

National Aeronautics and Space Administration

Commercial Space

NewSpace 2010 Conference
Silicon Valley, CA

July 24, 2010



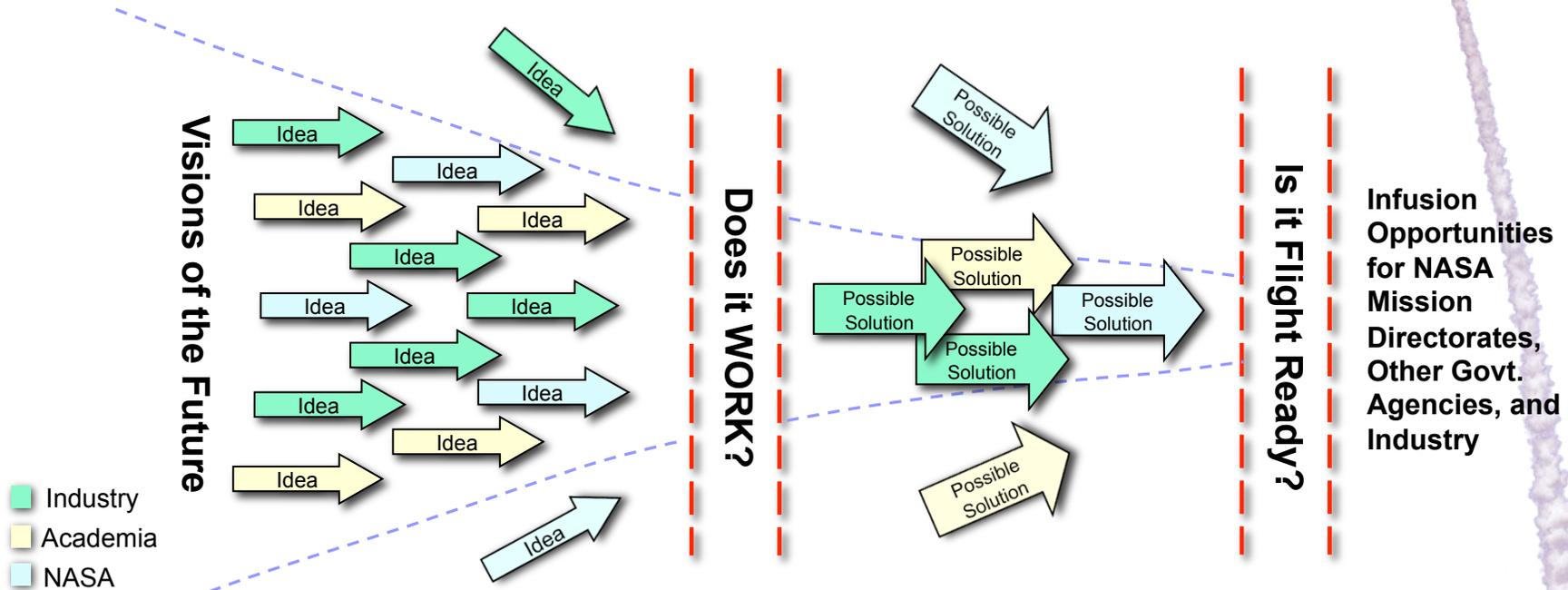
Space Technology Program, Office of Chief Technologist

Office of Chief Technologist



- **OCT established in February 2010**
- **OCT has six main goals and responsibilities:**
 - 1) Principal NASA advisor and advocate on matters concerning Agency-wide technology policy and programs.
 - 2) Up and out advocacy for NASA research and technology programs. Communication and integration with other Agency technology efforts.
 - 3) Direct management of Space Technology Programs.
 - 4) Coordination of technology investments across the Agency, including the mission-focused investments made by the NASA mission directorates. Perform strategic technology integration.
 - 5) Change culture towards creativity and innovation at NASA Centers, particularly in regard to workforce development.
 - 6) Document/demonstrate/communicate societal impact of NASA technology investments. Lead technology transfer and commercialization opportunities across Agency.
- Mission Directorates manage the mission-focused technology programs for directorate missions and future needs
- Beginning in FY 2011, activities associated with the Innovative Partnerships Program are integrated into the Office of the Chief Technologist

Space Technology Development Approach



Early Stage Innovation

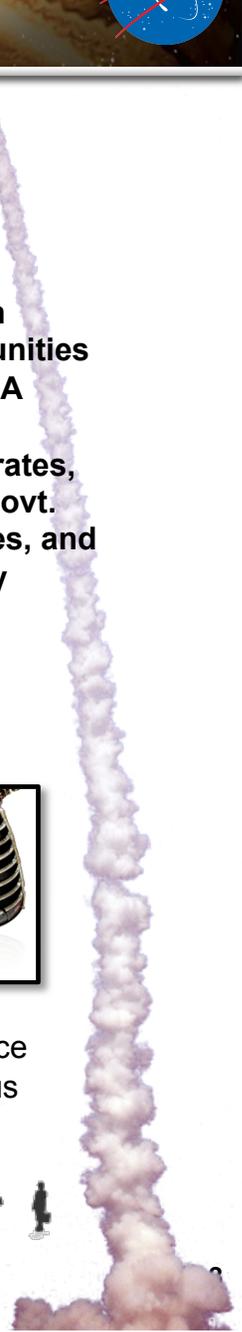
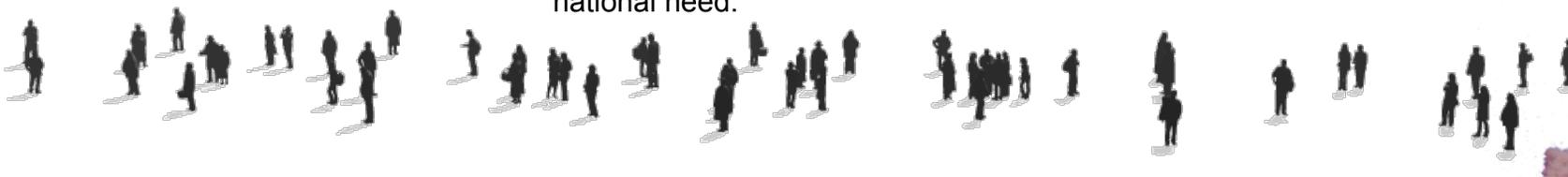
Creative ideas regarding future NASA systems or solutions to national needs.

Game Changing Technology

Prove feasibility of novel, early-stage ideas with potential to revolutionize a future NASA mission and/or fulfill national need.

Crosscutting Capability Demonstration

Mature crosscutting capabilities that advance multiple future space missions to flight readiness status



Building Disruptive and Game Changing Technology



Strategic Opportunities

Scientific Discovery

Human and Robotic Exploration

New and Innovative Space Technologies and Mission Capabilities

Challenge Goals

Enabling Capabilities

Systems Capabilities

Transformational Technology Demonstration

- Energetic Materials
- Inflatable Aerocapture
- Optical Communication
- Nano electronics
- Radiation Shielding
- Expandable Structures
- Robotic Repair
- Engineered Materials

Examples of New Technologies

Grand Challenges (DRAFT)



Make space part of our routine environment...



Achieve fast and economical space transportation

Enable in-space commercial/ marketable services

Improve spacecraft safety and protect astronaut health

Communications that enable virtual presence

Manage space as a natural resource...



Gain knowledge of climate change and natural disasters

Provide economical energy on demand

Improve Knowledge of the near-earth environment

Invent the materials of exploration using in-situ manufacturing

Quests of the Future...



Exploit machine intelligence/robotic autonomy

Understand laws of the universe

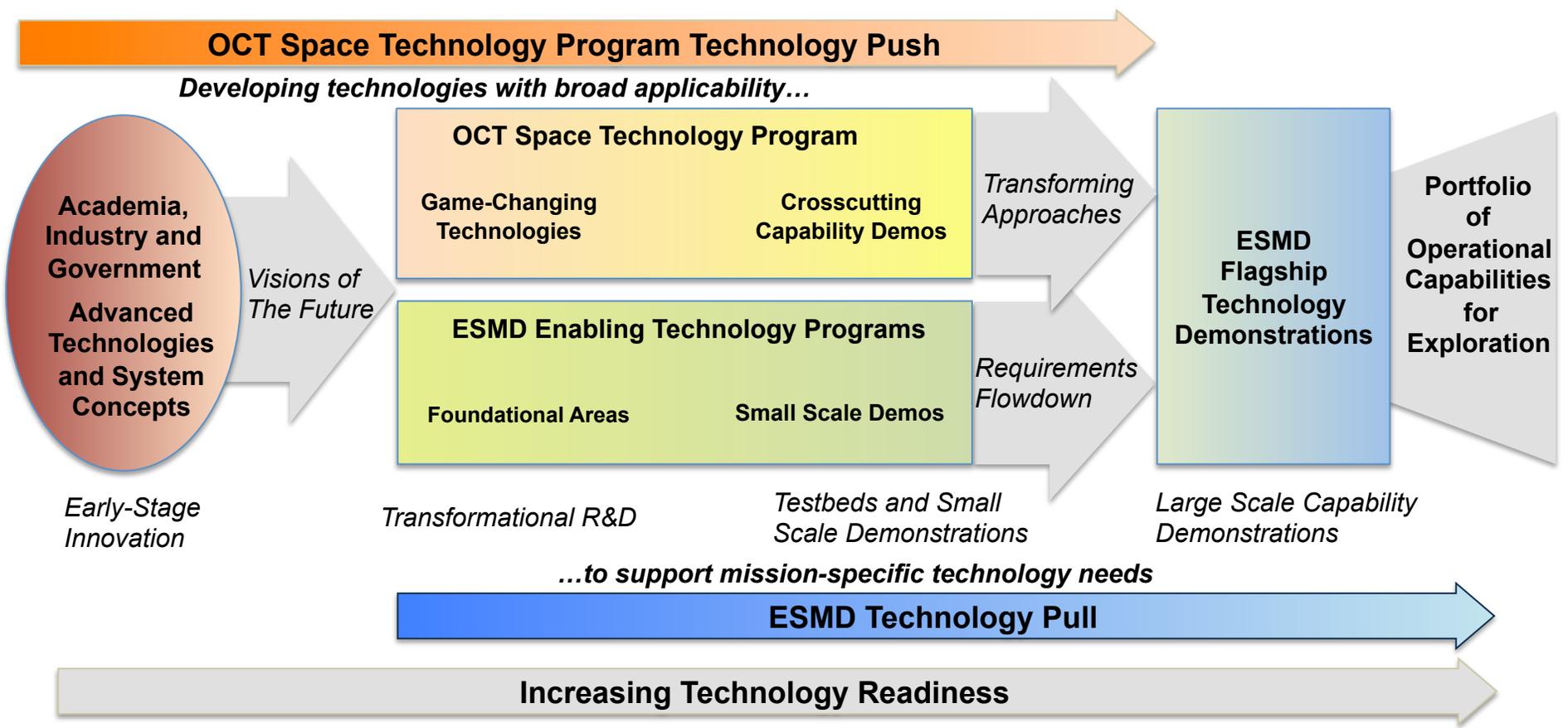
Discover life and earth-like worlds



Integration of NASA's Technology Investments



- OCT in partnership with ARMD, SMD, SOMD and ESMD will invest in a portfolio of technology investments enabling new approaches to NASA's current mission set, and allowing the Agency to pursue entirely new missions of science and exploration.
- The example below shows how the OCT and ESMD technology program relate. Similar relationships are in place for SMD, SOMD and ARMD.



Starting Strong

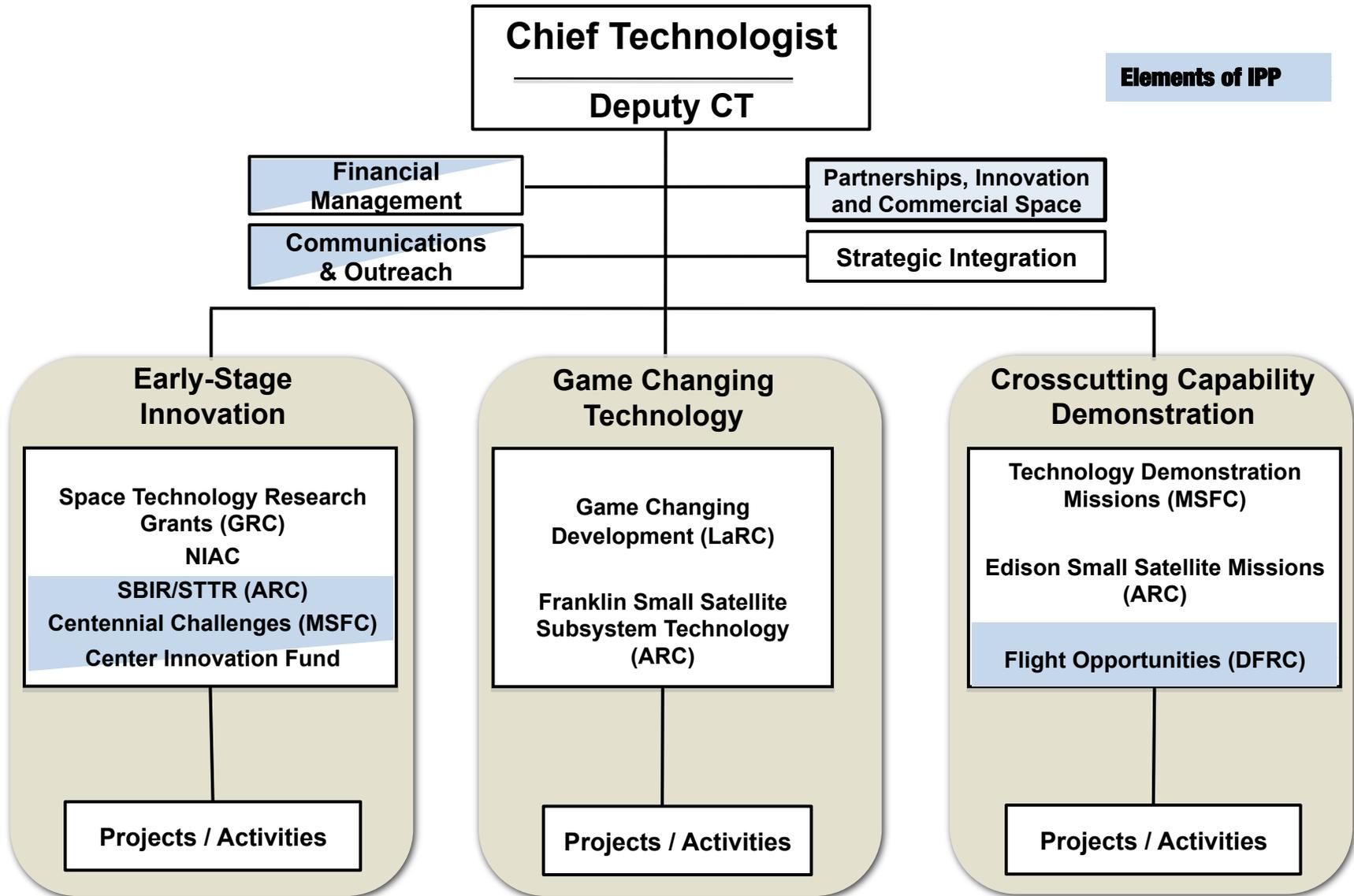


- **Building on the success of NASA's Innovative Partnerships Program**
 - Centennial Challenges
 - SBIR/STTR
 - IPP Seed Fund → Center Innovation Fund
 - FAST and CRuSR → Flight Opportunities
 - IPP Partnerships, Technology Transfer, Commercialization and Commercial Space → Partnerships, Innovation and Commercial Space
 - IPP Center field offices → Center Chief Technologist offices
- **In FY11, \$234 of \$572M and over FY11-FY15, \$1.2B of \$4.9B is IPP-related content**
- **Formulation of all Space Technology programs was initiated in February and has proceeded rapidly and effectively. We are ready for FY11 initiation of the new Space Technology programs.**

Office of the Chief Technologist Organization



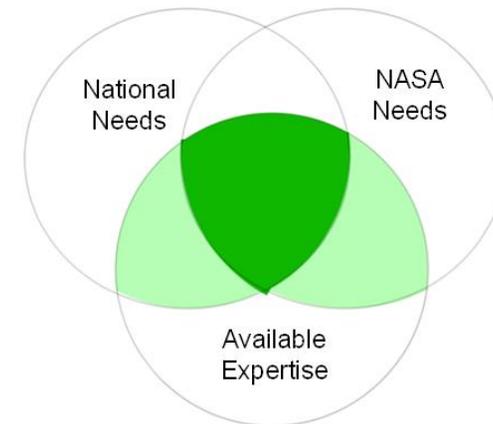
Elements of IPP



Innovation & Partnerships



- **Innovation**
 - Risk taking and failure tolerance – learning by doing.
 - Building networks and making connections.
 - Not just technology but new ways of applying existing technology, new processes and business models.
- **Partnerships**
 - Seek out common interests and partnerships that maximize mutual benefit.
 - Look for partners with skin in the game.
 - Seek out adjacent markets and industries
 - economies of scale.
 - Welcome non-traditional partners and fresh perspectives.



Innovation: Matching Technology Needs with Technology Capabilities

Entrepreneurship & Innovation



- A goal of the innovation strategy for the U.S., released by the National Economic Council and the Office of Science and Technology Policy, is to:
“Encourage high-growth and innovation-based entrepreneurship.”
- The white paper outlining the strategy states that:
“Entrepreneurship has played, and will continue to play, an essential role in generating innovation and stimulating U.S. economic growth.”
- NASA is a Critical Component of America’s Innovation Engine.
 - As a research and development agency, NASA plays a vital role in America’s innovation engine and, as such, its future economic prosperity and security.
 - An enhanced technology and innovation focus at NASA responds to the recommendations of multiple external stakeholders.
 - NASA’s new Space Technology investments will create a more vital and productive aerospace industry and address broader national needs, such as energy, health and wellness, and national security.
- NASA’s Office of the Chief Technologist offers entrepreneurs a wide variety of engagement opportunities and tools.

A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs; Executive Office of the President, National Economic Council, Office of Science and Technology Policy; September 2009

Model for Government-sponsored Prizes



“NASA’s Centennial Challenges have triggered an outpouring of creative solutions from students, citizen inventors, and entrepreneurial firms for technologies such as lunar landers, space elevators, fuel-efficient aircraft, and astronaut gloves.”

Memo to all Executive Departments and Agencies from Office of Management & Budget
Guidance on the Use of Challenges and Prizes to Promote Open Government,
March 8, 2010

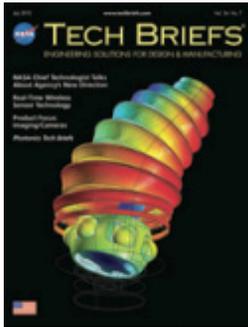
OCT Offers Numerous Benefits to Potential Partners



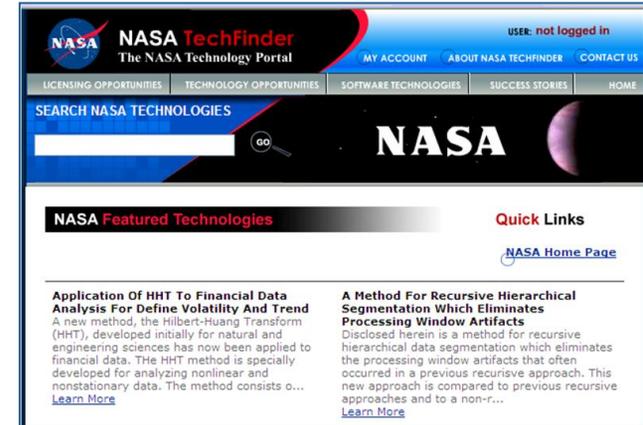
- Funding or Leveraged Resources through partnerships:
 - Early Stage Innovation.
 - Game-changing Technology.
 - Cross-cutting Demonstrations.
- Technology and Software.
 - Access through licensing or other partnerships.
- Test and Demonstration Facilities/Capabilities.
 - Access to NASA's facilities through partnerships.
 - Access to the space environment through flight opportunities.
- Expertise.
 - Access to NASA's technical expertise through partnerships.
- Facilitation to proactively seek and enable partnerships.



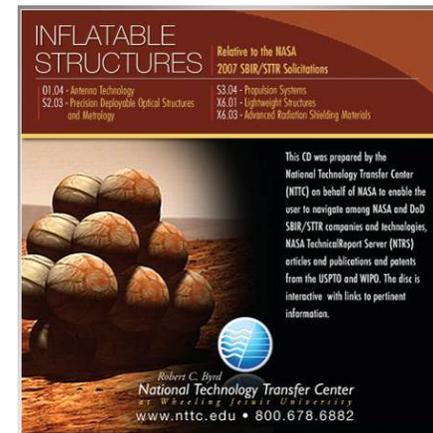
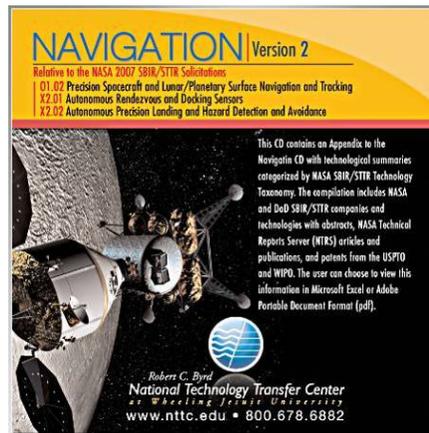
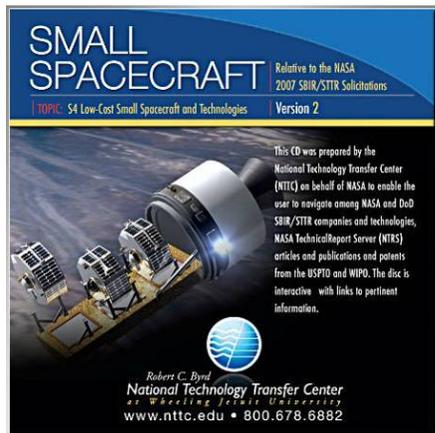
Finding Technologies



- NASA TechBriefs publishes new technologies in print and online.
- NASA technologies are searchable on many databases, including technology.nasa.gov.

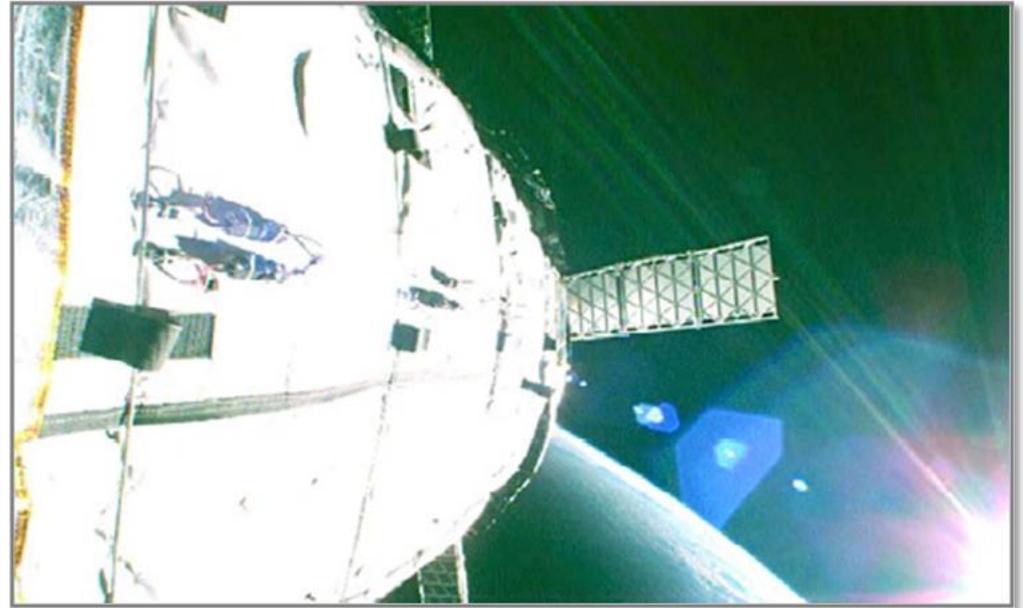


- Working with the National Technology Transfer Center (NTTC) we are generating focused technology databases.
- As part of OpenGov, NASA established an RSS feed with new technologies.



http://www.sbipp.com/technologyportfolios/technology_list.asp

Licensing and Partnerships Enable New Capabilities



Ad Astra

- 200 kW VASIMR prototype plasma rocket engine.
 - Technology licensed from NASA.
 - First Space Act Agreement in 2005.
 - Access to and use of NASA facilities.
 - NASA technical experts on-site for extended assignments working on technical issues.

Bigelow Aerospace

- Genesis I inflatable spacecraft.
 - Technology licensed from NASA.
 - First Space Act Agreement in 2002.
 - NASA technical experts on-site for extended assignments working on technical issues.
 - NASA experiments flown on prototype spacecraft.

Response to NASA Challenges Posted at InnoCentive.com

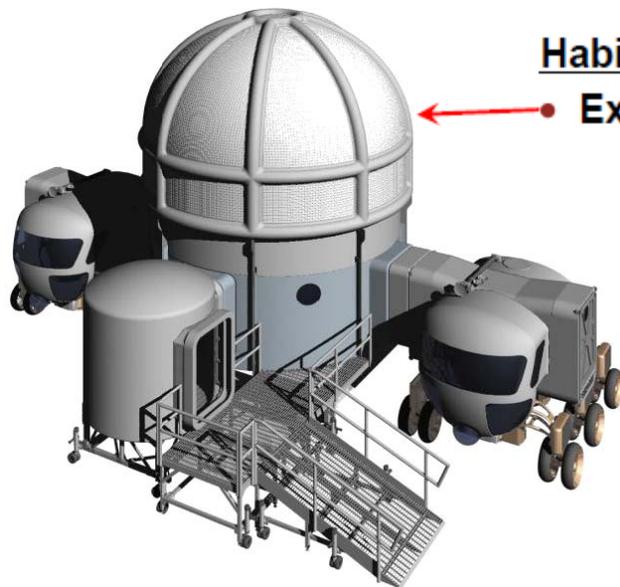


- **JSC Challenges** - Improved Food Packaging, Compact, Effective Aerobic and Resistive Device, and Forecasting Solar Activity.
 - A Total of 1,317 Project Rooms were opened from 65 Countries, resulting in 127 Submissions from 24 Countries.
- **LaRC Challenge** – Coordination of Sensor Swarms for Extraterrestrial Research.
 - There were 423 Project Rooms opened from 49 Countries, and 37 Submissions from 11 Countries.

X-Hab Academic Innovation Challenge



- OCT and ESMD have partnered with JSC and the National Space Grant Foundation to conduct a pilot innovation project.
- The exploration habitat (X-Hab) academic innovation challenge encourages academic innovation through a head-to-head competition to design and build an inflatable habitat loft.
- Solicitation released 6/23, notice of intent due 7/23, proposals due 8/20.
- The winner will participate with NASA's Habitat Demonstration Unit (HDU) Project in the Desert Research and Testing Studies in Aug-Sept 2011.



Habitat Innovation

← Expandable "Loft"

www.spacegrant.org/xhab/



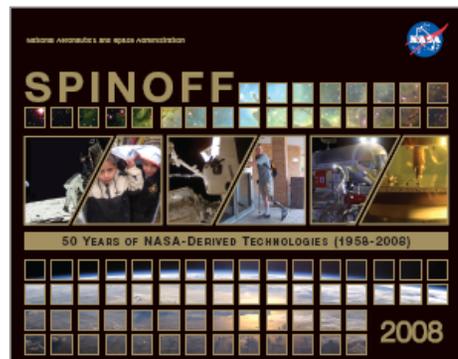
NASA Partnering for Innovation



- NASA has a long history of transferring technologies for public benefit.
- NASA's direction to do this traces to the Space Act that created NASA in 1958:
"Provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

Applications of NASA-Derived Technology

- Health and Medicine
- Transportation
- Public Safety
- Consumer, Home & Recreation
- Environmental and Agricultural Resources
- Computer Technology
- Industrial Productivity



NASA @ Home & NASA City
<http://www.nasa.gov/city>

Public Benefits of NASA-Derived Technology

- Economic Growth
 - New Jobs
 - New Markets
 - Increased Efficiency
 - Improved Competitiveness
- Quality of Life
 - Improved Safety
 - New Products
 - Lives Saved or Extended
 - Green Technologies
 - Environmental Cleanup

New National Space Policy

Excerpts on Commercial Space (June 28, 2010)

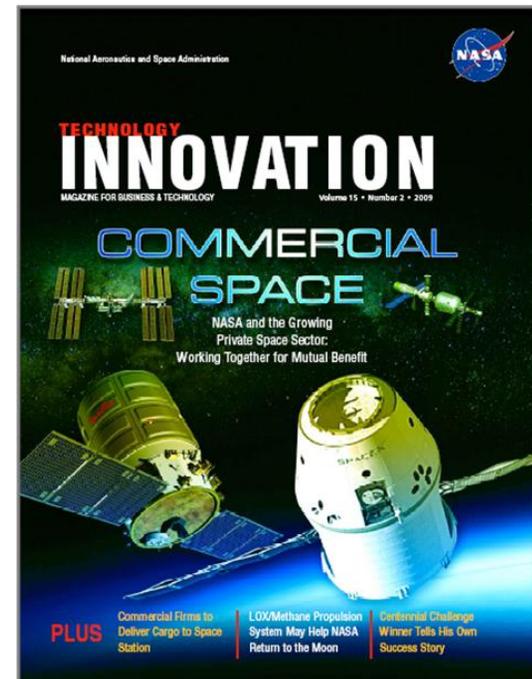


- **Principles:** A robust and competitive commercial space sector is vital to continued progress in space. The United States is committed to encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven entrepreneurship.
- **Goals:** Energize competitive domestic industries to participate in global markets and advance the development of: satellite manufacturing; satellite-based services; space launch; terrestrial applications; and increased entrepreneurship.
- **Guidelines** (Selected excerpts):
 - Purchase and use commercial space capabilities and services to the maximum practical extent ...
 - Actively explore the use of inventive, nontraditional arrangements for acquiring commercial space goods and services to meet United States Government requirements, including measures such as public-private partnerships, ...
 - Develop governmental space systems only when it is in the national interest ...
 - Refrain from conducting United States Government space activities that preclude, discourage, or compete with U.S. commercial space activities ...
 - Pursue potential opportunities for transferring routine, operational space functions to the commercial space sector where beneficial and cost-effective.



Commercial Space and NASA

- There are three key themes that underscore some of the changes already underway in how NASA is engaging the commercial space community:
 - Private sector role as partner rather than contractor.
 - Government purchase of services instead of hardware.
 - Creating broader opportunities for innovation.
- All themes are consistent with the relationship that NACA had with the emerging aviation industry.

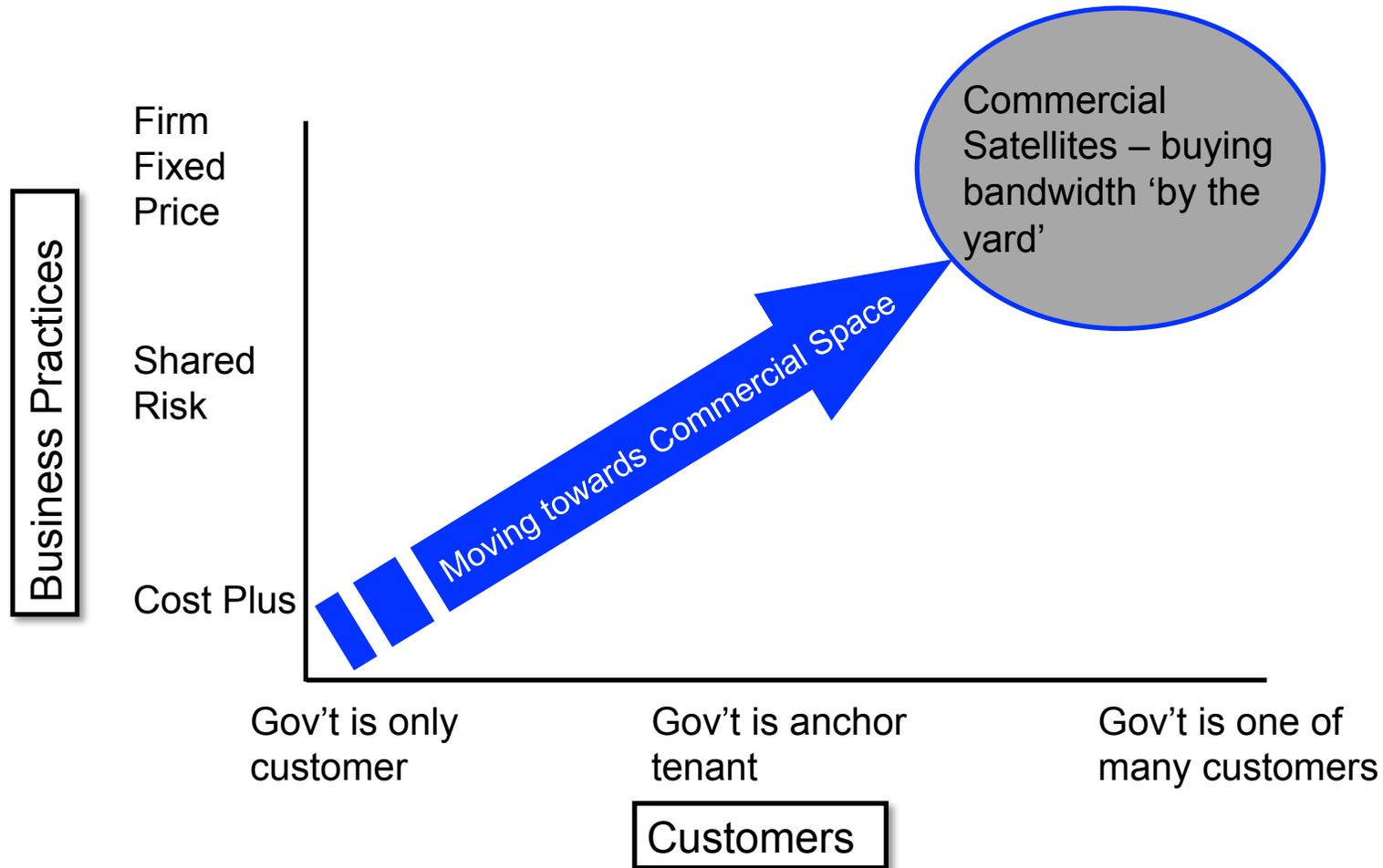


Recent edition of Technology Innovation focused on NASA's activities related to Commercial Space.

What is Commercial Space?



- No single discrete definition, but rather a context for understanding different aspects of what makes something a 'commercial space' activity.



The National Advisory Committee for Aeronautics



- U.S. creates NACA in 1915.
 - President Taft appointed commission in 1912 to address loss of U.S. leadership in aviation, resulting in proposed legislation.
 - Legislation was defeated in 1913, passed in 1915 after start of WWI.
 - The committee of 12, all unpaid, were allocated a budget of \$5,000.
- NACA brought together diverse federal agencies.
 - Army, Navy, Smithsonian, Bureau Standards, Weather Bureau.
 - Committee developed national consensus on critical problems.
 - Coordination/cooperation function was as important as R&D.
- NACA took a holistic view of national priorities.
 - Clearly focused on building a healthy competitive industry.

NACA Produced



- Solved practical aviation problems for the Nation.
 - Facilitated aircraft patent cross-licensing agreement.
 - Ended destructive U.S. industry patent fight between Wrights & Curtiss.
 - Created cooperative partnerships between government & industry.
 - Intervened on WWI aircraft engine deadlock resulting in Liberty engine.
 - Started advocating purchase of air mail services (beginning in 1916).
 - Leading to Kelly (Air Mail) Act in 1925.
 - Persuaded commercial insurers to start insuring aviation.
 - Recommended budget increase to President for Weather Bureau.
 - Purpose was to promote safety in aeronautics.
 - Recommended the creation of Bureau of Aeronautics.
 - Predecessor of the Federal Aviation Administration.
 - Developed methods for mapping from planes.
- Example Innovations
 - Area-rule and Supercritical airfoils were Early Stage Innovations that were developed into Game Changing Technologies for the aviation industry.
 - The X-1 and X-15 were Crosscutting Capability Demonstrations.

The NACA Mission Was in Part to Stimulate Industry

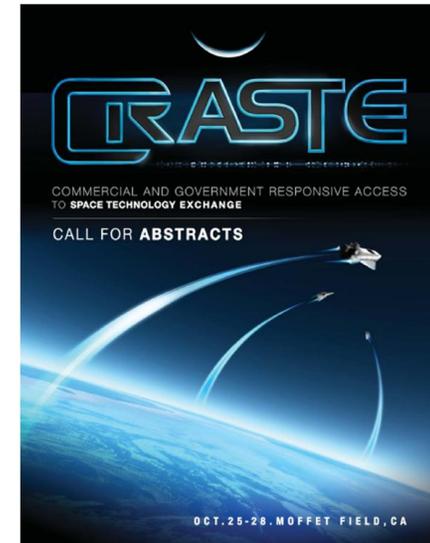


- *“... the members of the NACA believed to a man that the future of aviation in the United States depended on a healthy and prosperous aircraft-manufacturing industry, and that it was the NACA’s duty to help where it could. From the outset, the NACA was an industry booster limited only by its need to be fair and impartial in disbursing favors and assistance.”*
 - Alex Roland, “Model Research”, NASA History SP-4103, page 34
- Simply stated, the NACA approach focuses on building an industry, not a program.
- For NASA today, this implies seeking the Wright Brothers of 21st Century through open innovation and focusing on the foundational research and technology required to foster commercial markets.

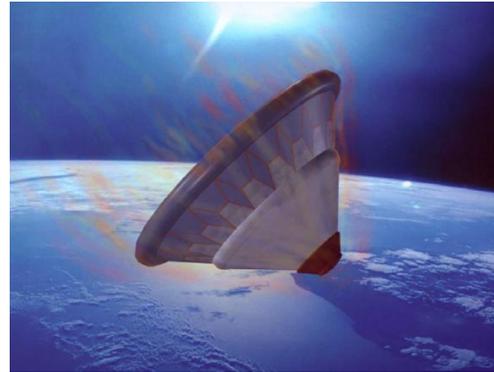
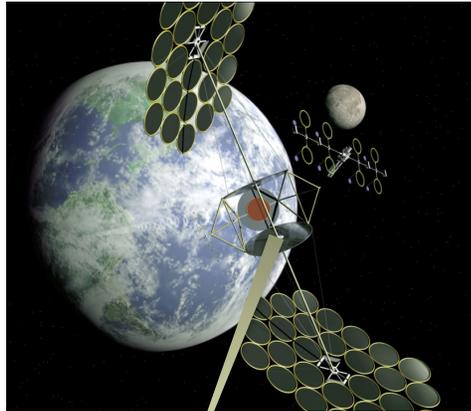
Upcoming Events and Activities



- NASA-USAF Co-sponsoring Annual Technology Exchange and Industry Forum.
 - Commercial Responsive Access to Space Technology Exchange (CRASTE).
 - OCT is the NASA lead for this forum.
 - NASA and USAF alternate hosting, WPAFB in 2009.
 - 2010 event will be at NASA Ames on Oct. 25-28.
- CRASTE Purposes:
 - Facilitate technology transfer, enable partnerships with a “Marriage broker” service among firms.
 - Forum for understanding industry technology needs.
- Learn more and register at:
<http://www.usasymposium.com/craste/>
- Beginning new approach to foster commercial industries and Low-Cost and Reliable Access To Space (LCRATS) which includes:
 - Flight Opportunities using Commercial Services.
 - Commercial Responsive Access to Space Technology Exchange.
 - Commercial RLV Technology Roadmap.
 - Horizontal Launch Access to Space feasibility study



Potential Space Technology Demonstrations



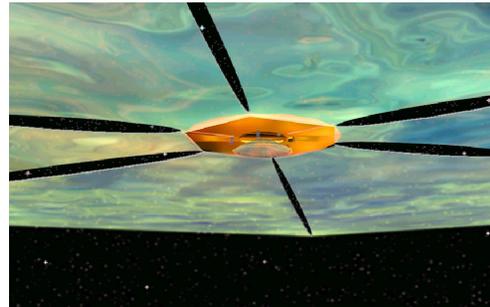
Inflatable Decelerators



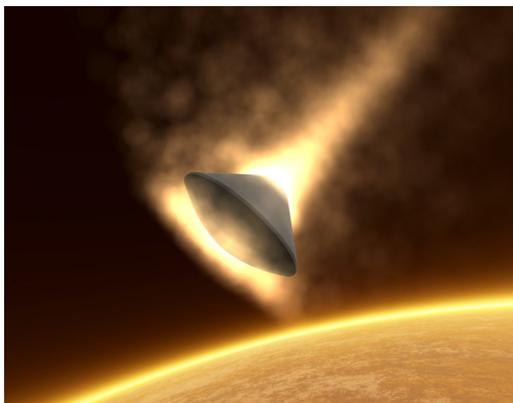
25-40 m Class Telescopes



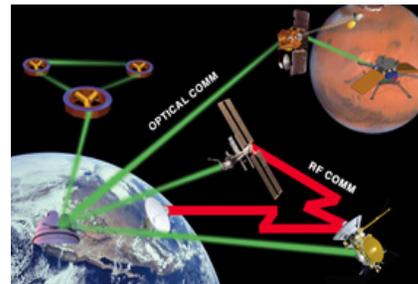
**Space Solar Power:
In-Space Power
Transmission**



Solar Sail Propulsion



Aerocapture



Optical Communications



**Electrodynamic
Tether Propulsion
Artist Concept of ISS
Reboost**

Importance of OCT Investments



- **A Critical Component of America's Innovation Engine:** As a research and development agency, NASA plays a vital role in America's innovation engine and, as such, its future economic prosperity and security. An enhanced technology and innovation focus at NASA responds to the recommendations of multiple external stakeholders.
- **Fostering American Industry:** NASA's new Space Technology investments will create a more vital and productive aerospace industry and address broader national needs, such as energy, health and wellness, and national security.
- **An Integral Part of our National Strategy:** NASA's new Space Technology programs represent an important aspect of our overall national investment in research, technology and innovation, designed to stimulate our economy, create new inventions and capabilities, and increase our global economic competitiveness.
- **The Next Generation:** NASA's new Space Technology emphasis will create a new pipeline of young engineers, scientists, and mathematicians to serve our future National needs, inspiring wonder in a new generation, sparking passions and launching careers.
- **Partnerships, Innovation and Commercial Space:** Activities are intended to leverage expertise and resources with partners, drive new sources and methods of innovation, and maximize the benefit to the U.S. from the taxpayer investment in NASA technology.

Interested in partnering with NASA?



Contact me, or the Chief Technologist at the relevant Center:

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