

# Technology and Innovation Committee Report

Esther Dyson

August 5, 2011

# August Meeting of T&I Committee

- NASA Ames on August 2, 2011
  - Meeting Agenda included:
    - Update and status of OCT and Space Technology
    - Presentation and discussion around NASA Tech Transfer and IP activities – NASA OCT and OGC
    - Special Presentation by Henry Tirri, Senior VP and CTO of Nokia
    - Presentation by JPL/Cal Tech on their Patents, Tech Transfer and IP
    - Updates on project implementation of Optical Communications and Robotic Satellite Servicing

# Members participating

- Bill Ballhaus
- Esther Dyson
- Gordon Eichhorst
- Alain Rappaport
- Susan Ying
- Mike Green, exec sec
- Note: John Cassidy resigned from Committee (And Esther Dyson's term is up.)

# Presenters

- Mike Gazarik, NASA Deputy Chief Technologist
- Courtney Graham, NASA Associate General Counsel, Comm and IP
- Doug Comstock, Director, Innovative Partnerships Office, OCT
- Henry Tirri, Senior VP and CTO, Nokia Corp.
- Ken Wolfenbarger, NASA JPL Commercial Programs
- William Farr, NASA JPL, Optical Communications Program Manager
- Preston Carter, Director, Game-Changing Tech Division, OCT



- **NASA has an Approved Operating Plan for FY 2011**

- Space Technology is funded at approximately the authorization level at \$350M

- Space Technology is transitioning from formulation to implementation

- Awards announcements have been issued and more to be announced in the coming weeks for a number of Space Technology Programs including:



- NASA Innovative Advance Concepts (NIAC)
- Space Technology Research Fellowships (STRF)
- Game Changing Development (GCD)
- Technology Demonstration Missions (TDM)
- Flight Opportunities (FO)



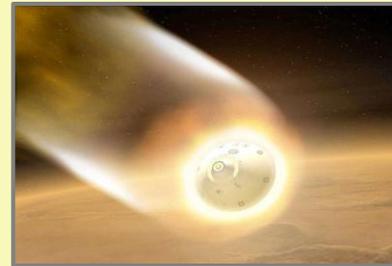
# Example FY 2011 Projects



**Flight Opportunities**



**NASA Innovative Advanced Concepts (NIAC) Program**



**Adaptive Entry Systems**



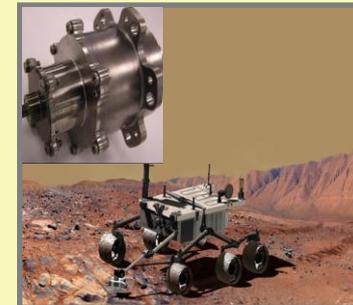
**Cryogenic Composite Tanks**



**Satellite Servicing**



**National Robotic Initiative**



**Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Program**



## ***From Red Tape to Results: Creating a Government that Works Better and Costs Less (1993)***

In 1993 Clinton Administration recommended:

- Technology transfer training for all employees.
- 10 to 20 percent of R&D budget goes to partnerships with industry.
- Improved metrics to measure its technology transfer performance.
- Mission objectives also include technology advancement and infusion into the private sector and that grant proposals should be evaluated on the basis of how such objectives would be achieved.



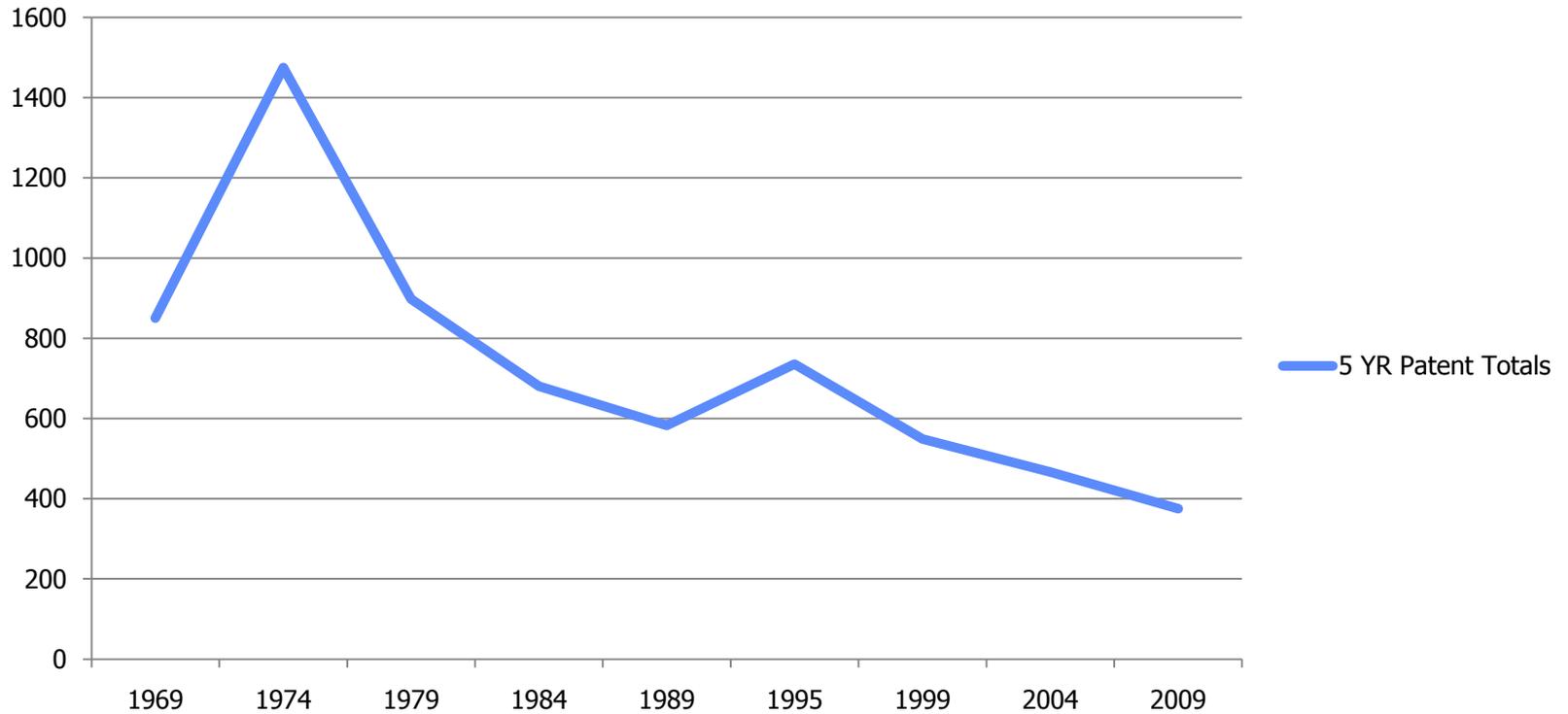
## ***From Red Tape to Results: Creating a Government that Works Better and Costs Less (1993)***

- All NASA contracts should require clearly defined technology transfer plans for the commercial application of technologies developed for NASA missions.
- NASA's Vision-Mission-Values (VMV) document should be amended to state that technology transfer is a major mission objective of the agency.



# Overall 5 Year Patent Totals

## 5 YR Patent Totals





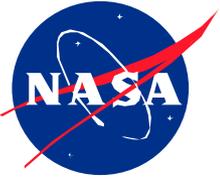
## 2009 – OSTP Strategy for American Innovation

**EXECUTIVE OFFICE OF THE PRESIDENT  
NATIONAL ECONOMIC COUNCIL  
OFFICE OF SCIENCE AND TECHNOLOGY POLICY**

**A STRATEGY FOR AMERICAN INNOVATION:  
DRIVING TOWARDS SUSTAINABLE GROWTH AND QUALITY JOBS**



NASA is not mentioned as an element of this Strategy



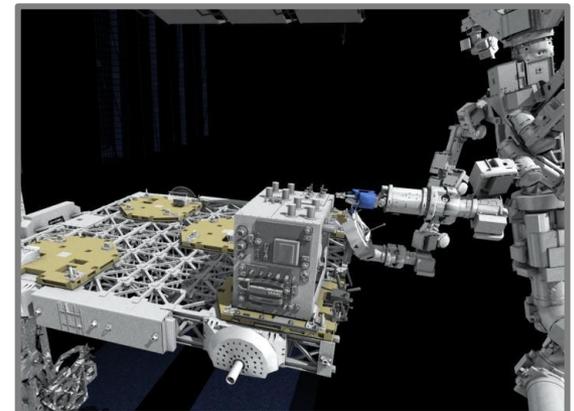
## Summary

- Because of changes external to the Agency, NASA will likely never regain the level of technology contributions it made during Apollo.
- The Agency is still suffering from the cuts to the technology transfer program made in FY2004.
- An Agency culture with a focus on immediate and near term mission needs deemphasizes activities which do not appear to directly result in mission benefit.
  - This is amplified in times of tight budgets and uncertainty.
- The Agency must take advantage of the shift in mission and the reemphasis on new technologies.
  - This is independent of current budget process (OCT).
- The observations and recommendations in the 2004 NAPA review are relevant today and should be strongly reconsidered as part of NASA's new direction.

# Satellite Servicing



- **Developing exploration technologies for complex manned servicing, assembly, and missions beyond LEO**
- **Robotic satellite servicing capabilities include**
  - satellite inspection
  - recovery, repair, relocation and orbital transfer
  - refueling, subsystem or component replacement
- **Developing strategies for supporting the development of commercially-financed, developed, owned and operated on-orbit robotic servicing capabilities for existing and future spacecraft**
  - leverage the Government's existing intellectual property, technological resources, and expertise in this area.
  - foster the creation of a domestic commercial industry capability that may meet both future government and non-government needs
- **Robotic Refueling Effort**
  - Launched on STS-135 to ISS
  - First NASA technology demonstration to test and prove technology needed to perform robotic refueling on spacecraft not built for refueling



# Deep Space Optical Communications



- **Objective:** 10 to 100X increased deep space data returns over present RF communications for future advanced instruments, live HiDef video, telepresence, and human exploration beyond Low Earth Orbit
- **Approach:** Develop and integrate key technologies from what is *sufficient* for near-Earth optical communications to what is *required* for deep space operations

## Challenges of deep space optical over demonstrated near-Earth solutions:

- **Pointing:** Must point downlink using a ~10,000X dimmer laser beacon and 100X greater round-trip light time
  - Requires improved [spacecraft disturbance isolation](#), ultra-sensitive [space receiver detector array](#) and *point-ahead confirmation without handshaking*
- **Modulation:** Need multi-Watt lasers with kilo-Watt peak powers for Pulse Position Modulation transmitter to mitigate huge signal loss
  - ~1,000,000X greater loss at Mars far range than moon requires power efficient [PPM laser transmitter](#)
  - *Laser amplifier is highest power dissipation assembly*
- **Detection:** Must shift burden from spacecraft by using > 10 m diameter telescopes on Earth
  - Requires large (~1 mm<sup>2</sup>) photon counting [ground receiver detector array](#) behind telescope due to *atmospheric blurring (> 50% efficiency needed)*



### Sun

- Can be in field of view
  - Primary source of optical noise

### Downlink

- Stabilized by disturbance isolation system & uplink beacon tracking
- Gb/s return link data
- Ranging



### Earth at T<sub>1</sub>+RTLT

- REQUIRES**
- Multi-kW power uplink lasers
  - > 10 m optical apertures
  - Efficient downlink detectors



### Earth at T<sub>1</sub>

### Uplink

- Blind points to spacecraft
  - Reference for removal of S/C jitter
  - Reference for point-ahead angle
- Aids downlink pointing
- Mb/s forward link data
- Ranging

- REQUIRES:**
- Stable / isolated platform
  - Efficient uplink detector
  - Efficient PPM transmit laser
  - Sub-microradian pointing



### Space Transceiver

- Large distance
  - Large 1/R<sup>2</sup> range loss
  - Large 2R/c round-trip light time (RTLT) requires point-ahead without handshaking

Point-Ahead Angle

# Recent T&I Committee Recommendation

## **Recommendation:**

- Request that senior Agency leadership address issues surrounding the significant delays in FY 2010 and 2011 in funding SBIR/STTR awardees and work to remedy these problems for FY 2012 and beyond.

## **Major Reasons for the Recommendation:**

- The 2010 determination of severability and subsequent cascading decisions regarding bona fide need provisions and funding rules have resulted in: (1) significant delays in funding of new start projects; (2) very small funding increments while operating under Continuing Resolutions; (3) an overall inability for NASA to meet its Congressionally mandated annual funding obligations to small businesses; (4) reductions in the benefits NASA can gain from these projects; and (5) de-motivation of internal staff and potential partners. Since 2010, NASA issued only about 30% of the total funding intended for SBIR/STTR. Over 200 SBIR Phase 2 projects selected in October 2010 have not yet been funded as of late April 2011; normally, SBIR Phase 2 projects selected in October are initiated in December and January.

# NASA Response to recent T&I Committee Recommendation

## **NASA Response: NASA concurs with this recommendation.**

- NASA's Office of the General Counsel (OGC), Office of the Chief Financial Officer (OCFO), and Office of the Chief Technologist (OCT) met in April and May to address this issue. An agreement-in-principle has been reached for revision of the SBIR/STTR contract severability determination (pending final review and approval by the OCFO), which is one of the main issues behind the delays in initiating the NASA SBIR/STTR contracts. Draft language for a new decision memorandum by the OCFO has been developed and is currently under review by OGC, OCFO, and OCT. Once finalized, NASA will forward the OCFO-signed memorandum on this issue to the Council and the Technology and Innovation Committee.
- In addition, the Agency's FY 2011 Initial Operating Plan has been submitted to Congress. The plan restores the funding that was transferred out of the SBIR/STTR in the July 21, 2010, Operating Plan update, as a result of the FY 2010 change of Cross Agency Support (CAS) to one-year funding and the severability of SBIR/STTR contracts. This restoration was committed to in the July 21, 2010, Operating Plan update, but needed to wait until the FY 2011 Initial Operating Plan to be implemented. With implementation, the SBIR and STTR programs will achieve a net zero change (across FY 2010 and FY 2011), thus meeting legally mandated funding levels. These funds have been authorized to be spent and released within the Science and Exploration accounts. For FY 2012 and out years, NASA has submitted proposed appropriations language with the FY 2012 Budget Request to help avoid this in the future by allowing CAS funding to remain available for two years.

# Alain Rappaport's thoughts

- NASA to focus on the really hard problems of strategic importance, innovate on science and tech, and then successfully transfer to or inspire industry. It has done this through Apollo, Shuttle, and must continue to do so.
- Leadership needed to create/sustain innovation culture

# Gordon Eichhorst's thoughts

- Over the last couple decades NASA has had varying policies towards Intellectual Property and perhaps even more broadly towards monitoring its own technology. At the moment NASA does not appear to have a clearly defined approach and we believe that clarity in this regard would provide a number of benefits.

# NASA IP versus Partner IP

- The word partner here is important as it ranges from private contractors (both large and small) along with Universities and other governmental organizations. The key question is whether NASA is receiving recognition (monetary and otherwise) for its contributions which are often the primary funding source...and should it do so?

# NASA HQ versus NASA center activity

It was recognized under a number of contexts that executing a new IP policy will be perilous. The ultimate holders of information are the scientists themselves and they currently have little incentive to spend time documenting which is a prerequisite for any form of IP protection.

# NASA = space + air + tech?

- At the heart of the IP question is whether NASA is viewed as a ‘technology’ organization. The missions capture the imagination of many but it does not appear that NASA is getting much credit for defining problems and creating the solutions that go on to make the world we live in a much better place. E.g., Without spaceflight the solar energy industry would not exist in its current form.

# Outgoing chairman's thoughts

- It's the culture, stupid!
- Fly early & often (Ed Lu)
- Financial stuff is only partly about NASA's costs
- It's also recognition for contributors
  - Both inside NASA and outside

# Outgoing thoughts (2)

- Other culture recommendations
  - Move people around
  - Recruit outside your home state
  - Use SBIRs, etc. for people as well as tech transfer
  - Help people see where their work fits the mission



# Appendix



## 1994: A NEW WAY OF DOING BUSINESS

- In July 1994, NASA launched “NASA's Commercial Technology: Agenda for Change” which implemented the recommendations, and set out the Agency’s newly defined Commercial Technology Mission.
- Targeted 20% of Agency R&D to support commercial partnerships.
- Launched TechTRACs which modeled 50,000 work areas representing an annual NASA investment of approximately \$12 billion to identify 2,700 new technologies.
- Instituted training across the Agency.
- All programs and contracts required to consider commercialization strategies.

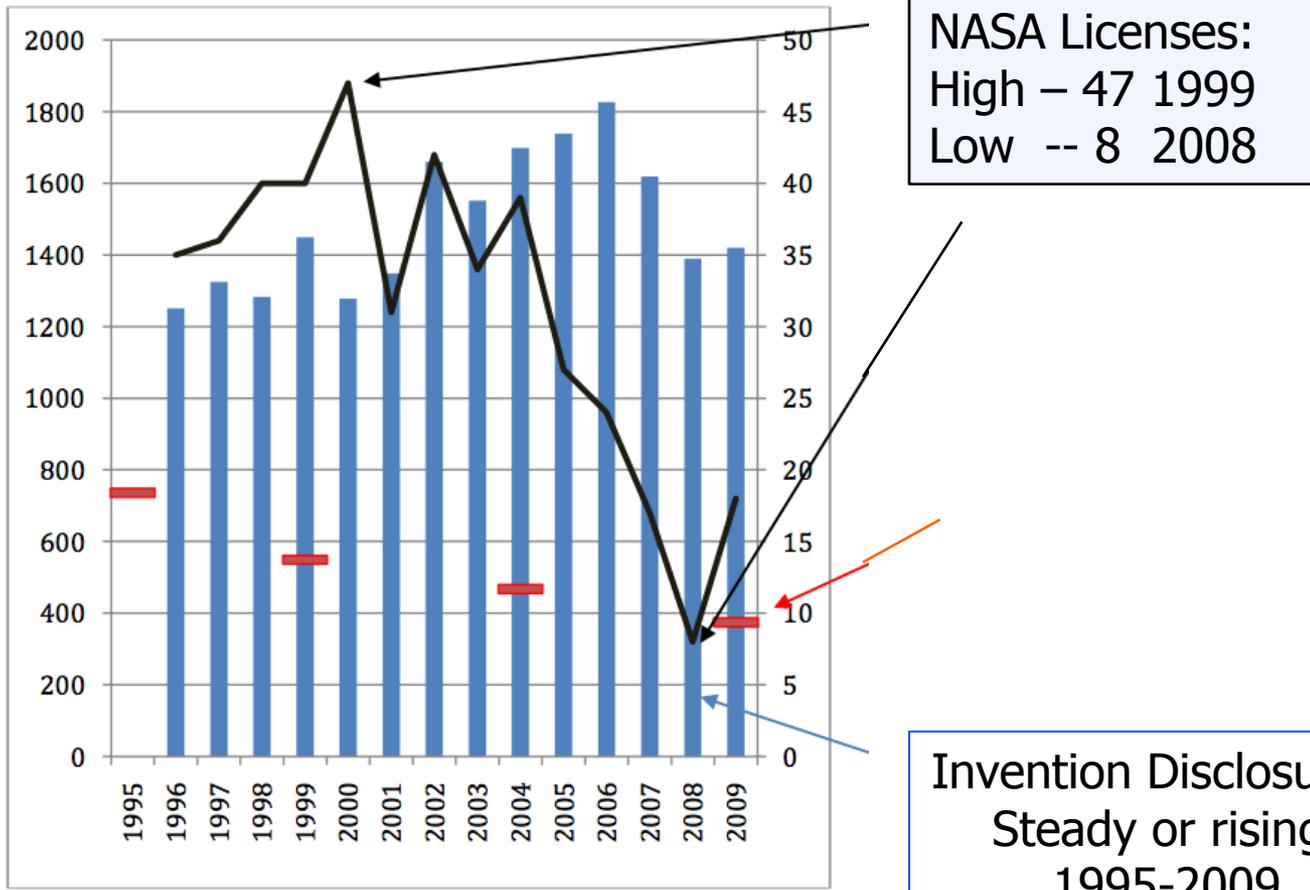


# THE ENTERPRISE ENGINE

- In FY 2004, NASA's Commercial Technology program under the "Agenda for Change" was cancelled.
- NASA's Technology Transfer Efforts were defunded in favor of an approach called the "Enterprise Engine" which refocused the Agency's partnership efforts on developing technologies with specific applications to NASA's mission needs.
- Shift from "spin-out" to "spin-in."
- Coincided with the Bush Administration's implementation of the Vision for Space Exploration.



# What happened then?



NASA Licenses:  
High - 47 1999  
Low -- 8 2008

Invention Disclosures:  
Steady or rising  
1995-2009



# Bringing Innovation to NASA and the Nation

- Review conducted by the National Academy of Public Administration, released in November 2004.
- Recognized that successes of the Agenda for Change paled in comparison to NASA's historic contributions to the Nation.
  - The private and university sectors of the economy now conduct much more research and development (R&D) than the federal government.
  - The issues of technology and technology transfer are multi-national, and the development of space-related technologies has been globalized.
  - Small businesses are an increasing source of innovation for new technology.



# Bringing Innovation to NASA and the Nation

- Cont'd.
  - Congress, NASA, and the Office of Management and Budget (OMB) have different views about how to best accomplish technology transfer. This disagreement plays out through the budget process and has created significant uncertainty about the program throughout NASA's technology transfer network.
  - Organizations in the technology transfer network operate at the margins of the agency's overall operations, lack executive support, and are likely to be at odds with each other.
  - The technology transfer program has recently undergone major changes. In FY 2004, the Commercial Technology Program was terminated, and the program's emphasis was changed from a primary focus on diffusion of technology to the private sector to a much greater focus on the infusion of technology into the agency to help meet mission requirements.

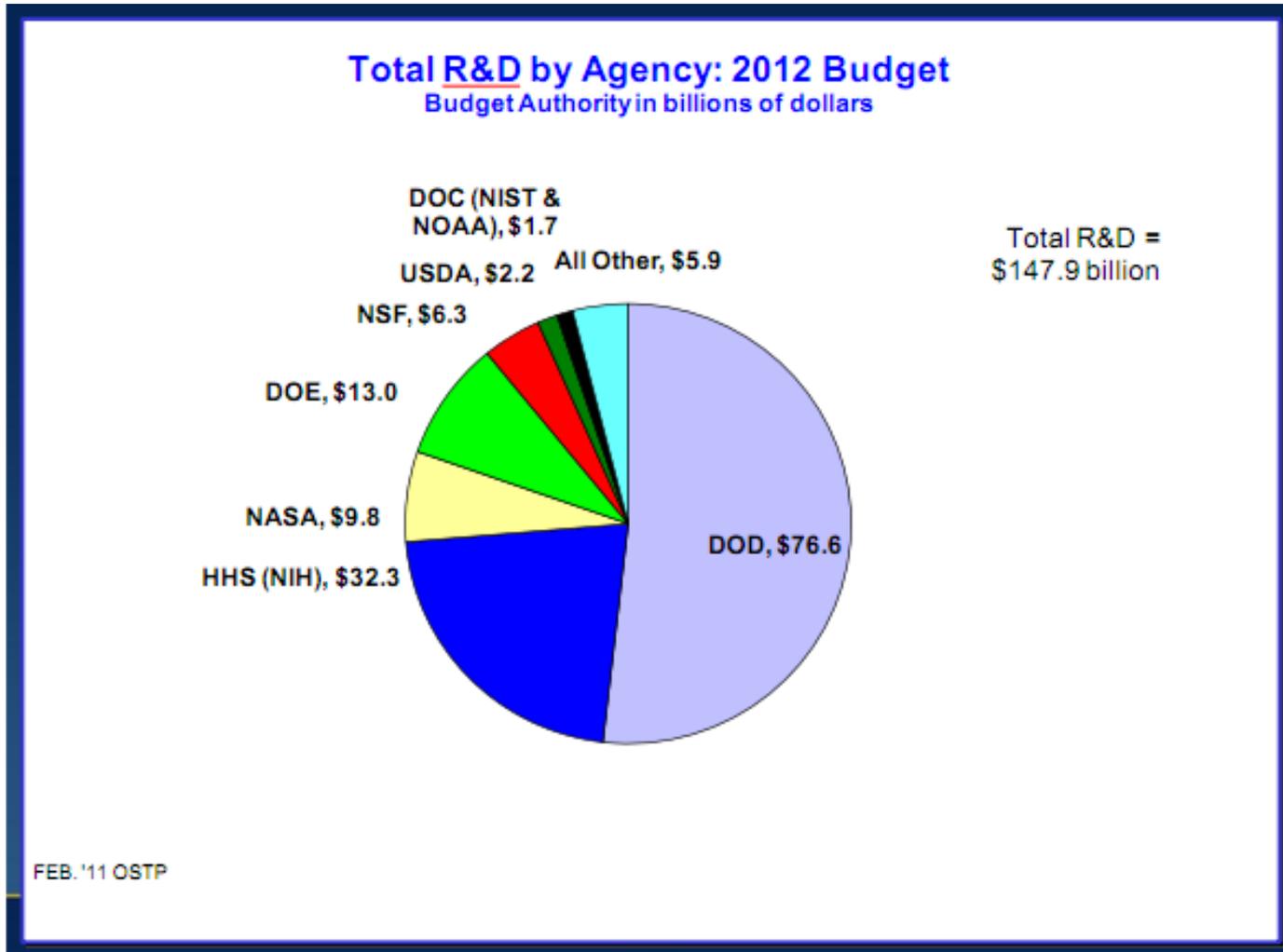


# Bringing Innovation to NASA and the Nation

- Specifically reviewed the Innovative Partnership Program Office
- Recommended:
  - Strong Leadership Commitment to technology transfer as a core element of the agency's mission.
  - Relocate IPP to the Administrator's Office to provide Agency-wide Accountability
  - Clarify Roles and Responsibilities for Spin-In and make better use of technology outside NASA.
  - Roles and Responsibilities for Spin-Out and make Center Directors responsible to support staffing and activities.
  - Improve the Timeliness of the Intellectual Property Process
  - Evaluate its technology transfer efforts to assesses the long-term economic and social impacts of NASA technology transfer, and establishes individual performance standards for all officials who have a role in technology transfer.



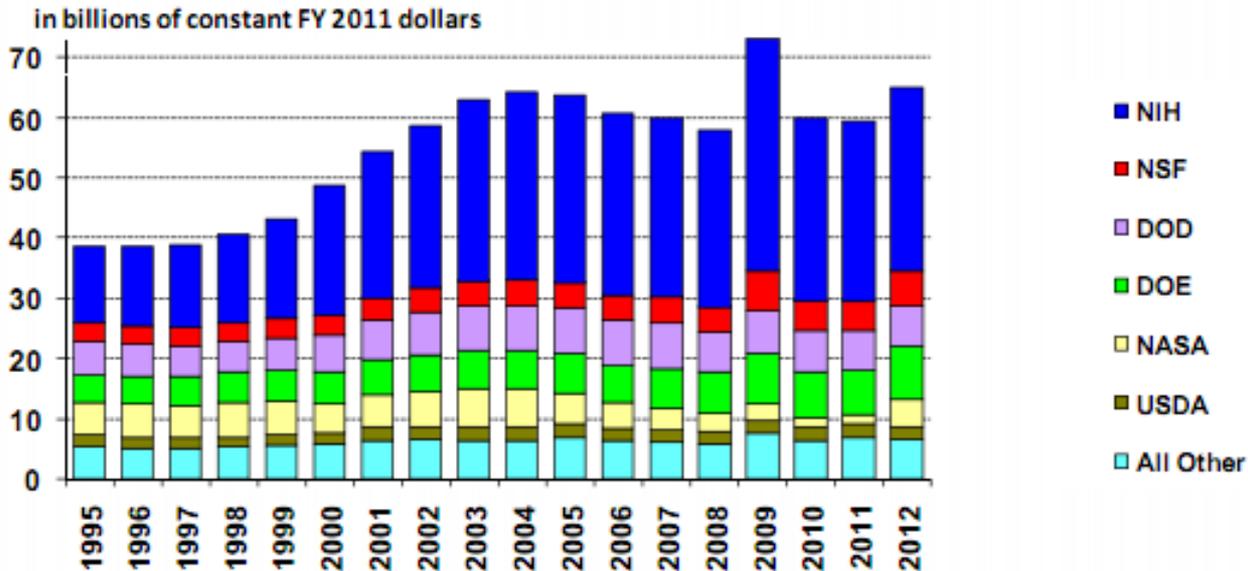
# Why is this relevant NOW?





# However, significant Increase in R&D Spending!

## Winning the Future: Federal Research by Agency, FY 1995-2012



FY 2009 figures include Recovery Act appropriations.  
2011 figures are preliminary estimates.  
Research includes basic research and applied research.  
FEB. '11 OSTP



# Modest Proposed Increase in R&D Budget

