



# NASA's Lunar Surface Power Strategy

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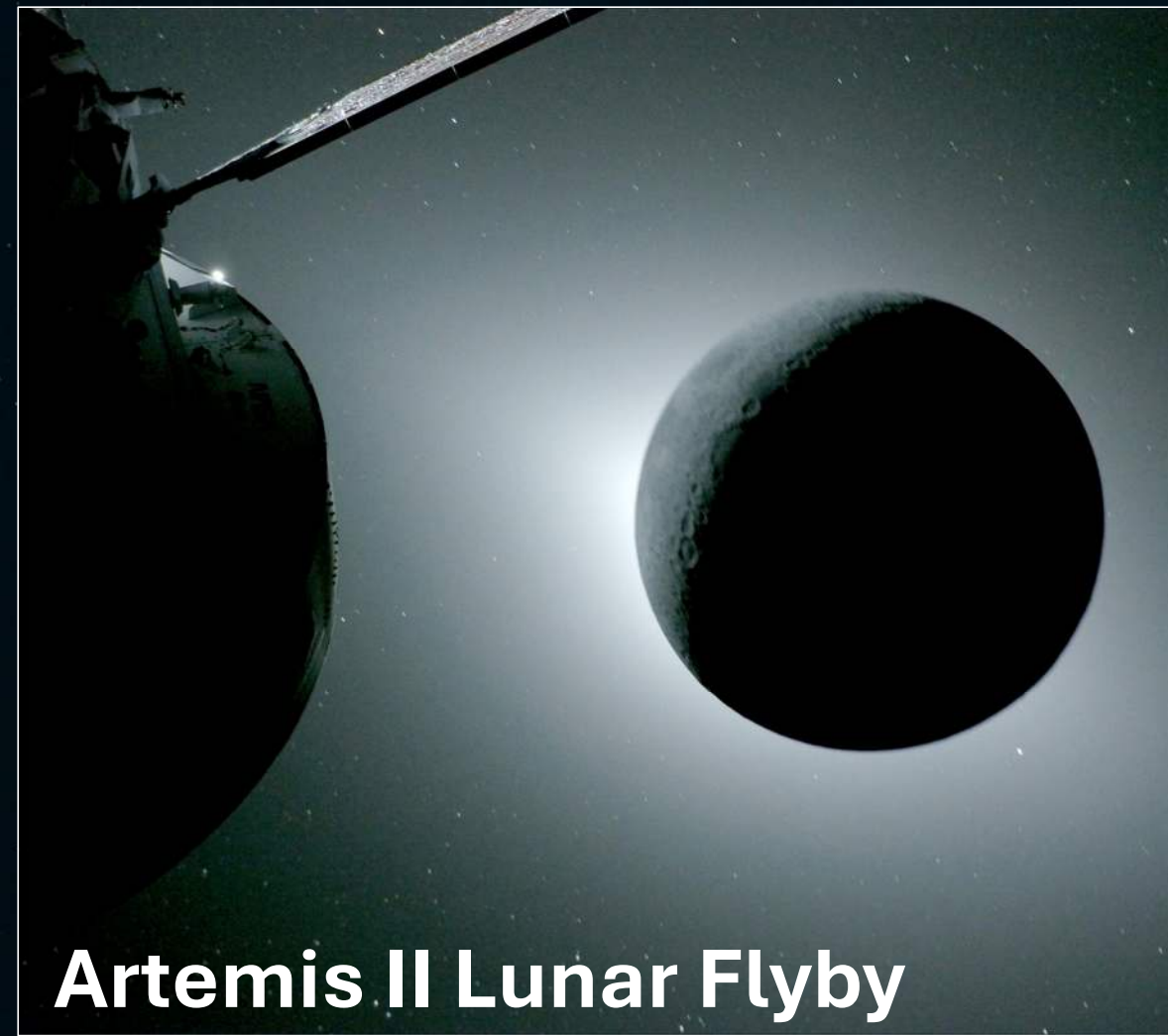
Space Power Workshop - 2026

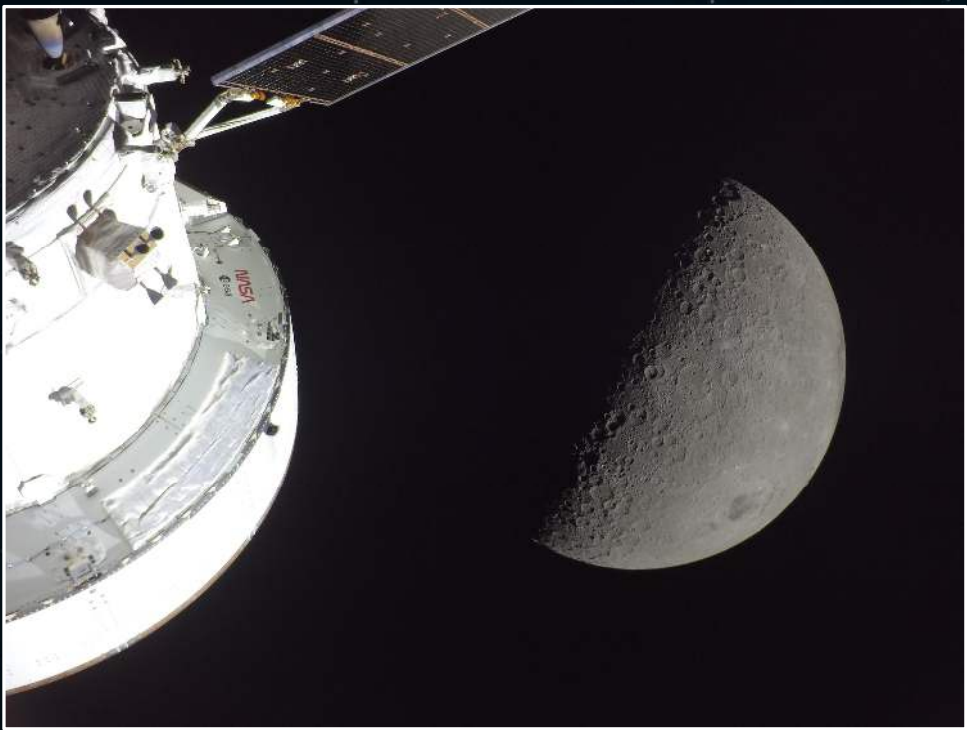




# Artemis II Mission







# Artemis II Solar Arrays

# Lunar Exploration Strategy

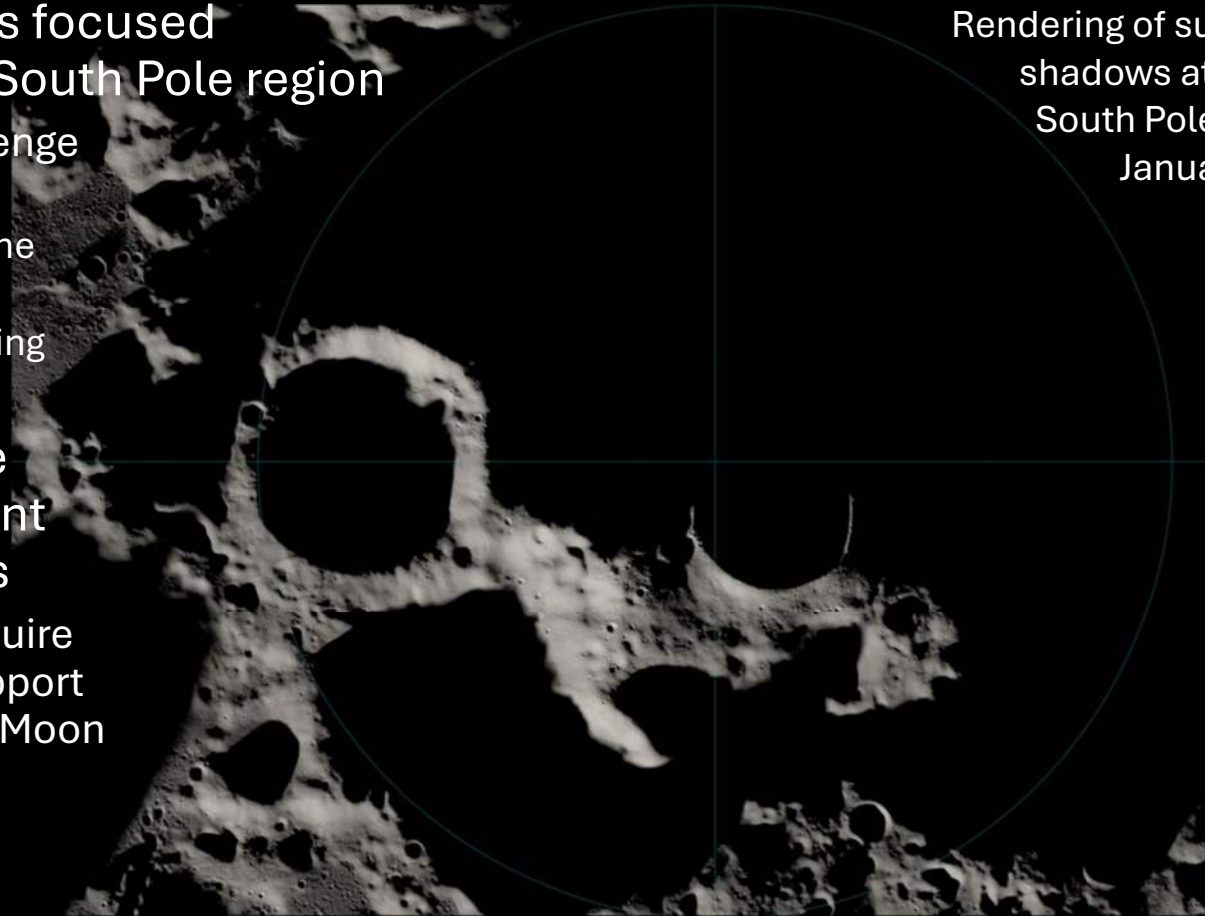


- NASA's Artemis campaign is focused on exploration of the lunar South Pole region

- Unique environmental challenge for power systems
  - Abundant sunlight during the summer months
  - Long darkness periods during the winter months

- Early exploration assets are expected to be self-sufficient for power and energy needs

- But future elements may require external power assets to support long-term exploration of the Moon



Rendering of sunlight and shadows at the Lunar South Pole region on January 1, 2030

*Lunar Environment Considerations*

# South Pole Lighting and Terrain

National Aeronautics and  
Space Administration



# NASA's Moon Base

National Aeronautics and  
Space Administration



Monday, May 18, 2026

NASA's Moon to Mars Architecture

# Exploration Phases



- Phase 1:

- Achieve high-rate, reliable surface access.
- Establish ground truth for Moon Base landing sites.
- Experiment and test capabilities.
- First crewed Moon Base mission.

- Phase 2:

- Establish initial lunar surface infrastructure.
- Increase CLPS payload mass capability to 5 MT.
- Technology demonstrations.
- Semi-annual Crewed Missions.

- Phase 3:

- Regolith manipulation and site preparation.
- Increase CLPS payload mass capability to 8 MT.
- Uncrewed cargo return capabilities.
- Continuous Crew Presence.

*Lunar Environment Considerations*

# South Pole Lighting

National Aeronautics and  
Space Administration



**Azimuth, Elevation**  
**Sun** 335.15° 6.85°  
**Earth** 300.80° 9.42°  
01 Jan 2026 00:00 UT

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Monday, May 18, 2026  
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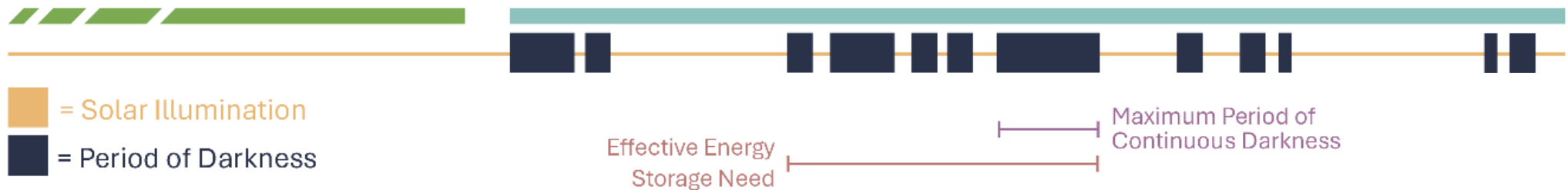
NASA's Moon to Mars Architecture

# Surviving the Night



## Lunar Summer

## Lunar Winter



### Effective Energy Storage Duration

The number of hours of energy storage capacity needed to account for the annual worst-case recharge and discharge of solar-generated power (i.e., winter survival mode).

# Phase 1: Functional Gaps



## 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+).

# Power Augmentation Benefits



SURVIVE

KEY

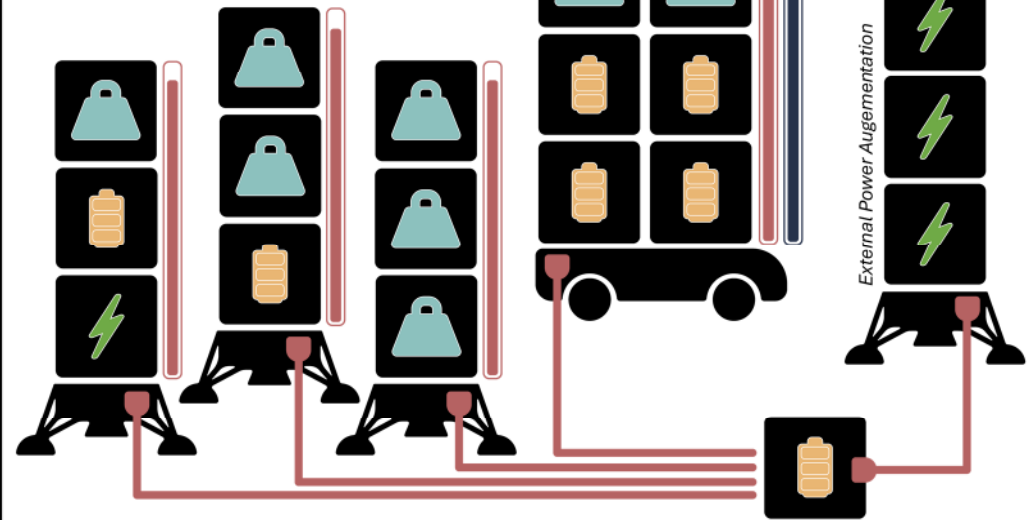
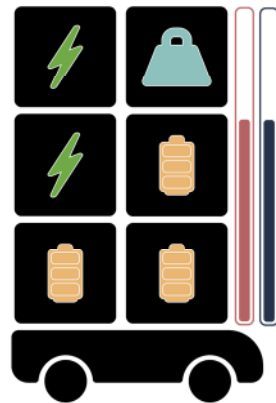
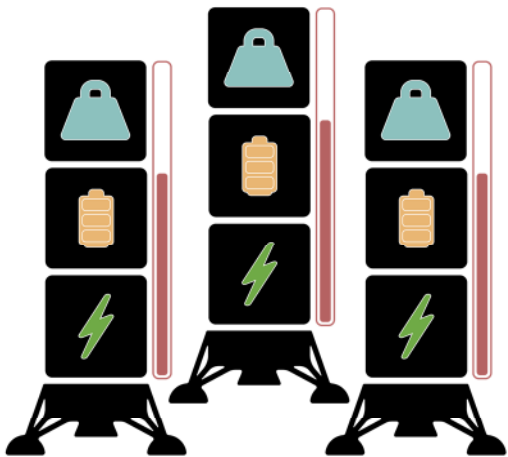
- Payload Mass
- Battery Mass
- Power System Mass

Power



Range

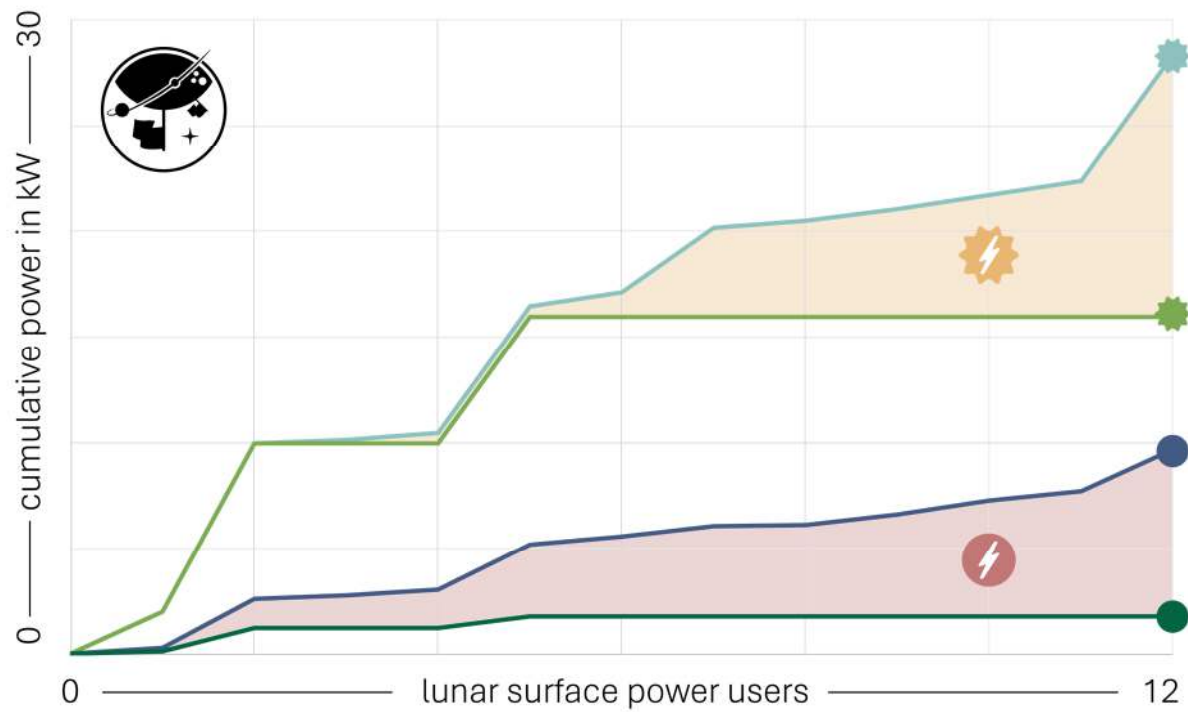
THRIVE



# Representative Growth in User Need



## Foundational Exploration Segment Power Profile



Day Power Needed

Day Power Available  
*(without augmentation)*

Day Power Gap

Night Power Needed

Night Power Available  
*(without augmentation)*

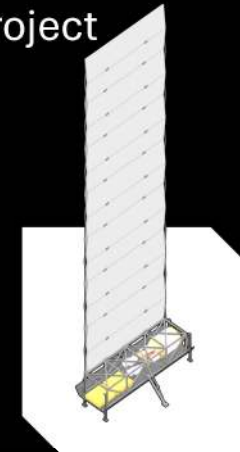
Night Power Gap

Values Notional

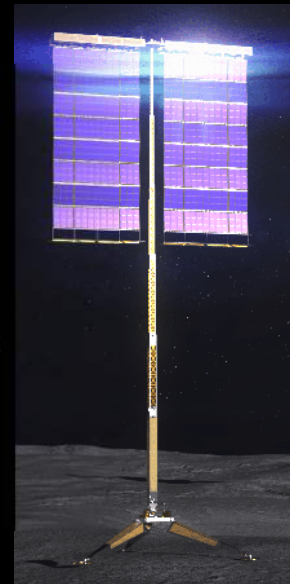
# Power System Technologies



- The unique challenges of the lunar surface environment require multiple power technologies to enable NASA's exploration vision
- High TRL – Phase 1
  - Solar array technologies like the Vertical Solar Array Technology (VSAT) project
  - High energy density lithium-ion batteries
  - Radioisotope Power Systems (heat and power!)
- Low-Mid TRL – Phase 2 & 3
  - Nuclear Fission systems like Fission Surface Power (FSP) project
  - Regenerative Fuel Cells (RFC)
  - Power beaming
  - And other advanced power system technologies



Lunar Nuclear  
Fission System



The unique lunar surface environment requires a wide range of power system capabilities to enable sustained lunar surface exploration.

# 2025 White Papers



## Architecture White Papers

- 1 Why Moon and Mars? Building an Evolutionary Architecture
- 2 Integrated Lunar Power Considerations
- 3 Architecture-Driven Planetary Protection Considerations
- 4 Comms and Navigation Needs for Foundational Exploration
- 5 Architecture-Driven Data Gaps
- 6 Architecture Definition (*update to prev. papers*)



Questions?

Thank You!