National Aeronautics and Space Administration

A New Space Exploration Enterprise

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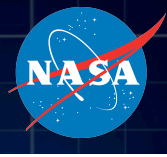
May 25, 2010

Disclaimer



This chart set was presented by Doug Cooke, Associate Administrator for NASA's Exploration Systems Mission Directorate on May 25, 2010 at the NASA Exploration Enterprise Workshop held in Galveston, TX. The purpose of this workshop was to present NASA's initial plans for the potential programs announced in the FY2011 Budget Request to industry, academia, and other NASA colleagues. Engaging outside organizations allows NASA to make informed decisions as program objectives and expectations are established.

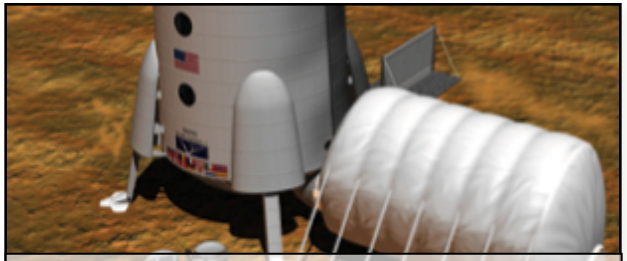
Contained within these charts is verification that the fundamental goals of Human Space Exploration remain the same, an outline of the new path for Human Space Exploration, and an explanation of the destinations that NASA is considering. Mr. Cooke discusses the value of investing in the identified technologies and how NASA plans to use a phased development strategy to eventually achieve sustainable human exploration of the solar system.

The charts go on to present an overview of the study team "point of departure plans", which describe at a high level where the planning is at this moment within the study teams as they work to define the proposed programs' objectives, and how each of those plans will fit into the Human Exploration Framework that is being developed.

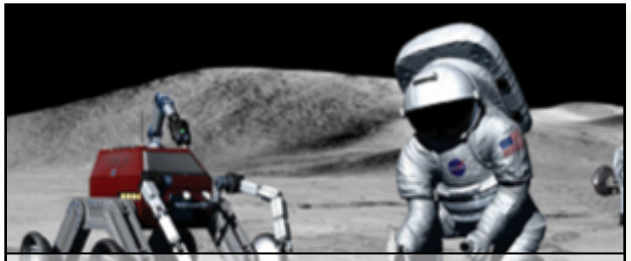
The presentation concludes with a discussion about the potential programs center assignments, how NASA regards international cooperation as essential to achieving the new direction, and the near term next steps for continuing to develop program and budget plans through the Fall.

DISCLAIMER: The following charts represent at "point of departure" which will continue to be refined throughout the summer and the coming years. They capture the results of planning activities as of the May 25, 2010 date, but are in no way meant to represent final plans. In fact, not all proposed missions and investments fit in the budget at this time. They provide a starting point for engagement with outside organizations (international, industry, academia, and other Government Agencies). Any specific launch dates and missions are likely to change to reflect the addition of Orion Emergency Rescue Vehicle, updated priorities, and new information from NASA's space partners.

Human Space Exploration Themes Remain the Same



A Sustained Presence - Extending Human Frontiers



New Knowledge in Science and Technology

Economic Expansion

Global Partnerships

Inspiration and Education

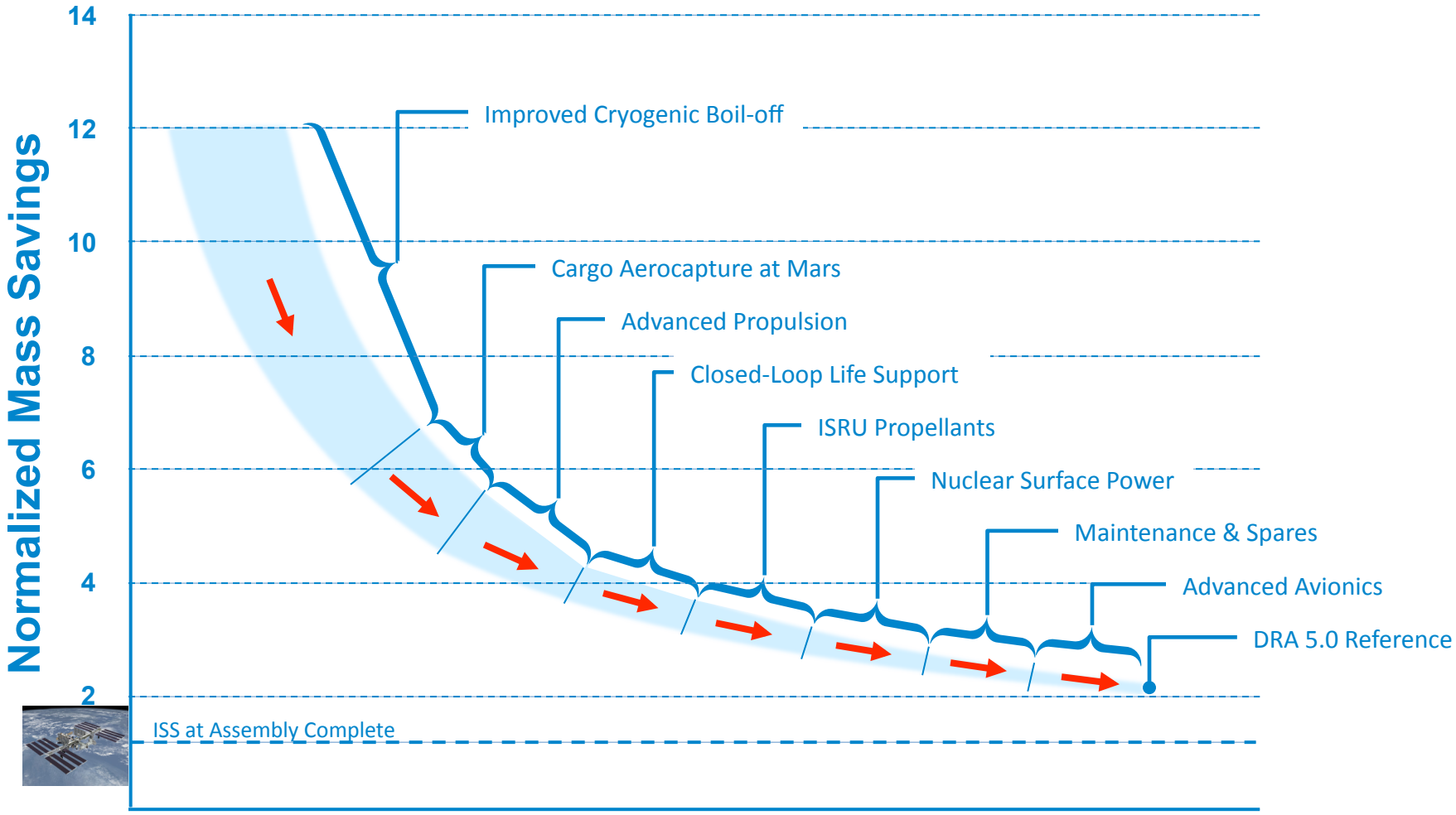
The New Path for Human Space Exploration

- **The FY 2011 budget request challenges NASA to embark on a new human space exploration program that is sustainable and affordable**
- **The budget request balances investments in future human spaceflight systems with obtaining key knowledge about future destinations and demonstrating critical enabling technologies for human spaceflight and exploration, including:**
  - Research & development of heavy-lift and propulsion engines and other key technologies
  - Technology development and demonstrations to reduce cost and prove required capabilities for future human exploration
  - Precursor robotic missions to multiple destinations to cost- effectively scout human exploration targets and identify hazards and resources for future human exploration
  - Increased investment in Human Research to prepare for long journeys beyond Earth
  - Expanded efforts to develop U.S. commercial human spaceflight capabilities, making space travel more accessible and affordable
- **The President's FY2011 budget will continue the development of the human crew capsule, an Orion-derived vehicle that will serve as an emergency return vehicle from ISS, and will be part of the technological foundation for advanced spacecraft to be used in future deep space missions**

What is the Destination?

- **The future human space flight program will build through a steady sequence of achievements, from a set of crewed flights to test and prove systems required for exploration beyond LEO orbit early in the next decade, to a near-Earth object mission in 2025, to missions to Mars' environs by mid-2030s, followed by landing on Mars**
- **This approach builds experience and capability through time, results in successive "firsts" (much like the Mercury and Gemini approach) and allows the human spaceflight systems to be developed serially rather than concurrently, making the endeavor affordable to the tax-payer**
- **Although we cannot provide a date with certainty for the first human landing on Mars, we can identify essential capabilities needed for such a mission. These are reflected in the programs within this budget request.**
  - They are capabilities that have been recommended consistently for over two decades in national level reports of committees and commissions addressing future human space exploration
  - They are the near-term steps NASA must take to create the new knowledge and capabilities required for humans to venture beyond low-Earth orbit (LEO) to stay

The Value of Technology Investments
Mars Mission Example



- Without technology investments, the mass required to initiate a human Mars mission in LEO is approximately twelve times the mass of the International Space Station (ISS)
- Technology investments of the type proposed in the FY2011 budget request are required to put such a mission within reach

Phased Development Strategy

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026

Phase I
Build the Foundation

Commercial Sector, Robotic Precursors, and Game-Changing Technology Development

Phase II
Systems Development

Design and Development of Heavy-Lift and In-space capabilities

Phase III
Sustainable Exploration of the Solar System

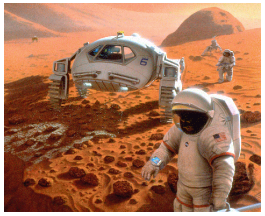
Human Exploration Missions to Solar System Destinations

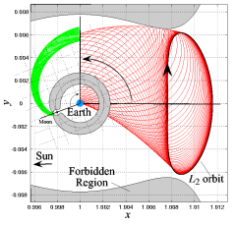
Strategy for Future Human Missions

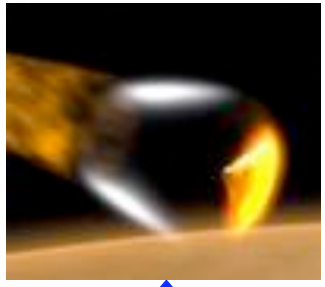
Potential Destinations

Mission Analyses

Common Capabilities







Systems Design

Technology Building Blocks

- Efficient In-Space P
- Aerocapture
- Low-cost Engines
- Cryo Fluid M
- Robust/Efficient P
- Lightweight S
- Radiation Research
- Zero/Low-g Research
- Regenerable Life S
- Advanced Lightweight EVA

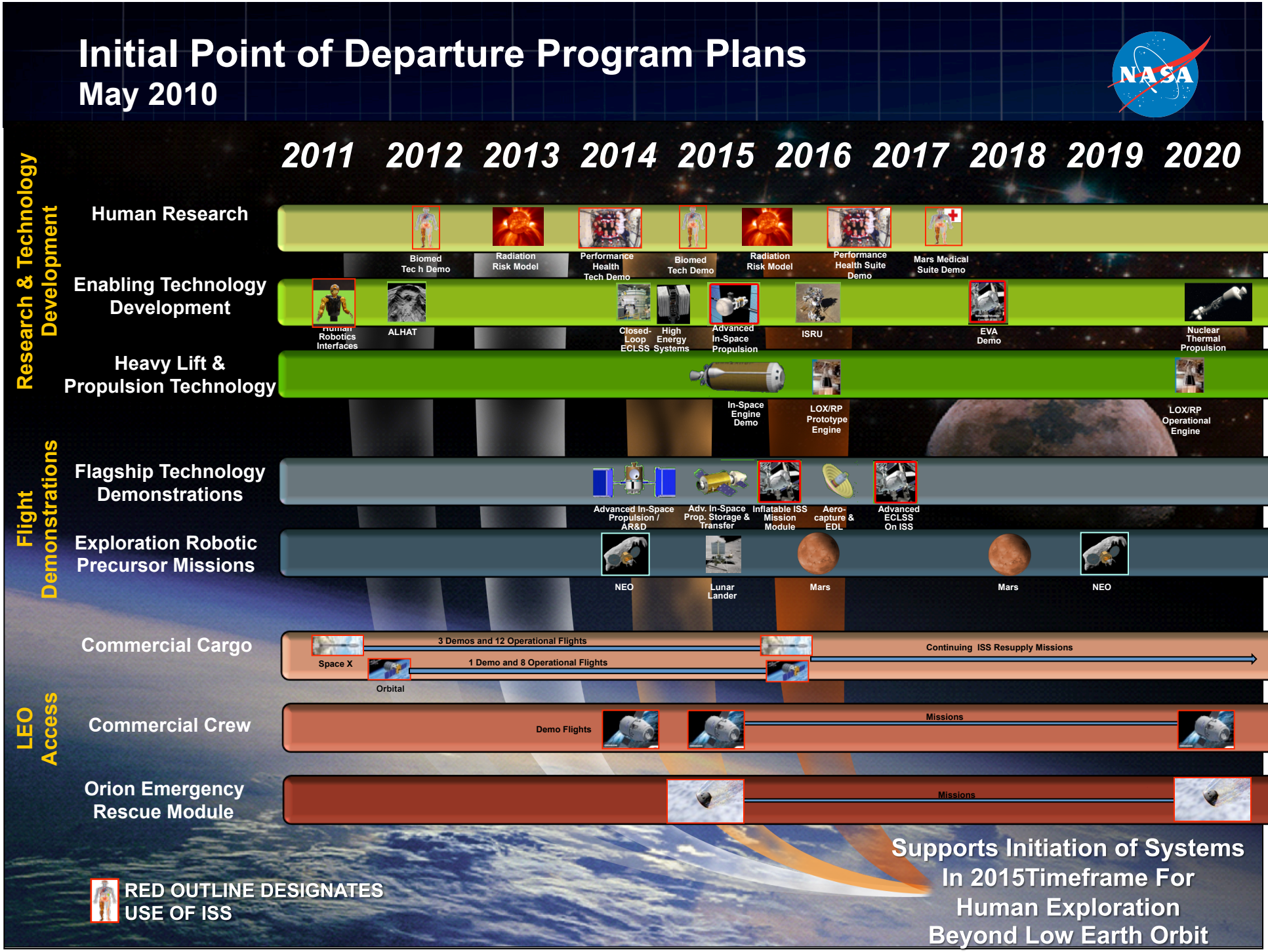
"Breakthrough" Technologies

- Hypersonic Inflatable aeroshell
- Regenerative A
- Revolutionary ETO Rockets
- Innovative Mission Concepts

ESMD "Point of Departure" Solutions

- **NASA has established initial plans for the programs announced in the FY2011 Budget Request**
  - A "point of departure" and will continue to be refined
  - Captures results of planning activities to date
  - Proposed missions and investments do not necessarily all fit in budget at this time
- **Allows NASA to make informed decisions and establish program objectives and expectations**
  - Provides a starting point for engagement with outside organizations (international, industry, academia, and other Government Agencies)
  - Determine capabilities needed and identify technology development and demonstration cost, schedule and associated risks
  - Enables high level integration across programs to develop full framework of future human exploration
  - Specific launch dates and missions are likely to change to reflect the addition of Orion Emergency Rescue Vehicle, updated priorities, and new information from NASA's space partners

Initial Point of Departure Program Plans
May 2010



Human Exploration Framework Team (HEFT) Charter

- **Mission:** The HEFT team is responsible for creating an evolvable decision framework for our Human Space Exploration Enterprise that drives out the knowledge, capabilities and infrastructure NASA needs to send people to explore multiple destinations in the Solar System in an efficient, sustainable way.

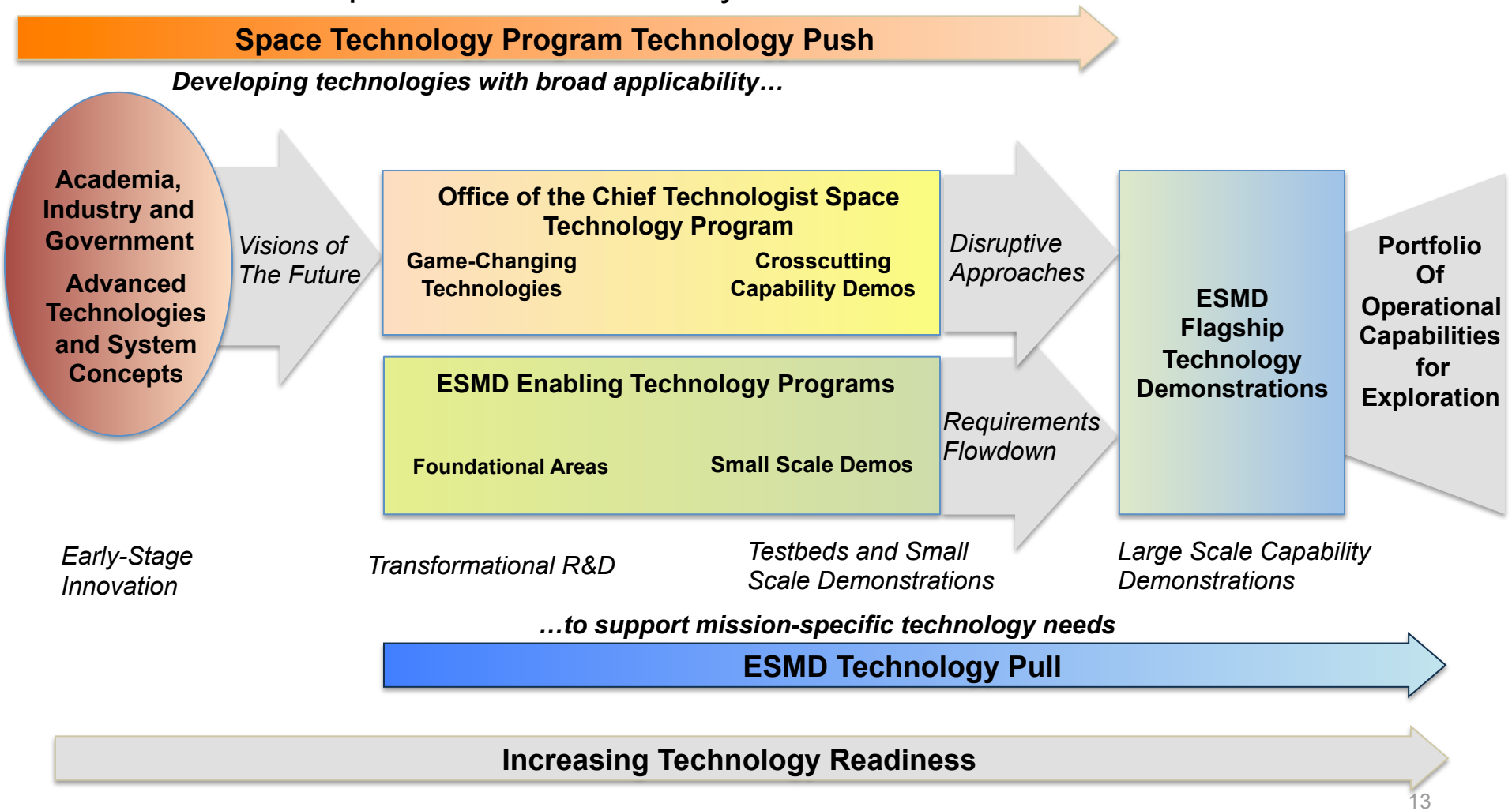
- **Objectives**
  - The initial HEFT activity will focus on standing up the organizational structure, getting it functioning, and conducting a first full iteration of the process
  - Near-term outcome of the process will be a suite of investment strategies and recommendations for human spaceflight capabilities and missions for 5, 10, and 15 year horizons, keeping Mars as the ultimate destination in mind
  - Impact the FY2012 Budget planning and budgeting process
    - Proposal must (and will) fit within NASA's space flight budget profile
    - Potential to influence the FY2011 budget priorities

HEFT Deliverables

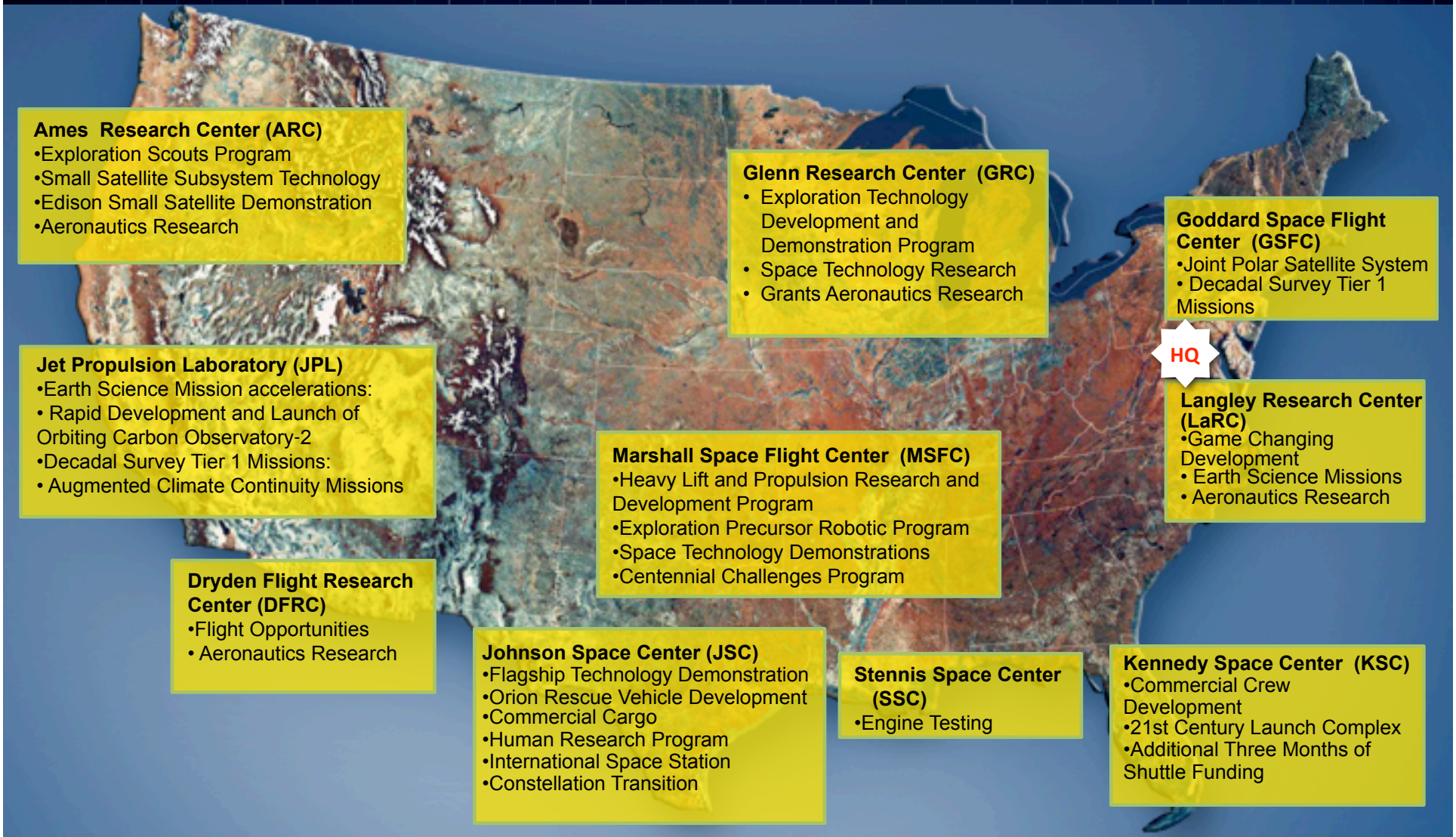
- Establish set of critical Stakeholders, capture their objectives
- Objectives and Constraints that explicitly address Stakeholder concerns and related FOMs
- Establish Foundational Architecting Guidelines and investment strategies that guide the following:
  - Smart Set of Design Reference Missions that supports key knowledge and capabilities needed for humans to explore space
  - Advanced Systems Maturation Roadmaps and Development Data including cost, schedule, technology requirements, phasing plans, performance milestones and demonstration targets, etc.
  - Flight Mission Designs including outlining program scenarios with rationale, specific mission plans, sequencing of missions, series of human spaceflight missions, with objectives of each, phasing plan, etc.
- Evaluation of portfolios in the investment strategies utilizing FOMs
- Tailored communications products for Steering Council and key Stakeholders, articulating key impacts of Objectives, Foundational Guidelines and Concepts

NASA's Integrated Technology Programs

- A portfolio of technology investments which will enable new approaches to NASA's current mission set and allow the Agency to pursue entirely new missions of exploration and discovery.



Proposed Agency-wide Program Center Assignments



Ames Research Center (ARC)
- Exploration Scouts Program
- Small Satellite Subsystem Technology
- Edison Small Satellite Demonstration
- Aeronautics Research

Glenn Research Center (GRC)
- Exploration Technology Development and Demonstration Program
- Space Technology Research
- Grants Aeronautics Research

Goddard Space Flight Center (GSFC)
- Joint Polar Satellite System
- Decadal Survey Tier 1 Missions

HQ

Jet Propulsion Laboratory (JPL)
- Earth Science Mission accelerations:
- Rapid Development and Launch of Orbiting Carbon Observatory-2
- Decadal Survey Tier 1 Missions:
- Augmented Climate Continuity Missions

Langley Research Center (LaRC)
- Game Changing Development
- Earth Science Missions
- Aeronautics Research

Marshall Space Flight Center (MSFC)
- Heavy Lift and Propulsion Research and Development Program
- Exploration Precursor Robotic Program
- Space Technology Demonstrations
- Centennial Challenges Program

Dryden Flight Research Center (DFRC)
- Flight Opportunities
- Aeronautics Research

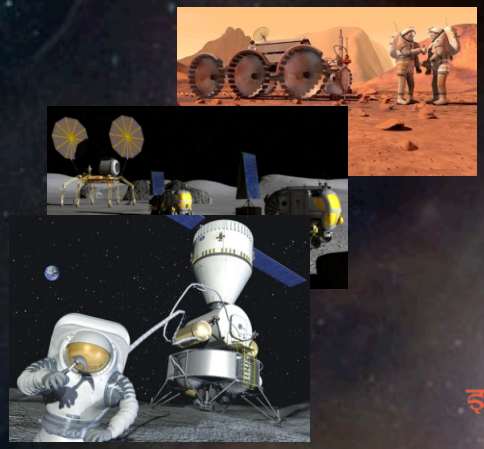
Johnson Space Center (JSC)
- Flagship Technology Demonstration
- Orion Rescue Vehicle Development
- Commercial Cargo
- Human Research Program
- International Space Station
- Constellation Transition

Stennis Space Center (SSC)
- Engine Testing

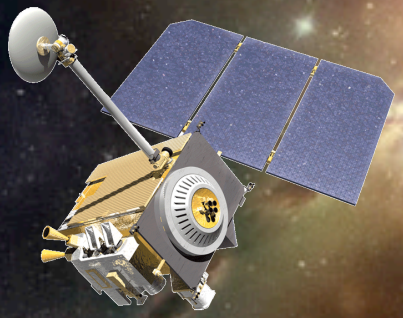
Kennedy Space Center (KSC)
- Commercial Crew Development
- 21st Century Launch Complex
- Additional Three Months of Shuttle Funding

Near Term Partnerships that Contribute to Long Term Vision

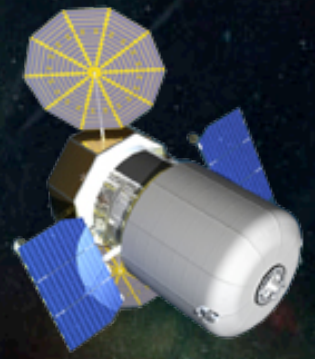
A Global Exploration Roadmap



Leveraging Investments in Technologies



Robotic Precursor Missions



Flagship Technology Demonstration Missions

International Cooperation is Essential

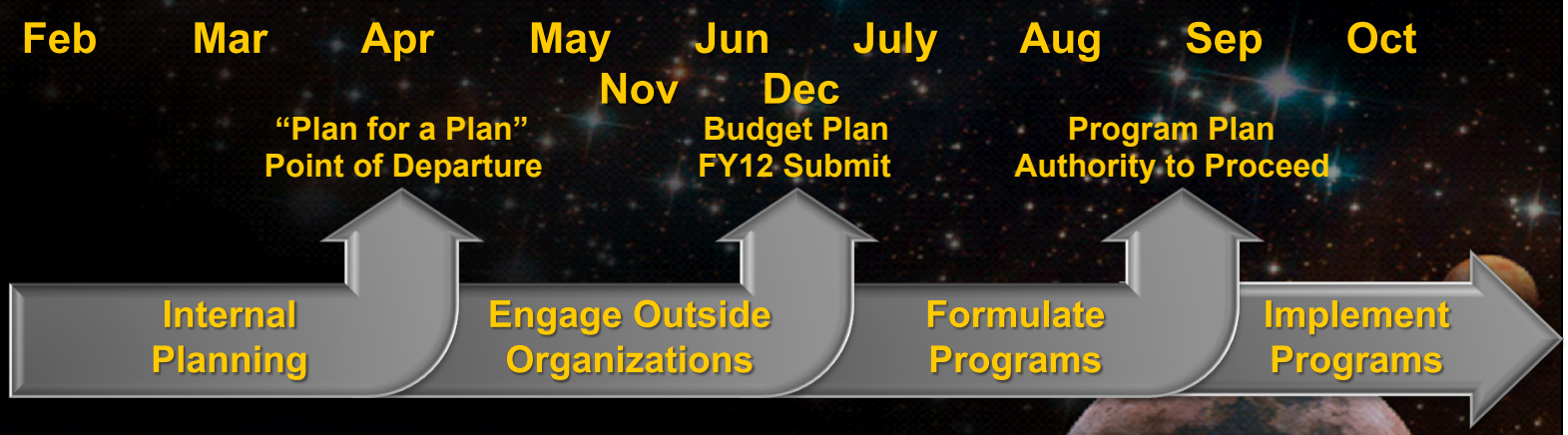
- NASA is committed to engaging international partners to build a sustainable and affordable human space exploration enterprise capable of exploring deep space destinations such as NEOs, the moon, Mars and its environs

- We will work with our partners through ISECG to develop a common long term vision of how we will explore our solar system
  - Advancing the Global Exploration Strategy
  - A meeting of senior agency management of the International Space Exploration Coordination Group (ISECG) will be held June 23, 2010 (Washington)

- We seek near-term partnerships that enable a shared long term vision.

  Near-term activities may include:
  - Pursuing opportunities to leverage our technology development and demonstration investments including using ISS, free flying Flagship missions, terrestrial analog environments
  - Pursuing opportunities for collaboration in exploration robotic precursor missions

Next Steps



- **First Phase of Internal Studies Complete**
- **Beginning Next Phase, Engaging with Larger Audience**
  - Addressing open trades on the point of departure solution, incorporating OERM and updating budget guidance
  - Use workshops, RFIs, BAAs for ideas and concept from industry, academia, other partners
- **Continue Developing Program and Budget Plans Through Fall**
- **With Congressional Approval, Begin Execution with the New Fiscal Year**

ESMD: Blazing a Trail Into the Solar System

- NASA's human spaceflight program seeks to extend human presence throughout the solar system
- The President's FY2011 Budget Request takes a new approach to this goal, focusing on capabilities that will allow us to reach multiple destinations, including the Moon, Asteroids, Lagrange points, and Mars and its moons
- The investments seek to create the new *knowledge* and *capabilities* required for humans to venture beyond low Earth orbit to stay
- Approach expands alternatives available for human exploration, currently limited by lack of strategic investment in technology development over past decades

www.nasa.gov/exploration
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