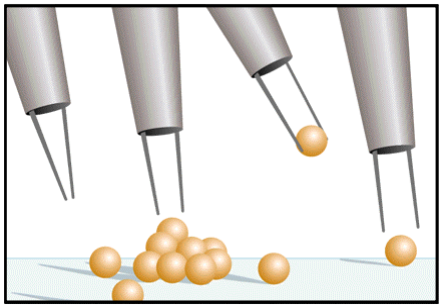
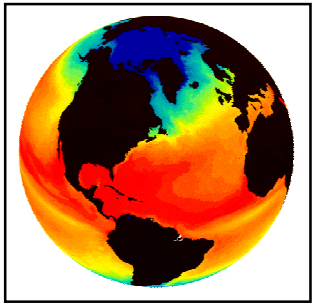
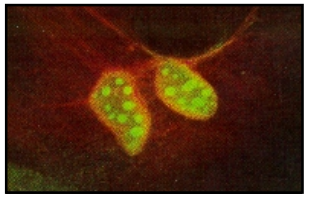
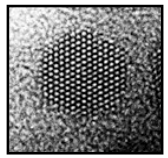
Strength Through Science









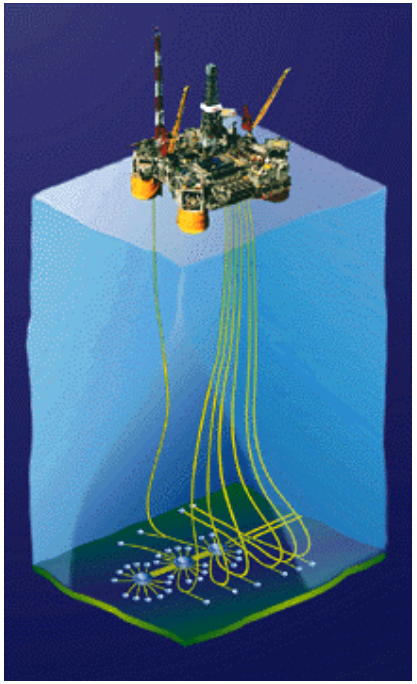
Fusion Energy Sciences Advisory Committee

The Department of Energy Perspective

Dr. Mildred S. Dresselhaus
Director, Office of Science
U.S. Department of Energy

November 14, 2000

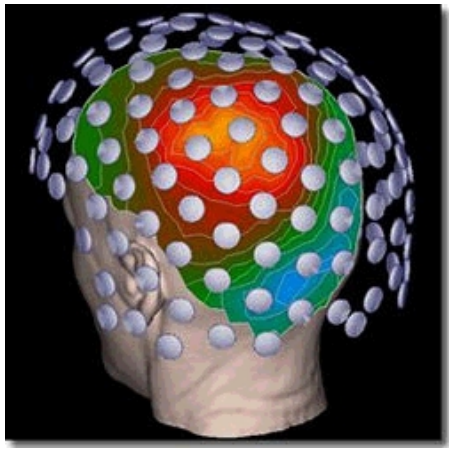
DOE Mission Areas



Energy Resources - *To Foster a Secure and Reliable National Energy Supply*

National Security - *To Maintain the Safety and Reliability of the Nuclear Stockpile*

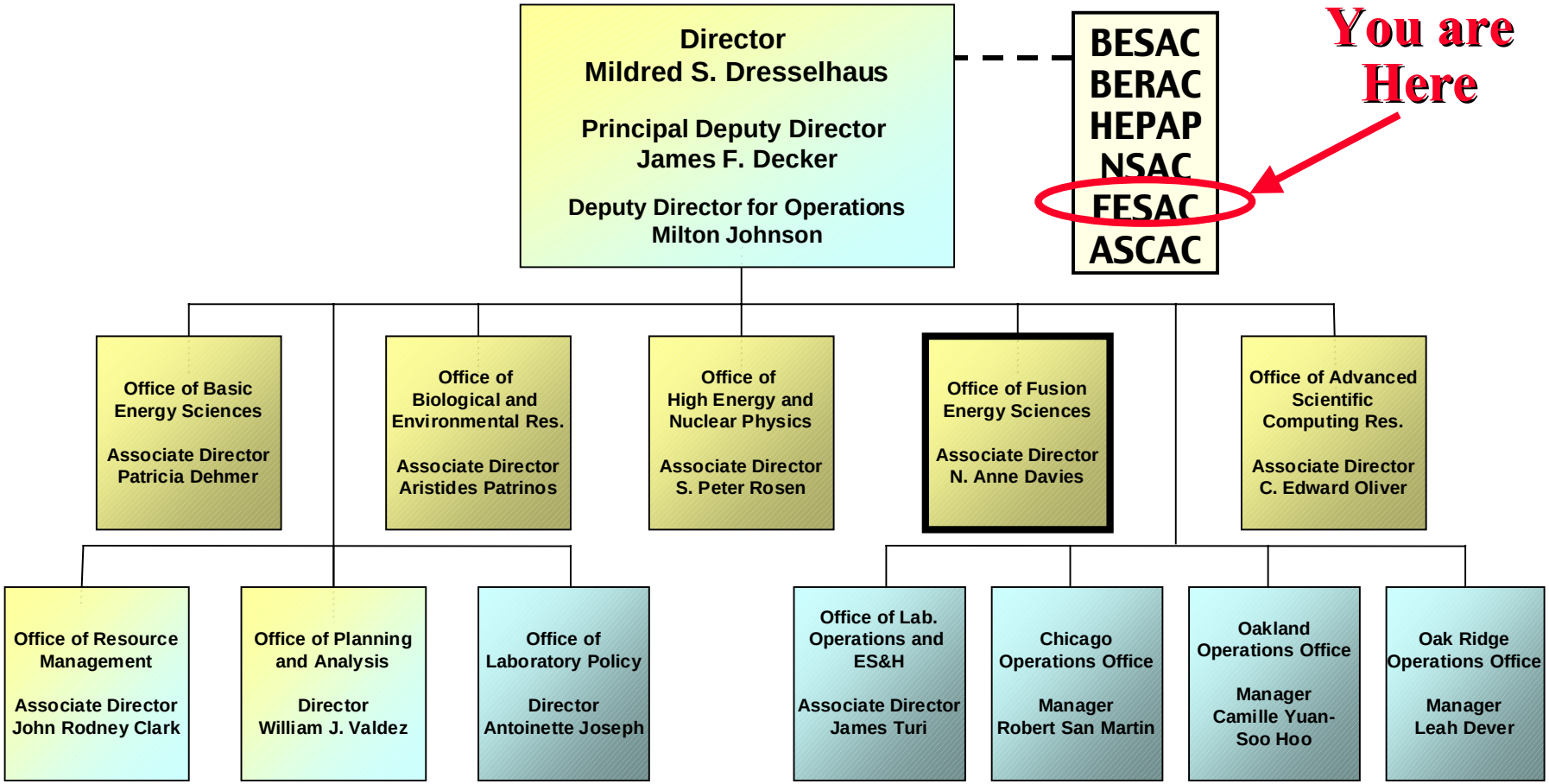
Science...



Environmental Quality

- To Repair the Environmental Consequences of the Cold War

Office of Science



Fusion Energy Sciences Mission:

The mission of the U.S. Fusion Energy Sciences Program is to advance plasma science, fusion science, and fusion technology, and thereby provide the knowledge base needed for an economically and environmentally attractive fusion energy source.

Department of Energy Science

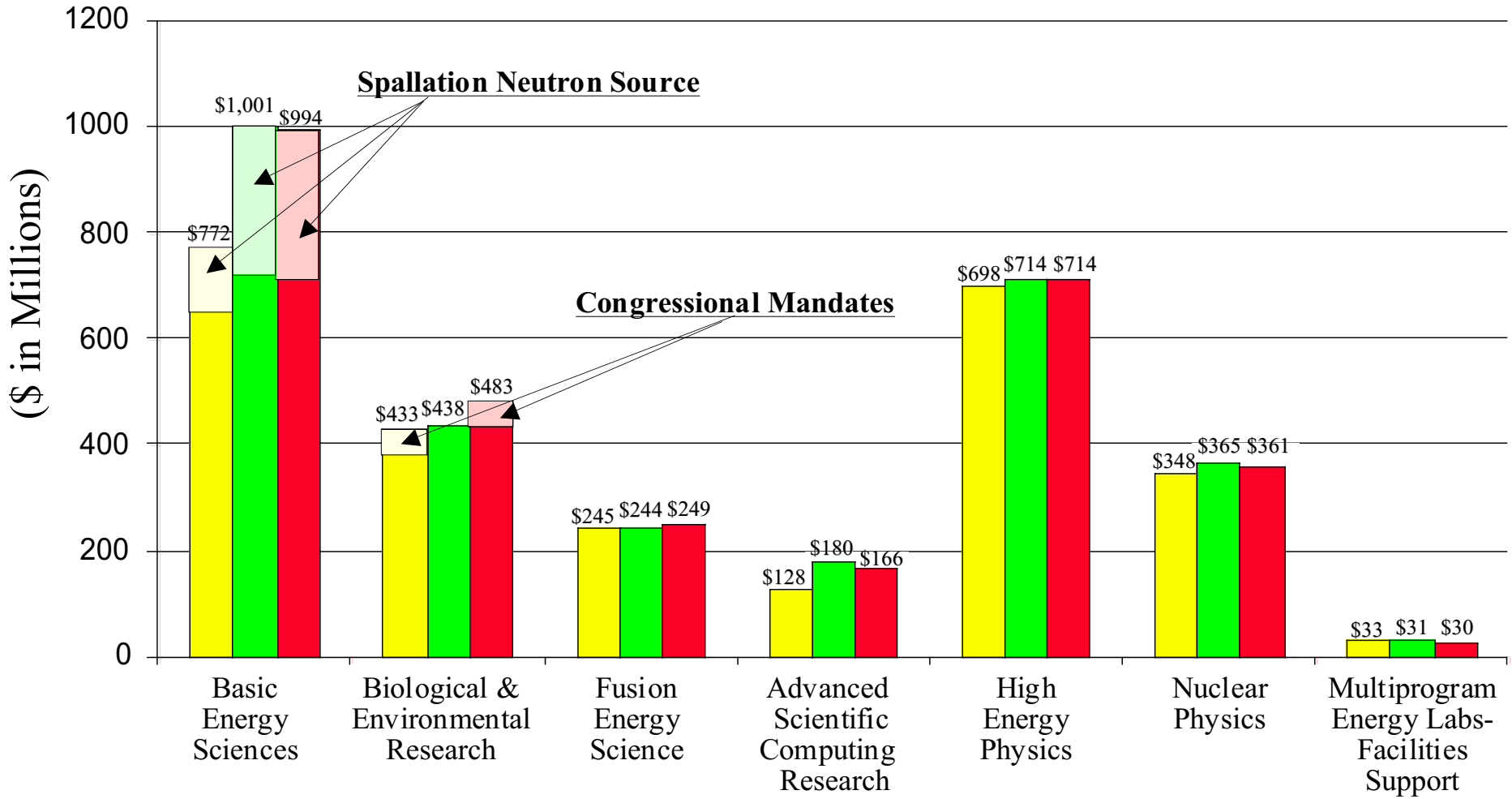
Top Five Government Research Organizations for:*

Physical Sciences	Earth and Environmental Sciences	Mathematics & Computing	Engineering	Life Sciences	R&D Facilities
1. Energy (2,012)	1. NASA (1,051)	1. DOD (657)	1. NASA (1,948)	1. HHS (11,838)	1. Energy (939)
2. NASA (1,019)	2. NSF (481)	2. Energy (623)	2. DOD (1,837)	2. USDA (1,215)	2. NASA (403)
3. NSF (515)	3. DOD (383)	3. NSF (399)	3. Energy (851)	3. DOD (519)	3. DOD (386)
4. DOD (412)	4. INTERIOR (364)	4. HHS (127)	4. NSF (484)	4. NSF (403)	4. NSF (271)
5. HHS (205)	5. Energy (335)	5. COMMERCE (89)	5. TRANS (323)	5. Energy (288)	5. HHS (227)

* *Numbers are FY 1999 Dollars in Millions - Source: NSF -- Preliminary Federal obligations for research, by agency and field of science and engineering: fiscal year 1999*

** *Numbers are FY 1999 Dollars in Millions - Source: OMB*

DOE Office of Science Budget



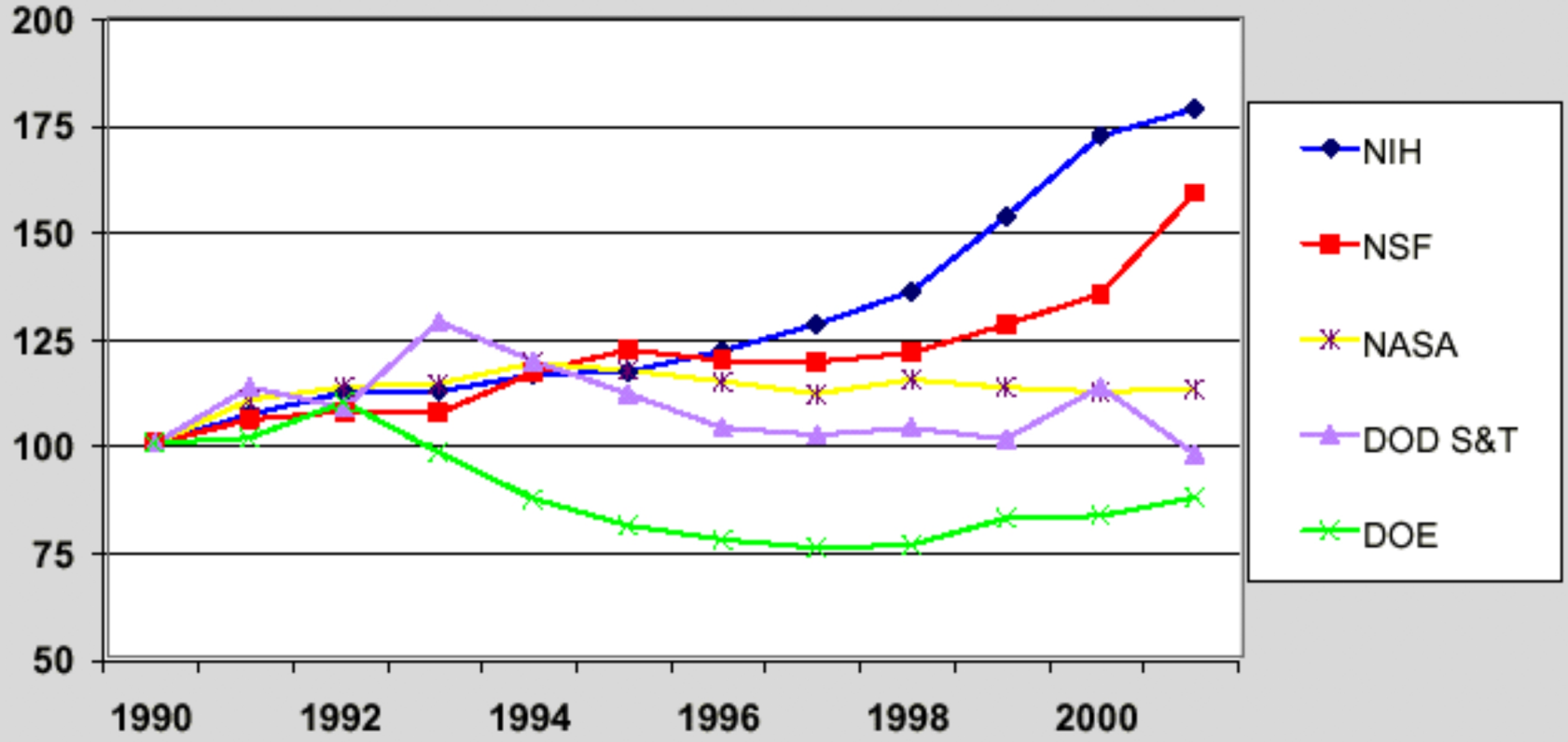
FY 2000

FY 2001 Amended Request

FY 2001 Appropriation with General Reduction allocated; includes $24 Million for Waste Management activities

Trends in Federal R&D, FY 1990-2001

selected agencies in constant dollars, FY 1990=100



Source: AAAS analyses of R&D in *AAAS Reports VIII-XXV*. FY 2001 figures are President's request; FY 2000 figures are latest estimates.

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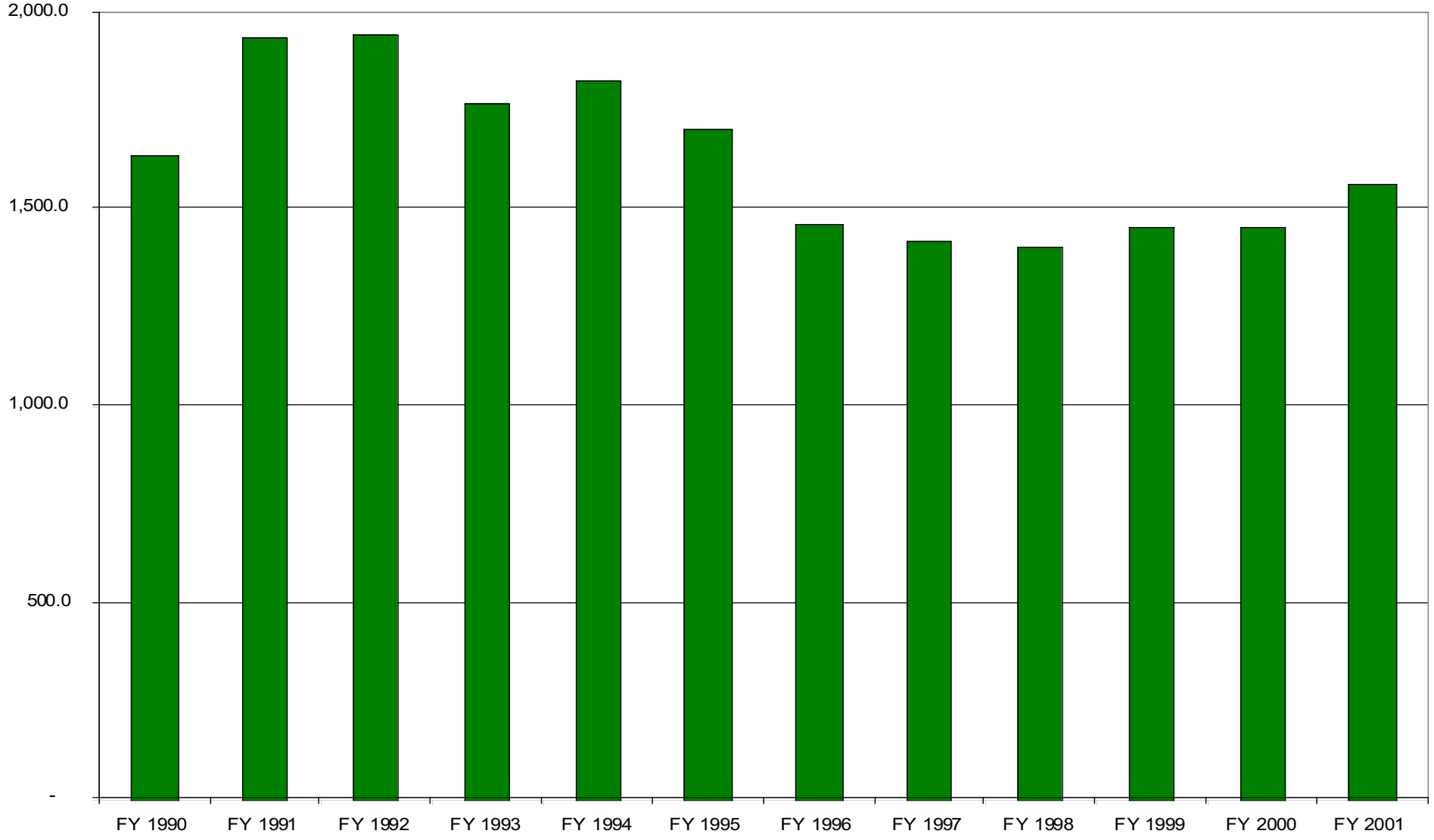
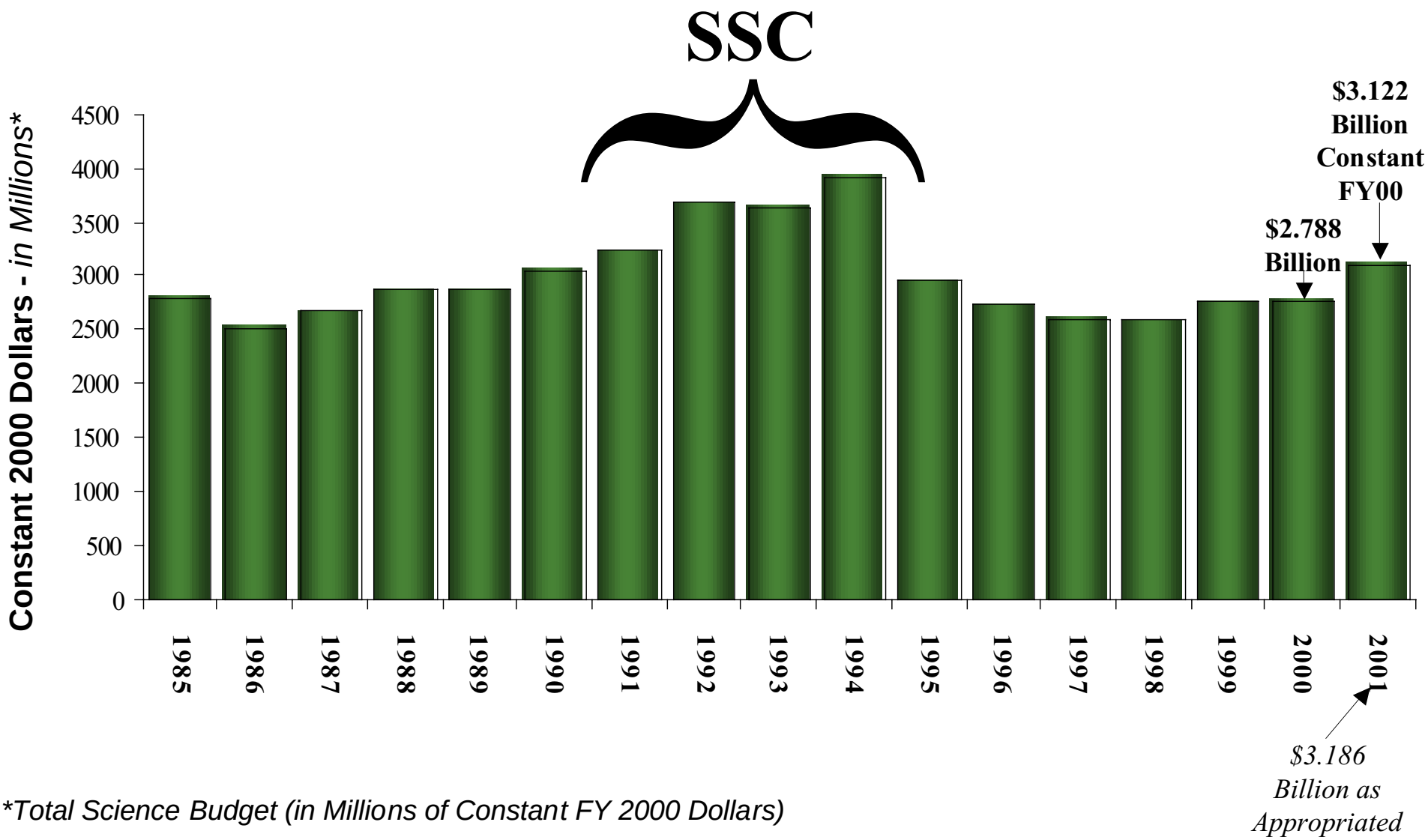
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Office of Science Research

in Constant FY 2001 Dollars



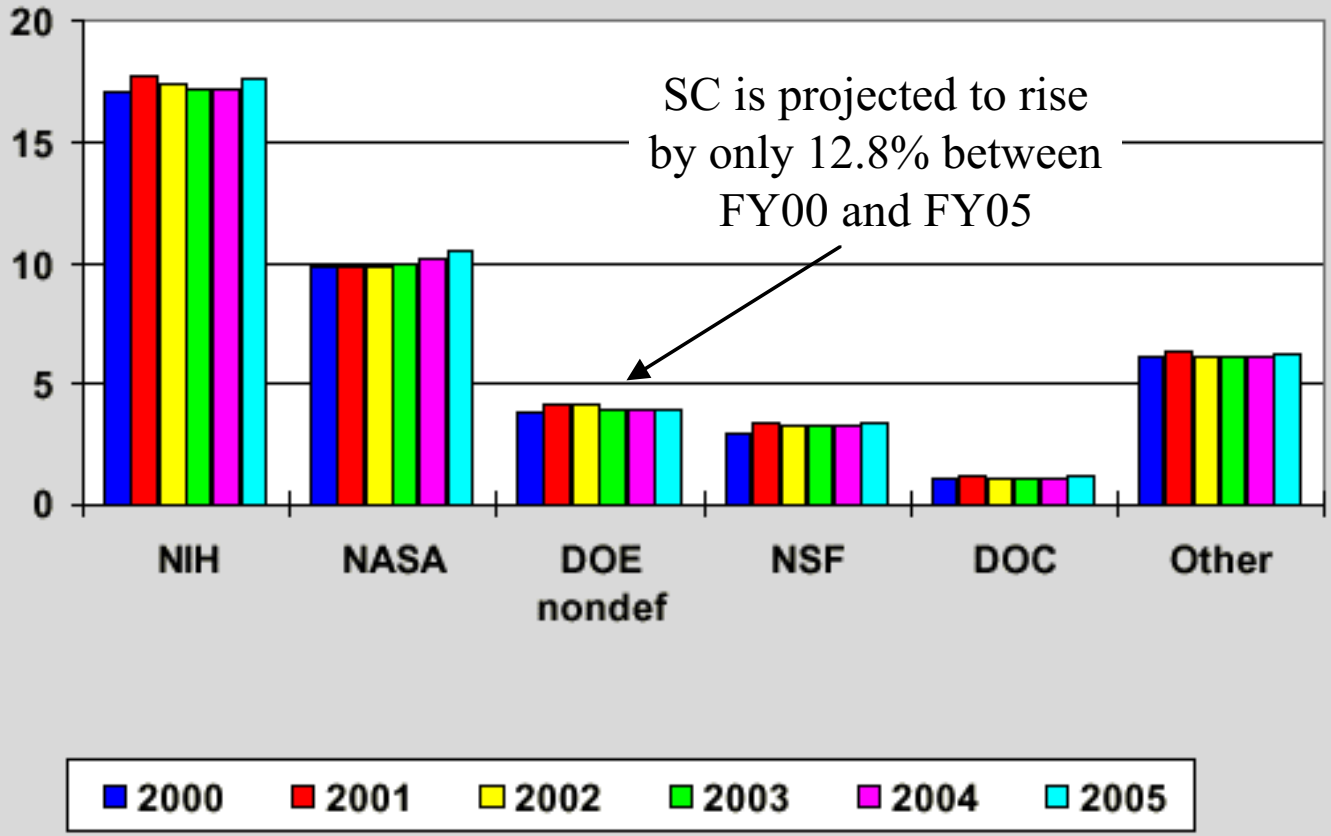
Office of Science Budget History*



*Total Science Budget (in Millions of Constant FY 2000 Dollars)

Projected Nondefense R&D in the President's Budget, FY 2000-2005

in billions of constant FY 2000 dollars



Source: AAAS analysis *Projected Effects of President's FY 2001 Budget on Nondefense R&D*

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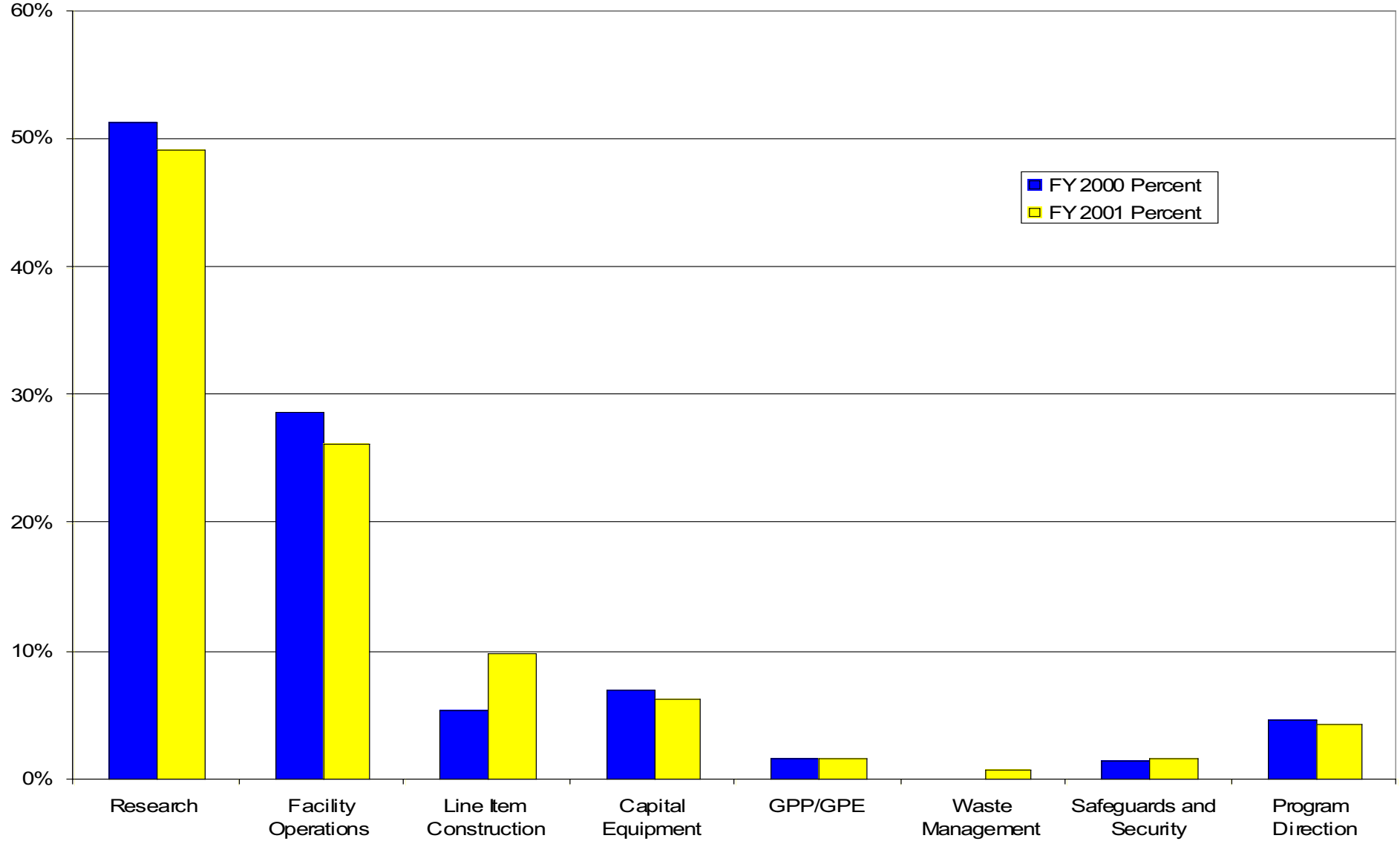
Comparing FY 2000 and FY 2001
(Dollars in Millions)

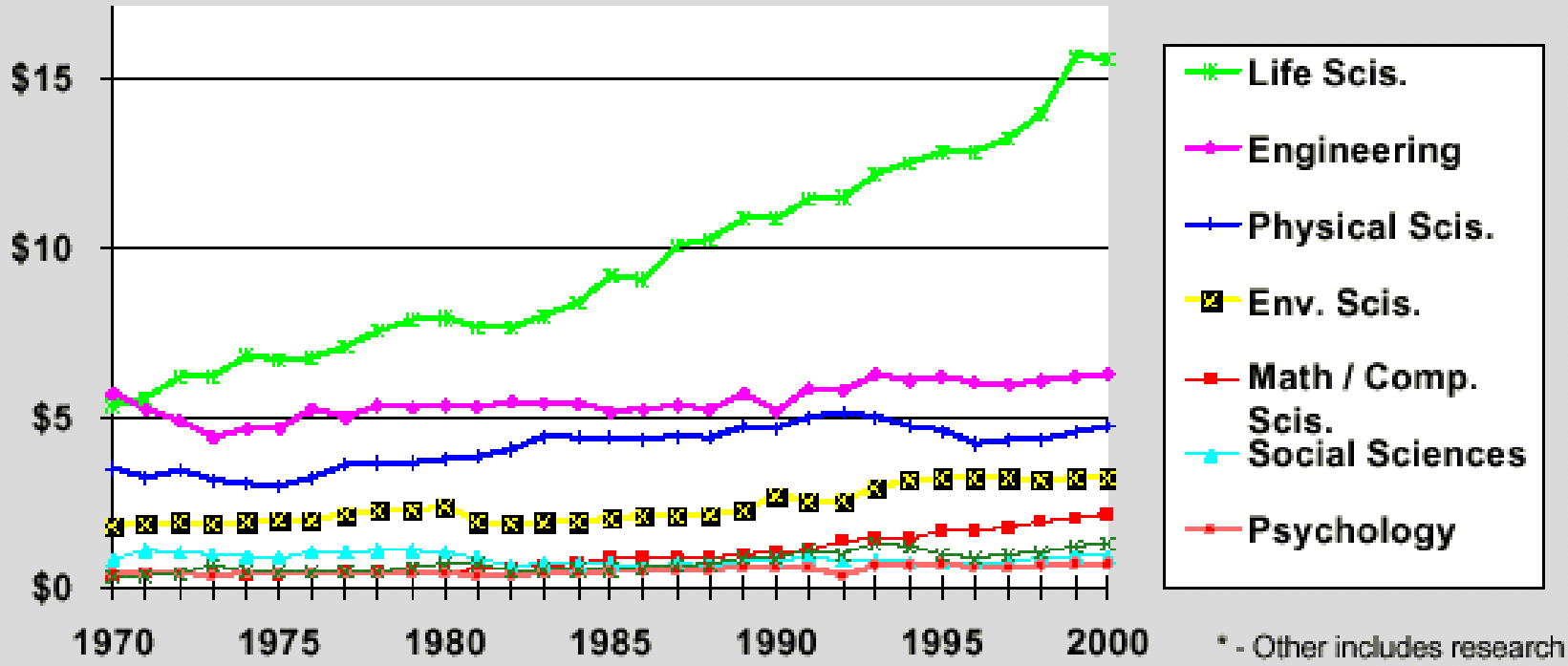
FY 2000		FY 2001
250.0	Appropriation	255.0
5.3	General Reduction	2.6
3.3	Safeguards and Security	3.4
13.3	TFTR D&D	19.1
--	PPPL Waste Management	3.2
1.4	General Plant Projects	1.5
169.9	Research	170.9
56.8	Facility Operations	54.3

Office of Science Funding
as Percent of Total



Trends in Federal Research by Discipline, FY 1970-2000

obligations in billions of constant FY 2000 dollars



* - Other includes research not classified (includes basic research and applied research; excludes development and R&D facilities)

Source: National Science Foundation, *Federal Funds for Research and Development FY 1998, 1999, and 2000,* 1999. FY 1999 and 2000 data are preliminary. Constant-dollar conversions based on OMB's GDP deflators. FY 2000 represents the President's request only, not final FY 2000 appropriations.

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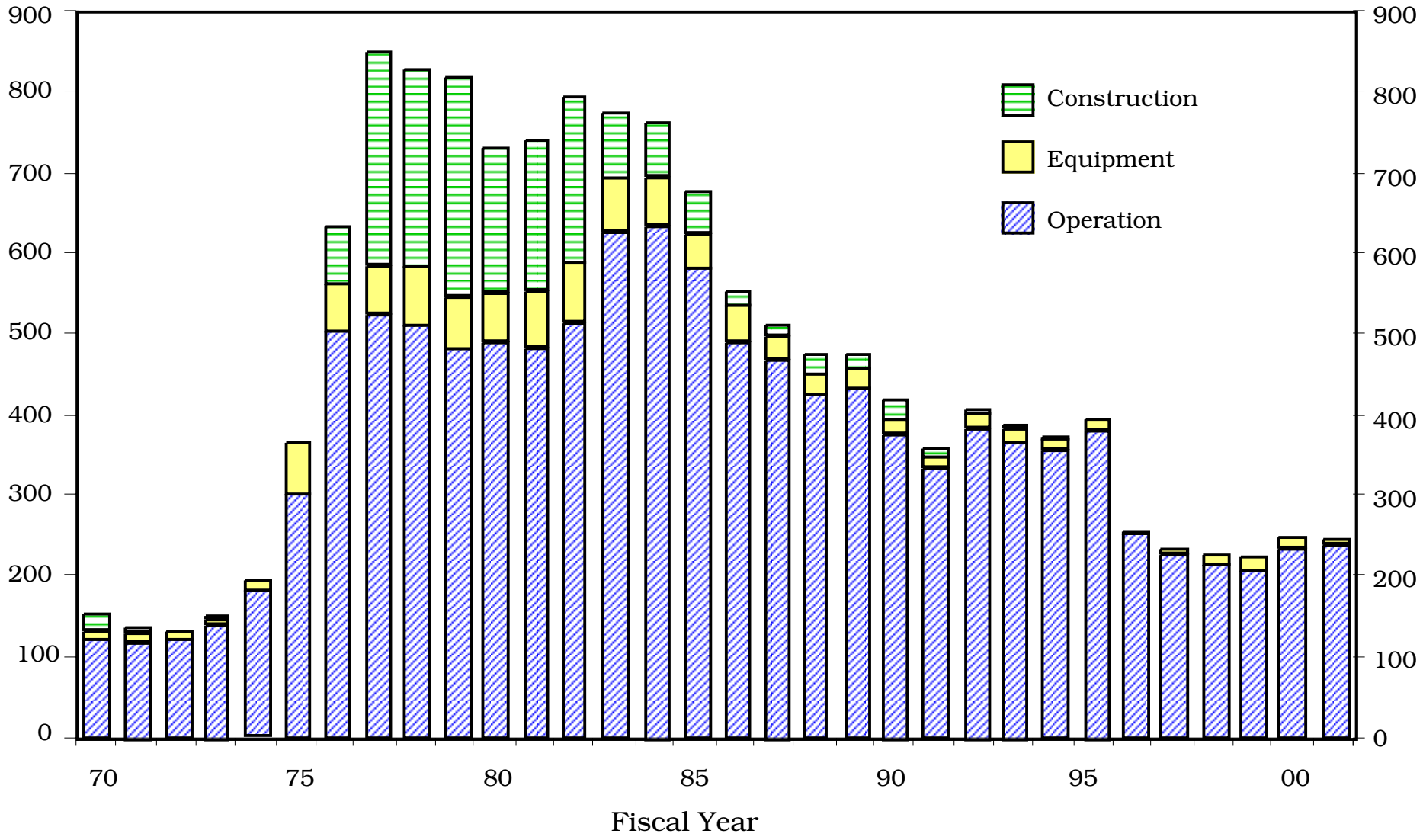
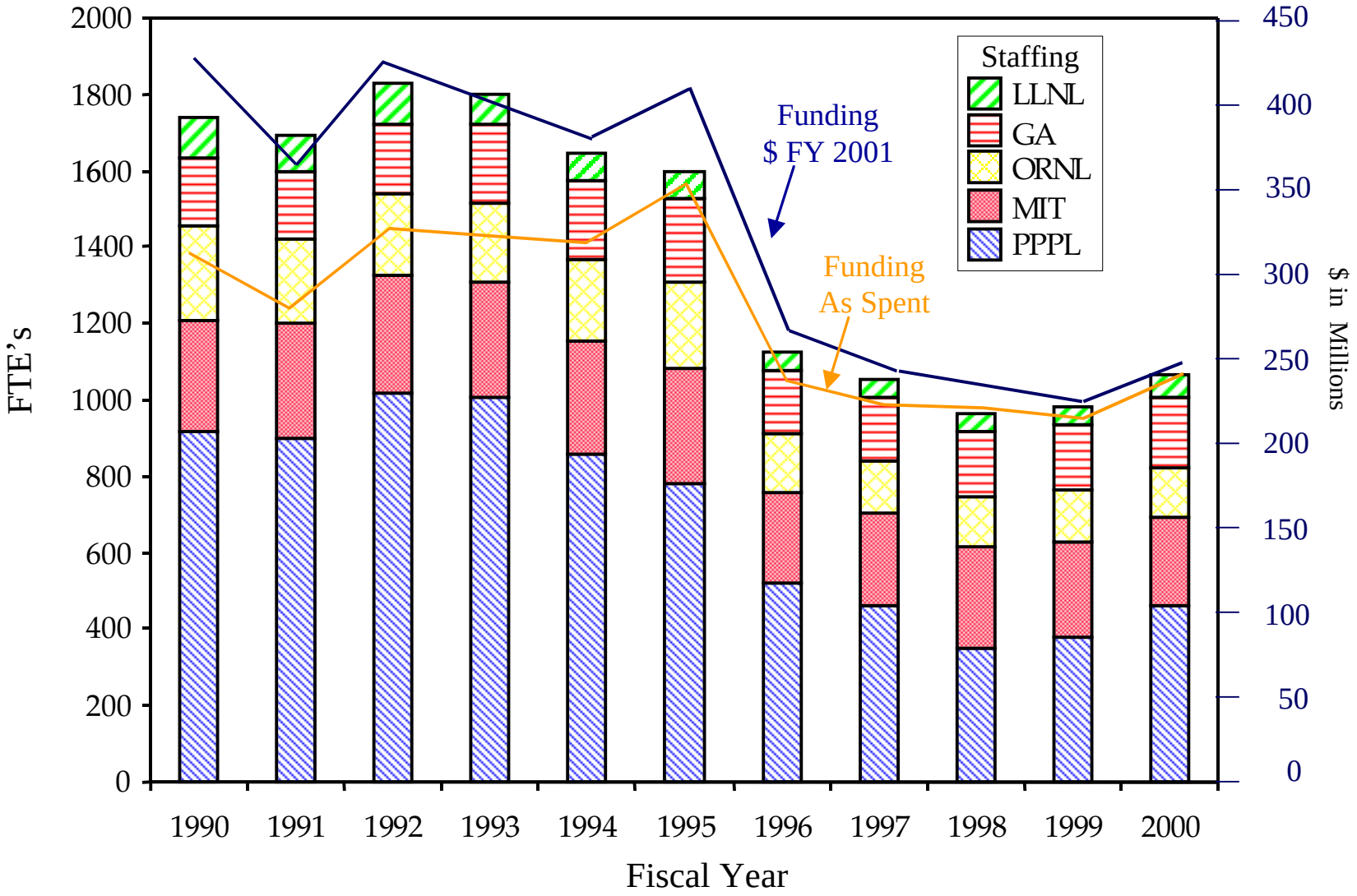
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Fusion Energy Sciences Funding

FY 2001 Dollars in Millions



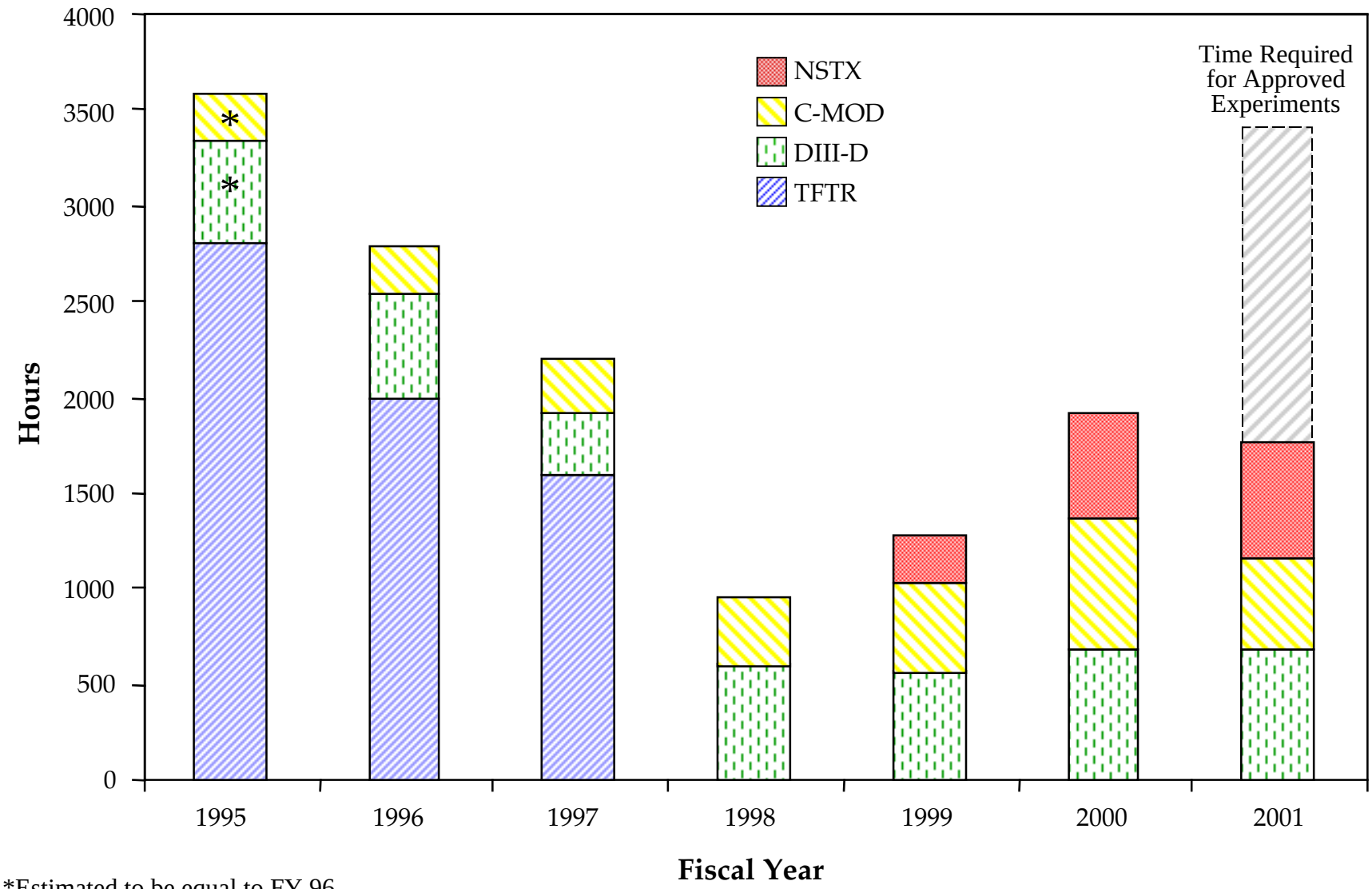
Staffing Trends at Major Fusion Contractors



FY 2001 Staffing

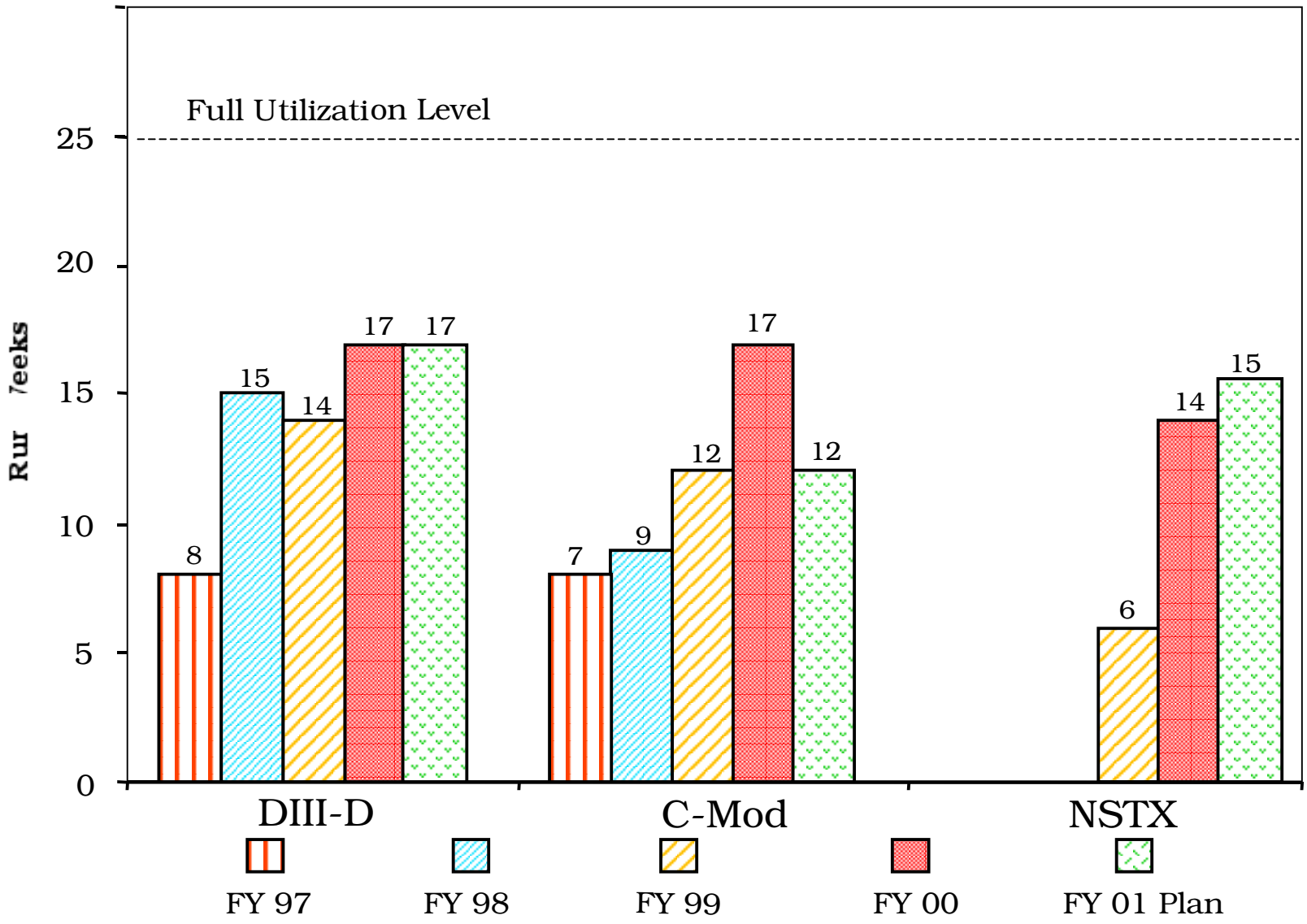
- Previous chart is based on OMB "Cost of Living" inflation rate. Science programs see inflation of about 4%. Going from 2000 to 2001, fusion would lose about 80 people, out of 1100, unless other drastic action is taken.
  - Reducing planned facility operations
  - Deferring small enhancements to facilities
  - Reducing travel and consumables

Operating Times at Major Fusion Facilities



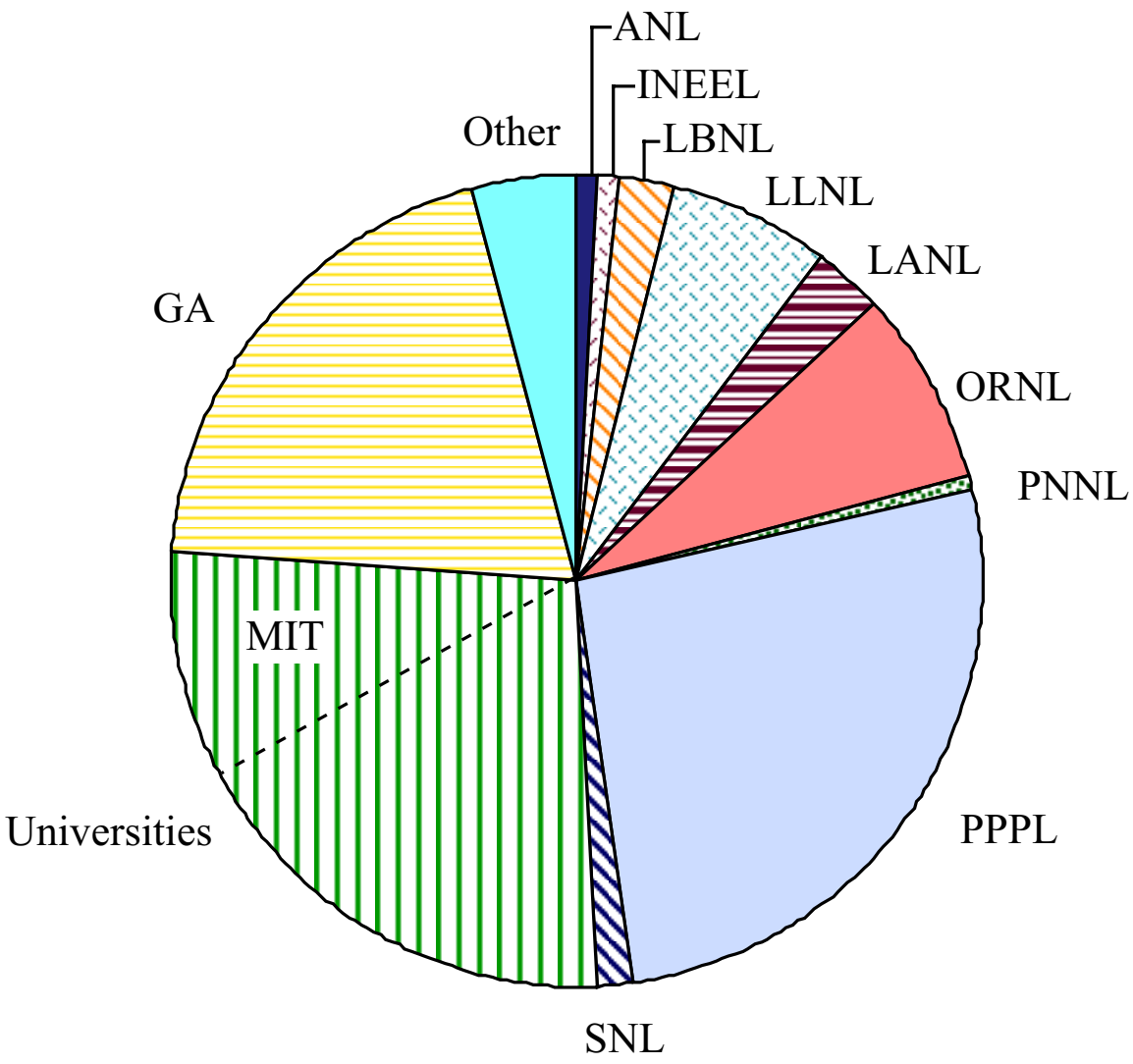
*Estimated to be equal to FY 96

Major Fusion Facilities Use



FY 2000 Fusion Energy Sciences Budget

$244.7 Million Total



National Science Goals

- The National Academy of Science Committee on Science, Engineering and Public Policy (COSEPUP) 1993 report entitled “Science, Technology, and the Federal Government: National Goals for a New Era” made two recommendations:

  “ The United States should be among the World leaders in all major areas of science.”

  - Supports World Class Research Toward National Goals
  - Enables Rapid Response to Breakthroughs in other Nations
  - Supports Excellence in University Science Education
  - Attract Bright Young Students to Science

  “ The United States should maintain clear leadership in some major areas of science.”

  - IF Required by National Objectives
  - IF a Field is of a Broad Interest to Society
  - IF a Field Significantly Affects Other Areas of Science

Support for the Office of Science

University Presidents

We, the undersigned university Presidents and Chancellors, write to express concern regarding funding levels currently contained in the House and Senate Energy and Water Appropriations bill for the Department of Energy's (DOE) Office of Science. If funding for DOE's Office of Science is not increased above the levels currently contained in the House and Senate bills, we believe that some of this country's most fundamental and exciting scientific research, much of which occurs at our universities, will be slowed.

U.S. Representatives

We are writing to express out strong support for the Department of Energy's (DOE) Office of Science and the world class scientific research that it has funded. To this end, we encourage you to increase the FY 2001 budget allocation for Energy and Water, making it possible for the DOE Office of Science to receive a level of funding equal to the President's request. This level of funding will allow for the fullest utilization of the tremendous scientific talent and world's best research facilities supported by the DOE Office of Science.

U.S. Senators

We write to express out strong support for the Office of Science in the Department of Energy (DOE).,… we urge that funding be increase to levels that will allow for the fullest utilization of the tremendous scientific talent and world class research facilities that the Office of Science supports.

A Balanced Portfolio
Essential to Progress in Science

The Washington Post

Harold Varmus

Squeeze On Science

In recent weeks both presidential campaigns have voiced their support of efforts to double the budget of the National Institutes of Health. This is an encouraging sign that the current bipartisan enthusiasm for medical research will continue in the next administration. But it also offers an opportunity to make an important point about the kinds of science required to achieve breakthroughs against disease.

The NIH does a magnificent job, but it does not hold all the keys to success. The work of several science agencies is required for advances in medical sciences, and the health of some of those agencies is suffering.

For the coming fiscal year, Congress has again--magnanimously and appropriately--slated the NIH for a major increase, its third consecutive 15 percent increase.

Wednesday, October 4, 2000; Page A33

"Congress is not addressing with sufficient vigor the compelling needs of the other science agencies, especially the National Science Foundation and the **Office of Science at the Department of Energy**. This disparity in treatment undermines the balance of the sciences that is essential to progress in all spheres, including medicine."

"Medical advances may seem like wizardry. But pull back the curtain, and sitting at the lever is a high-energy physicist, a combinational chemist or an engineer."

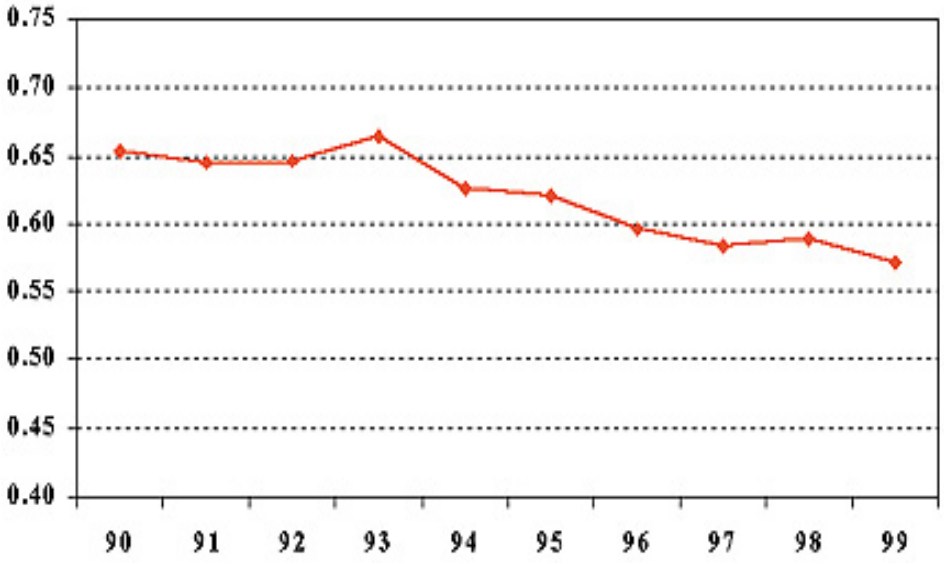
"Sens. Bond and Mikulski have proposed to **double the budget** of the NSF over five years. This admirable effort should be **vigorously supported** and **extended to include the DOE's Office of Science**, which funds half of all research in the physical sciences and maintains the national laboratories that are central to biomedicine."

Assessing Basic Research Programs

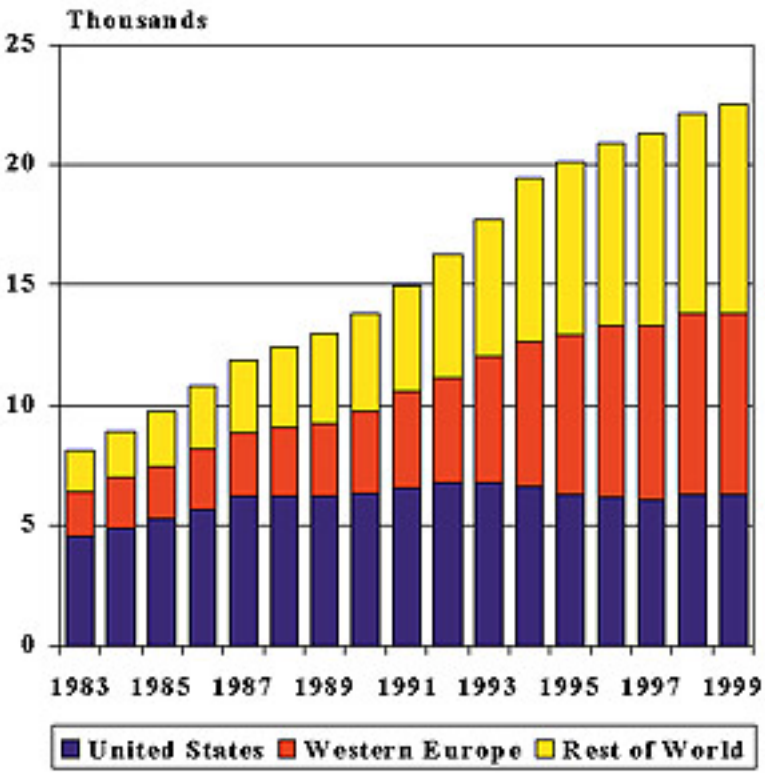
- Science Excellence and Relevance
  - Peer Review, Journal Publications, Advisory Committee Evaluations … ?? ...
- Science Leadership
  - International Benchmarking for Science Leadership … ?? ...
- Stewardship of the Human and Physical Infrastructure that Enables World-Class Science
  - Students Supported, User Facilities, … ?? ...
- Science Management and Operational Excellence
  - Facility Construction Cost and Schedule Baselines, ES&H … ?? ...

Physical Review & Physical Review Letters

Percent of Submissions Published

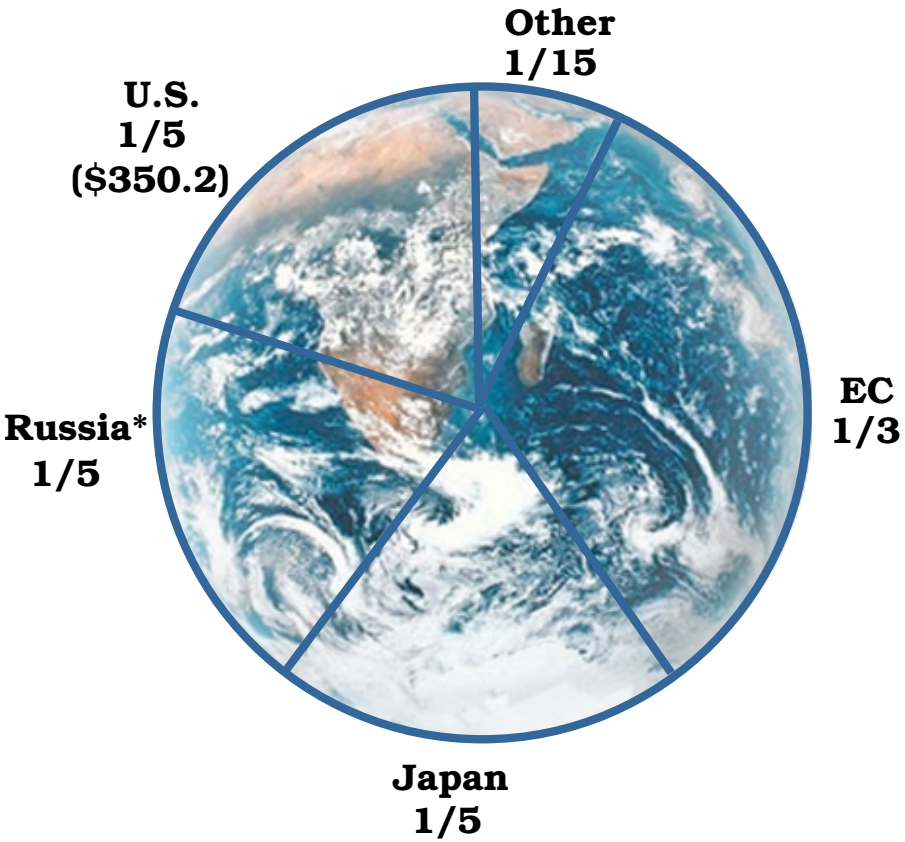


Total Submissions

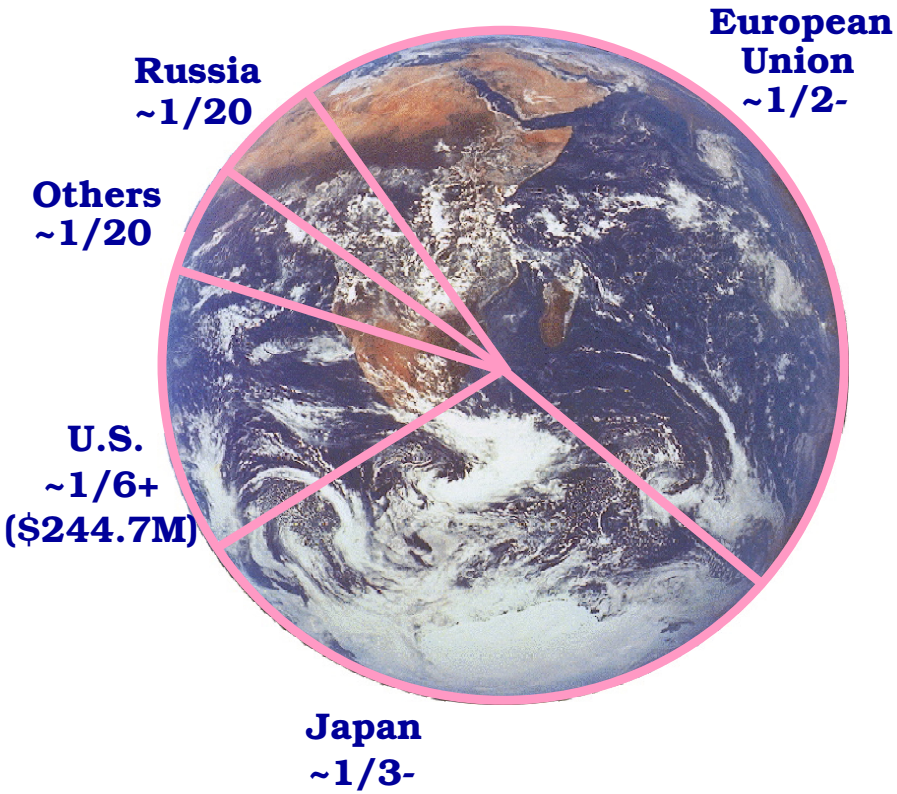


World Magnetic Fusion Effort

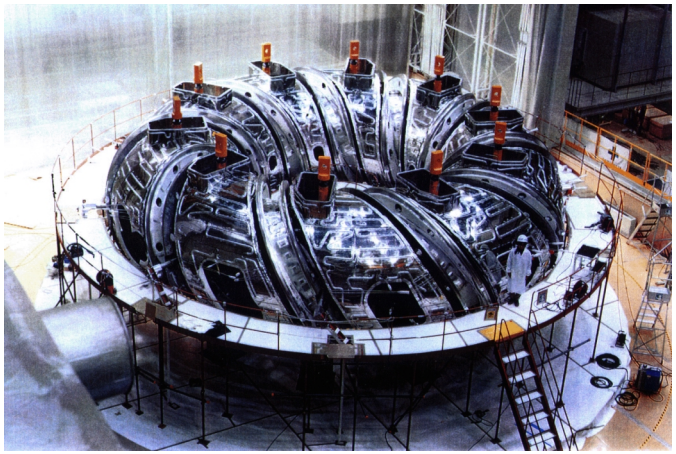
1995



2000

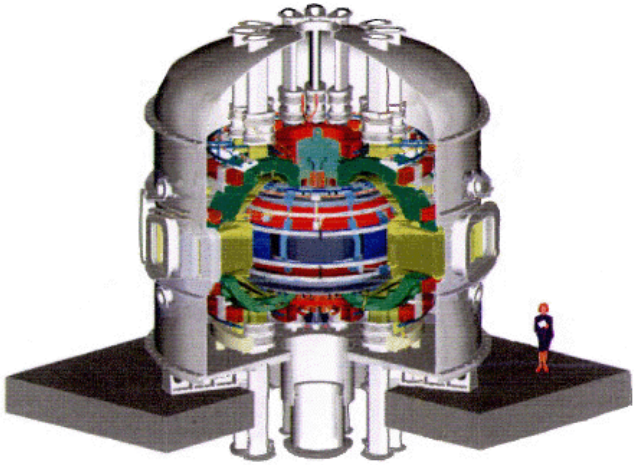


Major Fusion Facilities Abroad



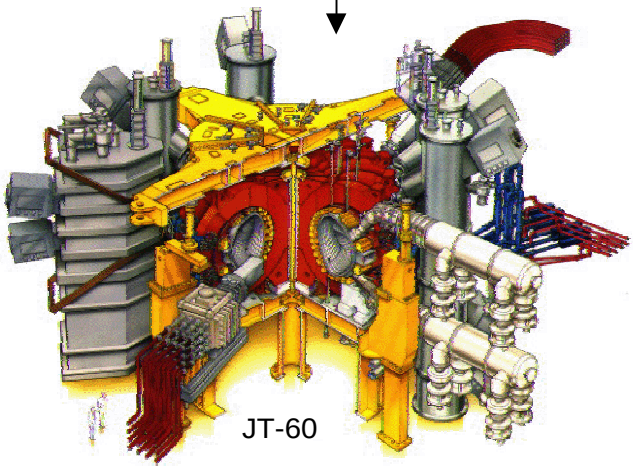
Large Helical Device (LHD)

New



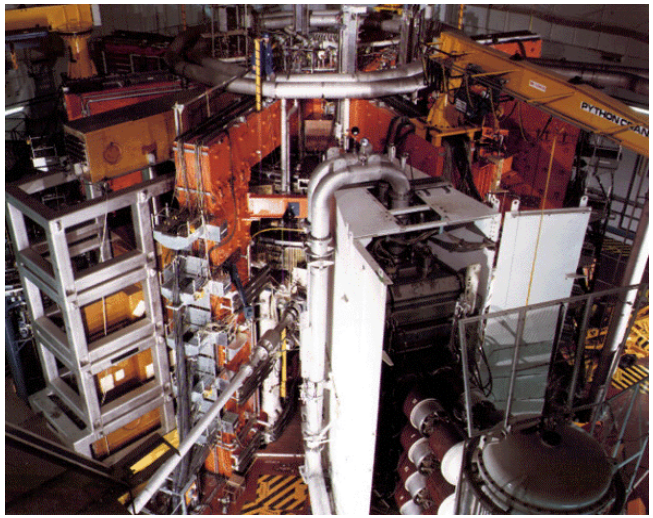
K-STAR (Korea)

Japan



JT-60

Upgraded



Joint European Torus (JET)

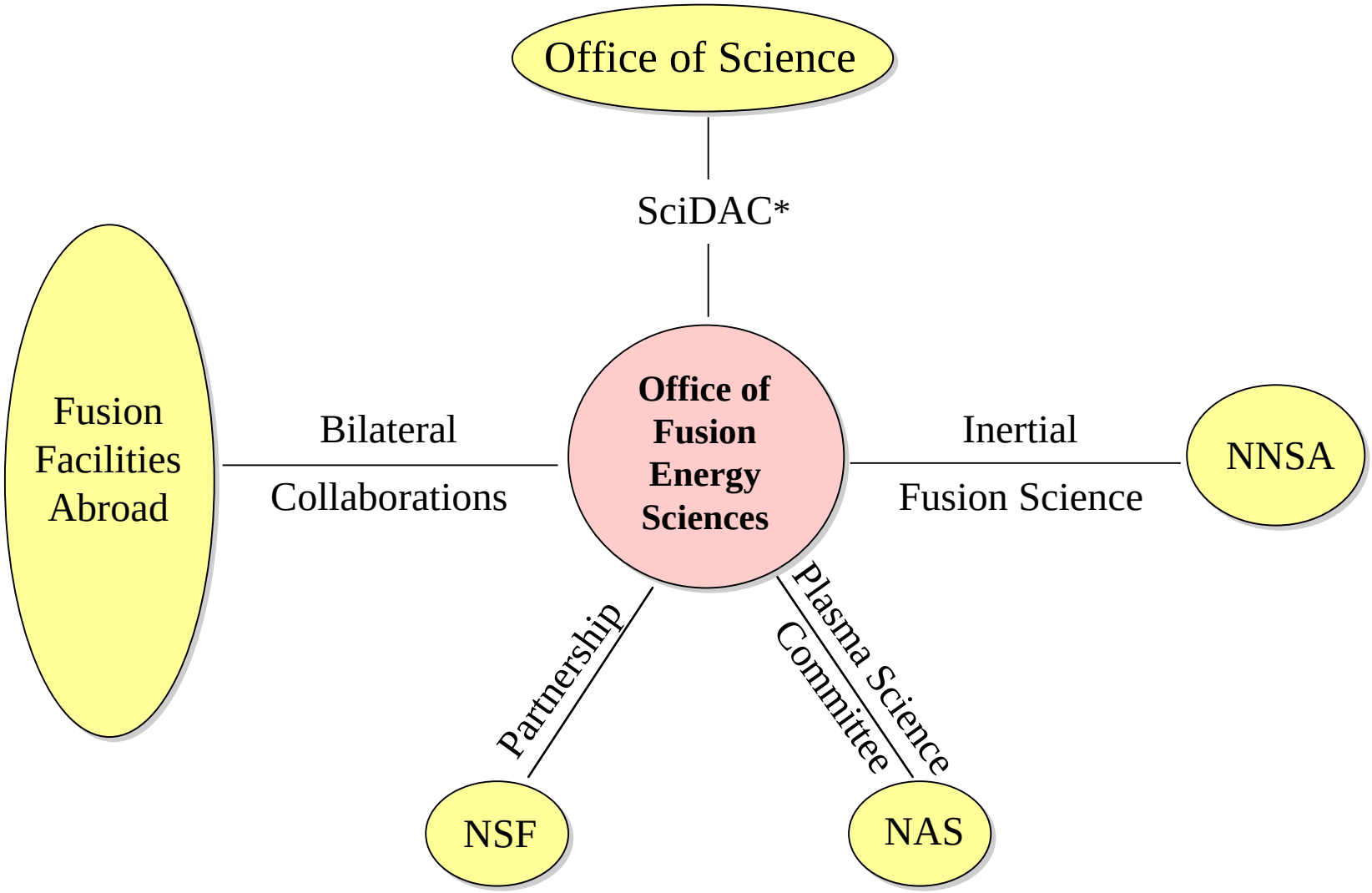
Difficult Career Paths

- Declining budgets
- Long graduate programs
- Acceptance/recognition in large collaborations
- Research dependent on facility schedules
- Difficulties in becoming tenured
- Competition with opportunities in industry

National Research Council Review

- Key Finding: Excellent science
- Key Recommendations:
  - Organize program around fusion science issues (instead of how to develop a concept into a reactor)
  - Connect with other scientific disciplines
  - Partner with NSF
- What are FESAC's views?

Fusion Energy Sciences Connections



*Scientific Discovery Through Advanced Computing

Questions for FESAC

Strategic Questions

- Are the priorities and thrust areas the same as in the Priorities and Balance report?
- Is the 5-year strategic vision the same? Are the 5-year goals still valid? How do we get there?
- Are the findings and recommendations in the NRC report consistent with the program's priorities?
- Are any changes in direction indicated?
- How does the U.S. fusion program compare to fusion programs abroad?

Questions for FESAC (continued)

Specific Questions

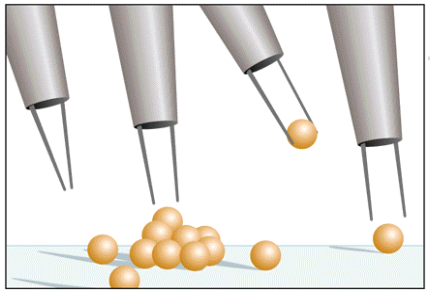
- Burning Plasma Physics charge
  - What scientific issues should be addressed by a burning plasma physics experiment and its major supporting elements? What are the different levels of self-heating that are needed to contribute to our understanding of these issues?
  - Which scientific issues are generic to toroidal magnetic confinement and which ones are concept-specific? What are the relative advantages of using various magnetic confinement concepts in studying burning plasma physics?
- Must make the case for the scientific imperative for burning plasma science
- Must have fusion community consensus and credibility in broader scientific community

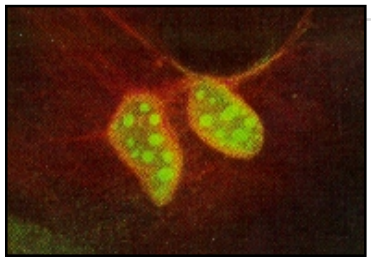
Questions for FESAC (continued)

- Theory and Modeling charge
  - Is the theory/computation program in balance?
    - Scientific issues
    - Performers
    - Vis-à-vis rest of program
  - Are you focussing on the long-range goal: a predictive capability for fusion embodied in your codes?
  - Are the current management practices of OFES sound? What is the appropriate balance between OFES management and community management?

DOE Office of Science

FY2001 Budget Highlights (Request + Increase over FY2000)





- Spallation Neutron Source ($281M, +161M)
- High-Performance Computing for Science in the 21st Century -- Enhanced Capabilities ($190M, +70M)
- Scientific User Facilities Upgrades & Increased Utilization ($1,207M, +65M)
- Nanoscale Science, Engineering, & Technology ($84M, +36M)
- Life Sciences -- Understanding the Microbial Cell & Microbial Genomes and Biomedical Engineering ($41M, +25M)