EXPLORE SPACE TECH

TECHNOLOGY DRIVES EXPLORATION

Space Technology Overview

AIAA Webinar Series 2020

Mr. James Reuter | Associate Administrator, Space Technology Mission Directorate | 06.29.2020

SPACE TECHNOLOGY PORTFOLIO

EARLY STAGE INNOVATION

- NASA Innovative Advanced Concepts
- Space Tech Research Grants
- Center Innovation Fund/ Early Career Initiative

PARTNERSHIPS AND TECHNOLOGY TRANSFER

- Technology Transfer
- Prizes and Challenges
- iTech

SBIR/STTR PROGRAMS

- Small Business Innovation Research
- Small Business Technology Transfer

TECHNOLOGY MATURATION

- Game Changing Development
- Lunar Surface Innovation Initiative

TECHNOLOGY DEMONSTRATIONS

- Technology Demonstration Missions
- Small Spacecraft Technology
- Flight Opportunities

Technology Drives Exploration

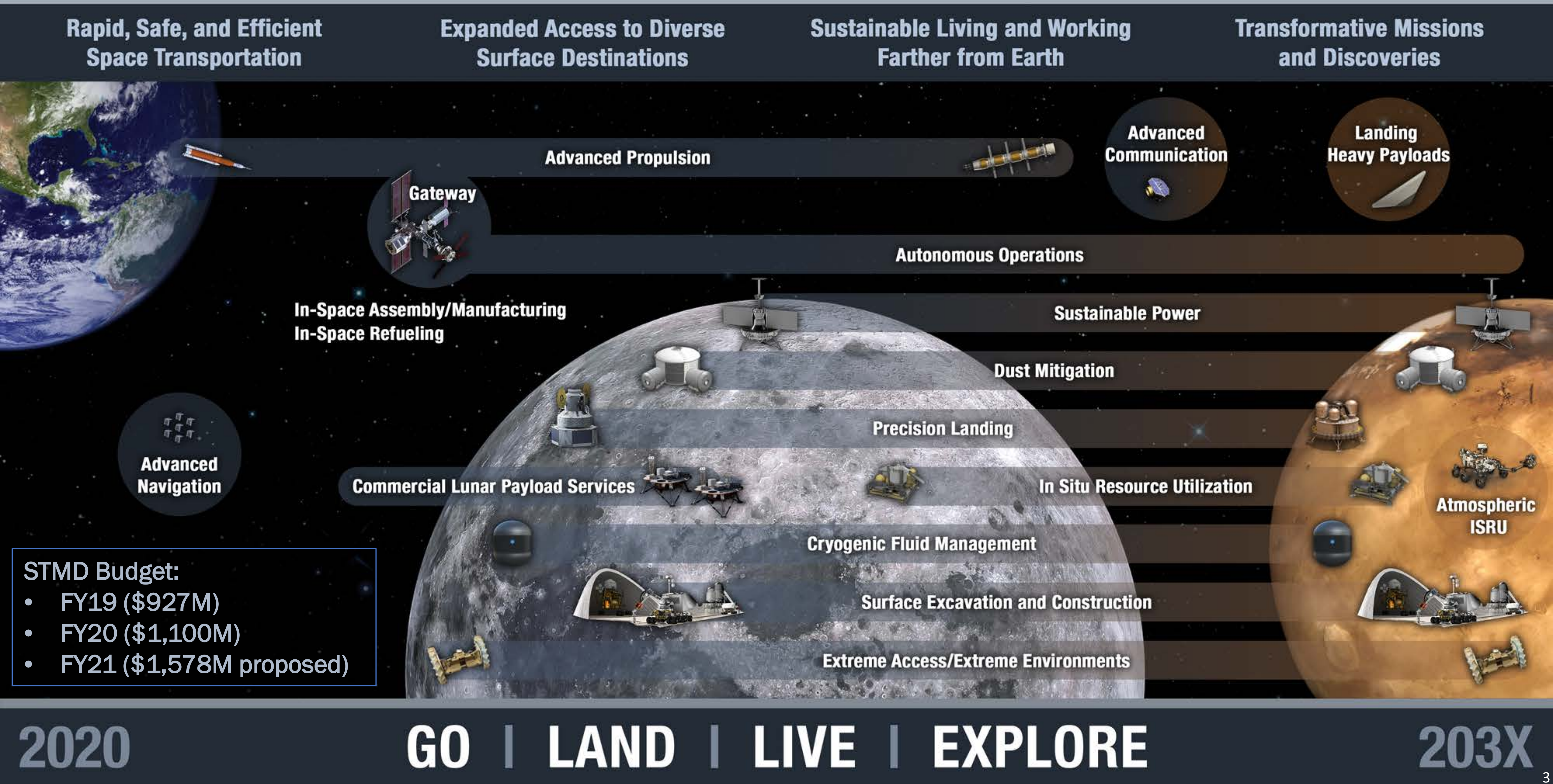
LOW

MID

HIGH

Technology Readiness Level

Reaching the Moon and Mars Faster with NASA Technology



STMD Budget:

- FY19 ($927M)
- FY20 ($1,100M)
- FY21 ($1,578M proposed)

Go

Rapid, Safe, & Efficient Space Transportation

Solar Electric Propulsion (SEP)

Nuclear Propulsion Technologies

Thruster Advancement for Low-temperature Operations in Space (TALOS)

Cryogenic Fluid Management

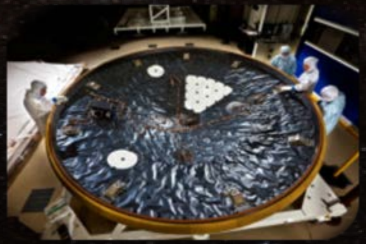
Green Propellant Infusion Mission (GPIM)

Rapid Analysis and Manufacturing Propulsion Technology

- **Enable Human Earth-to-Mars Round Trip mission durations less than 750 days.**
- **Enable rapid, low cost delivery of robotic payloads to Moon, Mars and beyond.**
- **Enable reusable, safe launch and in-space propulsion systems that reduce launch and operational costs/complexity and leverage potential destination based ISRU for propellants.**

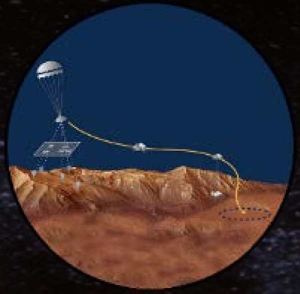
Land

Expanded Access to Diverse Surface Destinations




Mars Science Laboratory Entry Descent and Landing Instrument (MEDLI 2)

Navigation Doppler LIDAR



Terrain Relative Navigation

Mars Entry Descent and Landing

Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID)

Safe and Precise Landing – Integrated Capabilities Evolution (SPLICE)

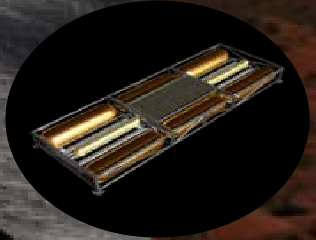
- Enable Lunar and Mars Global Access to land large (on the order of 20 metric tons) payloads to support human missions.
- Land Payloads within 50 meters accuracy while also avoiding local landing hazards.

Live

Sustainable Living and Working Farther from Earth

In Space Manufacturing

Regenerative Fuel Cells



Astrobee

Surface Power

Synthetic Biology

In-situ Resource Utilization (ISRU)

Integrated Systems for Autonomous Adaptive Caretaking

- Conduct Human/Robotic Lunar Surface Missions in excess of 28 days without resupply.
- Conduct Human Mars Missions in excess of 800 days including transit without resupply.
- Provide greater than 75% of propellant and water/air consumables from local resources for Lunar and Mars missions.
- Enable Surface habitats that utilize local construction resources.
- Enable Intelligent robotic systems augmenting operations during crewed and un-crewed mission segments.

Note: Mid TRL and High TRL Technology Development for Life Support and EVA suits are HEOMD Responsibility

LUNAR SURFACE INNOVATION INITIATIVE

In-situ Resource Utilization

Collection, processing, storing and use of material found or manufactured on other astronomical objects

Sustainable Power

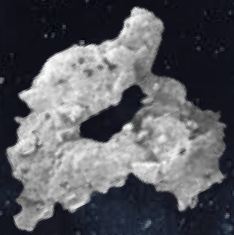
Enable continuous power throughout lunar day and night

Extreme Access

Access, navigate, and explore surface/subsurface areas

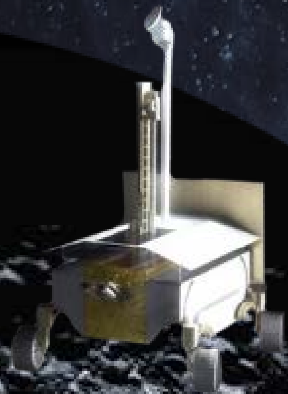
Surface Excavation/Construction

Enable affordable, autonomous manufacturing or construction



Lunar Dust Mitigation

Mitigate lunar dust hazards



Extreme Environments

Enable systems to operate through out the full range of lunar surface conditions

Explore

Transformative Missions and Discoveries

- Enable new discoveries at the Moon, Mars and other extreme locations.
- Enable new architectures that are more rapid, affordable, or capable than previously achievable.
- Enable new approaches for in-space servicing, assembly and manufacturing.
- Enable next generation space data processing with higher performance computing, communications and navigation in harsh deep space environments.

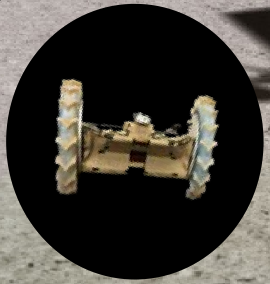
Laser and Optical Communications

CAPSTONE

SPIDER

Restore-L

Archinaut



Surface Robotic Scouts

Bulk Metallic Glass Gears

In Space Manufacturing

Atomic Clock

Space Technology for Mars 2020 Mission

MEDLI2 *(Mars Entry, Descent and Landing Instrumentation 2)*

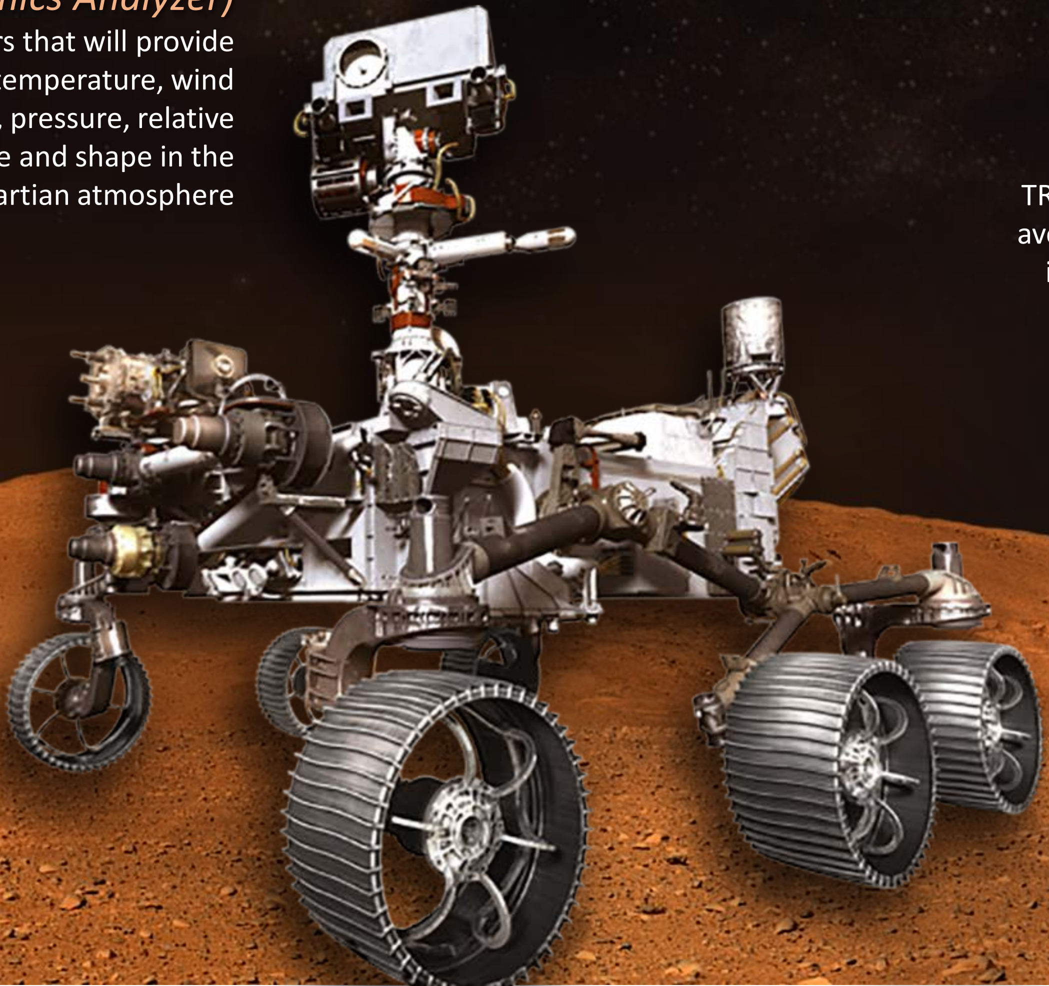
MEDLI2 is a next-generation sensor suite for entry, descent and landing (EDL). It collects temperature and pressure measurements on the heat shield and afterbody during EDL

MEDA *(Mars Environmental Dynamics Analyzer)*

A set of sensors that will provide measurements of temperature, wind speed and direction, pressure, relative humidity and dust size and shape in the Martian atmosphere

TRN *(Terrain Relative Navigation)*

TRN gives a spacecraft the ability to autonomously avoid hazards we already know about and can land in more (and more interesting) landing sites with far less risk



MOXIE *(Mars Oxygen In-Situ Resource Utilization Experiment)*

MOXIE will demonstrate a way that future explorers might produce oxygen from the Martian atmosphere for propellant and for breathing.

STMD Opportunities for Academia and Industry

STMD anticipates awarding ~$600M to academia and industry supporting 2020 solicitations & awards

STMD Tipping Point Multiple Awards: *Jan – Mar 2020*	$250M
Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Phases I, II, II-E, Civilian Commercialization Readiness Pilot Program (CCRPP), Sequential: *Phase I Solicitation Jan – Apr 2020*	$212M
Announcement of Collaborative Opportunity (ACO): *Jan – Mar 2020*	$10M
Flight Opportunities Tech Flights: *Feb – May 2020*	$10M
Early Career Faculty (ECF): *Feb – Apr 2020*	$6M
Early Stage Innovations (ESI): *Apr – Jun 2020*	$9M
NASA Innovative Advanced Concepts (NIAC) Phases I, II, III: *Phase I Solicitation Jun – Jul 2020*	$4M
Space Technology Research Institutes (STRI): *Jun – Aug 2020*	$30M
NASA Space Technology Graduate Research Opportunities (NSTGRO): *Sep – Nov 2020*	$19M
SmallSat Technology Partnerships (STP): *Sep – Nov 2021*	$3M
Centennial Challenges: *Varied release dates*	$8M
NextSTEP Broad Agency Announcements (BAAs): *Varied release dates*	*Varies*
Lunar Surface Technology Research (LuSTR) Opportunities: *Coming soon!!!*	$30M

Note: Funding awards are approximate and subject to change

Green: Open Solicitations as of June 5, 2020

Blue: Solicitations were/will be open *in the timeframe specified in italics*

STMD BY THE NUMBERS (FY 2019)

> 3,500
Proposals evaluated

> 1,000
Active technology projects

> 700
Proposals selected

> 2,300
Software releases

> 350
University partnerships with >100 universities

> 400
Industry collaborators

> 50
Projects leading to flight demonstrations

> 900
Transitions since 2011


NASA
www.nasa.gov/spacetech