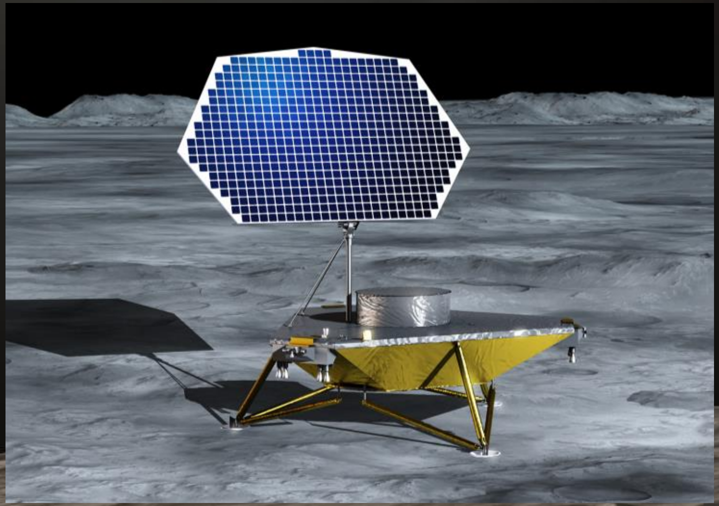
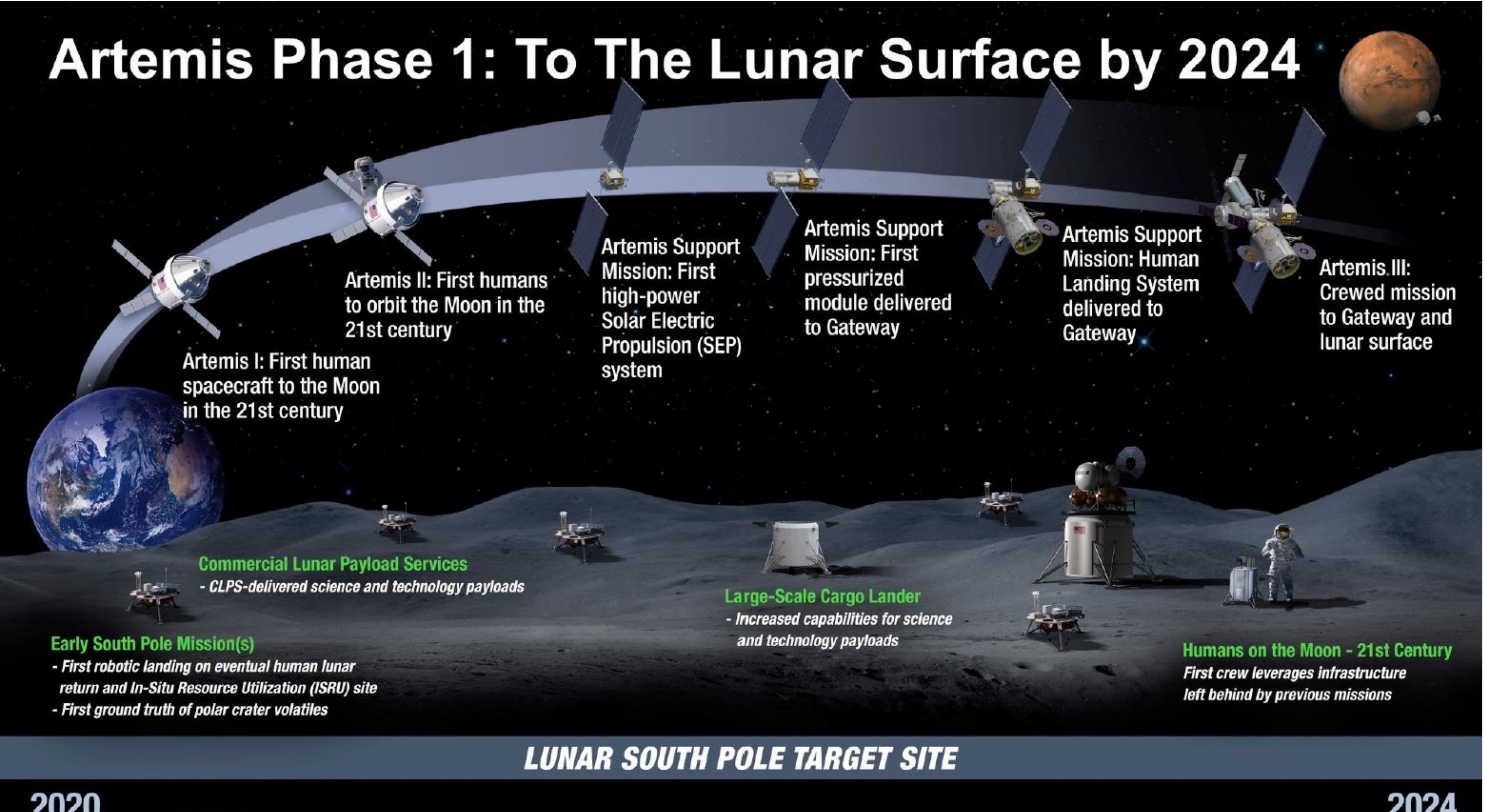
Forward to the Moon

Lunar Landers for Science and Exploration





Courtesy of NASA

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

Artemis I

First flight test of SLS and Orion as an integrated system

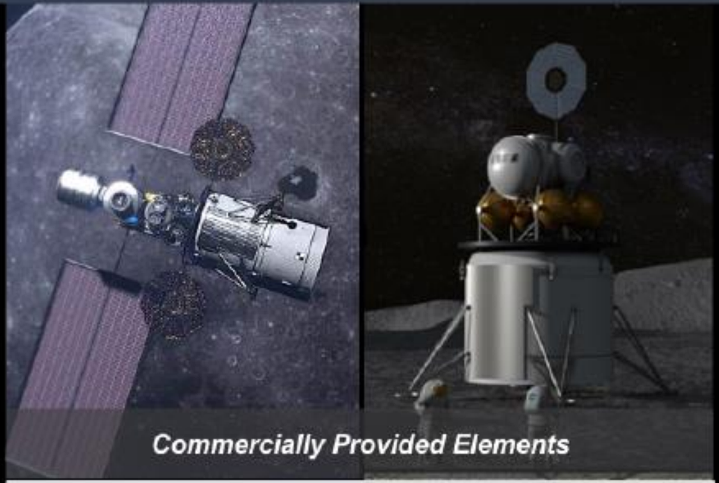
Artemis II

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.



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

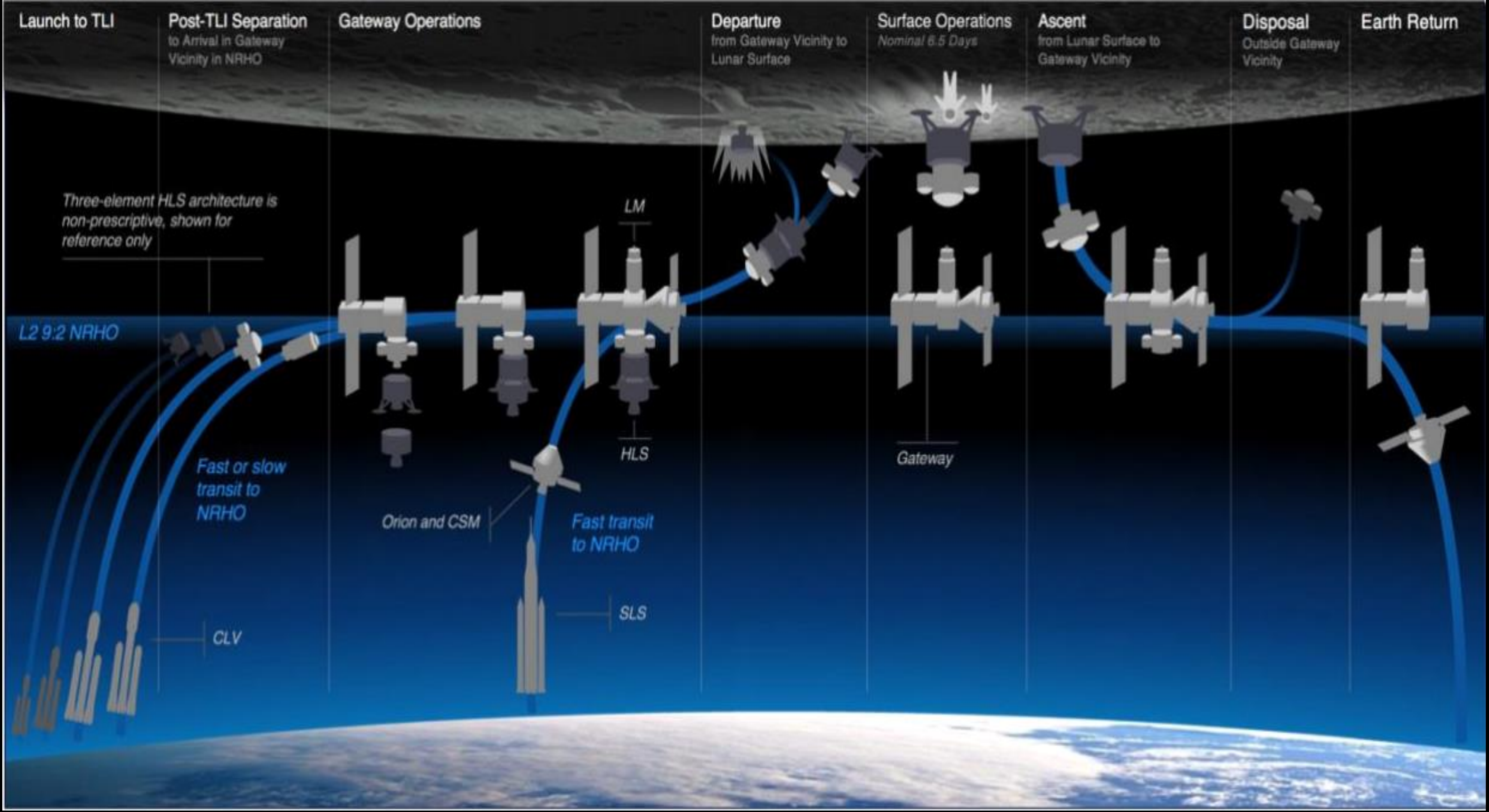
Descends from Transfer Vehicle to lunar surface

Ascent

Ascends from lunar surface to Gateway

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

Courtesy of NASA



Courtesy of NASA

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

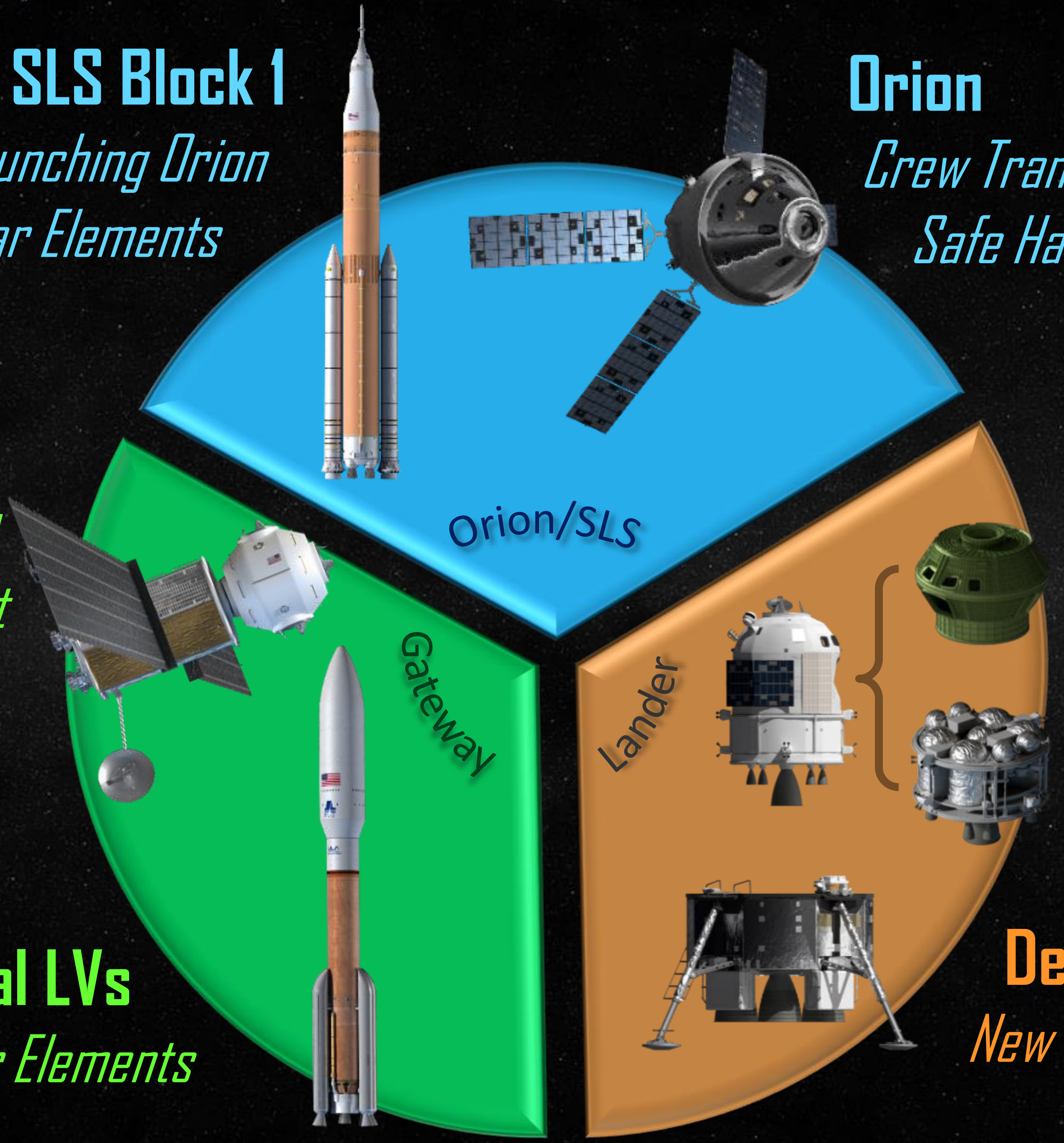
Existing Plans and Systems with a New Focus

SLS Block 1

Heavy Lift for Launching Orion and Lunar Elements

Orion

Crew Transport to and from Gateway; Safe Haven; Gateway Command Deck



Phase 1 Gateway

Power/Propulsion Element and

Commercial LVs

Launch PPE and Lunar Elements

Command Deck

Orion-Derived

Ascent Propulsion

ESM Propulsion

Descent Stage

New Cryogenics or Storable Propulsion

A Polar Destination

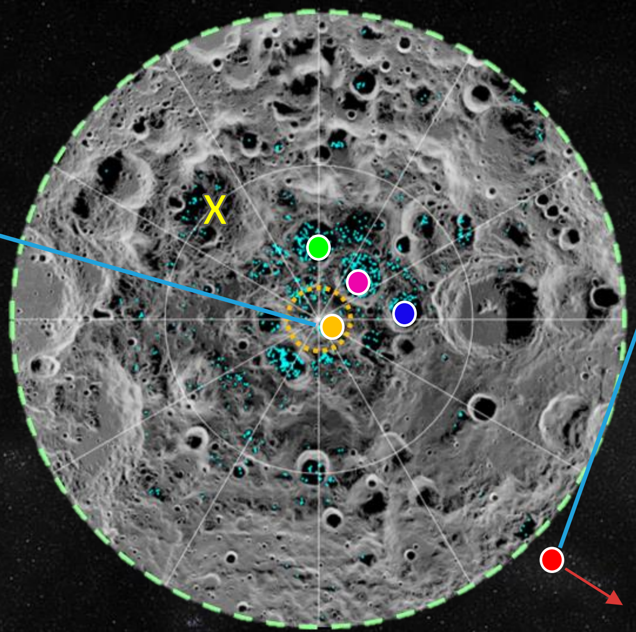
Shackleton Crater Region

Volatiles in the Permanently Shadowed Regions

Test models of lunar "water cycle"

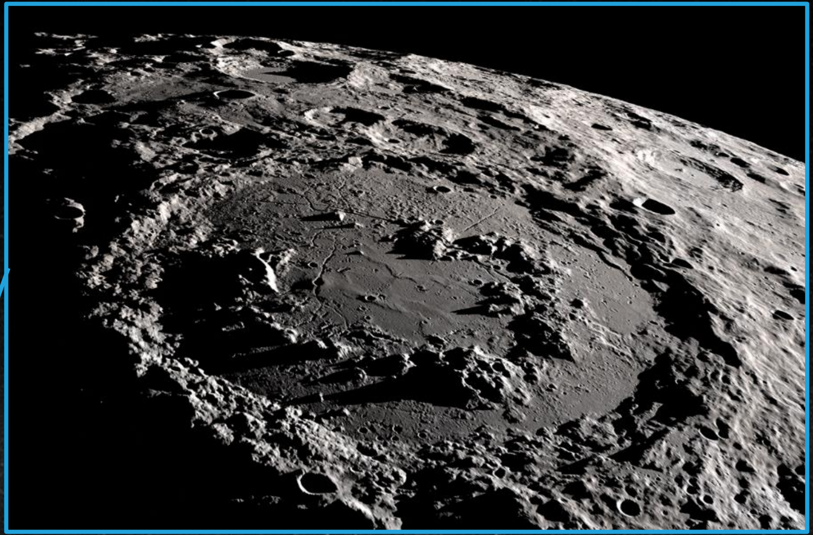
Potential Landing Sites of Scientific Interest

- South Pole Area - 10°
- Polar Regions
- LCROSS Impact Site
- Shackleton
- Haworth
- Shoemaker
- Faustini
- Schrödinger



Surface water ice deposits at the South Pole.

Schrödinger Basin



Crater fractures and bedrock exposure

Volcanic deposits and impact evidence

Possible location for a low radio frequency array

Science Questions

- How does bombardment at the Moon illuminate Solar System evolution?
- What is the Moon's past and present geologic history?
- Where and how deep is the water on the Moon located?

McCandless Lunar Lander

www.lockheedmartin.com/McCandlessLunarLander

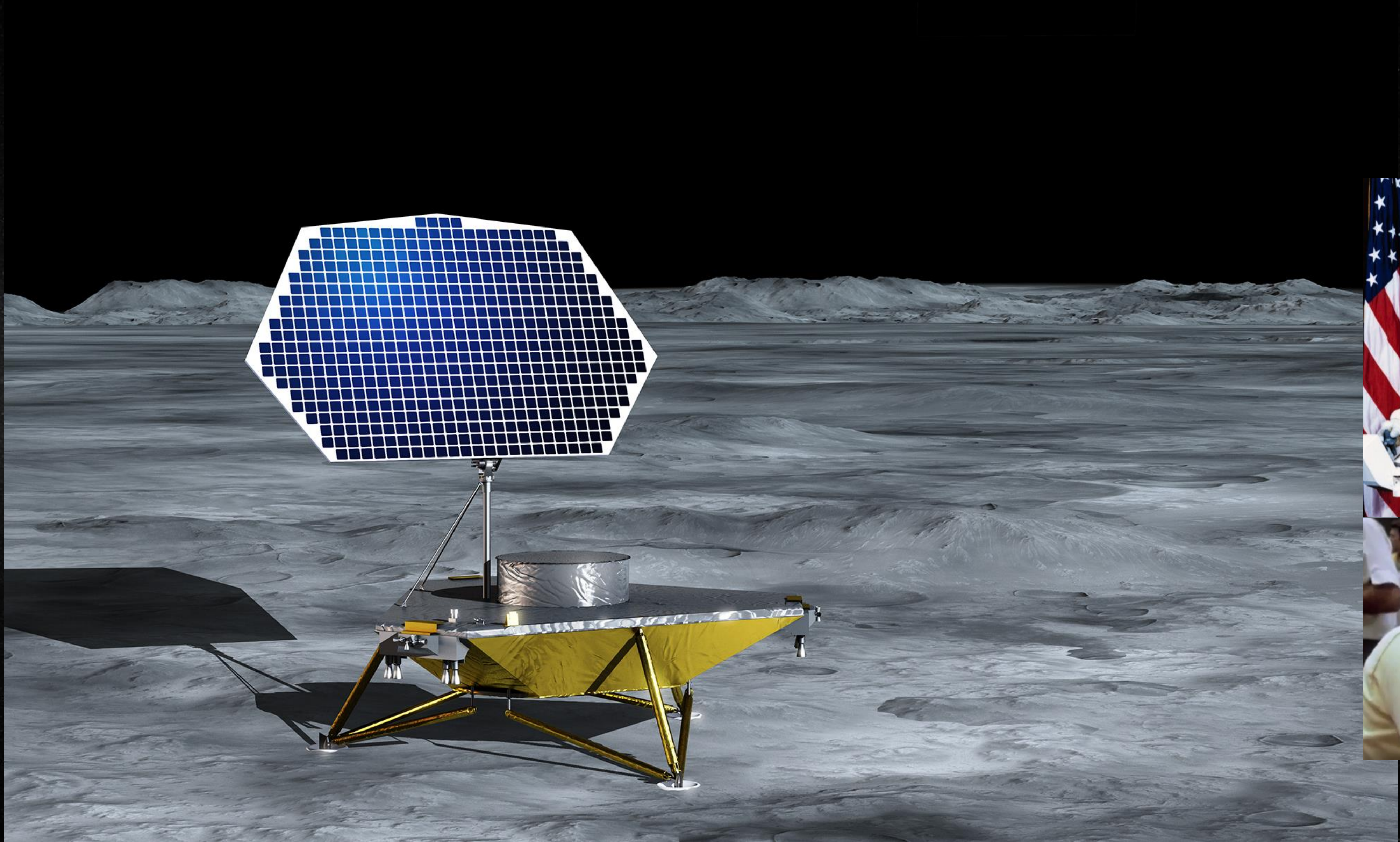
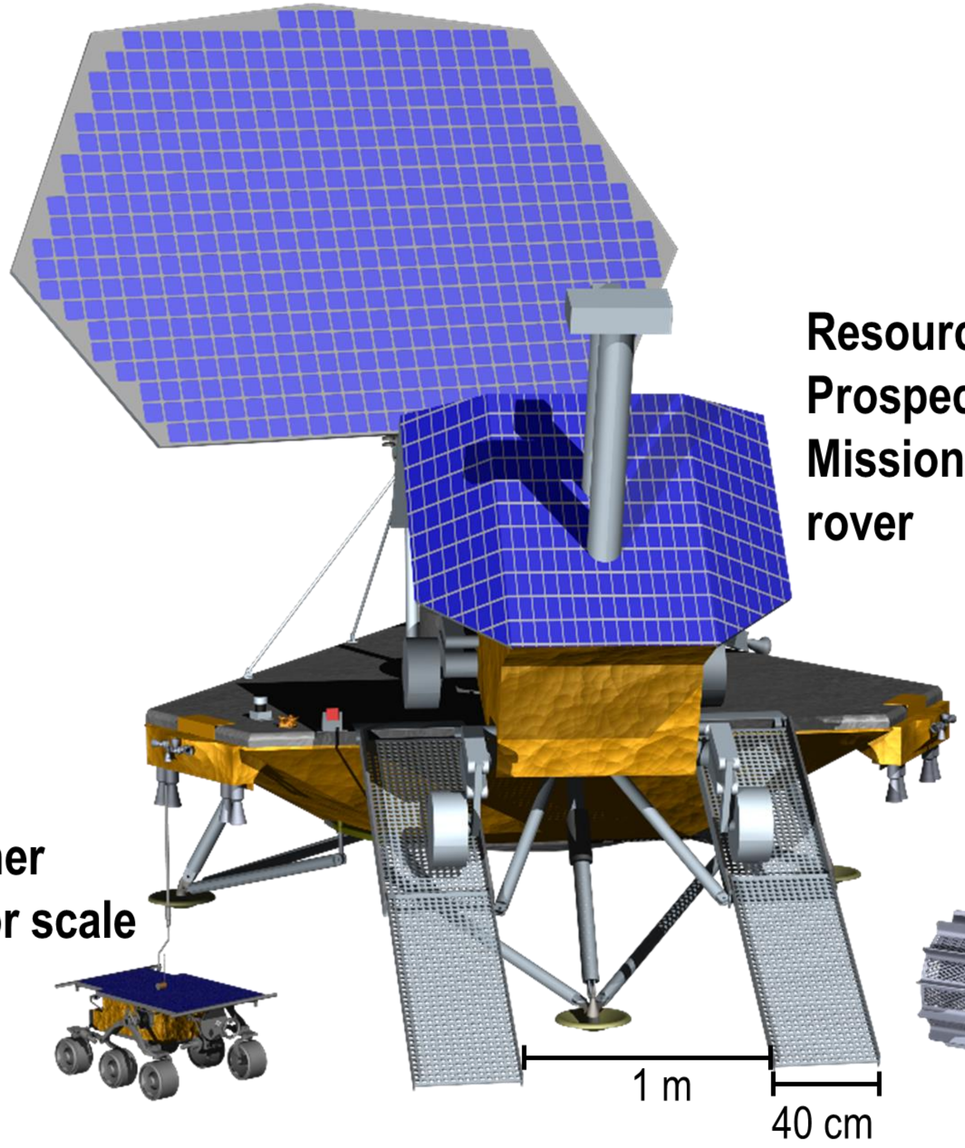


Image Credit: NASA

The McCandless Lunar Lander can accommodate large, high-power payloads and deployable rovers, such as the examples below

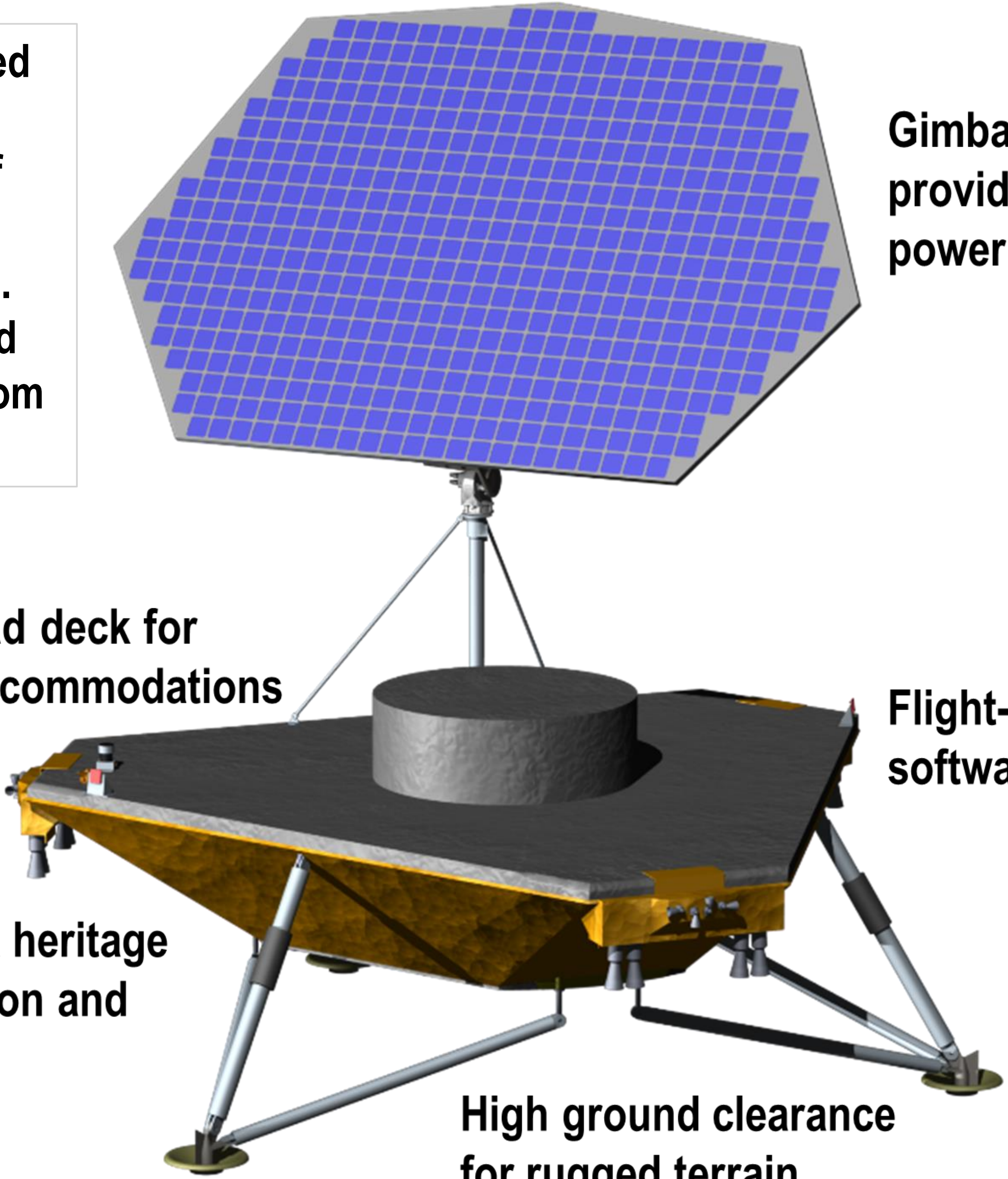


Resource Prospector Mission rover

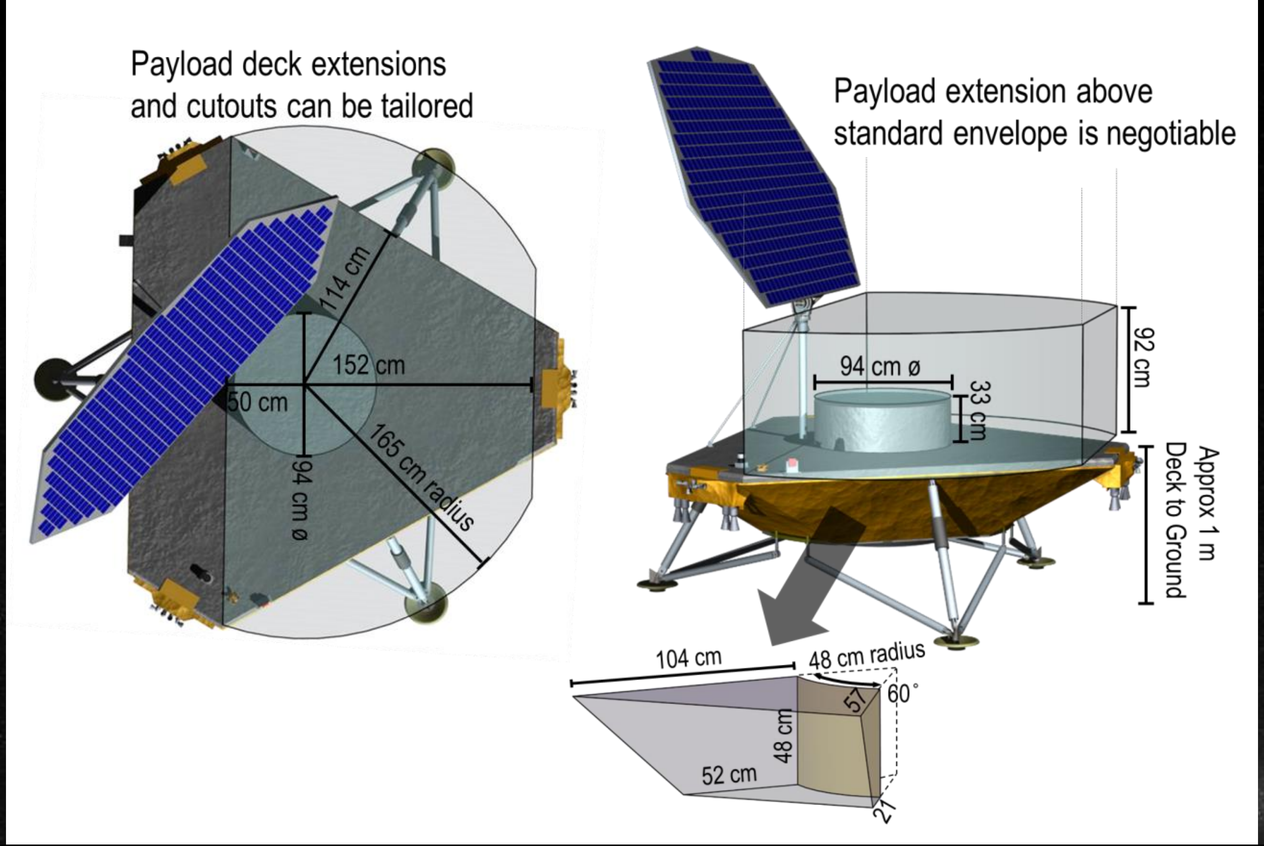
Sojourner rover for scale

Lunar Outpost HL-MAPP rover

McCandless is based on Lockheed Martin’s experience developing, testing, and/or operating many of planetary spacecraft in collaboration with NASA and JPL. For example, the landing gear and propulsion are closely derived from the InSight lander on Mars



Payloads can attach externally on the large upper deck, or internally in two payload bays protected from the space environment



Capability	Standard	Optional Enhancements
Cargo mass	Up to 350 kg	Evolvable to > 1000 kg
Payload power (landed)	400 W, 28 Vdc	
External payload volume	>4 m^3 external, above deck	Deployment Mechanisms
Internal payload bay volume	Two 0.4 m^3 internal compartments	Deployment Mechanisms
Surface mission duration	300 hours, nearly a full lunar daylight period	Lunar night survival or lunar night operations
Landing precision	< 2 km landing zone	< 100 m landing zone
Return data rate to Earth	100 kbps	>1 Mbps
Data storage	48 gigabits	
Payload data interfaces	LVDS, RS-422, MIL-STD-1553, Spacewire	WiFi, Ethernet

LOCKHEED MARTIN