




FORWARD TO THE MOON: NASA's Strategic Plan for Human Exploration

Updated 09/04/2019



Space Policy Directive 1: To The Moon, Then Mars



“Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations...”

Why go to The Moon?

Proves technologies and capabilities for sending humans to Mars

Establishes American leadership and strategic presence

Inspires a new generation and encourages careers in STEM

Leads civilization changing science and technology

Expands the U.S. global economic impact

Broadens U.S. industry and international partnerships
in deep space



Moon Before Mars

On the Moon, we can take reasonable risks while astronauts are just three days away from home.

There we will prove technologies and mature systems necessary to live and work on another world before embarking on what could be a 2-3 year mission to Mars.

The Artemis Program

Artemis is the twin sister of Apollo and goddess of the Moon in Greek mythology. Now, she personifies our path to the Moon as the name of NASA's program to return astronauts to the lunar surface by 2024.

When they land, Artemis astronauts will step foot where no human has ever been before: the Moon's South Pole.

With the horizon goal of sending humans to Mars, Artemis begins the next era of exploration.



American Leadership in Space Exploration

TODAY, WE ARE:

TOMORROW, WE WILL:



EARTH ORBIT

- Maintaining a constant human presence in LEO
- Strengthening international partnerships on ISS



EARTH ORBIT

- Grow a robust commercial space economy
- Continue critical Earth science research



LUNAR ORBIT

- Mapping the Moon in detail with Lunar Reconnaissance Orbiter
- Laser ranging between the Earth and lunar orbit



LUNAR ORBIT

- Strengthen international partnerships through Gateway
- Establish sustainable human and robotic programs



LUNAR SURFACE

- Characterizing the environment and finding suitable landing sites
- Studying lunar samples with improved technology



LUNAR SURFACE

- Explore the distribution and abundance of resources
- Create economic opportunities for U.S. industry



MARS & BEYOND

- Operating multiple orbital and surface missions
- Learning the structure of Mars (InSight)



MARS & BEYOND

- Understand the role and fate of water on Mars
- Answer the question of 'are we alone?'



ARTEMIS

PHASE ONE:

Lunar South Pole by 2024



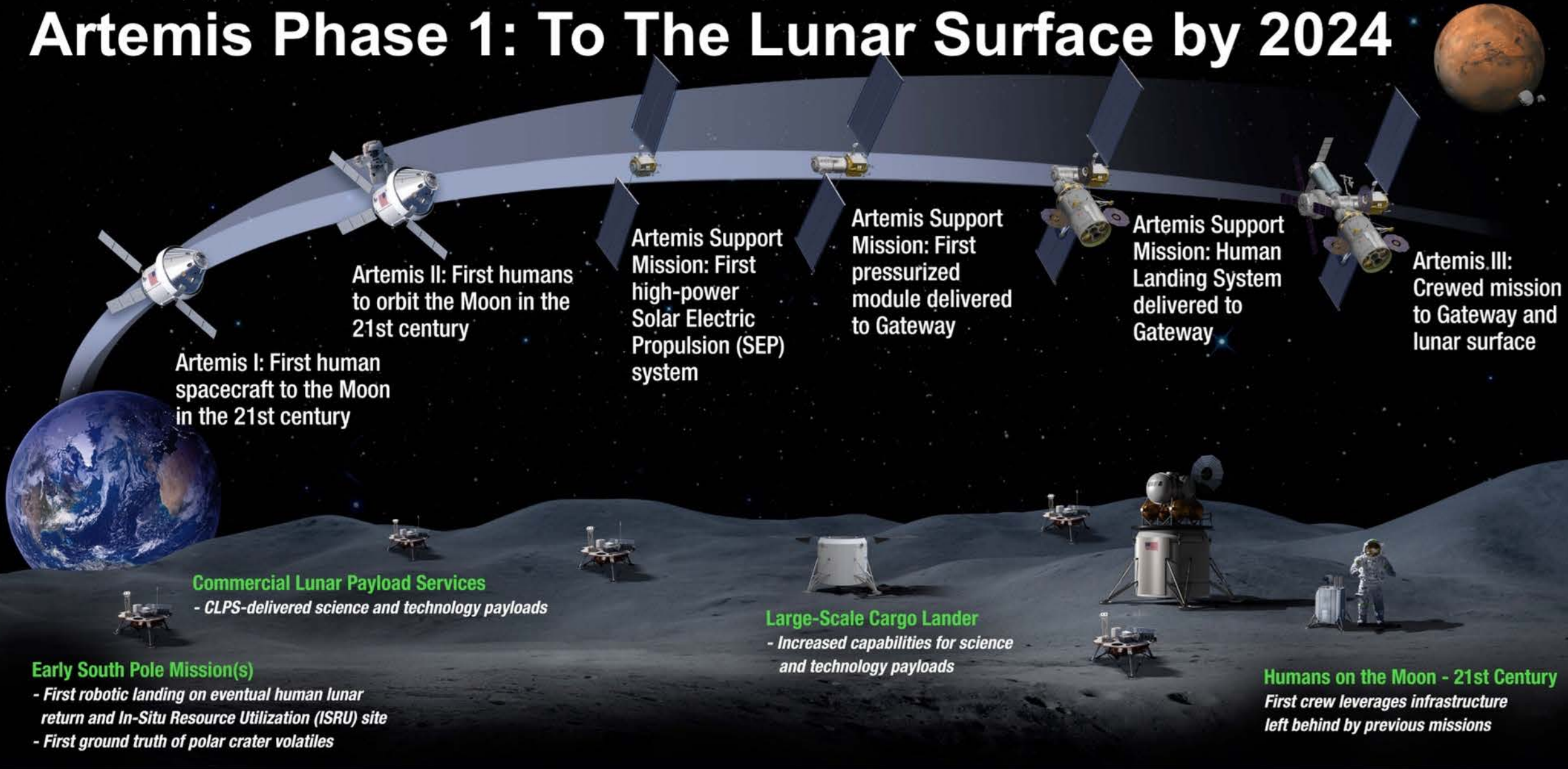
A Budget Increase Toward 2024

The FY2020 budget amendment provides an **increase** of **\$1.6 billion** above the president's initial **\$21 billion** budget request with no money taken from existing NASA programs. This is the **boost** NASA needs.

- \$1 billion to accelerate commercial partnerships in the development of human lunar transportation systems to take astronauts to the surface and back to Gateway*
- \$651 million towards the completion of SLS and Orion to support a 2024 landing
- \$132 million for new technologies to help astronauts live and work on the lunar surface and in deep space
- \$90 million for Science to increase robotic exploration at the lunar South Pole in advance of astronauts

**Focusing Gateway on just the capabilities needed for Phase 1 allowed for a \$321M scope reduction and shifts potential development and expanded capabilities for Gateway into Phase 2*

Artemis Phase 1: To The Lunar Surface by 2024



LUNAR SOUTH POLE TARGET SITE

2020

2024

Achieving 2024 – A Parallel Path to Success

Artemis will see government and commercial systems moving in parallel to complete the architecture and deliver crew

CREW

NASA Programs SLS and Orion



Artemis I

First flight test of SLS and Orion as an integrated system

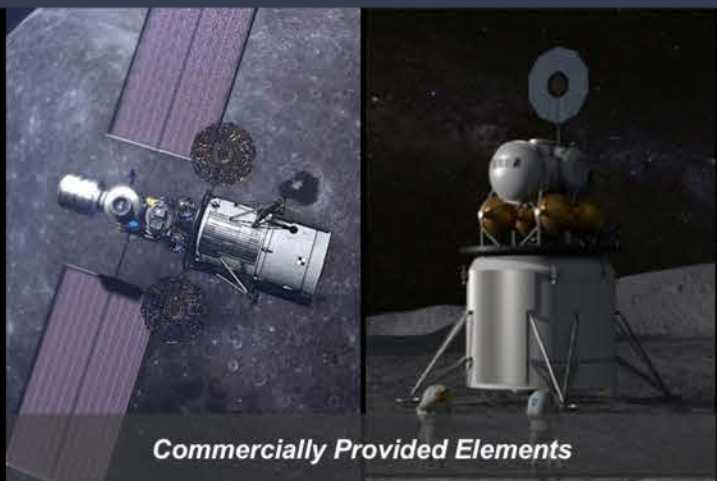
Artemis II

First flight of crew to the Moon aboard SLS and Orion

Artemis III

First crew to the lunar surface; Logistics delivered for 2024 surface mission

Between now and 2024, U.S. industry delivers the launches and human landing system necessary for a faster return to the Moon and sustainability through Gateway.



Commercially Provided Elements

CARGO

PPE

Power and Propulsion Element arrives at NRHO via commercial rocket

Pressurized Module

Small area for crew to check out systems prior to lunar transfer and decent

Human Landing System

Transfer

Transfers lander from Gateway to low lunar orbit

Descent

Descends from Transfer Vehicle to lunar surface

Ascent

Ascends from lunar surface to Gateway

Up to three commercial rocket launches, depending on distribution of the Transfer, Descent, and Ascent functions

The Power of SLS and Orion

A composite image featuring a rocket launch, the American flag, and the moon. In the upper left, a rocket is shown ascending with a large plume of white smoke and fire. In the center, the United States flag is waving on a flagpole. In the background, a large, detailed view of the moon is visible against a dark blue sky.

ORION

The only spacecraft capable of carrying and sustaining crew on missions to deep space, providing emergency abort capability, and safe re-entry from lunar return velocities

SLS

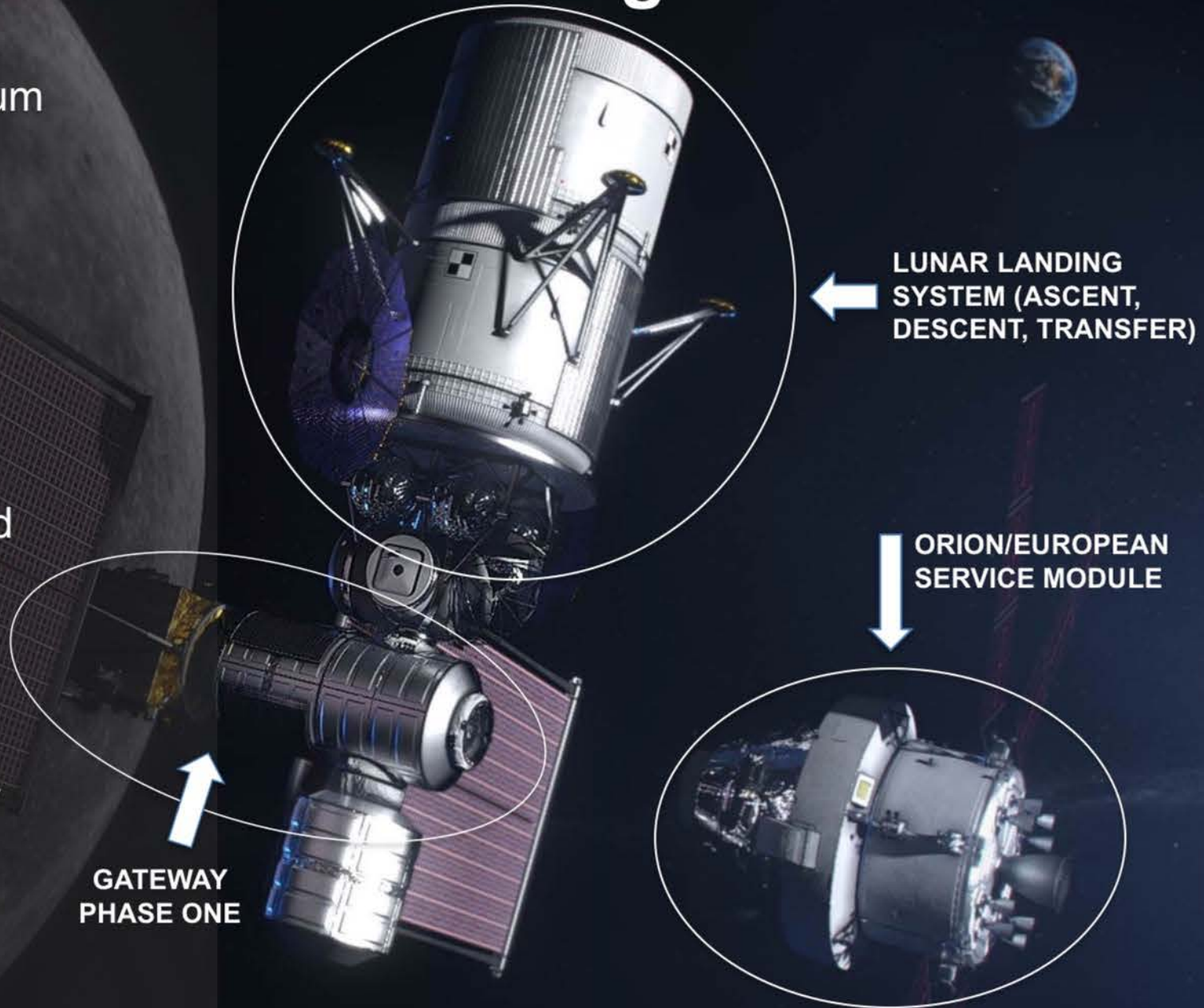
The only rocket with the power and capability required to carry astronauts to deep space onboard the Orion spacecraft

NATIONAL CAPABILITY

The SLS and Orion programs (including Exploration Ground Systems support at Kennedy Space Center) leverages over 3,800 suppliers and over 60,000 workers across all 50 states

Gateway is Essential for 2024 Landing

- Initial Gateway focuses on the minimum systems required to support a 2024 human lunar landing while also supporting Phase 2
- Provides command center and aggregation point for 2024 human landing
- Establishes strategic presence around the Moon – US in the leadership role
- Creates resilience and robustness in the lunar architecture
- Open architecture and interoperability standards provides building blocks for partnerships and future expansion



Lunar Science by 2024

POLAR LANDERS AND ROVERS

- First direct measurement of polar volatiles, improving understanding of lateral and vertical distribution, physical state, and chemical composition
- Provide geology of the South-Pole Aitken basin, largest impact in the solar system

NON-POLAR LANDERS AND ROVERS

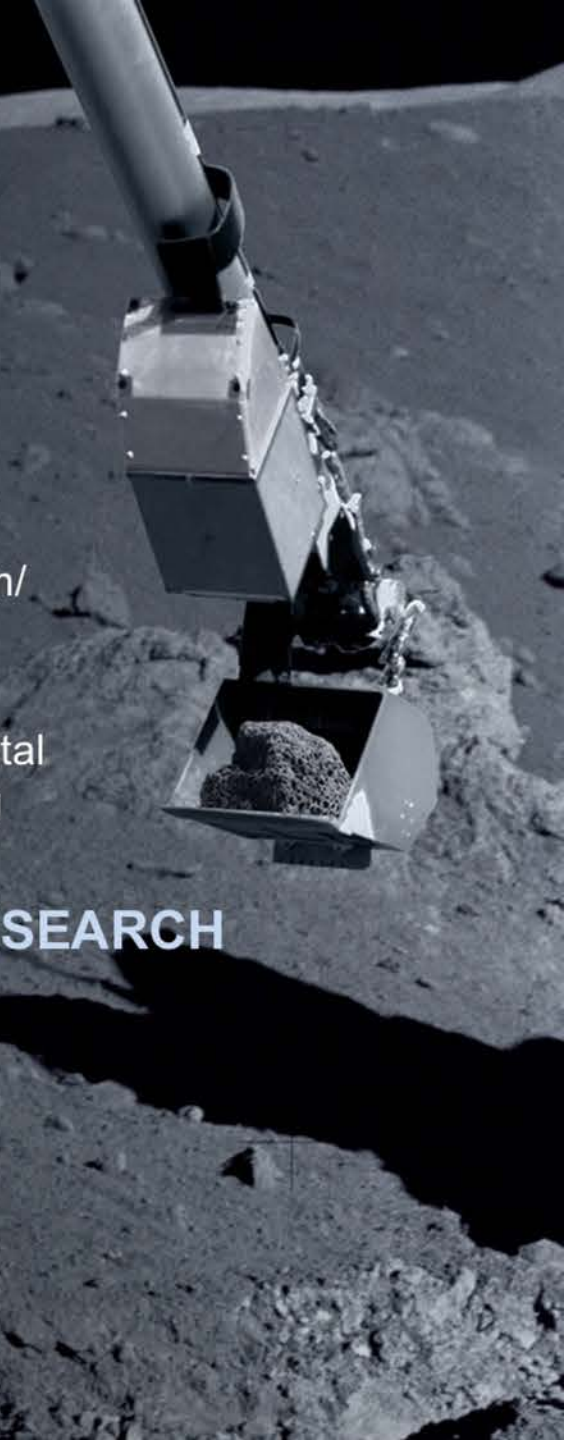
- Explore scientifically valuable terrains not investigated by Apollo, including landing at a lunar swirl and making first surface magnetic measurement
- Using PI-led instruments to generate Discovery-class science, like establishing a geophysical network and visiting a lunar volcanic region to understand volcanic evolution

ORBITAL DATA

- Deploy multiple CubeSats with Artemis I
- Potential to acquire new scientifically valuable datasets through CubeSats delivered by CLPS providers or comm/relay spacecraft
- Global mineral mapping, including resource identification, global elemental maps, and improved volatile mapping

IN-SITU RESOURCE INITIAL RESEARCH

- Answering questions on composition and ability to use lunar ice for sustainment and fuel



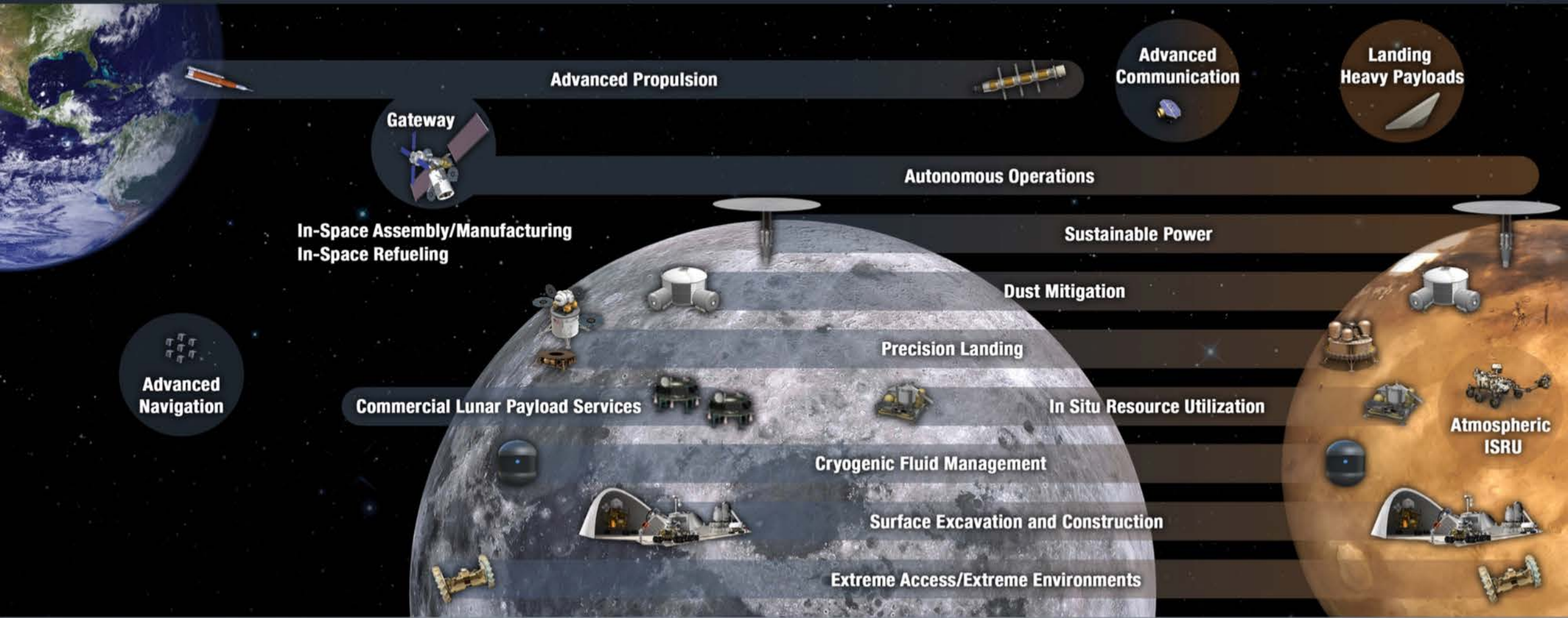
Reaching The Moon And Mars Faster With NASA Technology

Rapid, Safe, and Efficient
Space Transportation

Expanded Access to Diverse
Surface Destinations

Sustainable Living and Working
Farther from Earth

Transformative Missions
and Discoveries



2020 | GO | LAND | LIVE | EXPLORE | 203X



ARTEMIS

PHASE TWO:

Mars Forward Capabilities,
Sustainable Lunar Presence



Sustainability at The Moon, Preparation For Mars

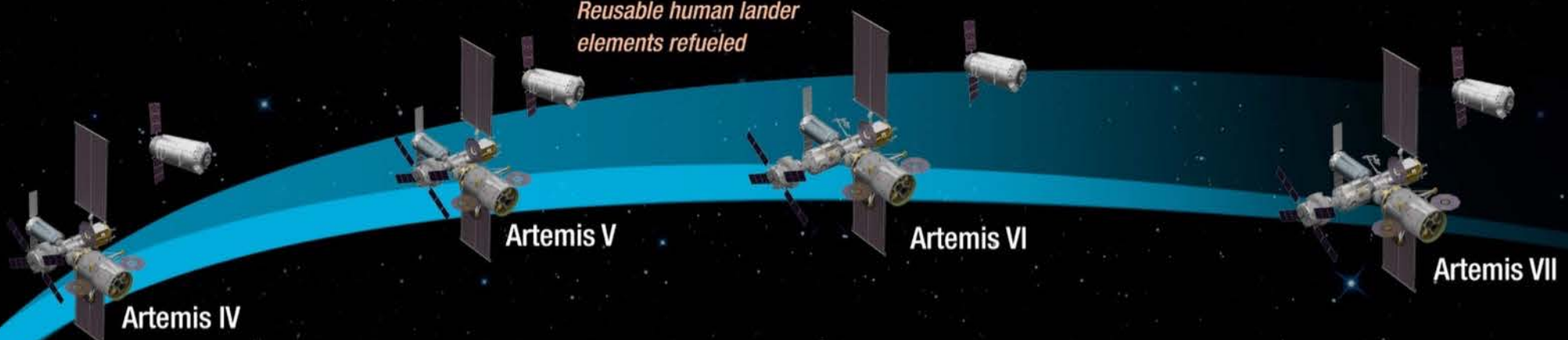
- American-led exploration and strategic presence
- Unbound potential for partnerships and collaboration
- Meaningful, long-duration human missions
- Understanding of impacts on human performance
- Repeatable operations with reusable systems
- Unprecedented science independent of Earth
- A new future on the Moon and Mars



Artemis Phase 2: Building Capabilities For Mars Missions



Reusable human lander elements refueled



Artemis IV

Artemis V

Artemis VI

Artemis VII

Artemis Support Mission
Lunar surface asset deployment for longer surface expeditions

CLPS opportunities



SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS

INTERNATIONAL PARTNERSHIP OPPORTUNITIES

TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

2025

2029

Science After 2024

Human and Robotic Missions Provide Unique Science Opportunities

ON GATEWAY

- Deep space testing of Mars-forward systems
- Hosts groundbreaking science study and observation
- Mars transit testbed for reducing risk to humans

SURFACE EXPLORATION

- Understanding how to use in-situ resources for fuel and life
- Revolutionizing the understanding of the origin and evolution of the Moon
- Studying lunar impact craters to understand impact cratering
- Setting up complex surface science instrumentation
- Informing and supporting sustained human presence

SURFACE TELEROBOTICS TO PROVIDE CONSTANT SCIENCE

- Sending rovers into areas too difficult for humans to explore





Let's go. *The Time is Now.*

We have the capability

We have the purpose

We have the charge

We have the responsibility



