A year in the APS
and
The importance of PHYSICS in the 21st Century

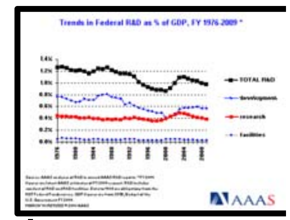
Cherry Murray
APS Past President
February 14, Washington, DC

HARVARD
School of Engineering and Applied Sciences

2009 – a year in the APS presidency

January – Barack Obama takes office and appoints physicists to Cabinet posts

February – financial crisis, ARRA - "Shovel ready Projects" - APS Washington Office works to provide jobs for science in bill / Ridge space task force/ Franz announces retirement / search for new Executive Officer/ new topical group on energy proposed/ APS copyright agreement with authors expanded to derivative works



March – 3 mo. strategic exercise at APS begins; APS budget cuts to deal with fiscal crisis; 2010 US budget maintains science funding

April – my charge to CISA: how to better serve international members; good bye party for Judy Franz, retiring after 15 years as APS Executive Officer/ Obama speech at NAS

May – petition to Council to replace 2007 APS statement on climate change; I appoint ad hoc committee to advise Council and line


Intergovernmental Panel on Climate Change (IPCC)

2009 – a year in the APS presidency

June – Executive Board retreat – APS guiding principles across society, new APS journal pricing and budget process, Ridge expansion plans

Physics

July – 1st anniversary of *Physics* - Kate Kirby begins as new Executive Officer; $6.5M PhysTec NSF grant awarded/ Phys Rev Letters announces more stringent review criteria

PHYSICS FRONTLINE

August – *Physics Frontline* APS Washington Office blog begins; APS and Harvard agreement on open source repository at Harvard

MINORITY BRIDGE PROGRAM

September – launch of NSF funded Minority Bridge pilot program

October – Nobel Prize to APS members – LaserFest plans

LASERFEST

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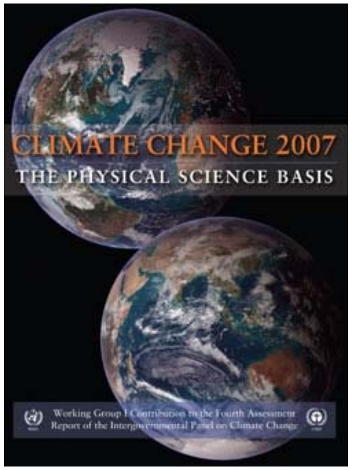
2009 – a year in the APS presidency

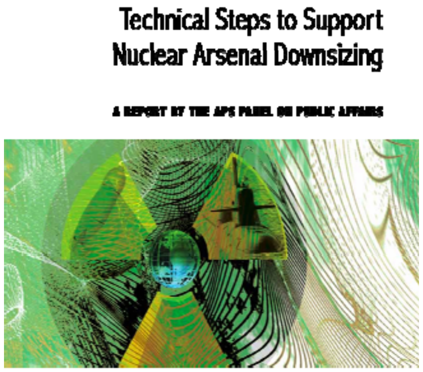
November – Council votes not to change 2007 climate statement but to have POPA review it for "clarity and tone"

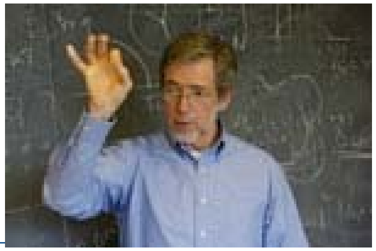
Executive Board requests Constitution and Bylaws Committee propose new procedures for future APS statements to allow due deliberation by Council including member comment period

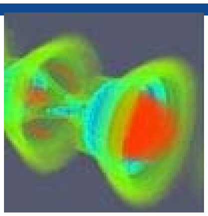
CISA report to Executive Board with recommendation to increase number of international Councilors



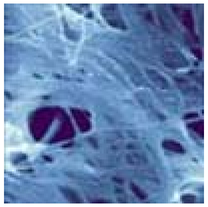
December – Copenhagen talks; presidential line discussions on possible APS study on climate science; new petition to Council for APS study; member emails; OSTP request for open access comments; START II talks; POPA report on nuclear downsizing








The importance of PHYSICS in the 21st Century

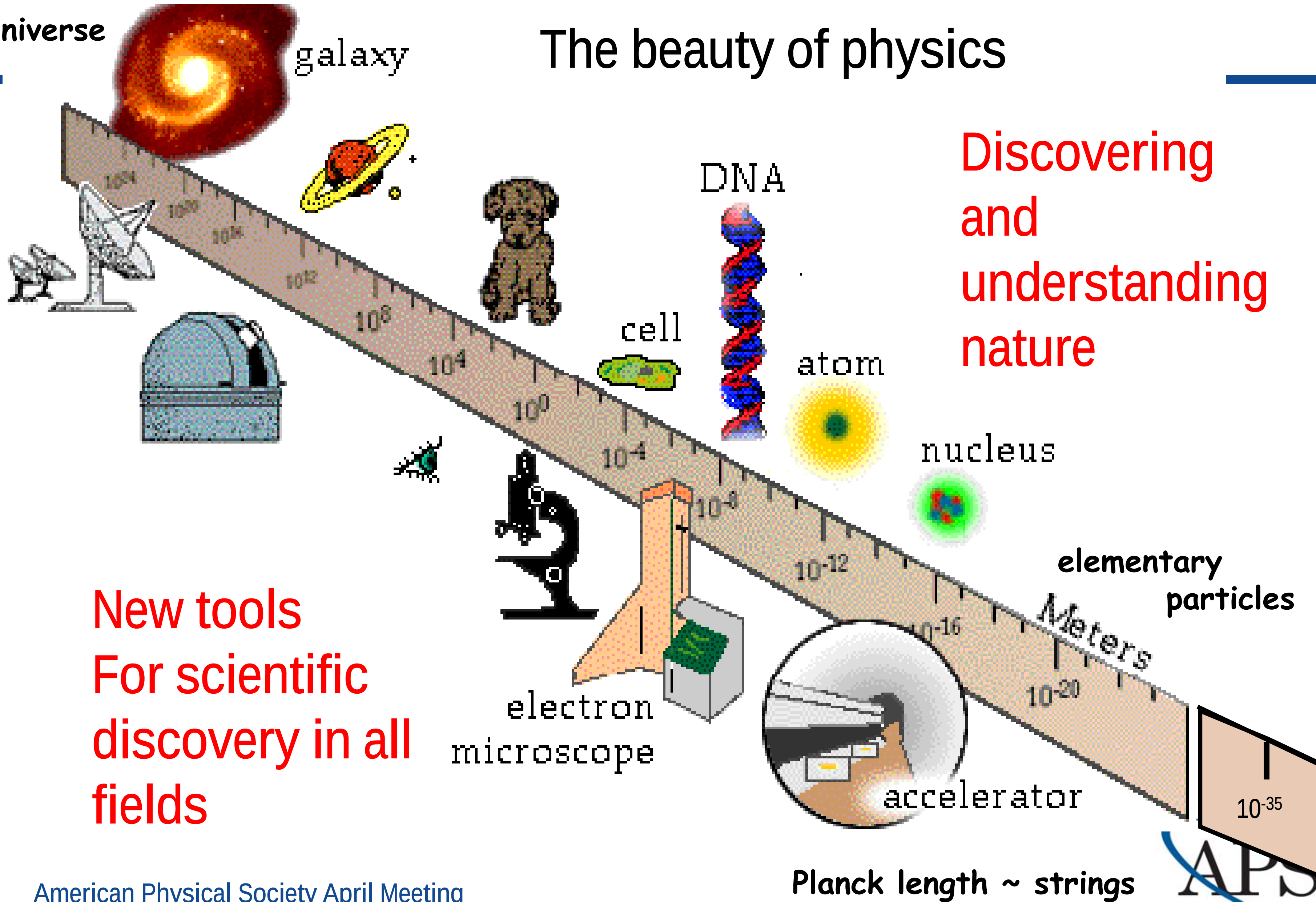



American Physical Society April Meeting

The Scale of Things – from the Planck length to the cosmos

The beauty of physics

Discovering
and
understanding
nature



New tools
For scientific
discovery in all
fields

Adapted from Astronomy lectures by J. Schombert, U. Oregon, 2005

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Why should the federal government fund physics R&D?

- National security
- Economic security
- Energy and environmental security
- New knowledge – discover, understand nature and the cosmos
- New tools for other sciences and society – biology, environmental sciences, medicine, etc.

Physics Community Focus   Government/Public Rationale

- National security
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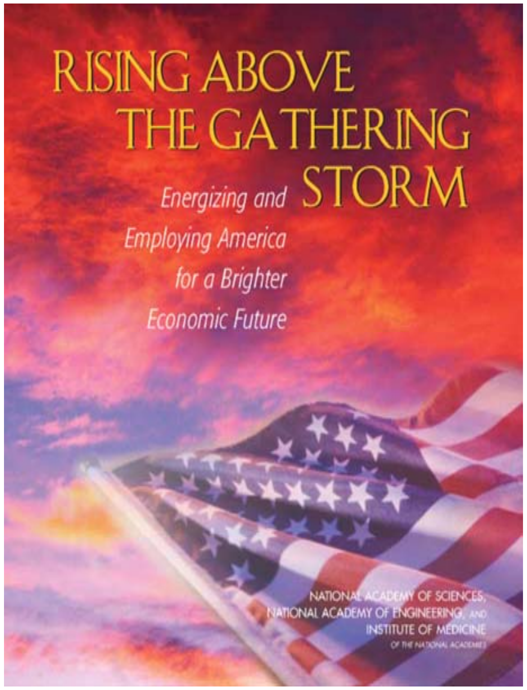
Economic Challenges: Globalization & Complacency



National Research Council, 2005

" … the Committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding when many other nations are gathering strength… We fear the abruptness with which a lead in science and technology can be lost - "

RECOMMENDATIONS

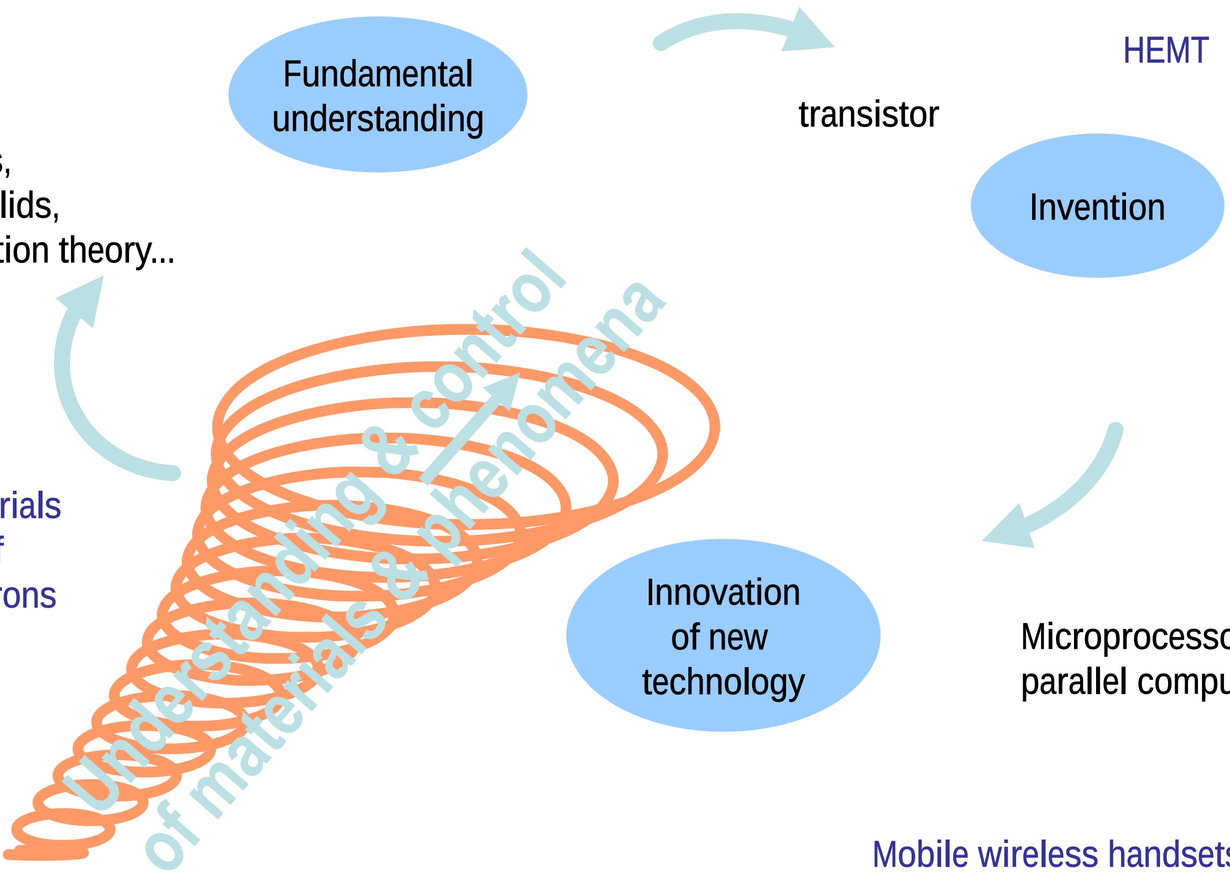
- 10,000 teachers, 10 million minds - K-12 science and mathematics education
- Sowing the Seeds through Science and Engineering Research: Strengthen the nation's commitment to long-term basic research that has the potential to be transformational to maintain the flow of ideas that fuel the economy, provide security, and enhance the quality of life.
- Best and Brightest in Science and Engineering Higher Education
- Incentives for Innovation

Economic driver: science-technology cycle

HEMT

transistor

Quantum mechanics,
band structure of solids,
semiconductor junction theory...



Advanced modeling of materials & phenomena, new states of matter observed in 2D electrons

Microprocessor,
parallel computation

Observation of cosmic bounce in cosmic background radiation, spectroscopy of single atoms,...

Mobile wireless handsets,
ultra-sensitive detectors

National Security Challenges

Irregular Challenges

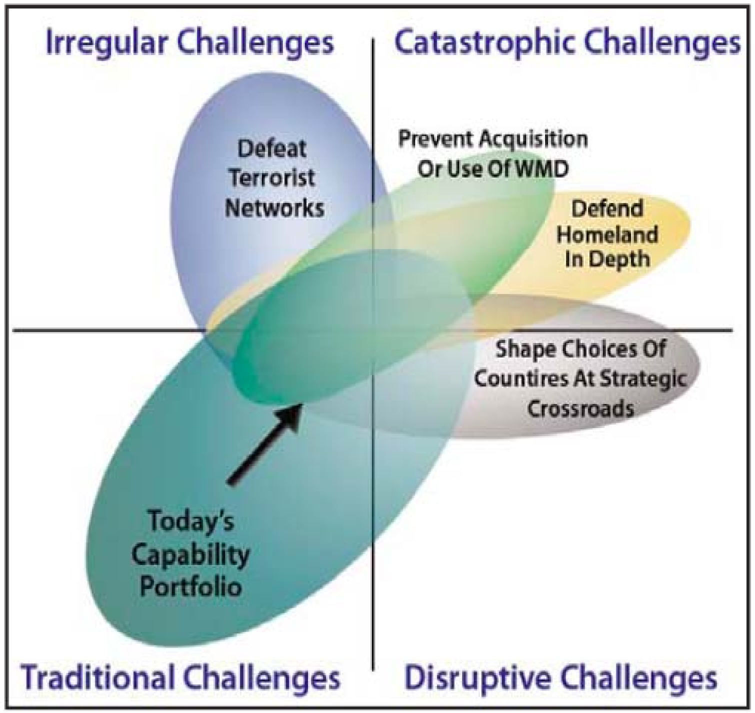
- Non-state and state actors employing "unconventional" methods to counter stronger state opponents- terrorism, insurgency, etc. (e.g. terrorism, civil war, insurgency, unrestricted warfare)

Catastrophic Challenges

- Terrorist or Rogue State employment of WMD or methods producing WMD-like effects against American interests. (e.g. attack on homeland, global markets, or key ally that would generate a state of shock and preclude normal behavior)

Higher likelihood

Lower vulnerability



Higher vulnerability

Lower likelihood

Traditional Challenges

- States employing military forces in well-known forms of military competition and conflict (e.g. conventional air, sea and land forces, nuclear forces of established nuclear powers)

Disruptive Challenges

- Competitors employing technology or methods that might counter or cancel our current military advantages (e.g. technological - bio, cyber, or space war, ultra miniaturization, directed energy, diplomatic blackmail, cultural or economic war)

Source: Quadrennial Defense Review, 2006

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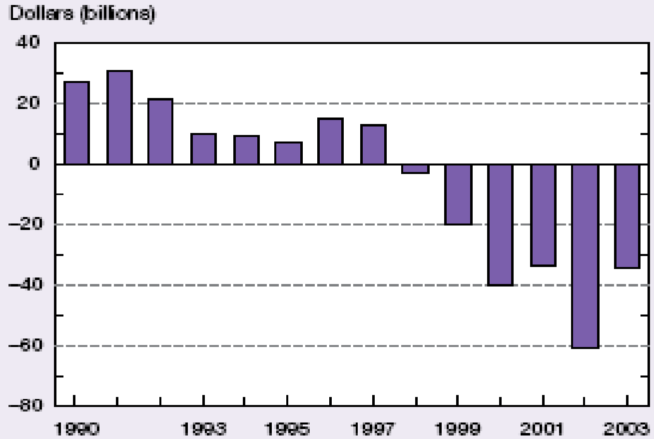
Economic Challenges: U.S. Trade Balance

Figure O-12
U.S. trade balance for five high-technology industries: 1990–2003

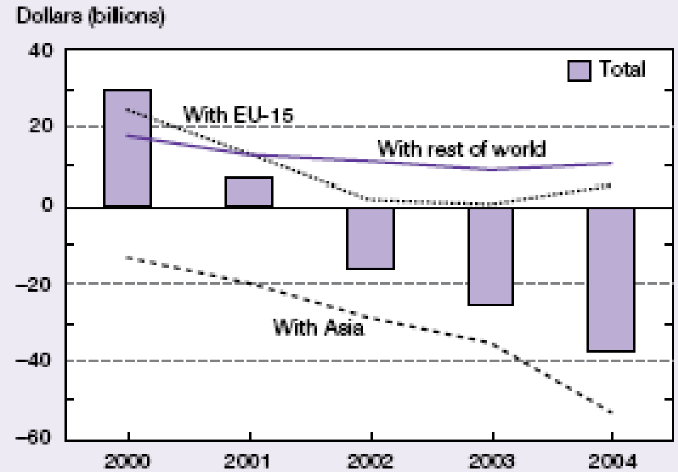


NOTE: Includes aerospace, pharmaceuticals, office and computing equipment, communications equipment, and scientific instruments.

SOURCES: Global Insight, Inc., World Industry Service database (2005). Historical data from United Nations Industrial Development Organization, United Nations System of National Accounts, Organisation for Economic Co-operation and Development; and country sources. See appendix table 6-4.

Science and Engineering Indicators 2006

Figure O-13
U.S. trade balance in high-technology goods: 2000–04



EU = European Union

SOURCE: U.S. Census Bureau, Foreign Trade Division, special tabulations (March 2005). See appendix table 6-6.

Science and Engineering Indicators 2006

Aerospace, pharmaceuticals, office and computing equipment, scientific instruments

Biotechnology, life sciences, optoelectronics, information and communication equipment, electronics, flexible manufacturing, advanced materials, aerospace, weapons, nuclear technology

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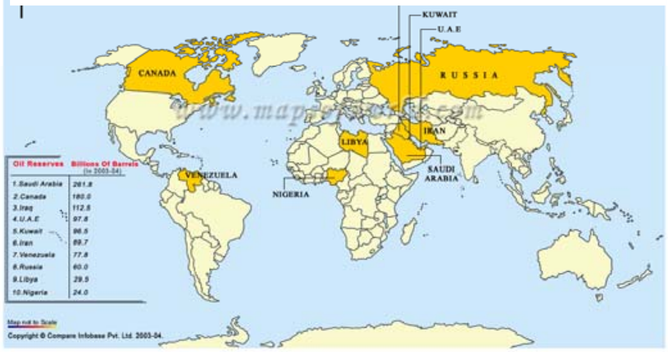
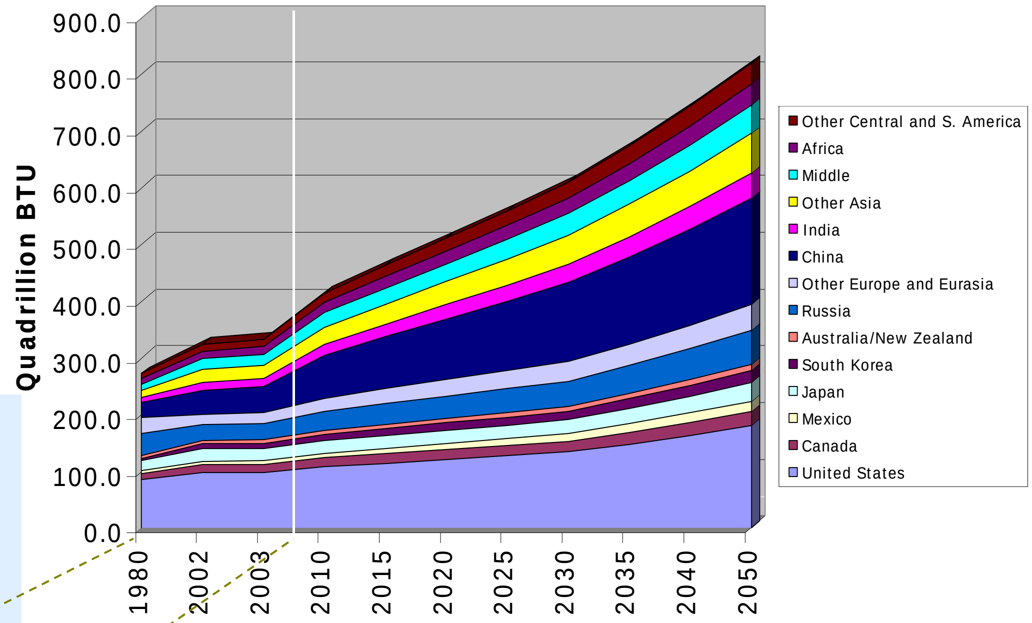
Energy Security Challenges

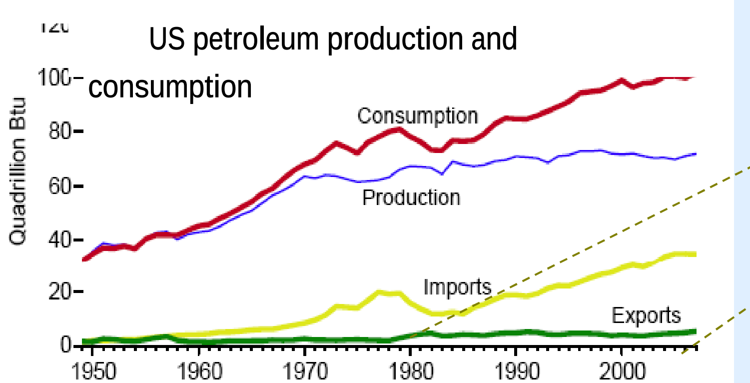
Top ten countries with oil reserves



World energy consumption



US petroleum production and consumption

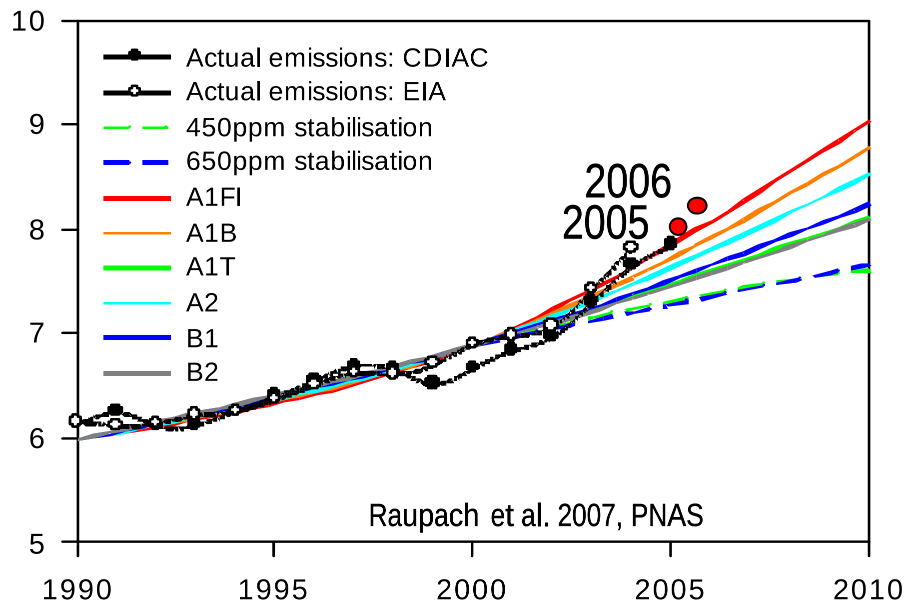


The United States was self-sufficient in energy until the late 1950s when ergy consumption began to outpace domestic production. At that point, Nation began to import more energy to fill the gap. In 2007, net imported energy accounted for 29 percent of all energy consumed.

Source: Energy Information Administration Annual Energy Review, 2007

Global Climate Challenges and Concerns

CO_2 emissions growth vs IPCC 2001 Projections



50-year constant growth rates to 2050

B1 1.1%,

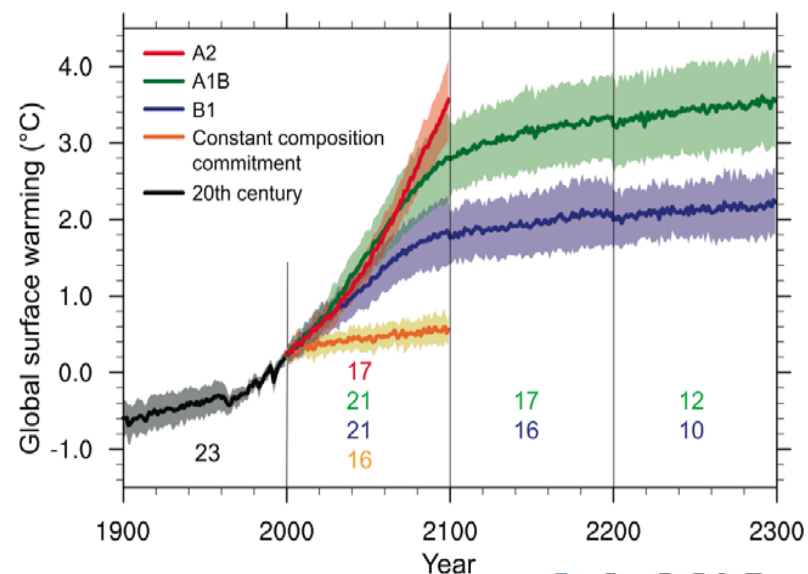
A1B 1.7%,

A2 1.8%

A1FI 2.4%

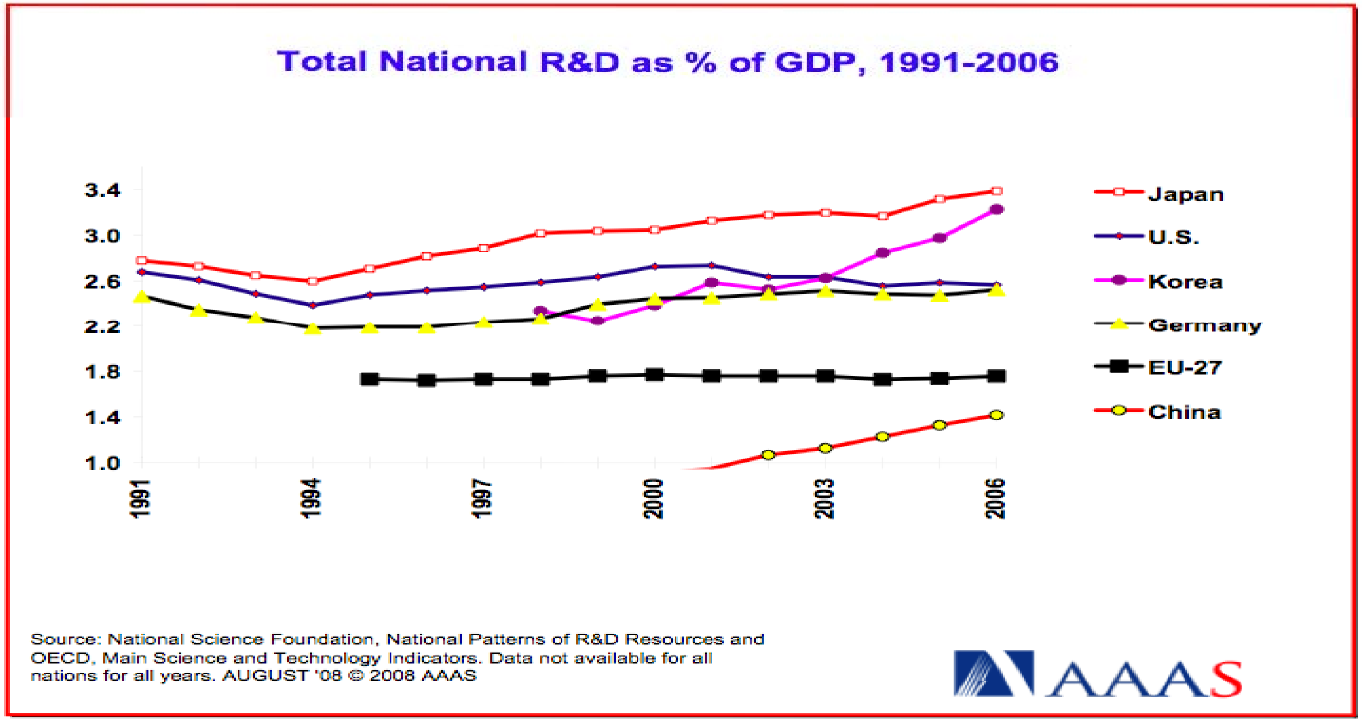
Observed 2000-2006 3.3%

IPCC 2007 Projections



US Funding Challenges and Concerns

Global R&D Environment



U.S. Total R&D Spending is about 2.5 % of GDP

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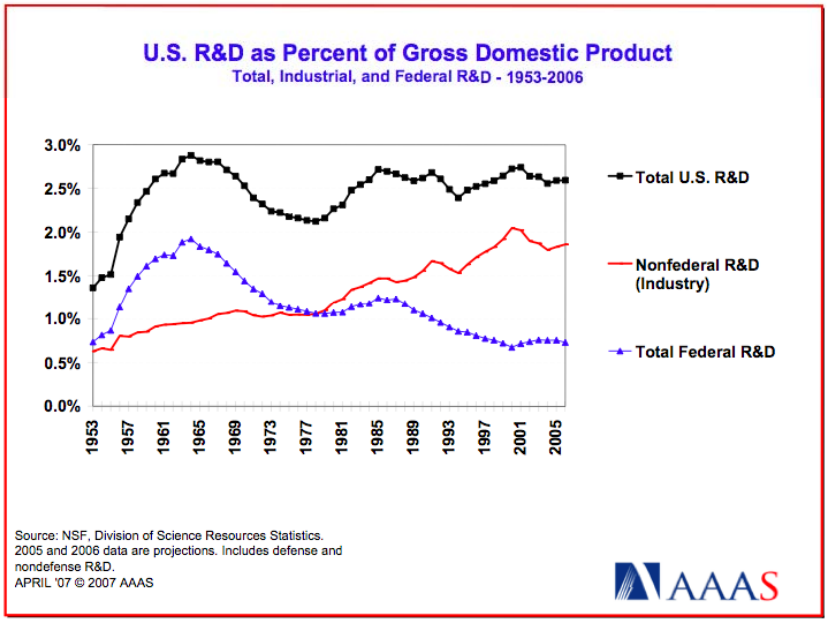
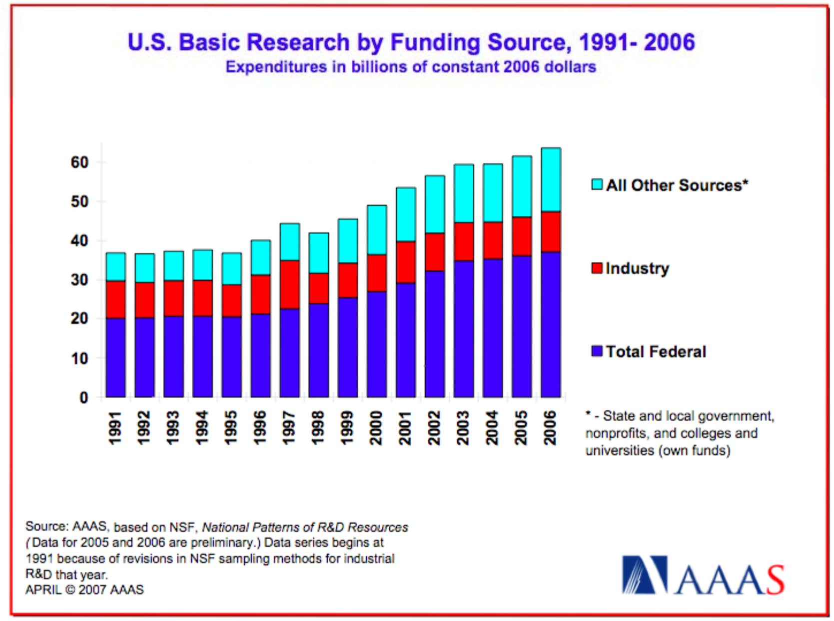
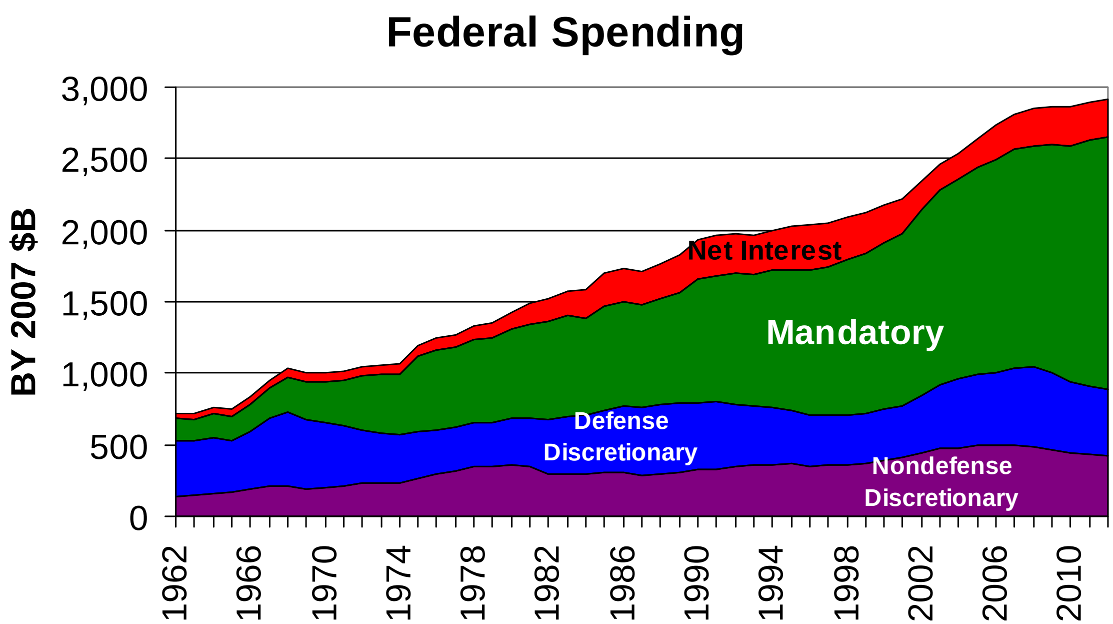
Decline in U.S. Industrial basic research



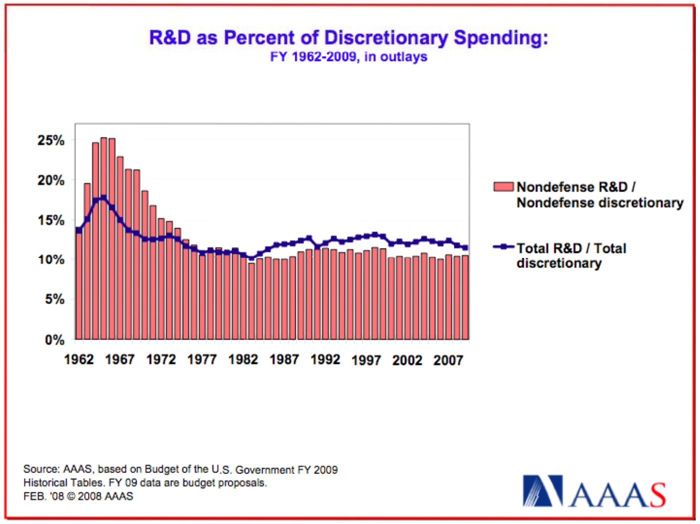


New partnerships between academia, national labs, industry need to take on a leadership role in the spectrum of goal - oriented, multidisciplinary basic - long term applied R&D to meet the nation's biggest challenges

Economic Challenges: U.S. Discretionary Spending



Source: OMB FY200 Budget History



Aging population; complex social security and health care system – financial bailout, International trade deficit

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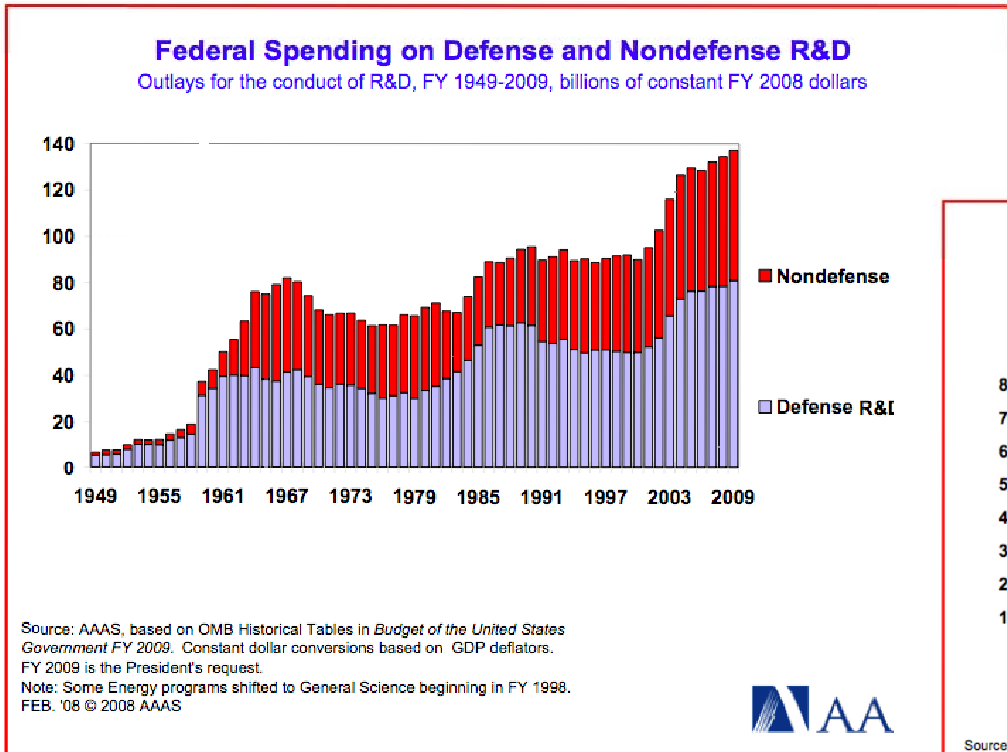
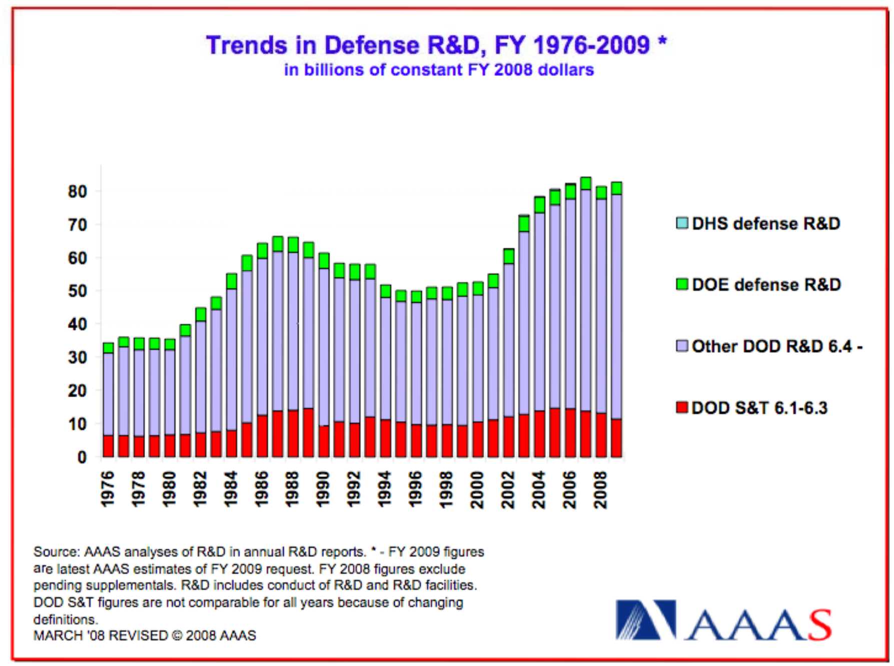
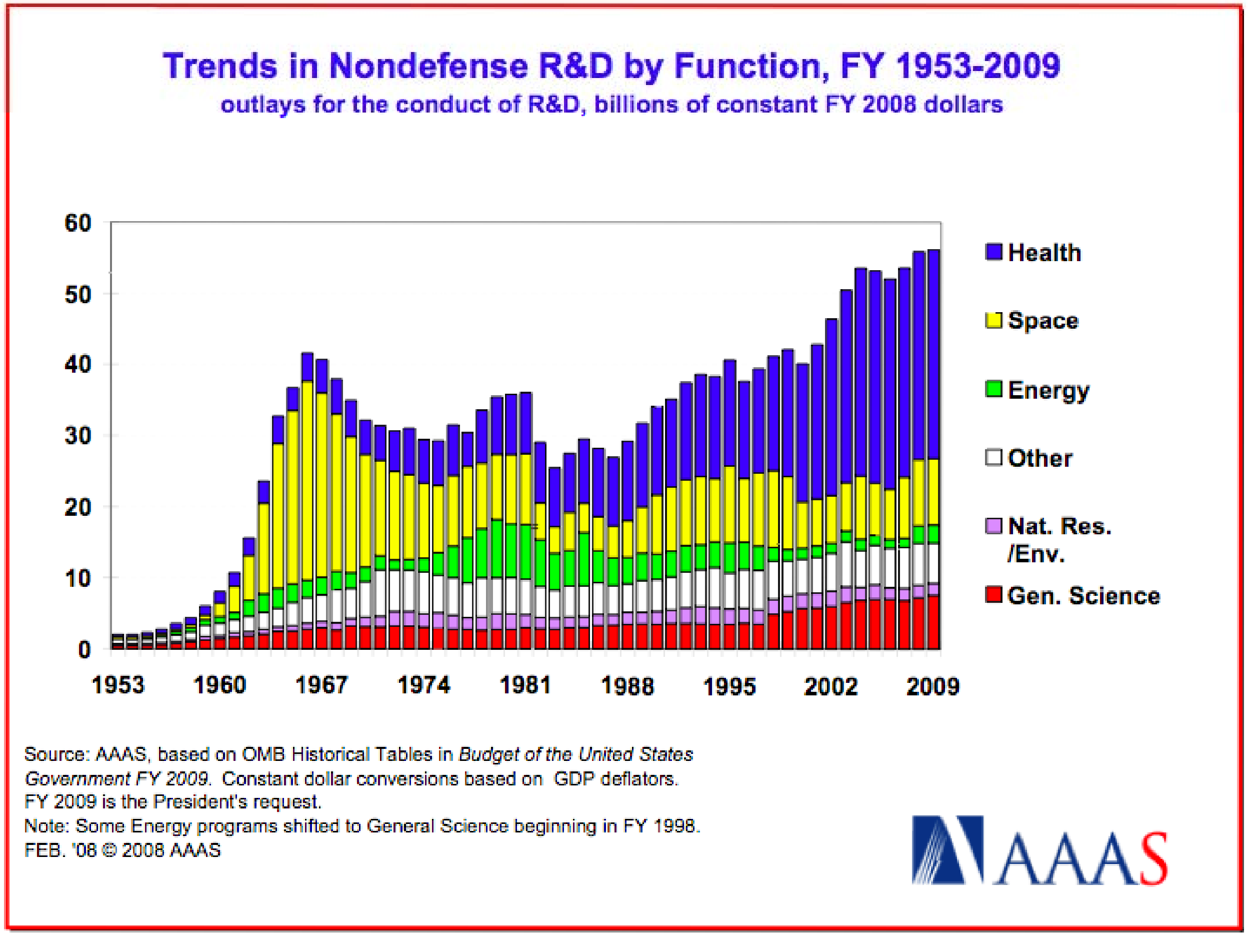
Defense vs non-defense federal R&D trends





Federal non-defense R&D spending balance



Physics Community Focus & Government/Public Rationale

"At such a difficult moment, there are those who say we cannot afford to invest in science. That support for research is somehow a luxury at a moment defined by necessities. I fundamentally disagree. Science is more essential for our prosperity, our security, our health, our environment, and our quality of life than it has ever been."

President Barack Obama
April 27, 2009
National Academy of Sciences

“Physics is what physicists do” (Brian Pippard)

Physics is a way of looking at the world, parsing and solving model problems as a way of gaining understanding of the essentials of the actual problem.

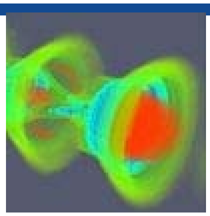
This kind of thinking is necessary in order to further the frontiers of knowledge AND to address societal challenges.

The 21st century research enterprise – and addressing 21st century global challenges such as a sustainable global energy supply, food and good health for all, international security – also require teamwork and multidisciplinary thinking.

Physicists are needed as part of the team! Think about training of bachelors, grad students, and those who will not replicate you as physics profs.

A 21st century physicist - "Physics is what physicists do"

- International
- Interdisciplinary – biophysics, geophysics, laser physics, …
- Works anywhere from fundamental to near-term applications
- Degree obtained and job content – BS, MS, PhD,…student, teaching, research, R&D, operations, management
- Sectors – education, academic, industry, national labs/government
- Diverse – gender, ethnic, …



PHYSICS is as important in the 21st Century as it was in the 20th!