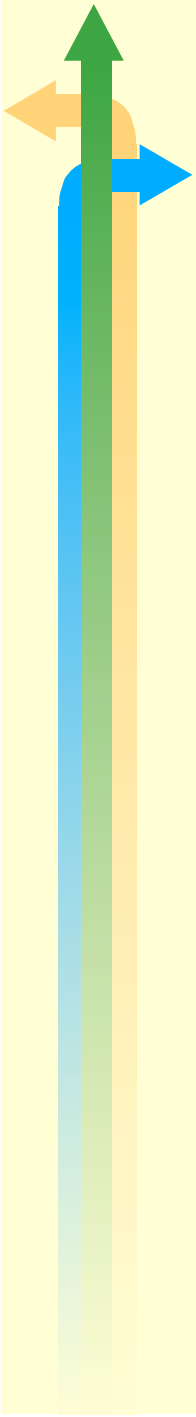
2. During the 1990s, the only big winner has been NIH (biomedical sciences); NSF has held its own; everybody else has lost (with DoD losing big time).

3. A serious imbalance has developed in federal funding among the physical sciences, engineering, social sciences, and life sciences.

4. The federal government's share of R&D has fallen far behind industry and no longer may be sufficient to sustain future economic growth of a technology-driven economy.

FS&T Budget: 1994-2001





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Winners and Losers

Changes in FS&T budget: 1994 to 2000

NIH: $11.5 B --> $17.1 B (+ 49%)

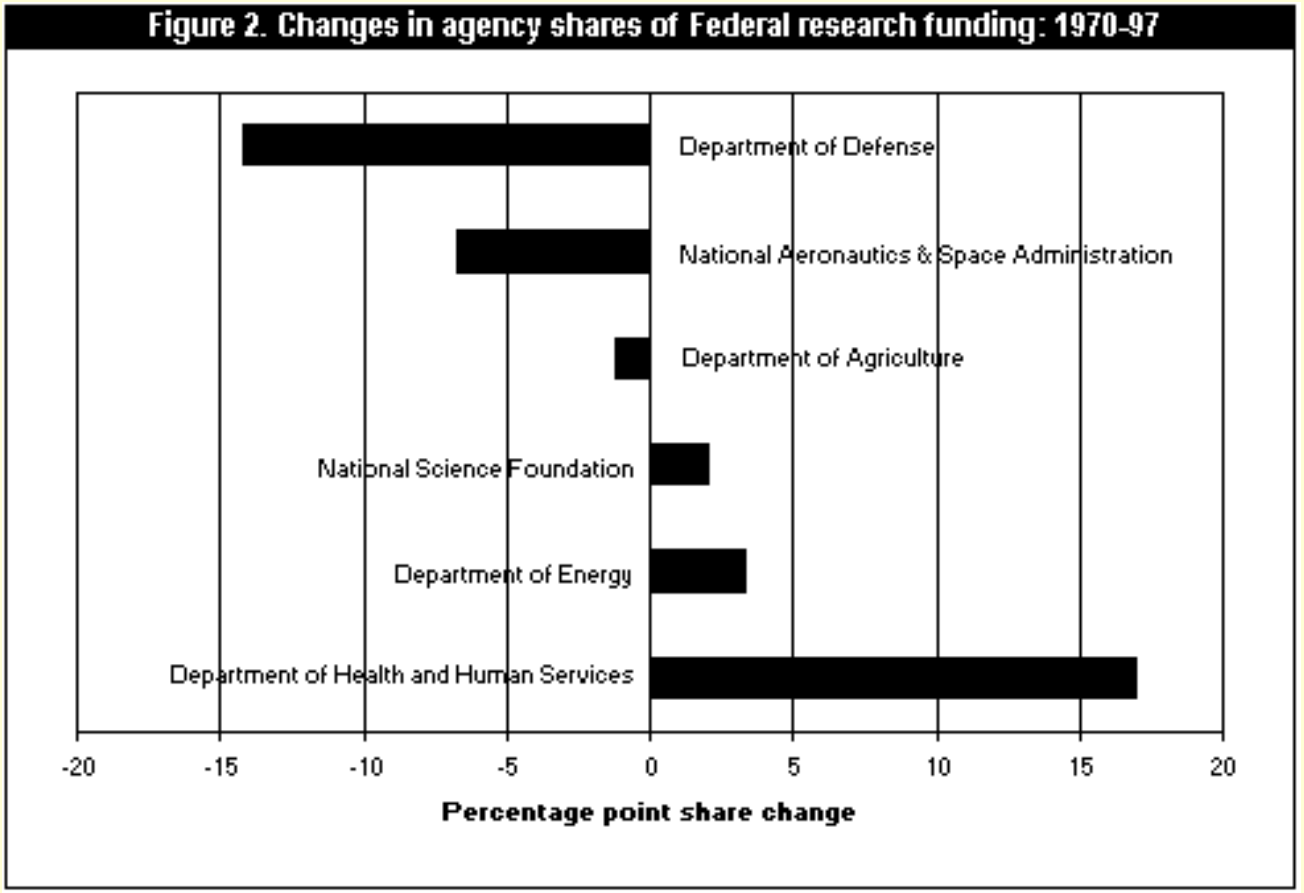
NSF: $2.4 B --> $2.8 B (+ 16%)*

DOD: $9.2 B --> $8.6 B (- 7%)

DOE: $6.5 B --> $6.3 B (- 1%)

NASA: $10.3 B --> $9.7 B (- 6%)

Changes in Agency Funding



SOURCE: National Science Foundation, Division of Science Resouces Studies, Survey of Federal Funds for Research and Development.

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Impact of Changes in Mission Agency Budgets on Key Fields

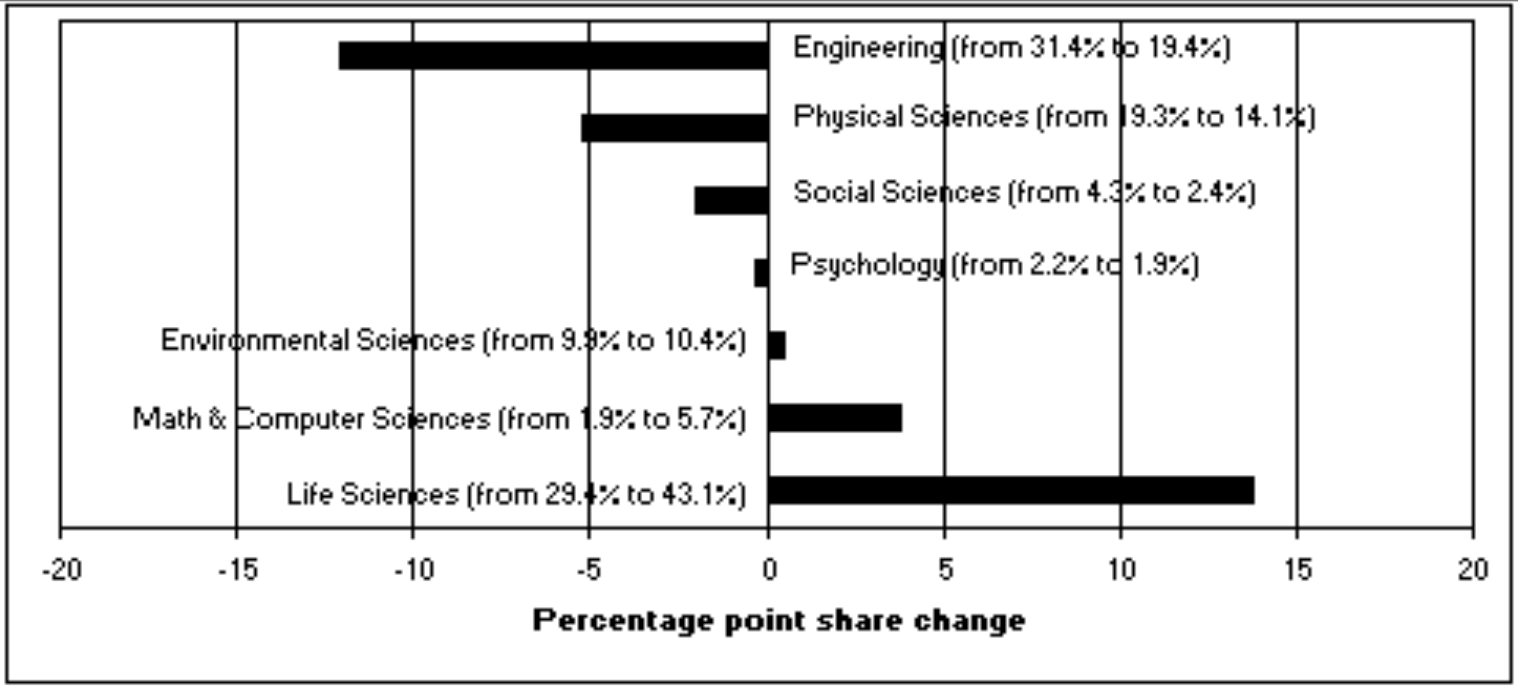
- Major increase in NIH budget (48%); minor increase in NSF budget (16%)
- Decreases in DOD, DOE, NASA, and USDA FS&T Budgets
- Concern: The impact that projected decreases in the FS&T budgets of mission agencies could have on selected fields

Fields with Majority of Support from Mission Agencies

- DOE: Physics (46%)
- DOD: Computer Science (60%), Electrical and Mechanical Engineering (69%), Biological and Social Aspects of Psychology(66%), (also Mathematics (27%) and Materials Science and Engineering (38%))
- NASA: Astronomy (68%), Aeronautical and Astronautical Engineering (40%)
- USDA: Agriculture (99%)

Changes in disciplinary funding

Figure 1. Changes in field shares of total Federal research funding: 1970-97



NOTE: Other sciences not classified within one of the broad fields listed above are excluded.

SOURCE: National Science Foundation, Division of Science Resouces Studies, Survey of Federal Funds for Research and Development.

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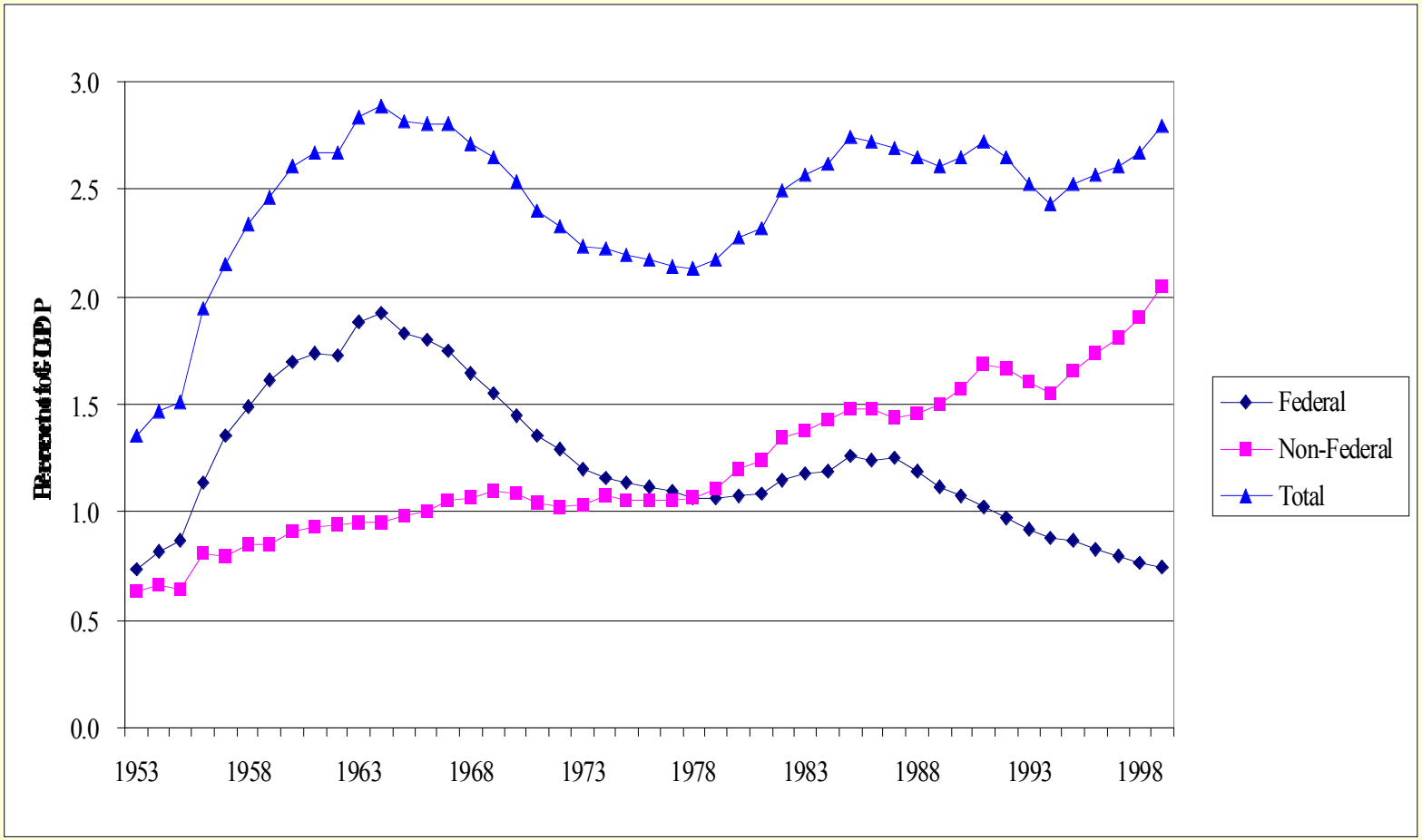
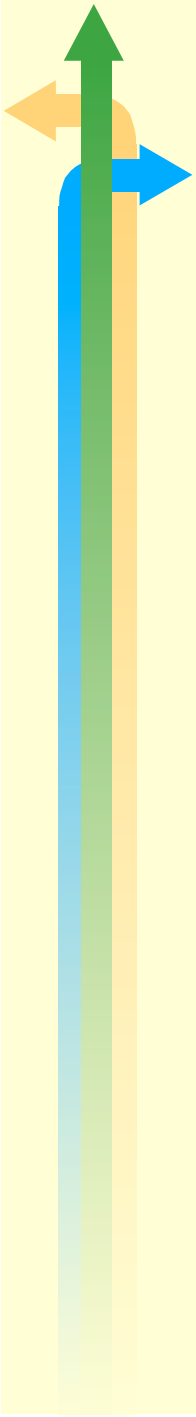
Federal vs. Non-Federal R&D



Some other observations

- Sharp increases in the biomedical fields threaten to outpace the capacity of available physical infrastructure and human resources.
- The proposed 17.5% increase for NSF is very important as a first step toward rebalancing federal support among the disciplines.
- The 21st Century Research Fund is an important step toward the FS&T concept.



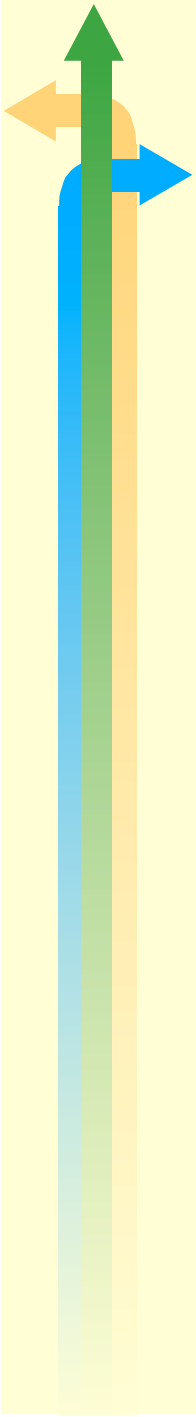
The Process

Retrospective:

- Shifting needs of society?
- Federal policies addressing strategic needs?
- Congressional sausage-making process?

Prospective:

- Press Report Approach (leadership)?
- Jeffersonian vs. Newtonian vs. Baconian science?
  - (Pasteur's Quadrant)



The Future of the Research University

Is the current culture (e.g., the university as “a holding company for research entrepreneurs”) sustainable?

Will market forces drive us into oblivion (or cyberspace)?

What about new models?

- Cyberspace (or virtual) universities
- Core-in-cloud universities
- A global knowledge and learning industry
- A society of learning (a 21st Century learn-grant act)