

ADVANCING SPACE TECHNOLOGY
Through the Double Hourglass

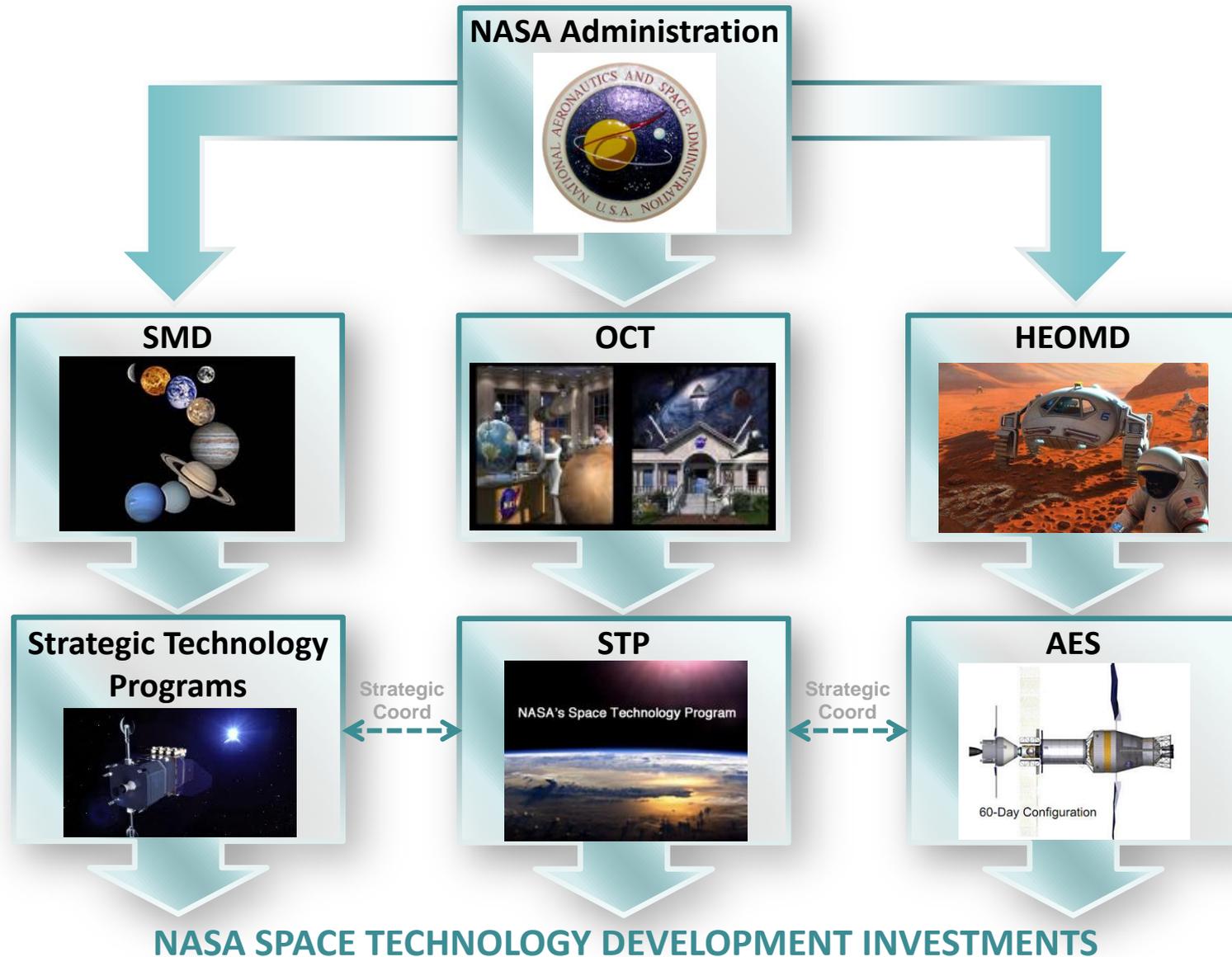
Ron Litchford

Principal Investigator
NASA OCT/STP/GCD

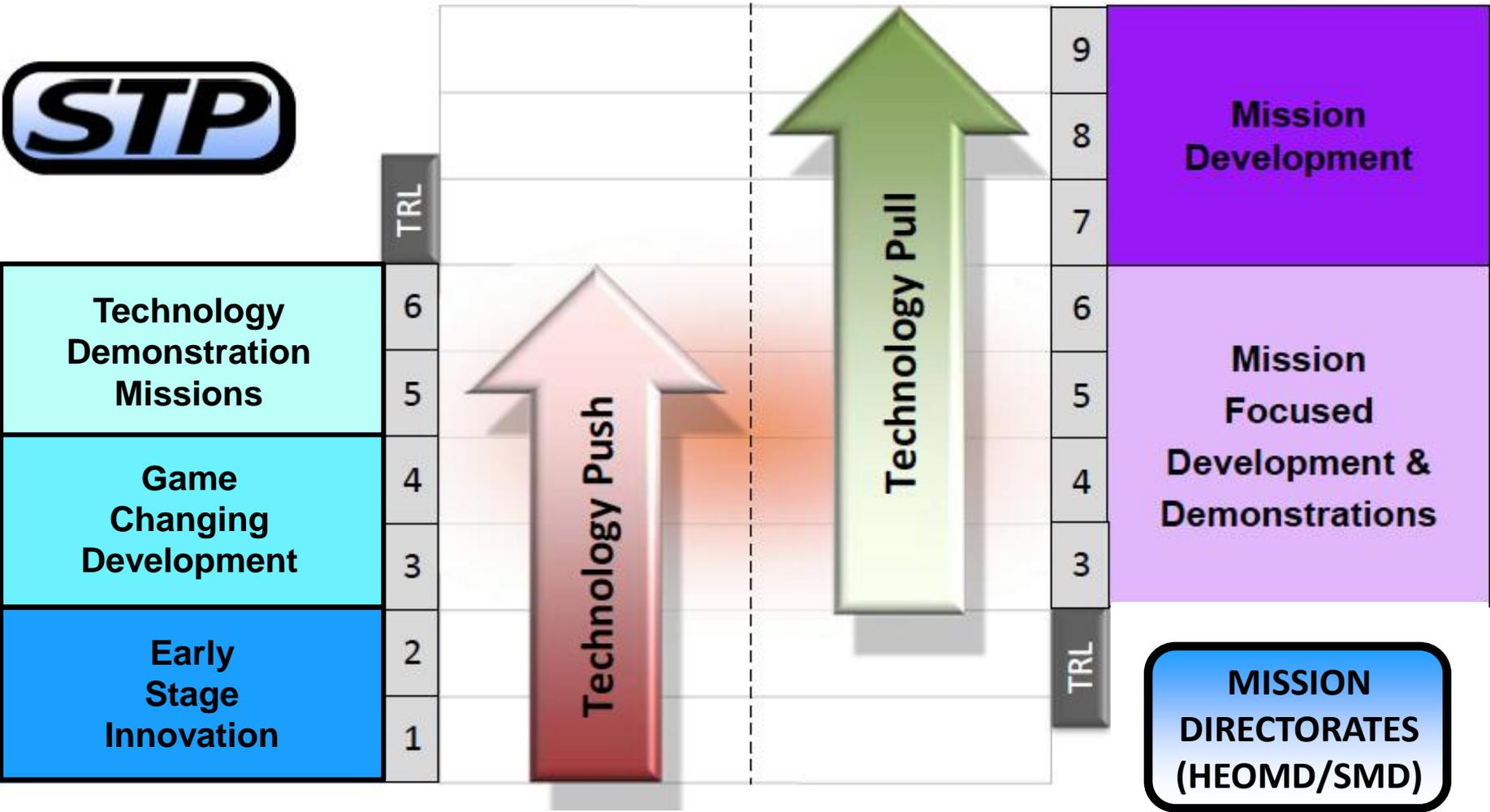
19th Advanced Space Propulsion Workshop
November 2012



NASA Space Technology Development Programs



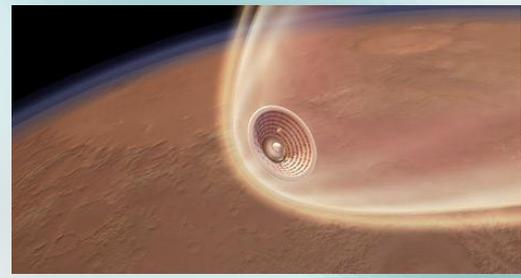
Technology Development Push-Pull Dynamics



MISSION DIRECTORATES (HEOMD/SMD)



Space Technology Program (STP) Overview



Game Changing Development (GCD) Program



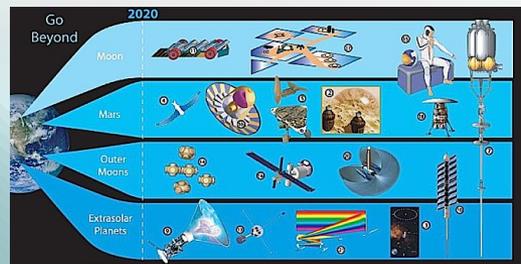
Technology Demonstration Mission (TDM) Program



Small Satellite Technology Program



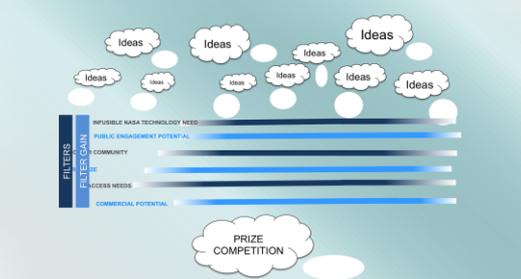
Space Technology Research Grant (STRG) Program



NASA Institute for Advanced Concepts (NIAC) Program



Center Innovation Fund (CIF) Program



Centennial Challenges Program



Small Business Innovative Research & Technology Transfer (SBIR/STTR) Programs

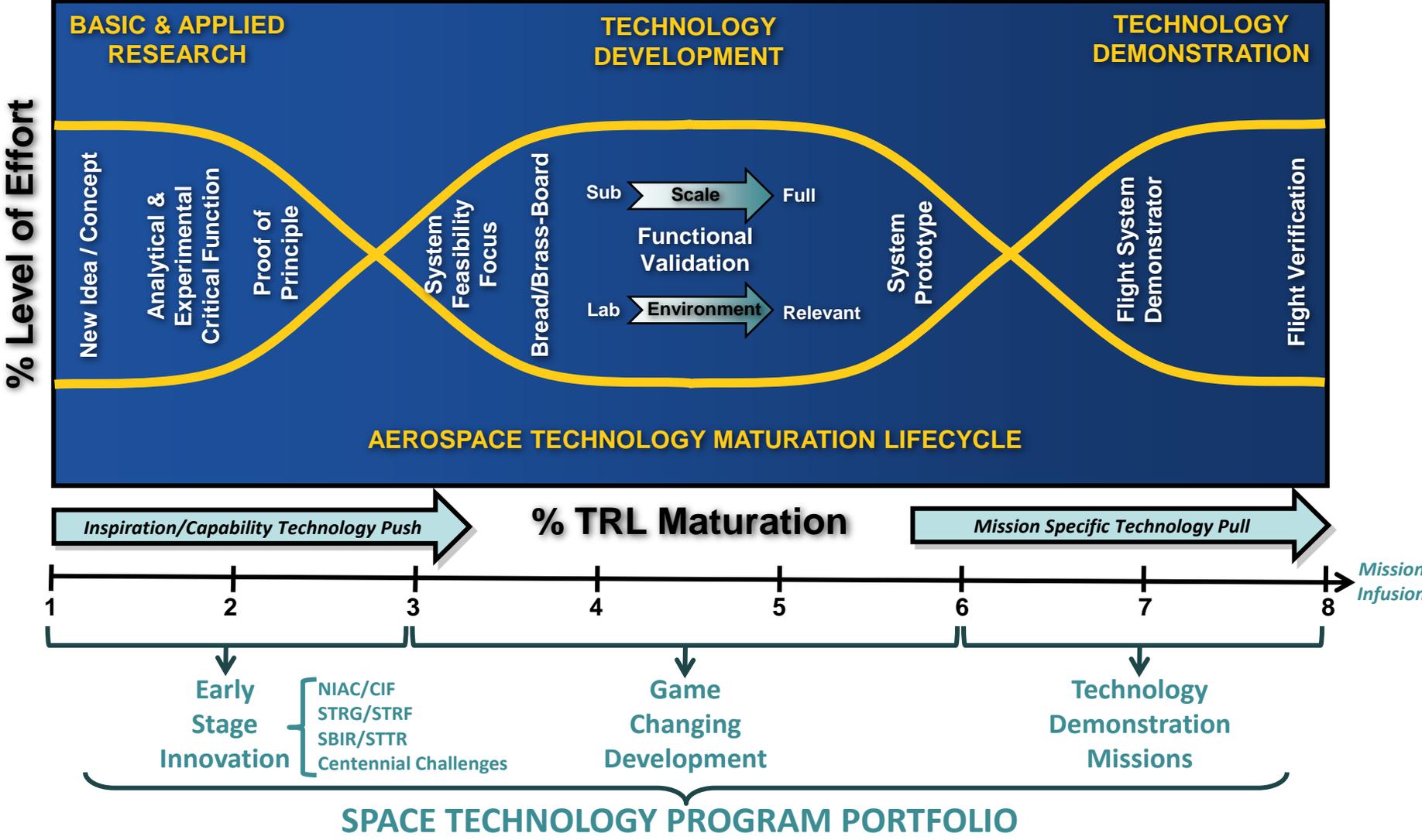


Flight Opportunities Program (FOP)

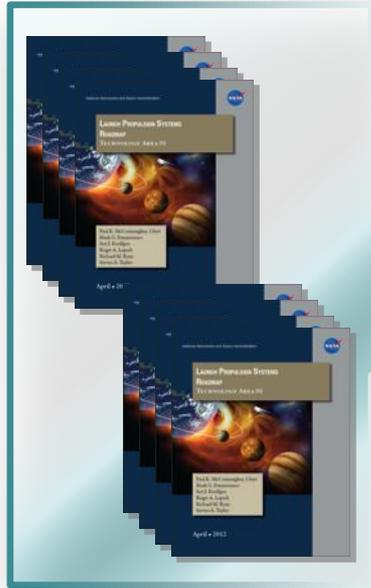


Aerospace Technology Maturation Lifecycle

Double Hourglass Transition & Infusion Model



Strategic Perspectives & Process



2010

Space Technology Roadmaps

Scope:

- 140 Challenges (10 per roadmap)
- 320 Technologies
- 20-Year Horizon

4-Year Revision Cycle



2011

National Research Council (NRC) Study

Prioritization:

- 100 Top Technical Challenges
- 83 High-Priority Technologies (roadmap-specific)
- 16 Top Technology Priorities (across all roadmaps)

4-Year Revision Cycle



2012

Strategic Space Technology Investment Plan (SSTIP)

Strategy:

- Incorporate NRC Study Results
- Consider Current Investments
- Consider Current MD Priorities
- Opportunities for Partnership
- Gaps vs. Budget and Capabilities
- 20-Year Horizon with 4-Year Implementation Cadence

2-Year Revision Cycle



Programmatic Execution

Investment:

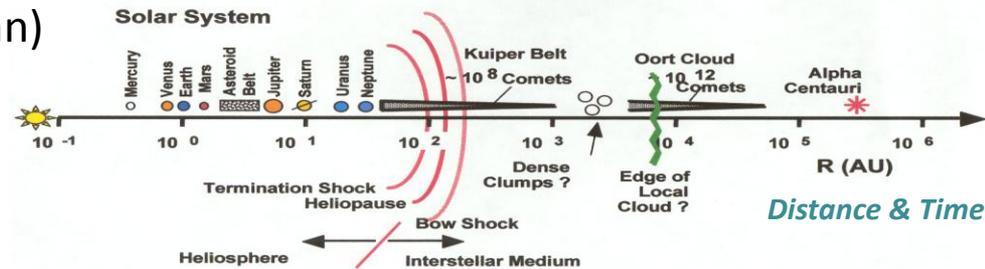
- Technology Development
- Flight Demonstrations
- Accommodations
 - Mission Needs
 - Push Opportunities
 - Affordability
 - Technical Progress
 - Programmatic Performance
 - Commitments

Budgeted Annually

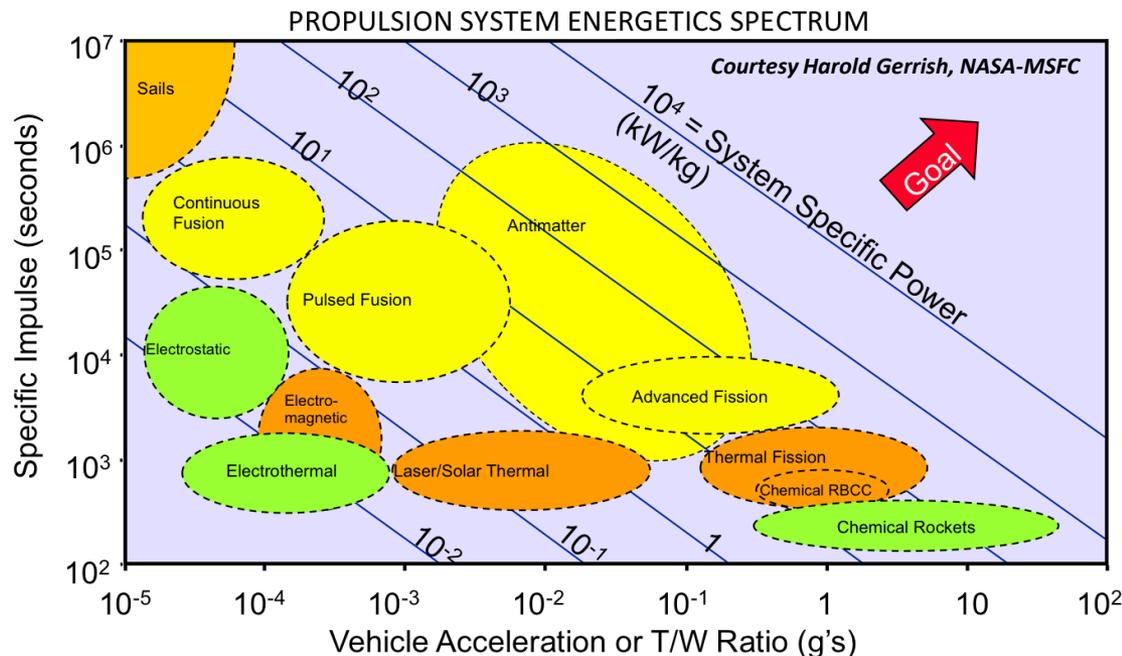
Deep Space Transportation Challenges

◆ Available Propulsion Technologies Limit Space Transportation Capability

- Key Enabler for More Ambitious Space Missions
- Larger Payloads (Science/Cargo/Human)
- Faster Trip Times



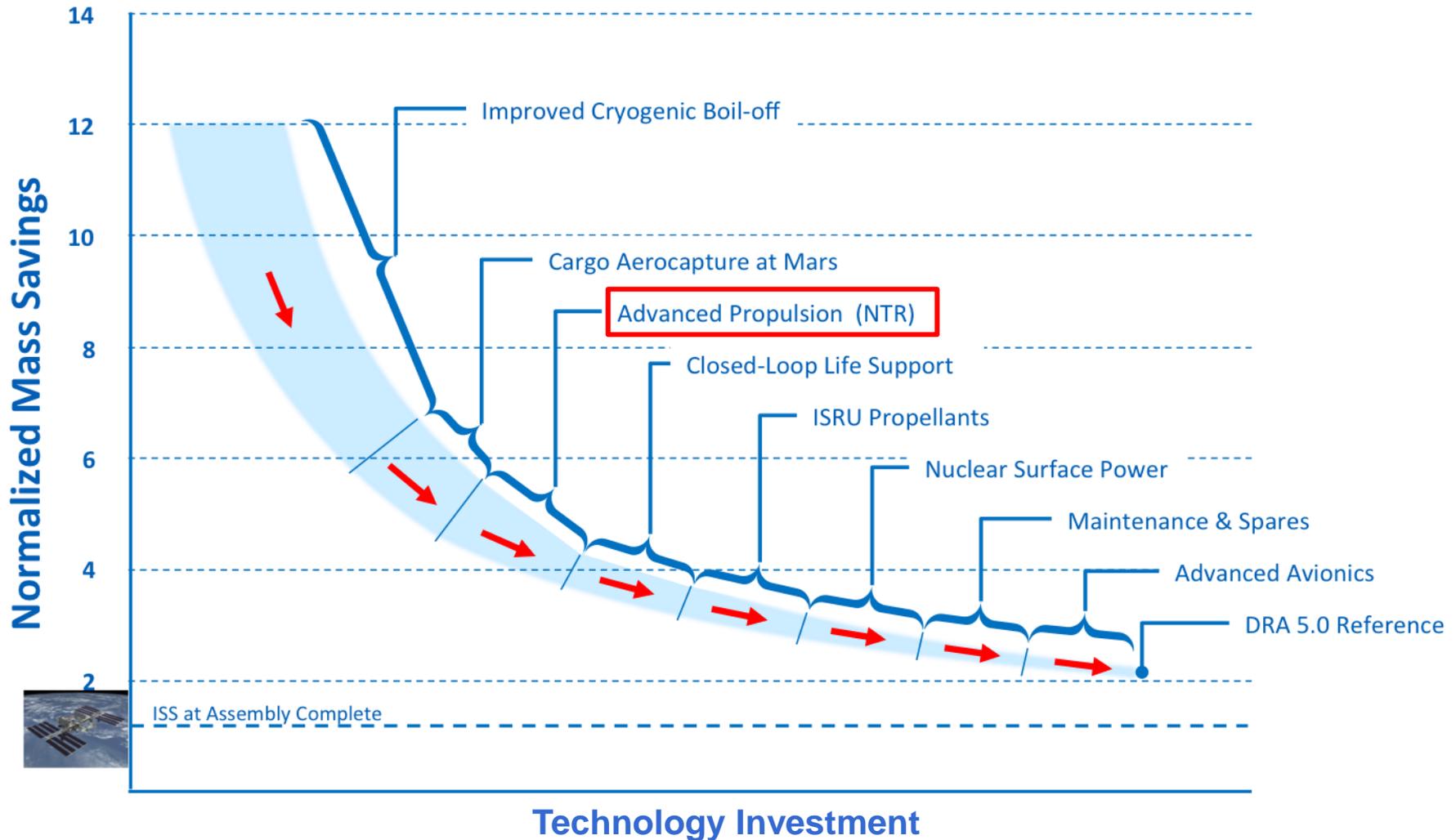
◆ Need Dramatic Extensions in Propulsion System Energy/Power Density



- Unproven Technology (TRL 1-3)
- Demonstrated Technology (TRL 4-6)
- Operational Systems (TRL 7-9)

Value of Technology Enhanced Mission Capabilities

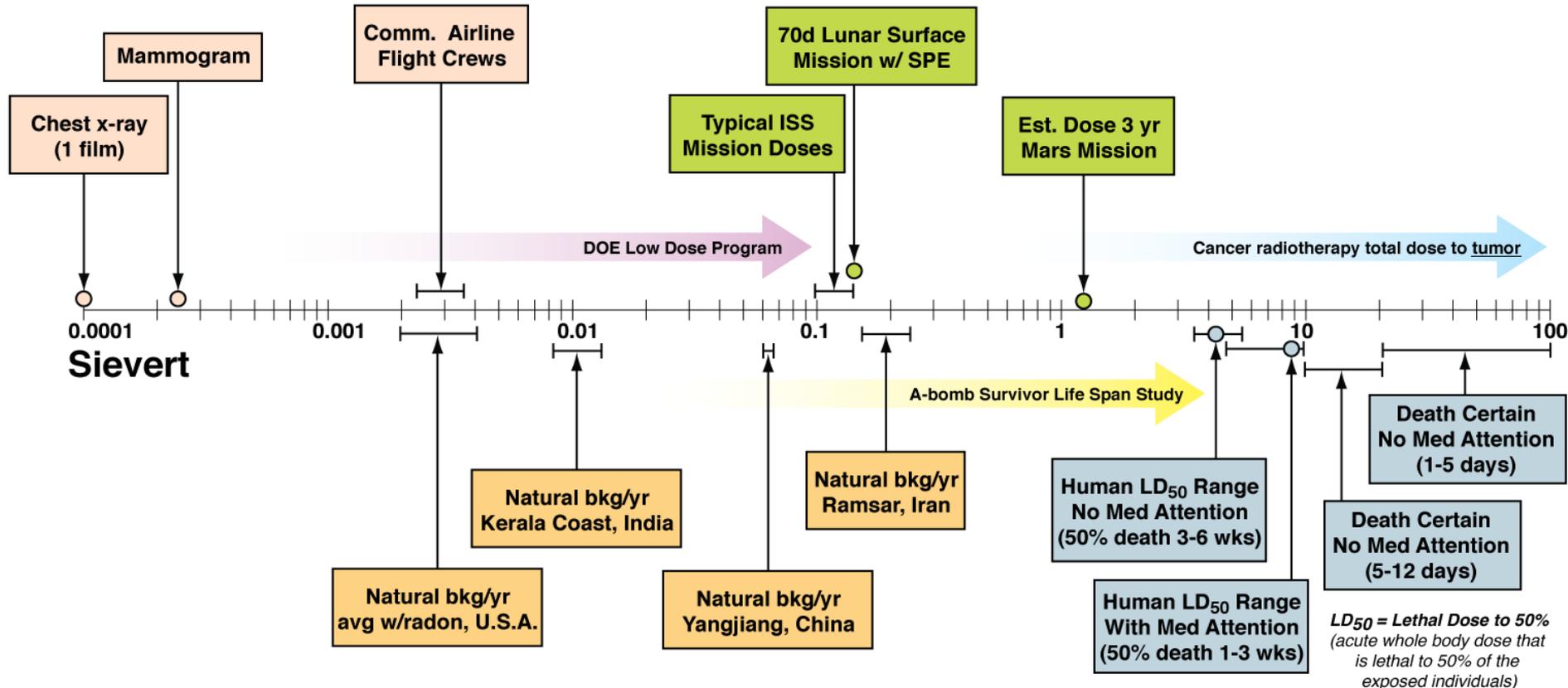
Design Reference Architecture 5.0: Systems/Operations for Human Exploration of Mars



Space Radiation Exposure Challenges

◆ Spectrum of Radiation Dosage Effects

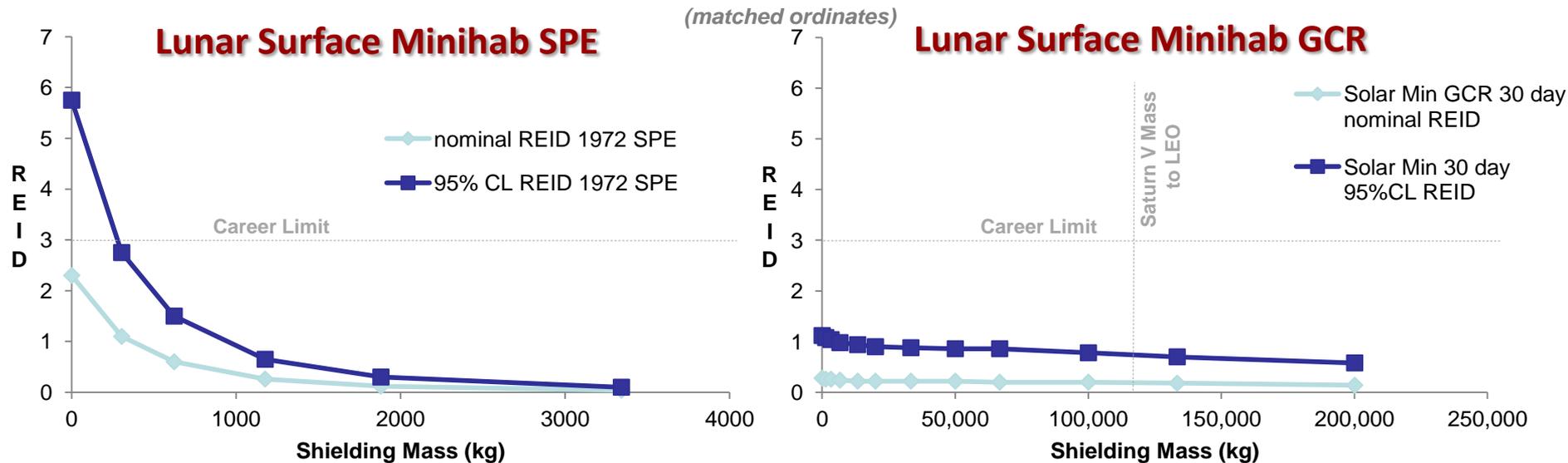
- Sievert Units: quantitatively evaluates biological effects of ionizing radiation
- Gray Units: quantitatively measurement of absorbed dose of radiation energy
- Space radiation sources: Solar Proton Events (SPE) & Galactic Cosmic Radiation (GCR)
- LEO exposure limited to 150 mSv (individual astronaut data protected under privacy act)
- Astronauts are getting cataracts earlier than terrestrial bound population



SPE/GCR Radiation Mitigation Challenges

◆ GCR is the “Tall Pole” for Human BEO Missions

- Career limit is 3% Risk of Excess Induced Death (REID) at 95% confidence interval
- Large SPE that occurred in 1972 was the Constellation design environment for human exposure
- Passive shielding is effective for SPE for reasonable amount of parasitic shielding mass
- Need enormous passive shielding mass to reduce GCR by large amounts (impractical up-mass requirements)
- Very large SPE’s might require crew descent to LEO or below



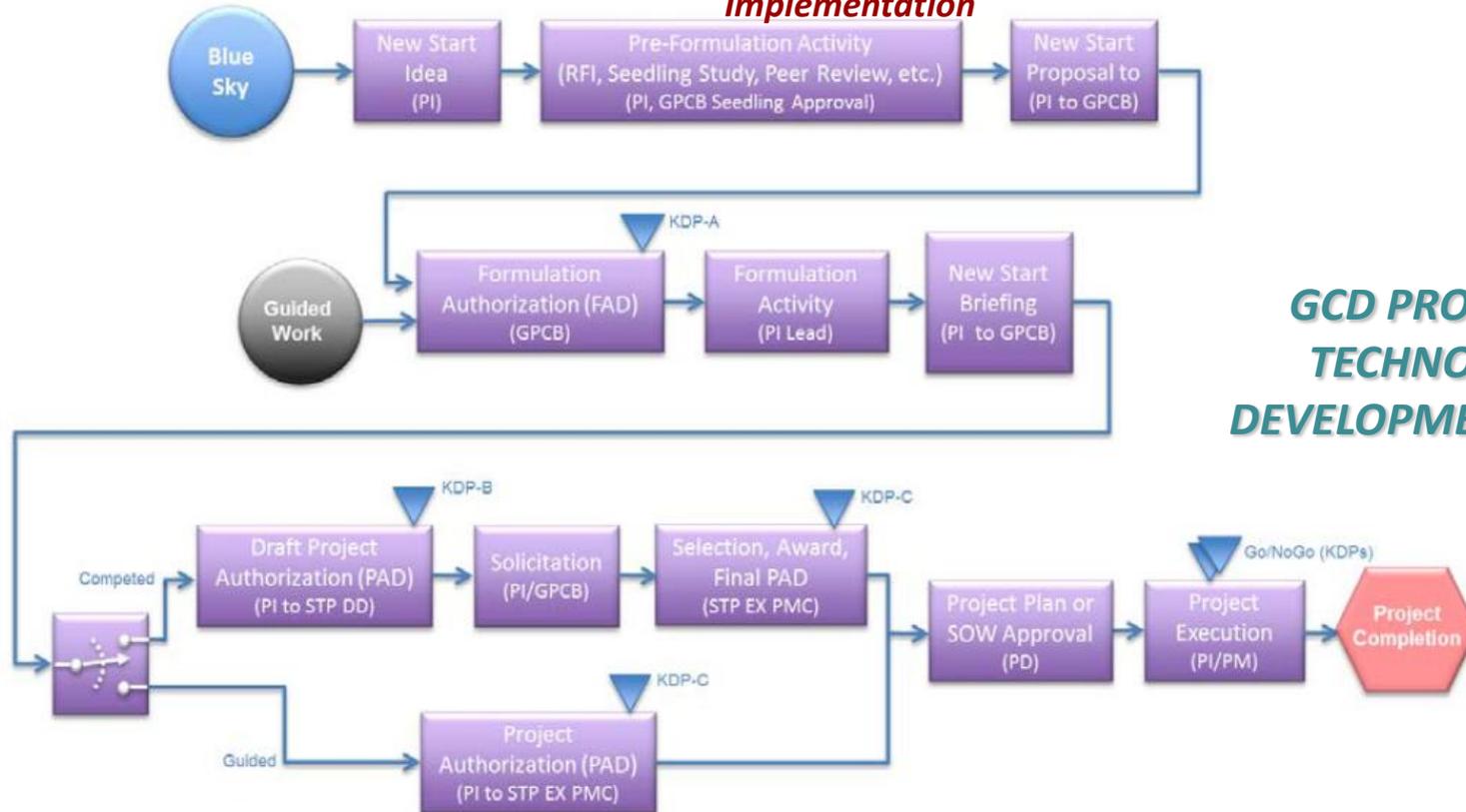
Internal Results from Lunar Architecture Trade Study

Towards an Advanced Space Propulsion Initiative

◆ GCD Advanced Space Propulsion Theme Pre-Formulation Activity

- Approved by GCD Program Control Board (GPCB-CR-00045, Sept. 2012)
- Utilize ASPW Workshop to Advise & Inform Formulation Development (Co-Sponsored by MSFC CT)
- Leverage GCD Sponsored FY2012 Advanced Space Propulsion Study Results
- Follow GCD Technology Development Flow Process / 6-Month Pre-Formulation Activity
- New Start Proposal Spring 2013

→ **Seeking Authority for FY14 Project Implementation**



**GCD PROGRAM
TECHNOLOGY
DEVELOPMENT FLOW**

Towards an Implementation Strategy

◆ Desired Project Characteristics

- Capability Driven Technology Push
 - NACA-Like
- Low-to-Mid TRL Transition
 - Critical Analytical & Experimental Function
 - Defined Forward Development Pathway
- Structured
 - Defined POP [2(+1)] / Schedule / Budget / Milestones / Authority / Accountability
 - Skunkworks-Like Focus & Execution
 - *“Technical Concept May Fail But Project Cannot Fail to Execute”*
- Competitive
 - Open Participation/Partnering
 - NASA Centers, OGA, Academia, Small & Large Business, Multinational
- Relevant
 - Addresses NASA & National Needs
 - *“Game Changing”*

REVOLUTIONARY

OBTAINABLE

CONCLUSIVE

INCLUSIVE

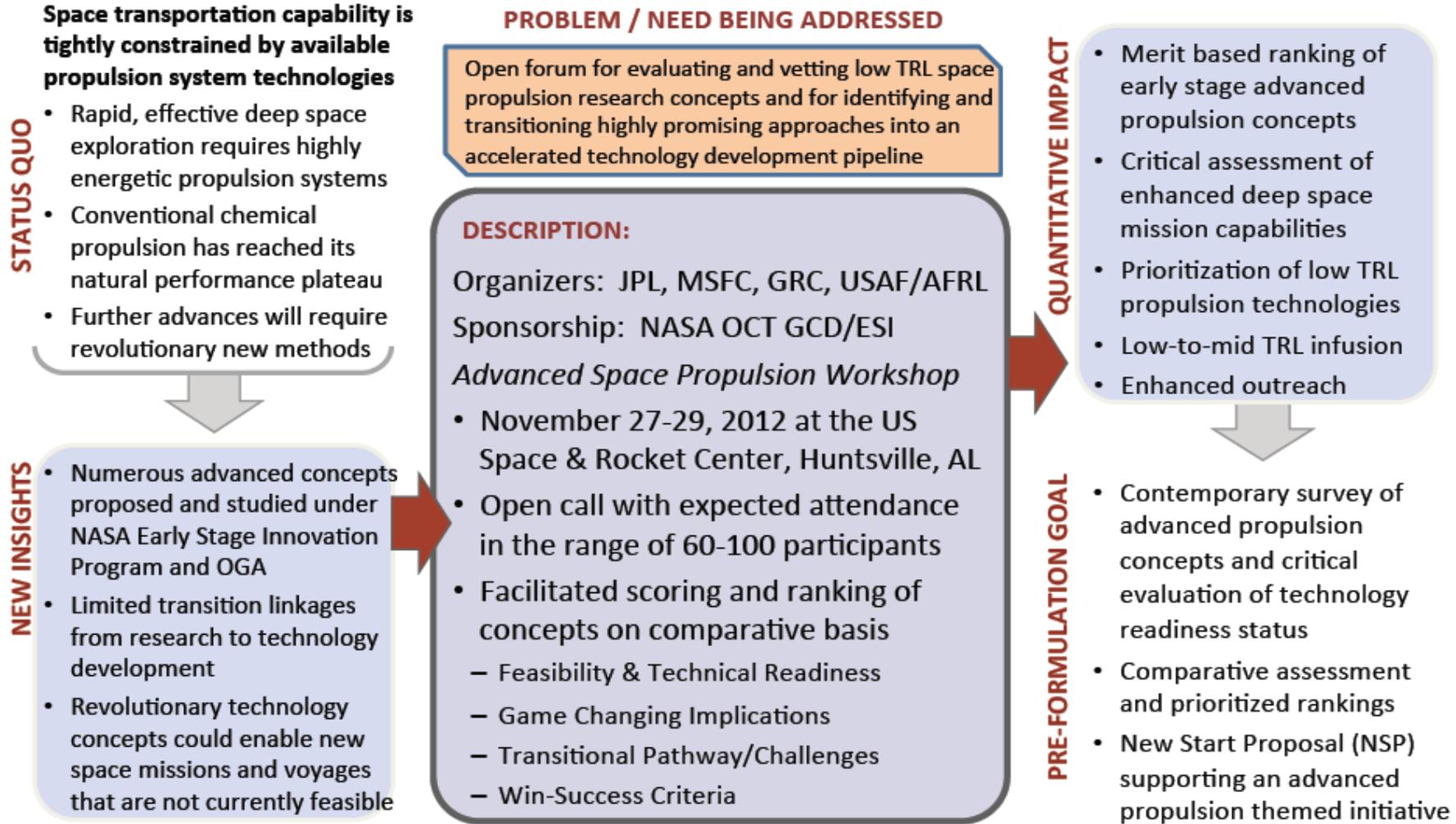
SUBSTANTIVE

We Want to Hear Your Ideas!





Forming an Integrated TechDev Strategy: ASPW Forum



Bridging the TRL Spectrum for Advanced Propulsion Technologies