



NASA Innovation and Technology Preliminary Planning

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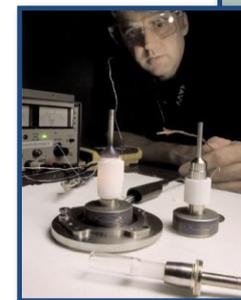
Outline

- NASA Innovation and Technology Initiative
- NASA Office of the Chief Technologist
- Space Technology Program



NASA Innovation Initiative Goals*

- Revitalize NASA as a preeminent R&D organization through significant investment in longer term technical or process innovations
- Encourage innovative application of NASA capabilities to address broader national needs such as energy, weather and climate, Earth science, health and wellness, national security, and STEM education
- Stimulate a vibrant commercial space sector through helping to create new types of engagement, creation of new markets, and investments in future technologies
- Generate excitement about NASA's work by investing in a large number of highly creative activities with potential for disruptive breakthroughs
- Provide exciting hands-on work for students and new employees





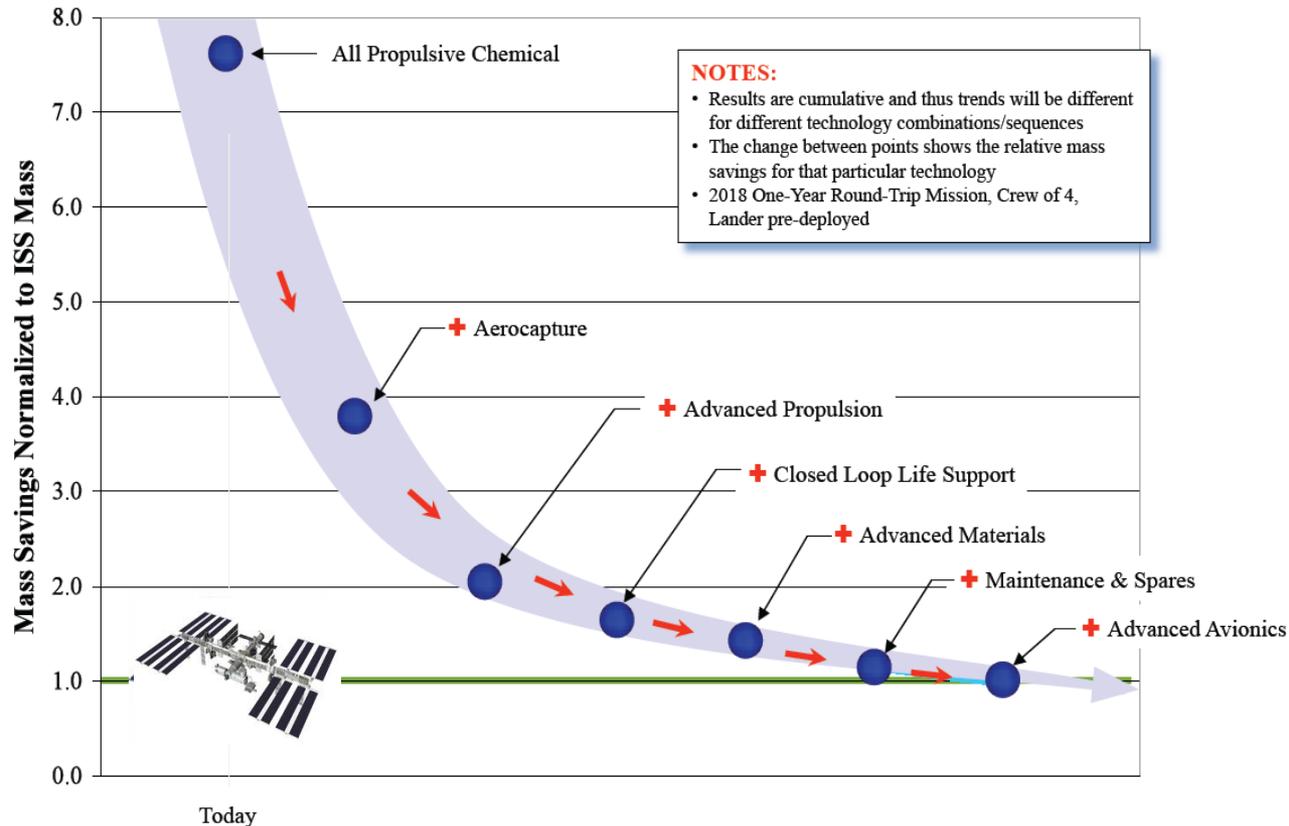
Attributes of a Reinvigorated Innovation and Technology Program

- **ISS Utilization Extended, likely to 2020 or beyond***
 - Implement priorities of Life and Physical Sciences community
 - Fully utilize ISS as a test bed for exploration, science and technology advances
 - Fundamental and applied research to improve crew health and performance for long-duration missions and development of countermeasures for microgravity effects
 - Promote the use of ISS as a National Laboratory by a variety of government and non-government organizations for the conduct of research across an array of science and engineering disciplines, some of which is anticipated to have terrestrial applications.
- **Early Stage Innovation and Game-Changing Technology**
 - An emphasis on non-mission-focused innovation and technology development
- **Expanded Commercial Sector Engagement**
 - NACA-like approach to developing investment strategy and partnerships to open long-term commercial markets
- **NASA Innovation Applied to Broader National Needs**
 - Leverage NASA capabilities and technology for applications in energy, weather and climate, Earth science, health and wellness, and National security
- **Technology Innovation for Flexible Human Exploration Capabilities***
 - Provide critical capabilities needed to implement various options examined by the Augustine Committee to extend human presence beyond low Earth orbit
- **Precursor Demonstrations and Flight Testing***
 - Demonstrate prototype systems and key capabilities on international robotic missions to reduce risk for future human exploration and more ambitious science missions

*Technology elements within NASA's mission directorates are not detailed in this presentation 4



Human Mars Exploration



- Without technology investments, the mass required to initiate a human Mars mission in LEO is approximately eight times the mass of the International Space Station
- Technology investments of the type proposed in the FY 2011 budget are required to put such a mission within reach



NASA Space Technology Foundational Principles

- The Space Technology Program shall advance non-mission-focused technology currently at low-to-mid Technology Readiness Levels (TRLs), in some cases to flight-ready status.
- The Space Technology Program shall meet the Nation's needs for new technologies to support future NASA missions in science and exploration, as well as the needs of other government agencies and the Nation's space industry in a manner similar to the way NACA aided the early aeronautics industry. There shall be multiple customers for Space Technology program products.
- The Space Technology Program shall employ a portfolio approach to innovation that ensures opportunities for technology investment and maturation over the entire TRL spectrum.
- The Space Technology Program shall sponsor research in academia, industry, and NASA field Centers based on the quality of research proposed at those institutions and in a manner that supports competition and balance.



NASA Space Technology Program Elements

TRL

1

2

3

4

5

6

7

Early-Stage Innovation

- System Concepts and Analyses
- Foundational Disciplinary Advances
- Technology Enablers
- Benefits/Feasibility Assessments

Game-Changing Technology

- New Capabilities
(Systems & Subsystems, Not Components)
- Large Scale
- Quantitative Performance
- Hardware Validation
- Risk Results in Moderate Failure Rate

Crosscutting Capability Demo.

- Relevant Environment Testing
- 7120 Flight Processes
- Not Mission Specific Technology
- 25% Cost Share Req. for Flight Tests

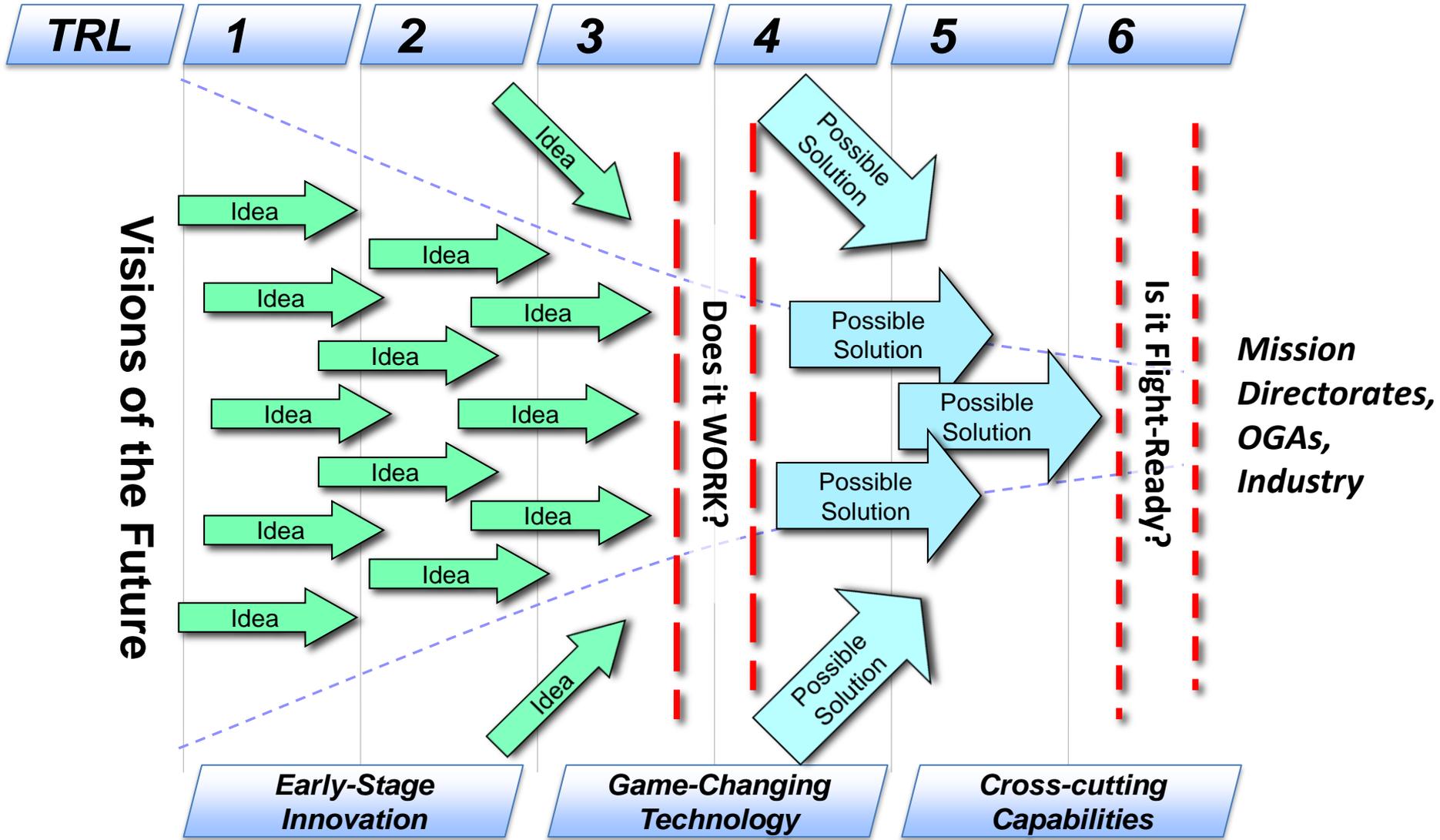


NASA Space Technology Program Elements

- 1) Early-Stage Innovation:** Creative ideas regarding future NASA systems and/or solutions to national needs. *Includes Space Technology Graduate Fellowship program.*
- 2) Game Changing Technology:** Prove feasibility of novel, early-stage idea that has potential to revolutionize a future NASA mission and/or fulfill national need.
- 3) Crosscutting Capability Demonstration:** Maturation to flight readiness of cross-cutting capabilities that advance multiple future space missions, including flight test projects where in-space demonstration is needed before the capability can transition to direct mission application.



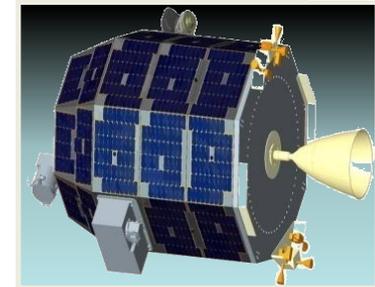
NASA Space Technology Program





New Exploration Research & Development Activities

- Exploration Technology and Demonstrations
 - *Develop and demonstrate technologies to reduce costs and expand capabilities for future exploration*
- Heavy-Lift and Propulsion Technology
 - *Research and development of new cost-effective propulsion systems, engines, LV materials, etc.*
- Exploration Precursor Robotic Missions
 - *Scout exploration targets, identify hazards and resources for human visitation and habitation*





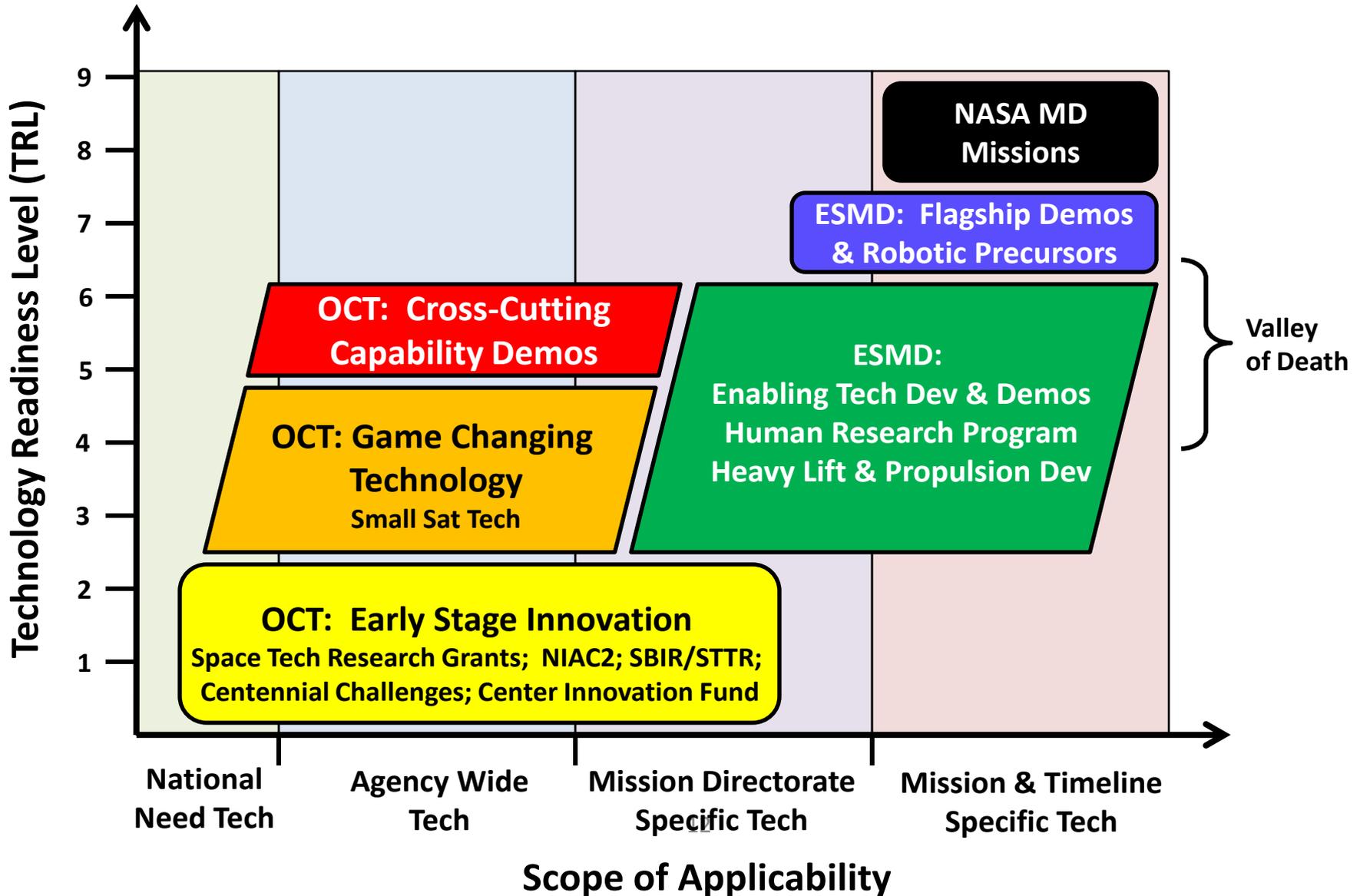
ESMD Flagship Technology Demonstrations - Approach

- Evaluation underway of highest leverage demonstrations; Mars destination is a driving case for high leverage demonstration and technology
- First three primary technology targets for single or combined missions to include:
 - In-orbit propellant transfer and storage
 - Lightweight/inflatable modules
 - Automated/autonomous rendezvous and docking
- Fourth flight program such as
 - Aerocapture/entry, descent and landing
 - Advanced life support
 - Advanced in-space propulsion (ion/plasma, etc)
- Initiate four technology demonstrations in FY2011
- Follow-on demonstrations informed by emerging technologies
- Identify potential partnerships with industry, other agencies, and international partners and leverage ISS for technology demonstrations, as appropriate





NASA Technology Program Elements





Summary

NASA as a Major Component of our Nation's Innovation Engine:

- America's economic competitiveness and high standard of living are based on decades of investment in innovation
- Investment in innovation in NASA communities will drive a sustainable, yet aggressive, future mission portfolio
- Innovative research and technology, tied to exciting missions with national importance, is a strong motivator for students in STEM disciplines, and a strong attraction for new hires
- This investment will also allow NASA to participate in the development of technological solutions addressing broader National needs in energy, weather & climate, Earth science, health & wellness, and National security
- NASA's focus on innovation and technology will:
 - Be responsive to Augustine and NRC input
 - Position NASA for human exploration beyond low earth orbit
 - Be highly engaging of our academic and industrial partners, and the emerging commercial space sector
 - Leverage efforts of other government agencies and international partners
 - Result in new inventions, new capabilities and creation of a pipeline of innovators trained to serve future national needs



NASA Space Technology Program

Space Technology Program Element	Early-Stage Innovation	Game-Changing Technology	Crosscutting Capability Demonstrations
Development Stage	Concept Validation (TRL 1-2)	Tech Demonstration (TRL 3-4/5)	System Qualification (TRL 6)
Number of Projects	100+	10-20	3-8
Typical Project Cost	\$50K-\$800K	\$45M (2 years) \$75M (3 years)	\$150M from STP
Project Duration	6 months – 2 years	2 yrs w/potential 1 yr extension	< 3 years
Programs	Space Tech Research Grants	Open Calls and Calls in Specific Technical Areas	Opportunities Coordinated with Funding Partners
	NIAC2		
	Center Innovation Fund		
	SBIR/STTR		
	Centennial Challenges		
Performer Selection	Competed	> 70% Competed	> 70% Competed
Typical Performers	Academia, NASA, Industry	NASA, Federal Labs, Industry, Academia	Industry, NASA
Funding/Partnership Mechanisms	Grants, Contracts, Cooperative Agreements, Prize Competitions	Grants, Contracts, Cooperative Agreements, Space Act Agreements	Contracts, Space Act Agreements
Cost-Sharing	Encouraged	Preferred	Required, 25% minimum
Partners	Academia Federal: NASA MDs, DARPA, DOD, DOE, NOAA, NSF, Other Industry: Aerospace, Non-Aerospace International Partners		