NASA's Exploration Systems Development Mission Directorate
Latest Activities and Space Technology Needs

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Exploration Systems Development Mission Directorate

Space Technology Industry-Government-University Roundtable
August 13, 2025

Artemis I

First Mission
(Uncrewed Flight Test)

COMPLETE

Artemis II

First Crew

Artemis III

First Human Surface Landing

Focus on Lunar Surface Capabilities

- Commercial transportation services
- Increased emphasis on lunar surface capabilities
- Lunar sustainment activities that support future Mars exploration

Human Exploration of Mars

More than $1 billion in new technology investments in FY 2026 to enable a crewed mission to Mars

$350 million to accelerate development of Mars technologies, executed by JSC and MSFC and leveraging agency-wide expertise

$200 million to conduct a near-term entry, descent, and landing demonstration for a human-class Mars lander

$200 million to start commercial payload deliveries to Mars

$50 million to lay the groundwork for space suits that are appropriate for the environment on Mars

$80 million to develop communications relay capabilities around Mars that provide more robust communication links between Mars and Earth

$50 million for partnerships with industry to mature concepts for transporting humans to and from the surface of Mars

$120 million for Mars robotic exploration missions and instrument payloads that will help prepare for human exploration

$80 million to accelerate development of space computers, Mars surface communications options, Mars-focused technology development prizes, and advanced surface power generation concepts

= Included in Exploration Budget Request

Rev X, Updated as of 7/3/2025

MAJOR MILESTONES FOR ARTEMIS II


PARACHUTES QUALIFIED FOR FLIGHT


*CREW EGRESS TRAINING AT NBL


ORION PRESSURE VESSEL ELEMENTS MACHINED


*HAND CONTROLLER EVAL


*DOCKING HATCH EVAL


ORION WATER IMPACT TESTING


*CREW EMERGENCY EGRESS TESTS


*CREW AT SEA TEST


*CREW MODULE UPRIGHT SYSTEM TEST


ORION ENVIRONMENTAL TESTS


HEAT SHIELD BLOCK INSTALL COMPLETE


SLS BOOSTER MOTOR SEGMENTS CAST


RS-25 ENGINES PROCESSED


SLS CORE STAGE PROOFING AND WELDING


*HUMAN-IN-THE-LOOP TESTS


*DIVER RECOVERY TRAINING


ORION MISSION CONTROL SIMULATIONS


*VACUUM PRESSURE CREW TEST


PRESSURE VESSEL COMPLETE


PRESSURE VESSEL ARRIVES AT KSC


*DISPLAY AND CONTROL EVAL


ASSEMBLY, INTEGRATION, AND TESTING AT KSC

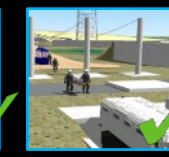

JETTISON MOTOR QUALIFIED


ATTITUDE CONTROL MOTOR QUALIFIED


SLS RL10 ENGINE COMPLETION


CREW MODULE TRAINING ARTICLE TRANSPORTED TO LETF


*EES MOCKUP EVALUATION


*PAD EMERGENCY EGRESS SYSTEM 60% DESIGN REVIEW


*EMERGENCY EGRESS SYSTEM BASKET PROTOTYPE


LH2 SPHERE


*MOBILE LAUNCHER 1 60% DESIGN REVIEW


ENVIRONMENTAL CONTROL SYSTEM CHILLERS INSTALLED


ENVIRONMENTAL CONTROL SYSTEM INFRASTRUCTURE INSTALLED


EUROPEAN SERVICE MODULE ASSEMBLY AT AIRBUS


EUROPEAN SERVICE MODULE SHIPS TO KSC


CREW MODULE ADAPTER/ EUROPEAN SERVICE MODULE MATE


CORE STAGE 2 FORWARD JOIN


CORE STAGE 2 4/5ths JOIN


CORE STAGE 2 ENGINE SECTION BREAKOVER COMPLETE


ARTEMIS I ORION N/C AVIONICS INSTALLATION IN ARTEMIS II CREW MODULE

SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETION

HEAT SHIELD INSTALL ON CREW MODULE

MOBILE LAUNCHER 1 ROLL TO PAD FOR MEVV

BOOSTERS ARRIVE AT KSC

EGS BOOSTER OFFLINE PROCESSING START

SLS INTERIM CRYOGENIC PROPULSION STAGE (ICPS) READY FOR TRANSFER TO EGS

CREW MODULE COMPLETE

CREW AND SERVICE MODULE MATE

CORE STAGE 2 READY FOR SHIPMENT TO KSC

VAB ECS UPGRADES COMPLETE

*MOBILE LAUNCHER 1 MULTI-ELEMENT V&V TEST AT PAD COMPLETE

EGS OPERATIONAL READINESS CHECKPOINT

*MOBILE LAUNCHER 1 MULTI-ELEMENT V&V AT VAB COMPLETE

BOOSTER STACKING COMPLETE

ETA TEST CAMPAIGN COMPLETE

CORE STAGE MOVED AND STACKED IN VAB HIGH BAY 3

CORE STAGE, LVSA, & ICPS INTEGRATED

ORION HANDOVER TO EGS

ORION MOVED TO MPPF FOR OFFLINE PROCESSING START

START SLS INTEGRATED TESTING

*1.4Mgal LH2 SPHERE TESTING COMPLETE

ORION TO VAB

ORION INTEGRATION TO SLS

CONDUCT FINAL INTEGRATED TESTING

ROLL TO PAD FOR TANKING TEST & LAUNCH

ARTEMIS II TANKING TEST

ARTEMIS II LAUNCH

ARTEMIS II

☐ Unique aspect of Artemis II (* unique for crew config.)

Artemis II Progress

Artemis II Core Stage Integration with solid rocket boosters at NASA Kennedy complete: March 24, 2025

NASA Ground Systems successfully integrated the SLS rocket's upper stage, including the interim cryogenic propulsion stage: May 1, 2025

Lockheed Martin completed assembly and testing of Orion and officially transferred to NASA EGS teams: May 1, 2025;

NASA Ground Systems fuel the Orion Service Module to prepare for stacking atop the SLS: June 3, 2025

Orion arrives at Kennedy's Launch Abort System Facility for integration with launch abort system: August 10, 2025

Artemis II Crew Training

Artemis II crew training in an Orion mockup at Johnson, allowing the crew to walk through what a day would look like during their upcoming mission and practice maneuvers inside the mock-up: May 2024

EGS teams test practice Artemis mission emergency escape or egress procedures during a series of integrated system verification and validation tests: August 2024

NASA and DOD conducted landing and recovery exercises with crew members: March 25-31, 2025

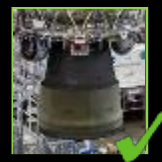
More recently, teams from NASA and DOD rehearsed abort scenario recovery procedures with the Crew Module Test Article. [VALENT]
June 12, 2025

Crew members and backup members for NASA's Artemis II mission and teams from the agency's Exploration Ground Systems Program participate in emergency egress training at Launch Complex 39B at NASA Kennedy. May 6, 2025

Artemis II crew members don their Orion Crew Survival Systems Suits for multi-day crew module training at NASA Kennedy: July 31, 2025

MAJOR MILESTONES FOR ARTEMIS III

Rev N
As of 7/9/2025



ICPS-3 ENGINE DELIVERY TO ULA

CREW MODULE ADAPTER INNER WALL DELIVERED TO O&C

CREW MODULE PRESSURE VESSEL DELIVERED TO O&C

CREW MODULE PRESSURE VESSEL PROOF TEST COMPLETED

MOTOR SEGMENTS COMPLETE

SLS INTEGRATED CRYOGENIC PROPULSION SYSTEM PRODUCTION COMPLETE

ENGINES READY FOR DELIVERY TO MAF

CONFIGURE ORION INTEGRATED TEST LAB FOR ARTEMIS III

ORION CREW MODULE ADAPTER COMPLETE

EUROPEAN SERVICE MODULE DELIVERY TO O&C

SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETE

BOOSTER AFT SKIRTS COMPLETE

BOOSTER FORWARD ASSEMBLY COMPLETE

ORION STAGE ADAPTER COMPLETE

CORE STAGE 3 LOX TANK COMPLETE

CORE STAGE 3 LH2 TANK COMPLETE

ORION DOCKING MODULE COMPLETE

CORE STAGE 3 4/5THS MATE

CORE STAGE 3 ENGINE SECTION COMPLETE

ORION SERVICE MODULE READY FOR MATE

LAS ASSEMBLY AND TEST COMPLETE

ORION CREW MODULE READY FOR MATE

CORE STAGE 3 COMPLETE

xEVAS Comm Test Complete

START BOOSTER STACKING

CREW AND SERVICE MODULE (CSM) MATE

ORION CSM DELIVERY TO EGS

ORION MPPF PROCESSING COMPLETE

EHP – xEVAS READY FOR INTEGRATION

CORE STAGE INTEGRATION

LAUNCH VEHICLE STAGE ADAPTER INTEGRATION

ICPS INTEGRATION

ORION STAGE ADAPTER INTEGRATION

ORION TO VAB

ORION INTEGRATION TO SLS COMPLETE

HLS Lunar Lander Launch

ORION SPECIFIC TESTING

CREW MODULE STOWAGE

FINAL CLOSEOUTS FOR LAUNCH & FSS

ROLL TO PAD FOR LAUNCH

EGS READY FOR ARTEMIS III LAUNCH

HLS LUNAR ORBIT CHECKOUT REVIEW (LOCR) MISSION READY

HLS - STARSHIP/SUPER HEAVY FLIGHT TEST COMPLETE

PROPELLANT TRANSFER FLIGHT TEST COMPLETE

LONG DURATION FLIGHT TEST COMPLETE

LC-39A UPDATES

HLS UNCREWED LUNAR LANDING DEMO LAUNCH COMPLETE

SCIENCE INSTRUMENT(S) DELIVERY FOR HLS INTEGRATION

HLS Uncrewed Mission Milestones

New milestones for Artemis III

For NASA Internal Use Only

Artemis III Progress

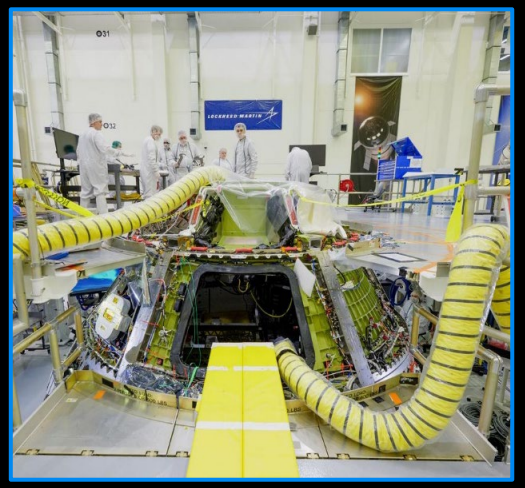
Interim cryogenic propulsion stage complete final testing and checkout: September 2023

European Service Module 3 joined with Crew Module Adapter: September 24, 2024

Integrated Artemis III testing: Full-scale airlock, elevator mockup, pressurized suits: April 2024

Artemis III Launch Vehicle Stage Adapter completed and ready to be moved to KSC: March 30, 2025

Thermal protection system applied to the SLS liquid hydrogen tank: May 14, 2025



Technicians power-on Artemis III Orion crew module for the first time at KSC: May 29, 2025

Core stage liquid oxygen tank lifted into vertical position at NASA Michoud: July 18, 2025

First pieces of flight hardware for Artemis III, the SLS rocket's boattail and engine section, arrive at Kennedy's VAB: July 30, 2025

SpaceX Starship flight 10 Successful 6- engine static fire test: August 3, 2025

Artemis III Crew Training and Equipment Testing

Wearing Axiom Space's lunar spacesuit, crew members practice for future lunar science operations during spacesuit task capability assessment: March-April 2025

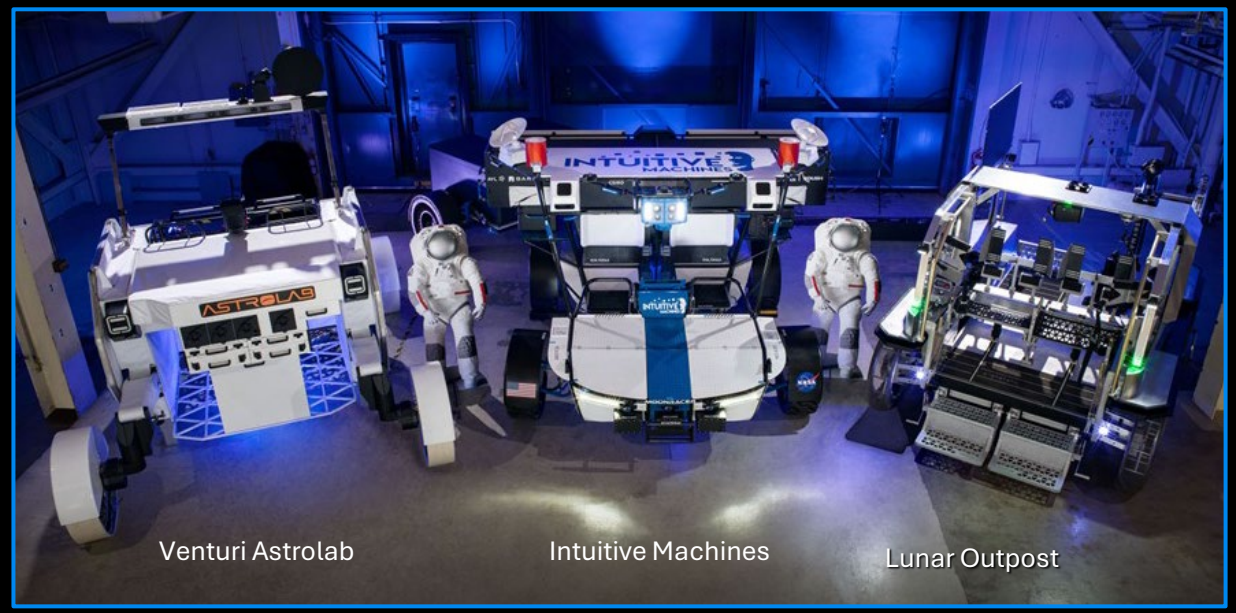
NASA's LEMS (Lunar Environment Monitoring Station), a seismometer being designed for the lunar surface, is ready for building and assembly: April 21, 2025

Axiom astronaut and NASA spacesuit engineers conducted spacesuit testing in NASA's Neutral Buoyance Lab. This is the first time that the spacesuits were tested in conditions that simulated gravity at the lunar surface. July 9, 2025

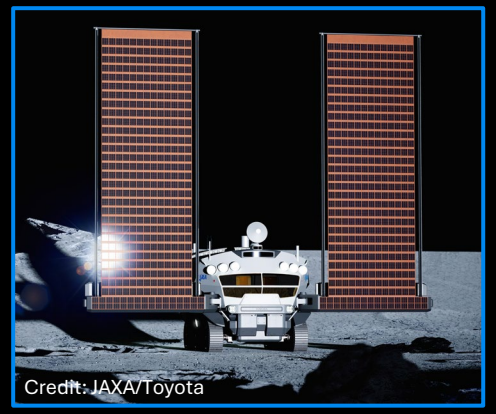
Other Recent Progress

The heavy-lift New Glenn rocket first flight test: January 16, 2025

Blue Origin's Blue Moon Mark 1 test flight will carry a NASA science payload when it lands near the lunar South Pole later this year.



Three commercial lunar rover concepts tested: December 2024
Three LTV science instruments selected: July 10, 2025



Pressurized Rover Agreement with Japan/JAXA.
Second Management Control Board meeting planned Sept. 2025.

Summary and Q&A

Backup Slides

Architecture Segments

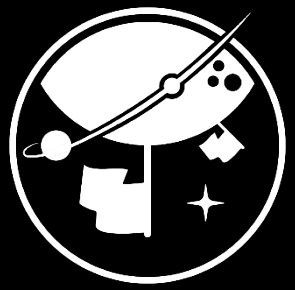
Segment | A portion of the architecture that integrates sub-architectures and progressively increases in complexity and objective satisfaction.

FUTURE SEGMENTS

Continued development and exploration at Mars and beyond for sustained exploration of the cosmos.

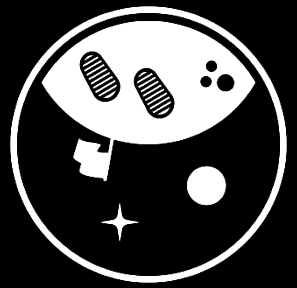
HUMANS TO MARS

Initial capabilities, systems, and operations necessary to **establish human presence** and initial utilization (science, etc.) on Mars and continued exploration.



SUSTAINED LUNAR EVOLUTION

Enabling capabilities, systems, and operations to support **regional and global utilization** (science, etc.), **economic opportunity**, and a steady cadence of human presence at the Moon.



FOUNDATIONAL EXPLORATION

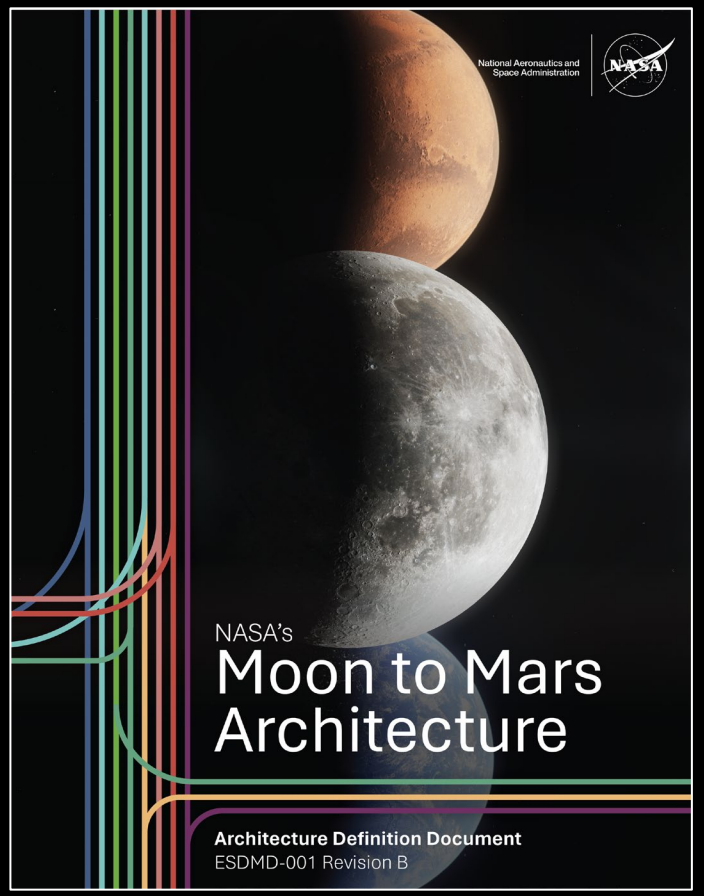
Expansion of lunar capabilities, systems, and operations supporting **complex orbital and surface missions** to conduct utilization (science, etc.) and **Mars forward** precursor missions.

HUMAN LUNAR RETURN

Initial capabilities, systems, and operations necessary to **re-establish human presence** and initial utilization (science, etc.) on and around the Moon.

Moon to Mars Architecture Website

Architecture Products



NASA's Architecture Definition Document

NASA documents its roadmap for deep space exploration in the Architecture Definition Document (ADD).

The agency updates the ADD yearly and publishes it alongside other public-facing products, including white papers on relevant topics and an executive overview of the architecture.

Architecture White Papers

Executive Overview

NASA's Moon to Mars Architecture Website
nasa.gov/architecture

Architecture products provide transparency of NASA planning and decision-making enabling collaboration and strategic alignment across government, industry, and international partnerships

Mars Surface Power Decision

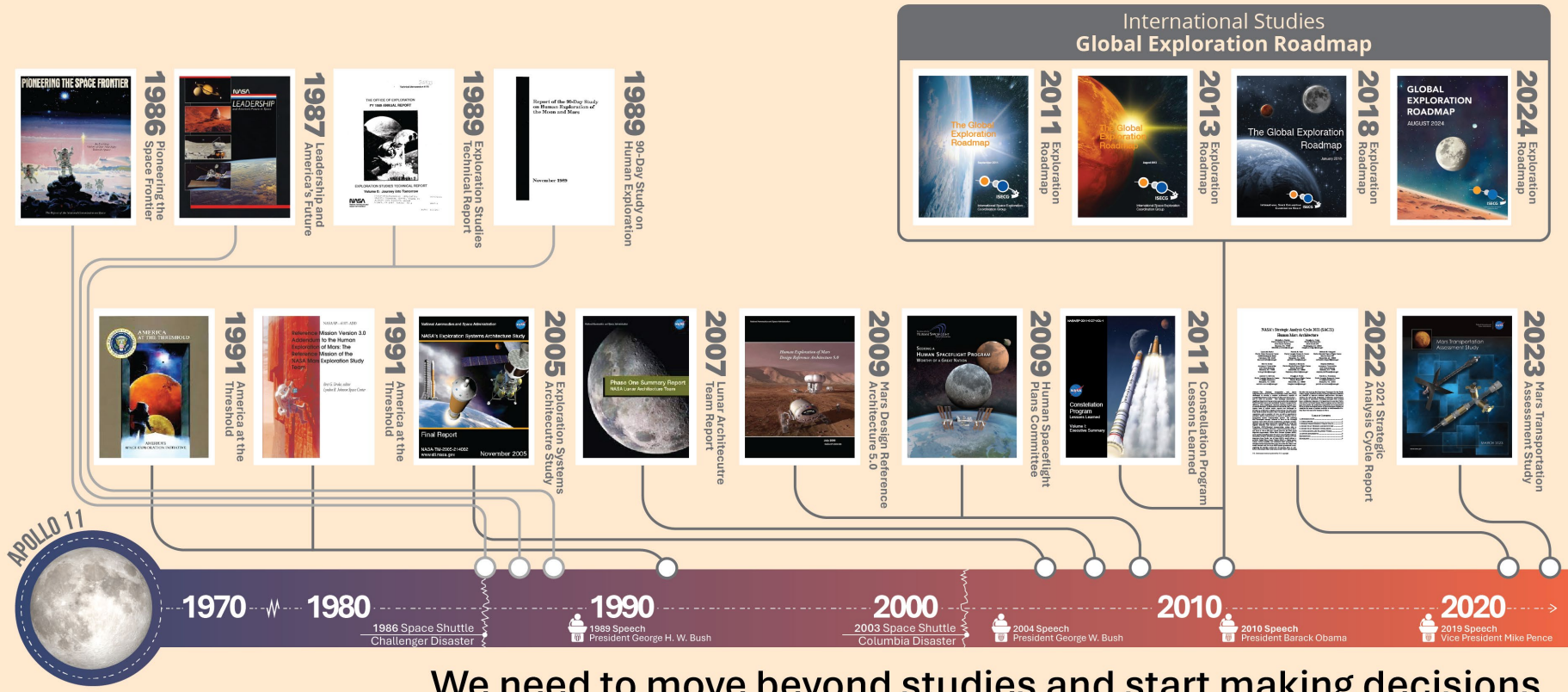
Attribute	Nuclear (Fission)	Non-Nuclear (Solar)
Robustness to Dust Storms	☑ Reliable power generation through severe storms	☒ Limited/no reliable power generation during storms with tau >7 increases system mass energy storage
Scalability	☑ Mass advantage Increases with increasing power	☑ Competitive mass at/below 10 kW ☒ Mass disadvantage grows with power need
Robustness to Solar Flux	☑ Power not appreciably affected by season, latitude, or day/night	☒ Mass/volume dependent on season/location; need energy storage mass for night-time operations
Affordability	☒ Higher development & unit cost ☑ Potential lunar cost/risk buy down	☑ Lower development & unit cost ☑ Potential for lunar activity cost/risk buy down
Robustness to Nominal Dust	☒ Dust build-up on radiators may require active/passive mitigation	☒ Dust build-up on arrays will require active mitigation ☒ Dust suspended in the atmosphere will reduce power generation and increase stored energy mass needed

Nuclear fission power selected as primary surface power generation technology for initial crewed missions to Mars

Power White Paper
https://bit.ly/3VN2Z1r

Mars-Forward Planning

Moving Beyond Studies



We need to move beyond studies and start making decisions.

**study list representative, not comprehensive.*

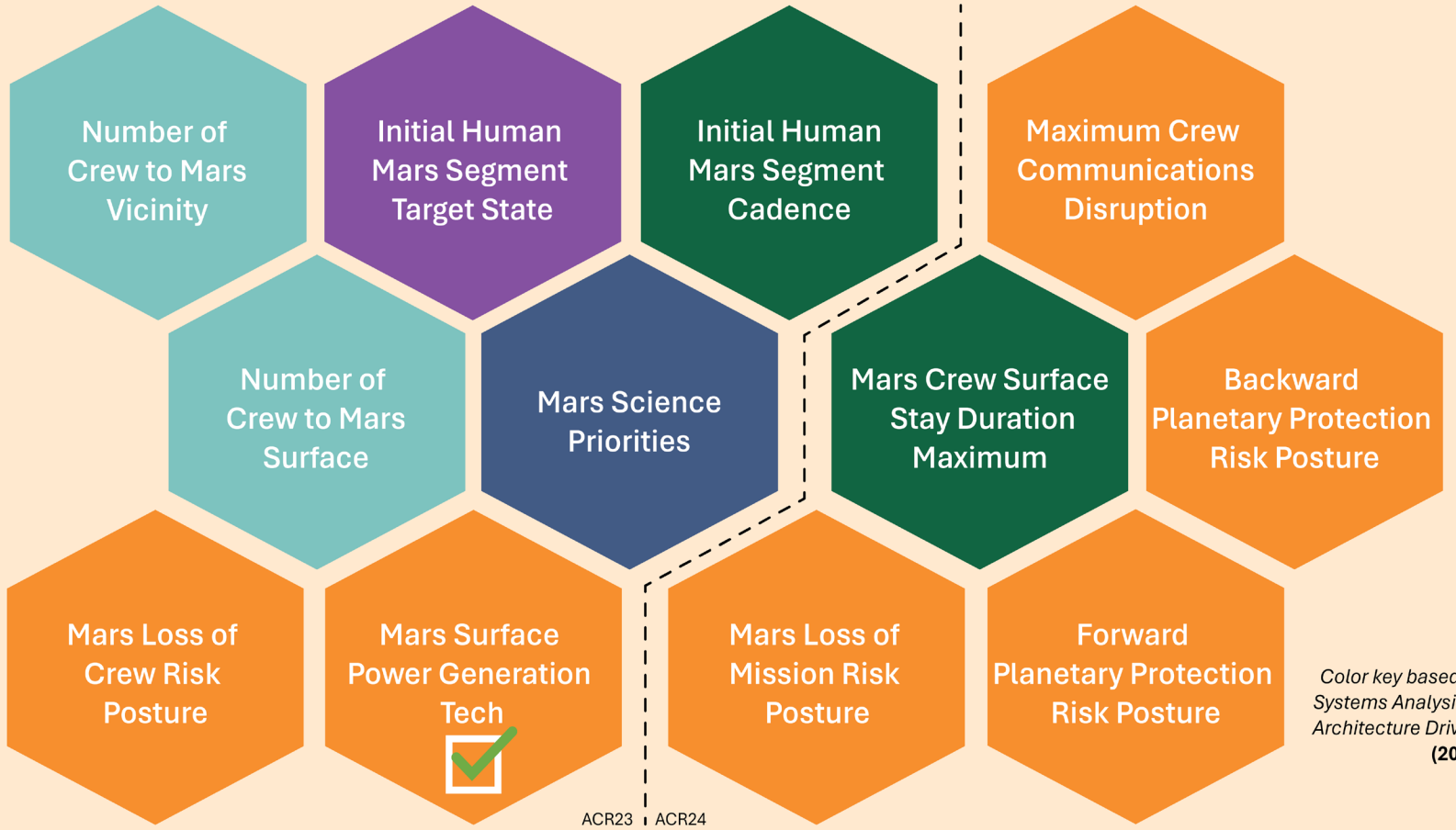
Historical Mars studies have generally focused on point solutions optimized to a single stakeholder constraint.

Historic Mars Architecture Studies

Mars Architecture: Priority Decisions

Priority Decisions

= Decision



Color key based on Systems Analysis of Architecture Drivers **(2022)**

- **Why** We Will Go
- **Where** We Will Go
- **When** We Will Go
- **What** We Will Do There
- **Who** Will Be Involved
- **How** We Will Get There and Back