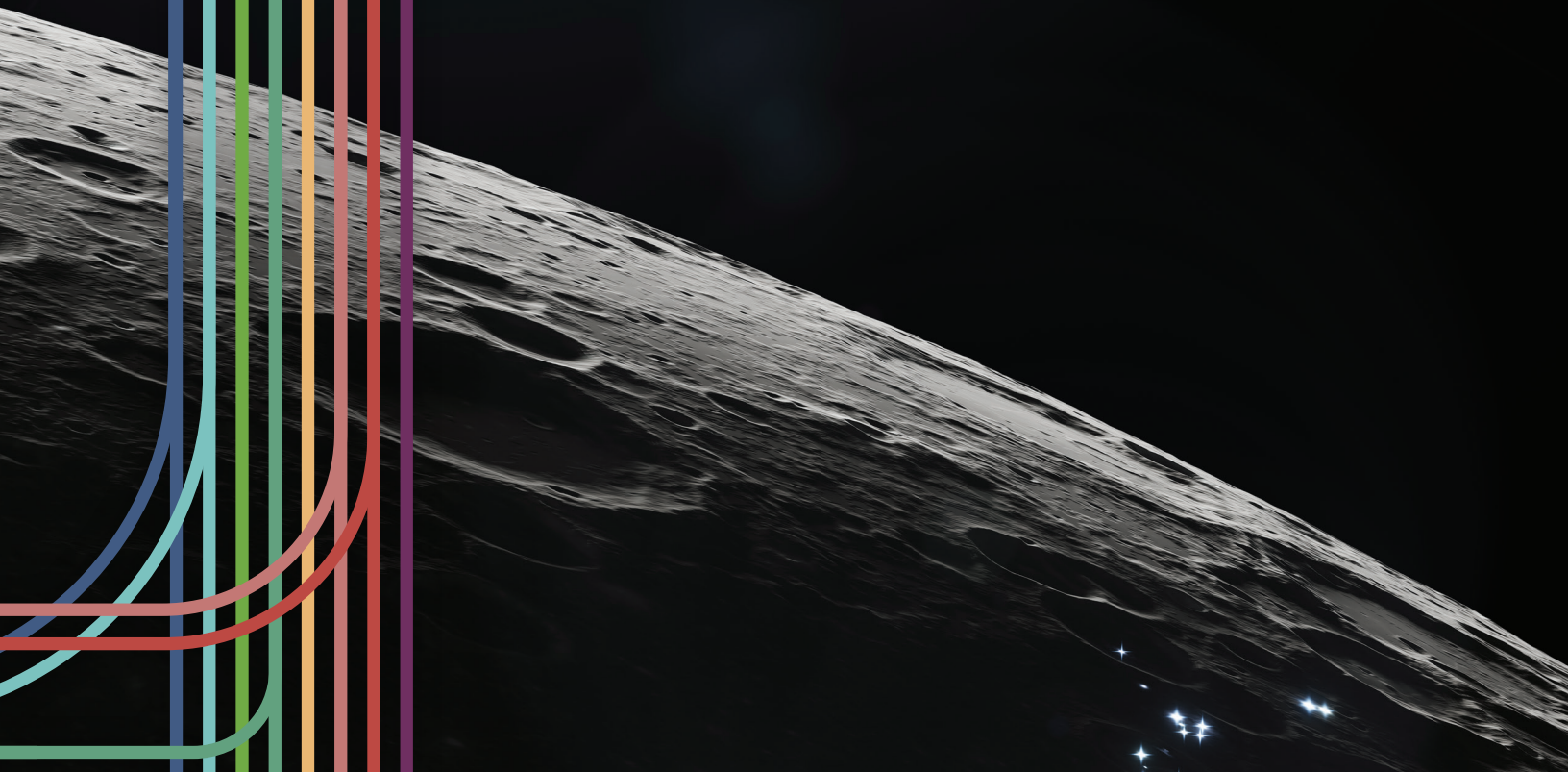


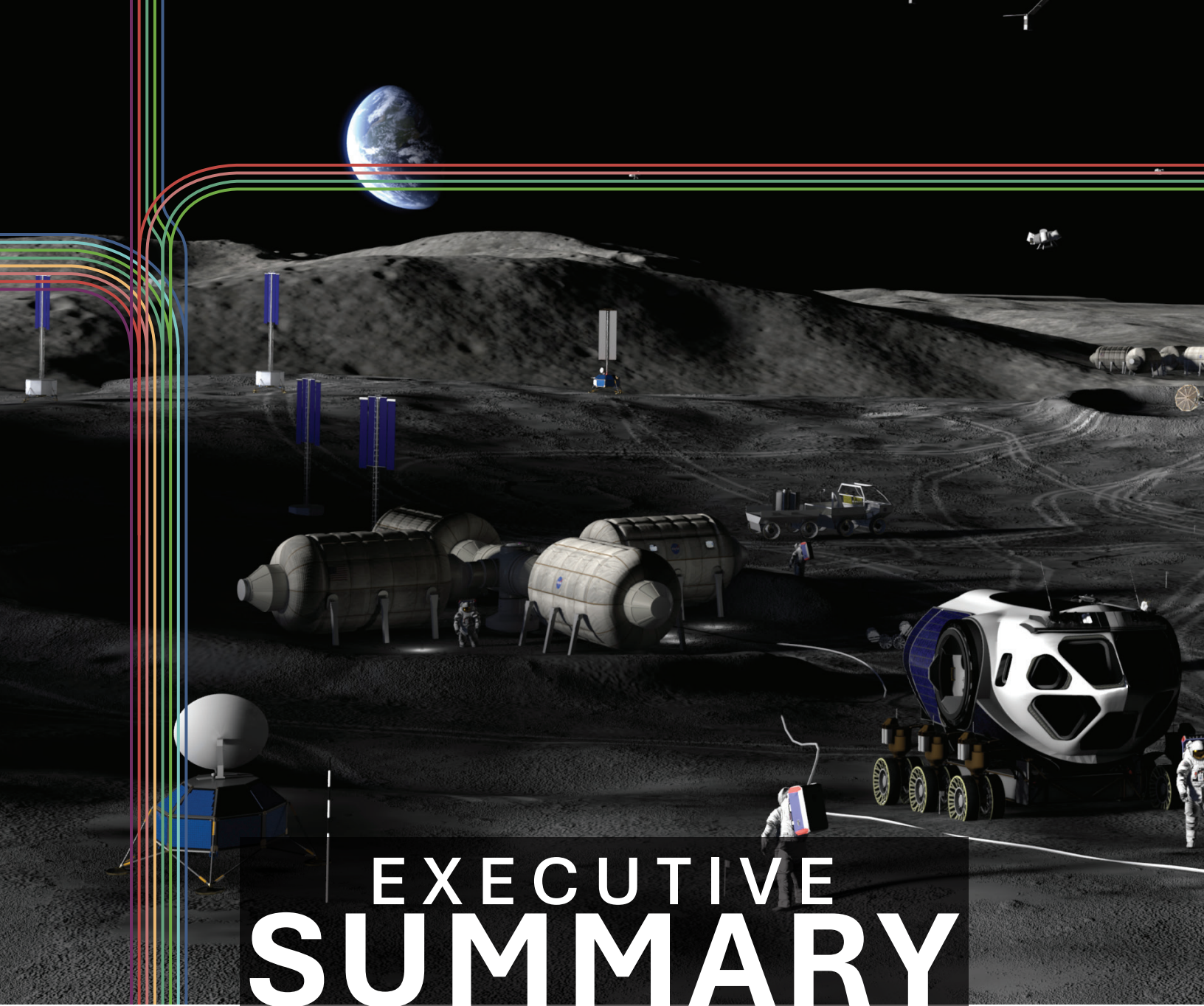
National Aeronautics and  
Space Administration



# Moon Base

Igniting Progress

**Moon Base User's Guide**  
Architecture Resources



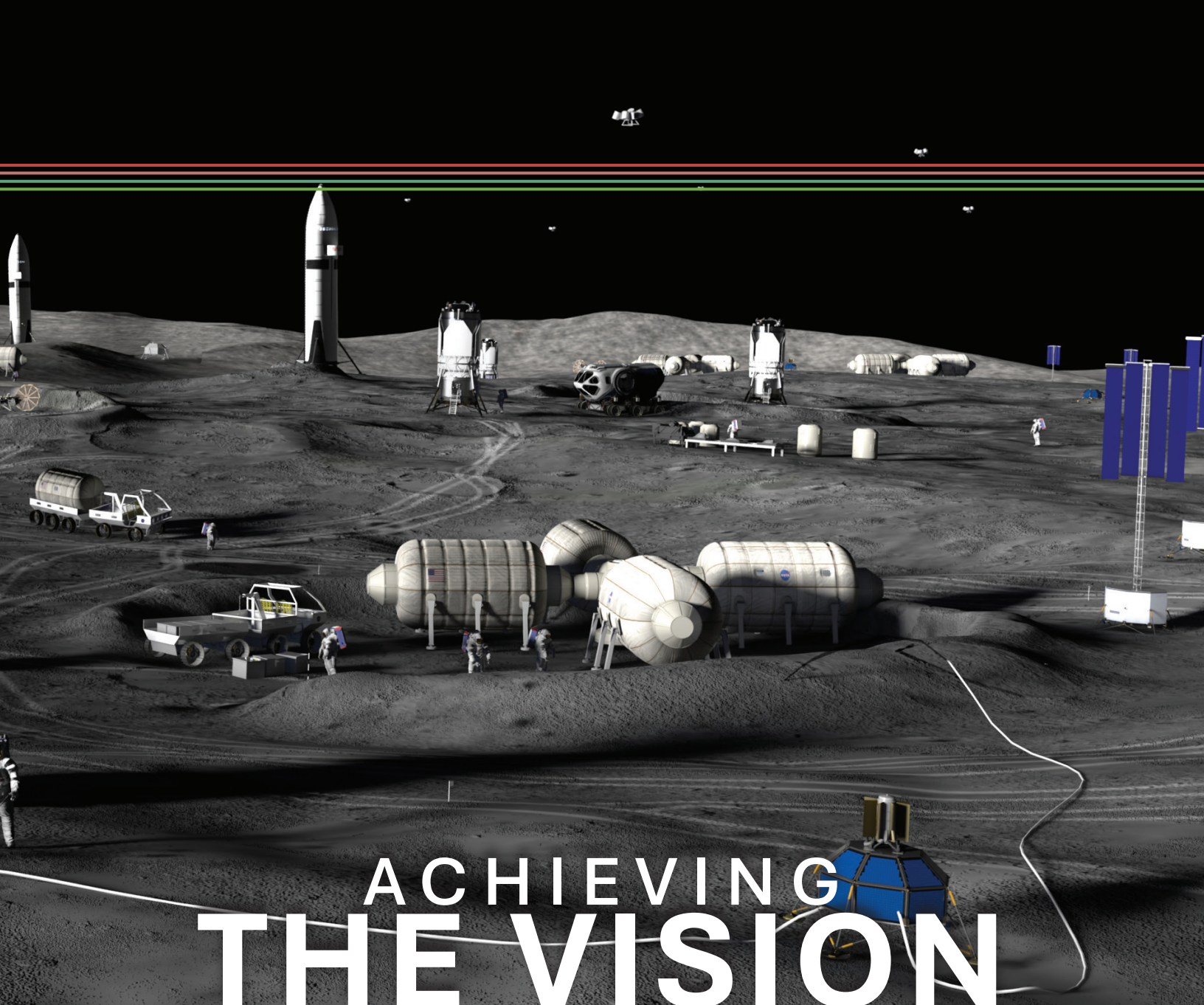
# EXECUTIVE SUMMARY

On March 24, 2026, NASA hosted a special *Ignition* event, inviting representatives from industry and the international space community to NASA Headquarters to discuss the future of space exploration. At the event, NASA Administrator Jared Isaacman made a number of announcements, including that the United States would establish a Moon Base in the lunar South Pole region, using a phased iterative approach. The announcement clarified the agency's vision for scientific, technological, and economic development at the Moon and reinvigorated a national focus on crewed exploration of deep space.

In addition to the Moon Base, NASA also announced plans for crucial Mars technology development efforts. This includes the development of Space Reactor 1 (SR-1) Freedom, a nuclear electric propulsion demo repurposing the Power and

Propulsion Element originally planned for the Gateway space station. SR-1 Freedom seeks to further unlock the benefits of nuclear power for space and demonstrates a commitment to exploration of the Red Planet through the maturation of a key transportation technology that could send crews there. The mission also includes a fleet of robotic helicopters that will scout the Martian surface for candidate landing regions for human missions to Mars.

To realize the bold vision of *Ignition*, NASA and its partners must thoughtfully accelerate development of enabling capabilities. This document overviews resources available within the agency's Architecture Definition Document that can help guide these research, technology, and infrastructure investments to realize the Moon Base and empower future human exploration of Mars.



# ACHIEVING THE VISION

The phased Moon Base development plan outlined during *Ignition* provides a vision of the scope and nature of development needed to achieve a sustained lunar presence. Further, *Ignition* offers an end goal — a continuous human presence on the lunar surface — which guides architecture development toward an enduring human presence on the lunar surface, where NASA fully unlocks the scientific, technological, and economic benefits of lunar exploration.

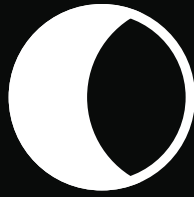
Aligning capabilities and functions from NASA's Architecture Definition Document to Moon Base priorities provides a framework by which NASA can develop partnerships with industry, academia, and international space agencies to achieve this vision.

The Architecture Definition Document includes a number of resources that outline the knowledge gains and technology development needed to realize the Moon Base and the Mars-forward technologies and operational experience it enables. Some key resources include appendixes for needed functions not currently allocated to exploration elements; technology areas that would benefit from research and development investments; and needed knowledge about the cislunar environment that could be met by current or future NASA or partner missions.

The following pages outline how NASA and its partners can empower the Moon Base effort using these resources to guide their investments.

for more information about exploration architecture development, visit [www.nasa.gov/architecture](http://www.nasa.gov/architecture)

# MOON BASE PHASED IMPLEMENTATION



PHASE  
**01**



25 LAUNCHES



21 LANDINGS



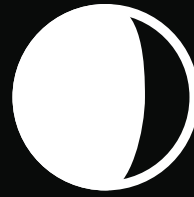
~4,000 KG  
payload to surface

Achieve high-rate, reliable surface access.

Establish ground truth for Moon Base landing sites.

Experiment and test capabilities.

First crewed Moon Base mission.



PHASE  
**02**



27 LAUNCHES



24 LANDINGS



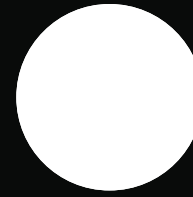
60,000 KG  
payload to surface

Establish initial lunar surface infrastructure.

Increase CLPS payload mass capability to 5MT.

Technology demonstrations.

Semi-annual Crewed Missions.



PHASE  
**03**



29 LAUNCHES



28 LANDINGS



150,000 KG  
payload to surface

Regolith manipulation and site preparation.

Increase CLPS payload mass capability to 8MT.

Uncrewed cargo return capabilities.

Continuous Crew Presence.

for full, up to date phasing implementation details, visit [www.nasa.gov/ignition](http://www.nasa.gov/ignition)



This winning submission from NASA's 2024 architecture art challenge shows a spacecraft orbiting above a Moon Base with a variety of surface elements.

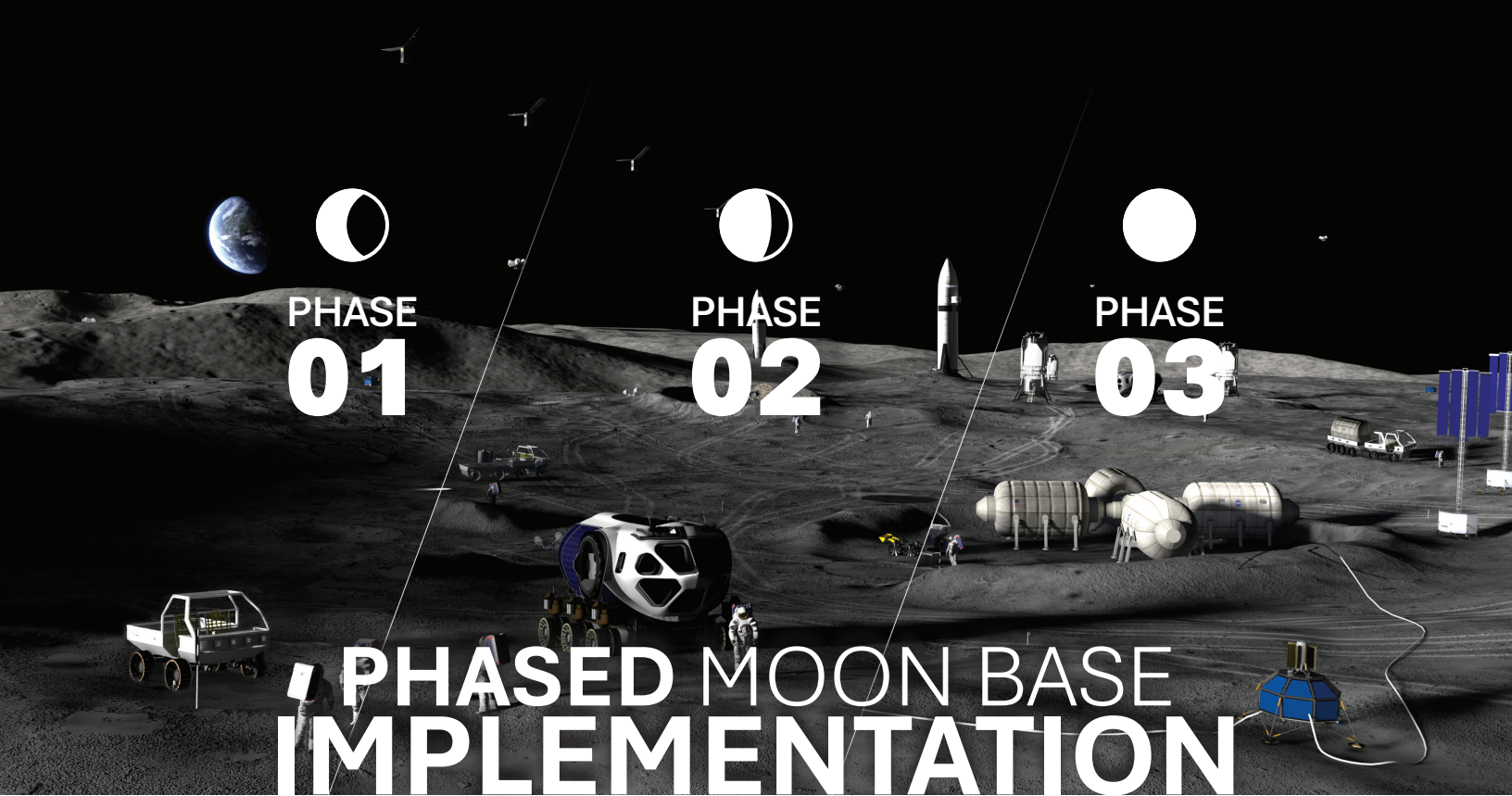
Artist Credit:

**Jimmy Catanzaro**  
Henderson, Nevada

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NASA is embarking on the most ambitious space project in recent history: building a **Moon Base**. Located in the lunar South Pole region, this long-term effort will strengthen **American leadership in space**, usher in **scientific discoveries**, and serve as the **proving ground** for **crewed Mars missions** — and NASA will not undertake this endeavor alone. This program will be built alongside our **commercial innovators** and **international partners**, whose contributions will be essential to achieving an **enduring presence** on the lunar surface.

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# PHASED MOON BASE IMPLEMENTATION

The phased Moon Base approach begins now. By starting with near-term, small-scale technology demonstrations and experiments, NASA and its partners can test systems and iterate toward the major capabilities that continuous habitation will require. Missions in Phase 1 can directly influence the systems that NASA and its partners build in Phases 2 and 3.

While NASA and its partners have designed early Artemis program elements (e.g., the initial surface habitat) for self-sufficiency, ongoing exploration creates needs for shared lunar infrastructure. To enable Moon Base development, NASA and its partners can start building scalable, shared systems for power, logistics, communications, and navigation. While self-sufficiency enables early lunar exploration, sharing these services across the architecture will offer increasing flexibility, efficiency, and robustness as the Moon Base progresses through implementation phases.

The phased approach addresses two key strategic factors: **market enablers** and **technology readiness**.



**MARKET ENABLERS**



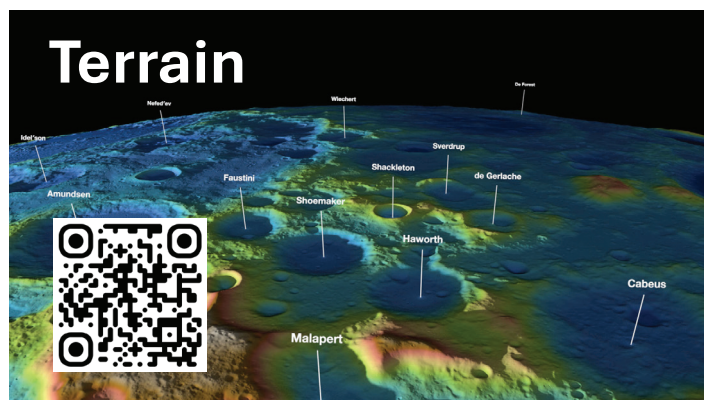
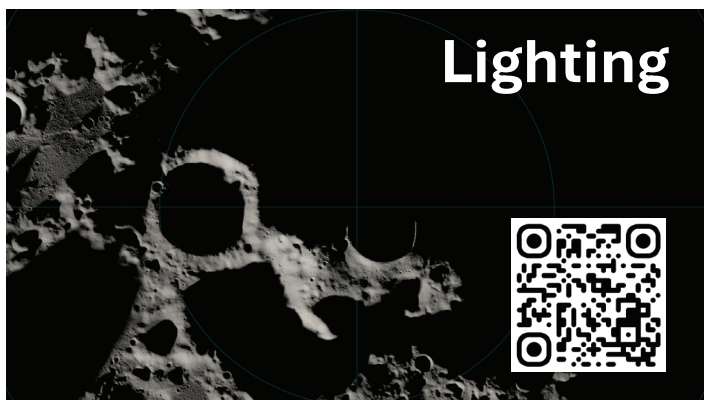
**TECHNOLOGY READINESS**

Applying lessons learned from the CLPS (Commercial Lunar Payload Services) program, NASA will use bulk buys and multiple awards to enable cost savings in long lead parts purchases, reassurance of capital investments, and diffusion of base costs. This economy of scale offers sustained business cases to industry partners, empowering the development of a lunar marketplace and economy, while assuring effective allocation of taxpayer investments in civil space.

While many Moon Base-enabling technologies already exist on Earth, NASA must mature these capabilities through flight test missions. Near-term flights aboard CLPS landers and other commercial missions during phase one will prove these technologies in space and create opportunities for iteration and advancement, all while buying down risk for subsequent Moon Base phases.

# ENVIRONMENTAL CHALLENGES

To begin implementing the Moon Base, NASA and its partners must consider and address the many challenges presented by exploration of the lunar South Pole region, including lighting and terrain.



The Moon Base elements and development will occur in the lunar South Pole region, which has an incredibly different lighting environment than the equatorial maria and highlands visited by Apollo. At the Moon Base, the Sun will remain low on the horizon, casting dramatic shadows that hinder solar electricity generation and subject systems to prolonged periods of extreme cold and dark.

Systems, operational paradigms, and site plans must be robust to the challenges presented by lighting in the lunar South Pole region. Areas of interest for technology development include heating and power solutions that allow systems to survive the lunar night and explore areas of permanent shadow. Operational considerations include new shadows cast by emplaced infrastructure.

NASA has selected the lunar South Pole region for its strategic, scientific, and economic potential — prioritizing long-term objectives rather than short-term success. The same features that make the lunar South Pole region so strategically important also make it challenging. The region features a topography of extremes, including high mountains, deep craters, and a wide variety of terrain types to explore.

For example, mobility systems will need to traverse deep craters to access frozen volatiles in permanently shadowed regions. NASA and its partners must develop systems that can descend and climb these craters' extreme slopes to collect scientific samples, prospect for resources, and enable in-situ resource utilization activities.

## INTEROPERABILITY

The Moon Base will comprise systems developed and built by many providers across government, industry, academia, and the international community. Ensuring compatibility of the interfaces between these systems will accelerate progress through the phases of Moon Base development and efficient use of resources. The collaborative development of interoperability standards for lunar systems like power, docking, and communications will empower effective partnerships and foster an ecosystem of innovation at the Moon.



PHASE 01

# FUNCTIONAL GAPS



## AUTONOMOUS SYSTEMS AND ROBOTICS

Software and hardware to assist crews and develop and maintain the Moon Base during uncrewed periods.

### ARCHITECTURAL VALUE

Maximizes exploration value, reducing burden on crew or performing functions that the crew cannot, including:

- Unloading and repositioning of surface items.
- Remote surveys, reconnaissance, and identification of resources or other sites of interest.

### CAPABILITY TARGETS

- Demonstration of capabilities to unload and manipulate cargo (10kg) on the surface.
- Demonstration of lunar site preparation capabilities.
- Demonstration of remote mating/demating of cables.

### FUNCTIONAL GAPS

<b>FN-A-104 L</b>	Perform robotic manipulation of payloads, logistics, and/or equipment on the lunar surface.
<b>FN-A-105 L</b>	Interface robotic system(s) with logistics carriers on the lunar surface.
<b>FN-A-201L</b>	Control robotic system(s) in sunlit areas and non-PSRs on the lunar surface from Earth.
<b>FN-A-302 L</b>	Provide safeguards for automated asset(s) operating near crew.
<b>FN-A-401 L</b>	Command and control asset(s) from Earth on the lunar surface during uncrewed periods.
<b>FN-M-401 L</b>	Unload a limited amount of cargo (100s of kg) on the lunar surface.
<b>FN-M-501 L</b>	Reposition a limited amount of cargo (100s of kg) in the south pole region on the lunar surface.



## COMMUNICATIONS & POSITIONING, NAVIGATION, AND TIMING

Systems to transmit data, commands, and timing information between Moon Base components and between the Moon Base and Earth.

### ARCHITECTURAL VALUE

Support surface operations, enabling:

- Communications between astronauts, surface assets, and Earth.
- Wayfinding for crewed and uncrewed excursions.
- Location documentation of surface samples and resources.

### CAPABILITY TARGETS

- Deployment of a second orbital relay constellation with surface imaging capabilities and lunar surface ground stations to enable > 500Mbps capability.
- Deployment of orbital navigation and timing assets.

### FUNCTIONAL GAPS

<b>FN-C 101 L</b>	Provide communications and data exchange between the lunar surface and Earth.
<b>FN-C 103 L</b>	Provide communications and data exchange between assets on the lunar surface.
<b>FN-C 105 L</b>	Provide high bandwidth, high-availability communications and data exchange between the lunar surface and Earth.
<b>FN-C-201 L</b>	Provide position, navigation, and timing services at the south pole region on the lunar surface.



## HABITATION SYSTEMS

Habitable volumes and supporting systems ensuring the health and performance of astronauts in controlled environments of the Moon Base.

This table summarizes sets of functional gaps that NASA and its partners must close to enable the first phase of Moon Base development by associated sub-architecture. Functional gaps are architecture functions that are either currently unallocated to any existing elements, or functions that need additional performance to be fully satisfied.

A full list of unallocated functions can be found in an appendix of the Architecture Definition Document, which is available through the QR code at the right. The list will evolve over time to reflect the needs of the base and the closure of gaps through instantiation of base systems and capabilities.



### ARCHITECTURAL VALUE

Habitation capabilities expand the duration that crew can live and work on the lunar surface, allowing for:

- Expanded exploration and science.
- More excursions.
- Additional EVA time.

### CAPABILITY TARGETS

- Demonstrate extended crew habitation capabilities, including hygiene, exercise, and nutrition.
- Demonstrate extended duration medical capabilities
- Demonstrate Earth-independent operations.
- Demonstrate management of waste streams on the lunar surface.

### FUNCTIONAL GAPS

<b>FN-H-101 L</b>	Enable a pressurized, habitable environment on the lunar surface for short durations (days to weeks)
<b>FN-H-102 L</b>	Enable a pressurized, habitable environment on the lunar surface for moderate duration (month+) use
<b>FN-X 103 L</b>	Provide crew countermeasure system(s) to support the crew for moderate durations (month+) on the lunar surface.
<b>FN-L-301 L</b>	Manage waste from habitable assets (s) on the lunar surface.
<b>FN-H-201 L</b>	Operate habitation systems(s) in uncrewed mode between crewed missions on the lunar surface.



### LOGISTICS SYSTEMS

Systems and capabilities related to the packaging, handling, transportation, staging, storage, tracking, and transfer of items and cargo for the Moon Base.

### ARCHITECTURAL VALUE

Empowers long-duration crewed exploration through:

- Resupply of crew consumables (food, clothing, etc.)
- Resupply of key resources (water, gases).
- Supply of system spares.

### CAPABILITY TARGETS

- Demonstration of capabilities to transfer pressurized goods, water, and gases on the lunar surface.

### FUNCTIONAL GAPS

<b>FN-L 101 L</b>	Provide mating between pressurized assets on the lunar surface.
<b>FN-L-201 L</b>	Transfer pressurized cargo into habitable assets on the lunar surface.
<b>FN-L-203 L</b>	Transfer water to habitable assets on the lunar surface.
<b>FN-L-205 L</b>	Transfer gases to habitable assets on the lunar surface.



### MOBILITY SYSTEMS

Systems to move crew and cargo around the lunar surface and between Moon Base components.

### ARCHITECTURAL VALUE

Expand the area of crewed and uncrewed exploration on the surface, allowing for extended excursions from landing sites.

### CAPABILITY TARGETS

- Deployment of small utility rovers and hoppers to conduct science, reconnaissance, and resource discovery.
- Deployment of large crewed and uncrewed rovers with speeds of 10 km/hr.



PHASE 01

# FUNCTIONAL GAPS

(CONTINUED)

## FUNCTIONAL GAPS

<b>FN-M-302 L</b>	Enable local unpressurized surface mobility in sunlit areas and non-PSRs in the south pole region on the lunar surface.
<b>FN-M-304 L</b>	Enable local unpressurized surface mobility in PSRs at the south pole region of the lunar surface.
<b>FN-A-103 L</b>	Provide a robotic system capable of conducting reconnaissance.
<b>FN-U-103 L</b>	Conduct resource identification utilization payload and/or equipment operations on the lunar surface.



### POWER SYSTEMS

Systems to generate, store, condition, and distribute electricity for the Moon Base, supporting infrastructure, and utilization systems.

#### ARCHITECTURAL VALUE

Provides a critical shared resource for:

- Recharging mobility assets.
- Crew habitation on the surface.
- Science payloads in shadowed regions.
- In-situ resource utilization (ISRU) processing.

#### CAPABILITY TARGETS

- Demonstrate 5 kW power generation and storage, as well as survival through 120+ hours of darkness
- Demonstrate survive the night capability using radioisotope thermal generators

## FUNCTIONAL GAPS

<b>FN-P 101 L</b>	Generate power in the south pole region on the lunar surface.
<b>FN-P 102 L</b>	Store energy in the south pole region on the lunar surface.
<b>FN-P-301L</b>	Distribute power in the south pole region on the lunar.
<b>FN-P-401L</b>	Provide power for deployed surface utilization payloads/equipment.
<b>FN-P-402 L</b>	Provide power for deployed external surface utilization payload(s) and/or equipment for mid- (month+) to long-durations (year+).



### TRANSPORTATION SYSTEMS (CARGO)

Systems that convey cargo between Earth and the Moon (e.g., launch vehicles, transportation systems, cargo landers).

#### ARCHITECTURAL VALUE

Empowers fundamental surface operations, enabling:

- Delivery of surface assets and infrastructure.
- Delivery of logistics items and carriers to the surface.
- Delivery of science and utilization payload.

#### CAPABILITY TARGETS

- Deployment of landers with two metric ton cargo delivery capability to the lunar South Pole region.

## FUNCTIONAL GAPS

<b>FN-T-201 L</b>	Transport a limited amount of cargo (100s of kg) from Earth to South Pole region sites on the lunar surface.
<b>FN-T-202 L</b>	Transport a moderate amount of cargo (1000s of kg) from Earth to South Pole region sites on the lunar surface.

# ARCHITECTURE-DRIVEN TECH & DATA GAPS

NASA's architecture driven **technology gaps** and **data gaps** capture new technologies and information, respectively, that the agency needs to achieve its exploration objectives and build the Moon Base. They serve as demand signals from NASA to industry, academia, and international partners. Both lists continue to evolve over time.

The following pages highlight key technology and knowledge challenges associated with near term Moon Base development efforts. Missions during phase one of Moon Base development offer opportunities to collect data and mature technologies to enable essential phase two and phase three capabilities. You can read more about both technology gaps and data gaps in NASA's Architecture Definition Document appendices.

## TECH GAPS

The **architecture driven technology gaps** represent the difference between available functional capabilities and desired future capabilities. The gaps require technology development investments to ensure necessary performance or capabilities beyond the current state of the art.

If a new project or program can meet an architectural need using existing technology, then that area is not a technology gap. Architecture driven technology gaps require entirely new technologies or significant advancement in performance to establish a capability needed to realize phased implementation of the Moon Base.

Each gap captures multiple data points, including the identified need, the current state of the art, the gap's significance to exploration, and the gap's urgency. Closure of the gaps listed on the next pages will empower near term Moon Base capabilities. The full list of gaps is available in NASA's Architecture Definition Document.

Follow the QR code below for a white paper with more detail about the architecture driven technology gaps.



*The Moon, backlit by the Sun during a solar eclipse, is photographed by NASA's Orion spacecraft on Monday, April 6, 2026, during the Artemis II mission. Orion is visible in the foreground on the left. Earth is reflecting sunlight at the left edge of the Moon, which is slightly brighter than the rest of the disk.*

## DATA GAPS

The architecture driven data gaps exist when a lack of information affects NASA's ability to implement the Moon Base and enable lunar exploration. The missing information comprising a data gap could impact the agency's ability to perform architecture analyses, characterize or reduce mission risk, develop hardware, mature technology, or advance science.

The gaps represent areas where current and future NASA or partner missions can provide data to support future exploration. Through the clear demand signal that these architecture driven data gaps provide, NASA and its partners can better align their data gathering efforts to support human exploration of the Moon, Mars, and beyond.

NASA published an initial list of architecture driven data gaps in revision C of the Architecture Definition Document; they are not comprehensive or prioritized. Future revisions of the document will update the list of data gaps.

Follow the QR code below for a white paper with more detail about the architecture driven data gaps.



# TECHNOLOGY & KNOWLEDGE CHALLENGES

The capabilities below are essential for building and operating the Moon Base. NASA and its partners are working to fill the associated technology and data gaps, starting with initial missions in phase one.

## Landing Safely and Accurately on the Lunar Surface

### KNOWLEDGE CHALLENGE

Observe the lunar surface to identify surface blocks, such as rocks and craters; map surface topology; and characterize variance in gravitational fields to enable precise and safe landings.

Characterize and predict the properties of a plume-surface interaction (PSI) event, including ejecta trajectory, particle size distribution, and resulting surface site alterations to evaluate impact risk to mission and nearby assets.

DN 001 L | DN 014 L | DN 002 L | DN 017 L | DN 018 L

### TECHNOLOGY CHALLENGE

Develop precision landing systems capable of taking highly accurate range and velocity measurements over low-visibility terrain, including in shadow and with induced PSI effects.

Develop hazard avoidance systems capable of real time identification of hazardous terrain to find safe touch down locations.

#1101

*Associated Challenges*

### Securing Sites

Identifying, selecting, and landing at individual sites requires more data about the lunar surface, including regolith properties, high-resolution imagery, mapping, and resource locations.

DN 001 L | DN 002 L | DN 003 L | DN 004 L | DN 005 L | DN 006 L | DN 007 L | DN 008 L  
DN 009 L | DN 010 L | DN 013 L | DN 014 L

### Small Cargo Return

Returning cargo from the lunar surface (e.g., scientific samples) requires a detailed understanding of how launch from the surface affects lunar regolith and nearby assets.

DN 017 L | DN 018 L

## Operating on the Lunar Surface for Long Durations

### KNOWLEDGE CHALLENGE

Characterize the lunar surface environment to predict performance impacts and risks associated with long duration surface operations.

Investigate dust mechanics, regolith geotechnical properties, and radiation/charged particle fluctuations, seasonal patterns, and scattering.

DN 008 L | DN 009 L | DN 010 L | DN 011 L | DN 012 L | DN 013 L | DN 015 L | DN 016 L  
DN 019 L

### TECHNOLOGY CHALLENGE

Develop extreme temperature-tolerant mechanisms and electronics for operating through periods of lunar shadow without dedicated heating systems.

Develop mitigation systems and strategies to limit system degradation from lunar dust, which is extremely abrasive and electrostatic, meaning it will cling to and damage surface hardware.

Develop navigation and timing systems that account for the lunar surface electromagnetic radiation environment, which can impact their accuracy.



#0101 | #0201 | #0301 | #0801 | #0804

*Associated Challenges*

### Surface-to-Surface Comms

Deploy communications systems that can operate in the lunar geological, electromagnetic, and radio frequency environment.

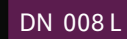
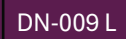
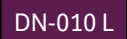
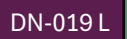

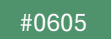



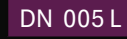
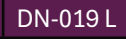

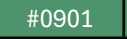
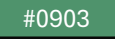
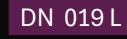
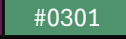
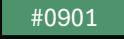
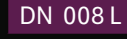
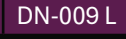
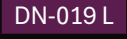
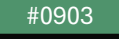
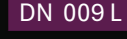
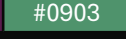
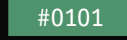

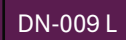
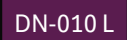
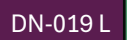



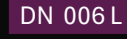
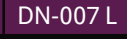

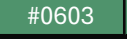
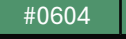
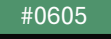
#0103

 = Data Gap  
 = Tech Gap

# TECHNOLOGY & KNOWLEDGE CHALLENGES

The capabilities below are essential for building and operating the Moon Base. NASA and its partners are working to fill the associated technology and data gaps, starting with initial missions in phase one.

*Associated Challenges (Continued)*

<b>Manipulating Regolith</b>	Manipulating lunar regolith at scale for excavation, compaction, and site preparation requires in depth understanding of regolith properties and large scale excavation and construction.	 DN 008 L  DN-009 L  DN-010 L  DN-019 L  #0505  #0605
<b>Moving Logistics</b>	Manipulating and transferring lunar surface logistics requires robotic systems for off loading and manipulating payloads, as well as long duration packaging systems for protecting cargo.	 #0701  #0806  #1001
<b>Solar Power</b>	Deploying systems to generate, store, and distribute solar power requires precise knowledge of lighting conditions and array performance, as well as systems robust to the lunar environment.	 DN 005 L  DN-019 L  #0504  #0901  #0903
<b>Thermal Generators</b>	Using radioisotope thermal generators (RTGs) to provide survive the night capabilities requires detailed knowledge of the lunar environmental and systems that can operate there.	 DN 019 L  #0301  #0901
<b>Electrical Connections</b>	Connecting systems and sharing power on the lunar surface requires dust tolerant connections and the ability to deploy cables.	 DN 008 L  DN-009 L  DN-019 L  #0903
<b>Wireless Charging</b>	Demonstrating wireless charging for rovers requires both detailed knowledge of the lunar environment and interoperable wireless power systems that work in that environment.	 DN 009 L  #0903
<b>Timing Systems</b>	Timing systems must be capable of providing precise real time synchronization between assets on the lunar surface with low latency and drift.	 #0101
<b>Pressurized Mating</b>	Mating pressurized systems on the lunar surface requires dust tolerant systems, which rely on detailed knowledge of lunar regolith and the surface environment.	 DN 008 L  DN-009 L  DN-010 L  DN-019 L  #0807
<b>Initial Habitation</b>	Demonstrate deployment and operation of a small, pressurized, crew rated surface module with a minimal environmental control and life support system and externally supplied power.	 #0807  #0903
<b>ISRU Systems</b>	Using local lunar resources to enable exploration requires both detailed knowledge of resource availability and systems to extract and process those resources.	 DN 006 L  DN-007 L  #0601  #0603  #0604  #0605

# MARS-FORWARD CONSIDERATIONS



The Moon Base will empower NASA to develop, test, and demonstrate needed technologies, capabilities, systems, and operational paradigms for future human missions to Mars. Realizing a continuous presence on the lunar surface will also provide experts with data needed to understand the impacts of long-duration spaceflight missions on human explorers. Key areas of Mars-forward development and risk reduction at the Moon Base include:

## NUCLEAR TECHNOLOGIES



Developing Moon Base nuclear power systems empower Mars exploration, where NASA has already selected nuclear fission as primary power generation technology for its robustness to the planet's environment (i.e., to dust storms). These efforts also benefit nuclear propulsion development efforts for Mars transportation systems.

## INDEPENDENT OPERATIONS



As human explorers venture further from their home planet for longer durations, Earth-independent operations become increasingly important. NASA can test many enabling capabilities and operational principles at the Moon Base, including autonomous systems, human/robotic interactions, and astronaut autonomy.

## HUMAN FACTORS



A continuous presence at the Moon Base means more data on astronaut performance in deep space than ever before. The Moon Base will offer scientists better insight into human responses to human spaceflight hazards and help mission designers better plan for prolonged missions, gravity adaptations, and partial gravity EVAs.

## LOGISTICS STRATEGIES



Long-term habitation at the Moon Base means developing long-term strategies for deep space logistics. Fostering a marketplace for lunar logistics will empower government and industry to develop the capabilities and operational competencies needed to support crewed missions to the Red Planet.

## DUST TOLERANCE



Systems developed for the lunar and Martian surfaces both contend with dusty regolith that can damage systems or impede operations. Developing dust-tolerant systems or dust mitigation strategies as a part of Moon Base implementation will advance the capabilities available for Mars mission development.

## PLANETARY PROTECTION



Planetary protection practices protect the Moon and Mars from Earth-based contamination (forward contamination) and Earth from extraterrestrial contamination (backward contamination). Developing planetary protection principles and technologies for the Moon Base will help guide planetary protection for Mars missions.

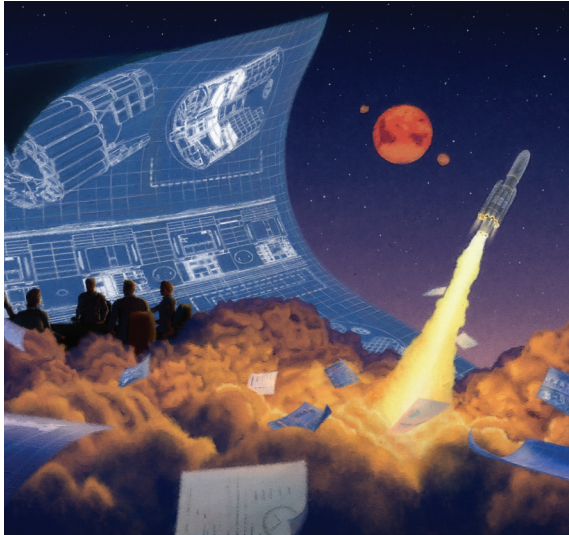
## SYSTEMS DEVELOPMENT



Developing systems, technologies, and capabilities for the Moon Base that can also be used at Mars offers great benefit to Mars architecture development. Sharing systems between destinations can reduce cost, development times, and risk. Shared engineering expertise across both architectures offers additional synergies.

# PARTNERSHIP PRIORITIES BUILDING AN ENDURING LUNAR PRESENCE

Early Moon Base activities offer the experimentation and iteration to inform the development of major Moon Base systems, services, and infrastructure. Evolving through the phases of Moon Base implementation toward a continuous lunar presence will require major strategic partnerships on flagship exploration systems and capabilities. In addition to addressing the immediate architectural gaps identified throughout this document, NASA seeks long-term Moon Base partnerships with industry, academia, and international space community. Some key areas ripe for strategic partnership include:



**SURFACE HABITATION**

**LOGISTICS SERVICES**

**SMALL MOBILITY AND ROBOTICS**

**HIGH CAPACITY MOBILITY SYSTEMS**

**LARGE CARGO DELIVERY AND RETURN**

**RESOURCE MAPPING AND RECONNAISSANCE**

**SAMPLE STORAGE AND CONDITIONING**

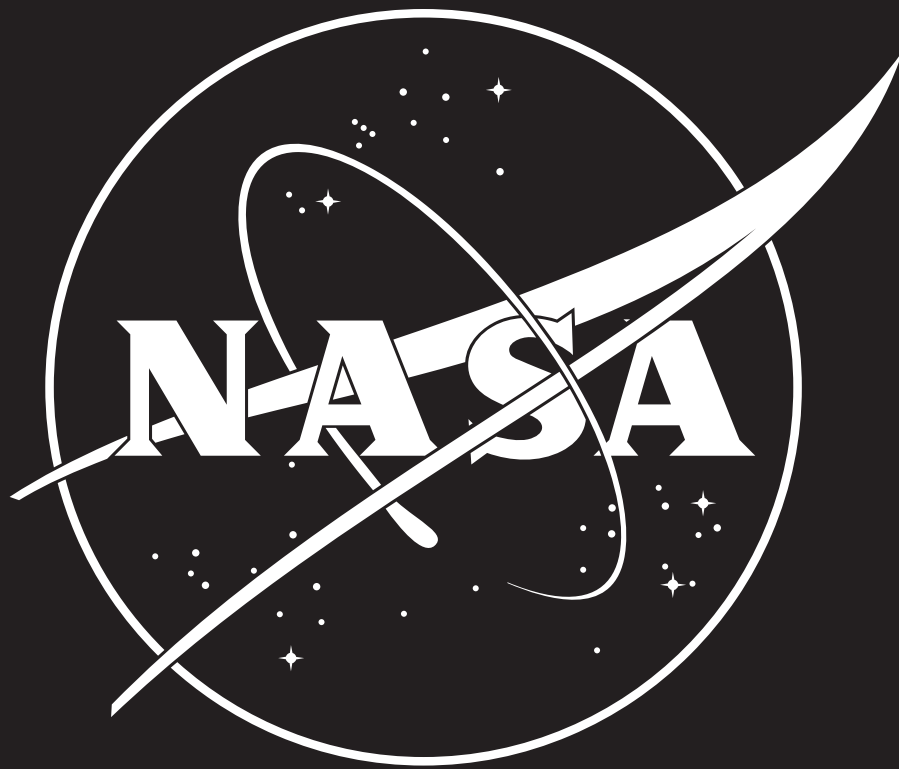
**ADVANCED NAVIGATION CAPABILITIES**

**AND MORE...**

**GET INVOLVED** [HQ-MoonBase@nasa.gov](mailto:HQ-MoonBase@nasa.gov)



The Artemis II crew captured this view of Earth setting on April 6, 2026, as they flew around the Moon. The image is reminiscent of the iconic Earthrise image taken by astronaut Bill Anders 58 years earlier as the Apollo 8 crew flew around the Moon.



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