

National Aeronautics and  
Space Administration



# Artemis: Partnerships Are Key to Sustainable Lunar Presence

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MMPACT Principal Investigator

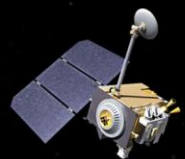
June 28, 2022



**EXPLORE**  
**MARSHALL**



# Artemis: Landing Humans On the Moon



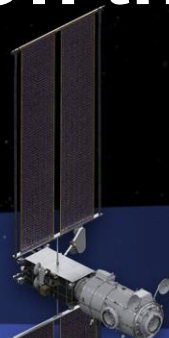
Lunar Reconnaissance Orbiter: Continued surface and landing site investigation



Artemis I: First human spacecraft to the Moon in the 21st century



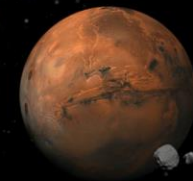
Artemis II: First humans to orbit the Moon and rendezvous in deep space in the 21st century



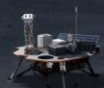
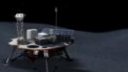
Gateway begins science operations with launch of Power and Propulsion Element and Habitation and Logistics Outpost



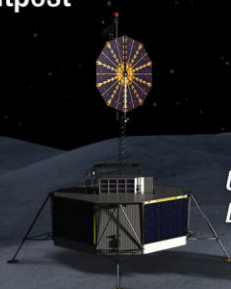
Artemis III-V: Deep space crew missions; cislunar buildup and initial crew demonstration landing with Human Landing System



**Early South Pole Robotic Landings**  
Science and technology payloads delivered by Commercial Lunar Payload Services providers



**Volatiles Investigating Polar Exploration Rover**  
First mobility-enhanced lunar volatiles survey



Uncrewed HLS Demonstration



**Humans on the Moon - 21st Century**  
First crew expedition to the lunar surface

**LUNAR SOUTH POLE TARGET SITE**



# SLS



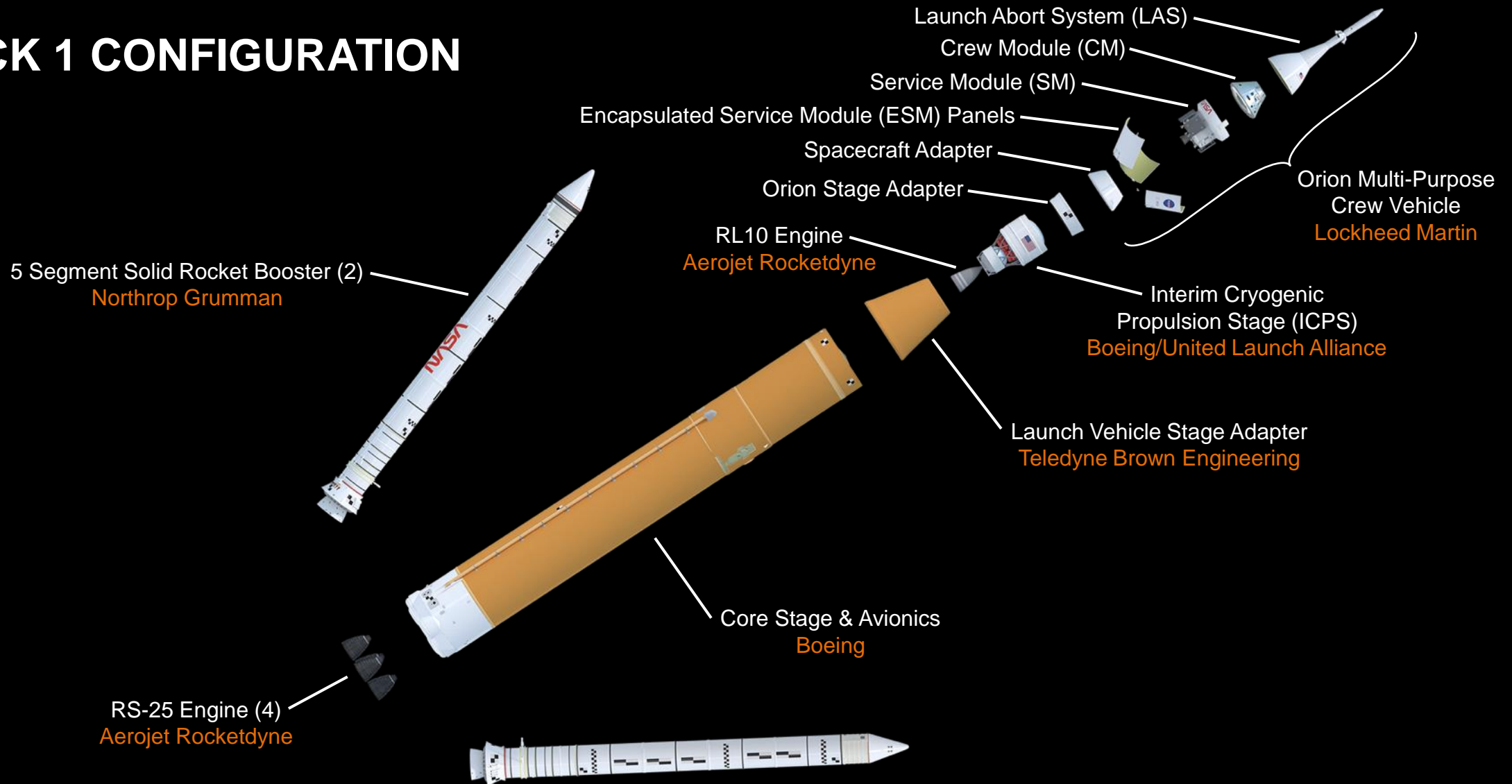


# NASA'S SPACE LAUNCH SYSTEM

BACKBONE OF DEEP SPACE EXPLORATION



## BLOCK 1 CONFIGURATION



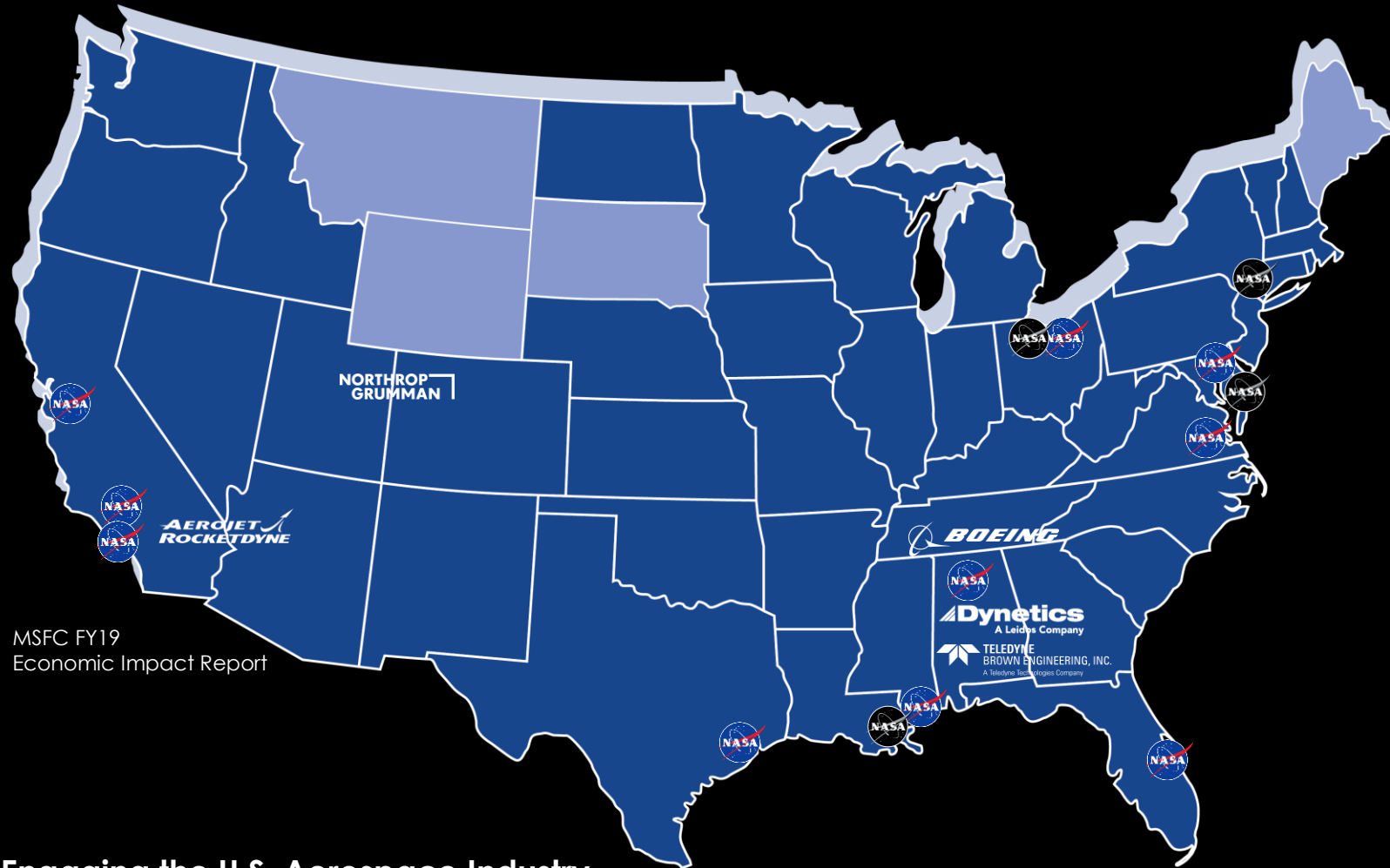
# SLS NATIONWIDE TEAM

WORKING WITH MORE THAN 1100 SUPPLIERS IN 45 STATES



## SLS Program Economic Impact (U.S.)

>28,000 jobs  
\$5.5 billion



MSFC FY19  
Economic Impact Report

- Engaging the U.S. Aerospace Industry
- Strengthening Sectors such as Manufacturing
- Advancing Technology and Innovation for Deep Space Exploration
- Partnering with High Tech Universities across the Country

 NASA Facility  
 NASA Center

# ARTEMIS III







Human Landing System

# HLS

Sustaining Lunar Transport

Using proven commercial partnership strategies, NASA is working with U.S. industry to build towards regular human lunar landings.

Companies will develop human landing systems and NASA will purchase transport services, while maintaining oversight to ensure safety standards are met.

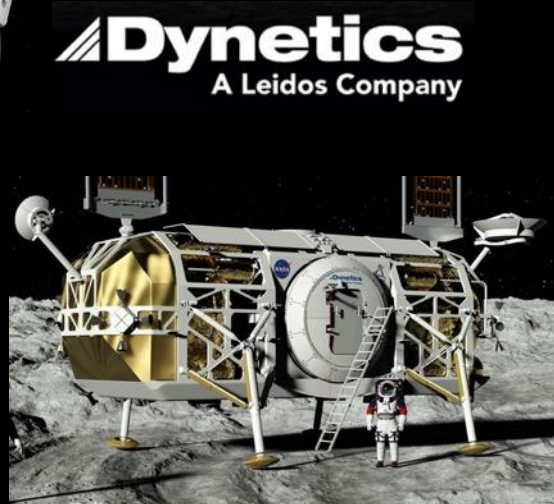
# NextSTEP Appendix N: Sustainability Studies



In preparation for Sustaining Lunar Development, NASA selected five providers in September 2021 to develop lander design concepts, evaluate mission requirements, and mitigate risks by conducting critical component tests and advancing the maturity of key technologies.



**BLUE ORIGIN**

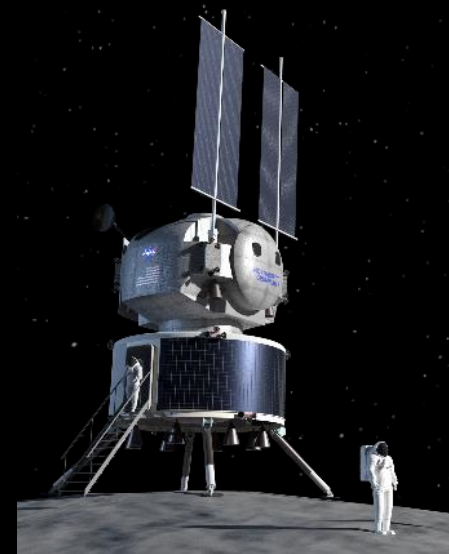


**Dynetics**  
A Leidos Company



**LOCKHEED MARTIN**

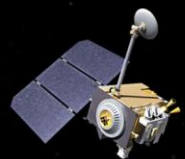
**NORTHROP GRUMMAN**



**SPACEX**



# Artemis: Landing Humans On the Moon



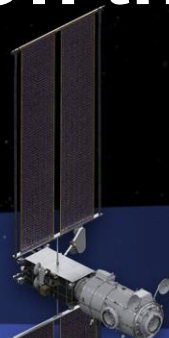
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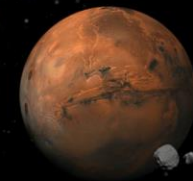
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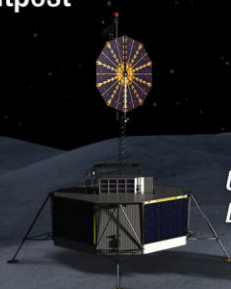
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**LUNAR SOUTH POLE TARGET SITE**





# Commercial Lunar Payload Services

14 CLPS providers are currently on contract and eligible to bid on payload deliveries to the Moon

- NASA solicits bids from CLPS companies and awards contracts to deliver science, exploration, and technology payloads to the lunar surface
- NASA has already awarded four CLPS contracts that will deliver a total of 29 payloads beginning with three landers in 2022, and one in 2023
- NASA is also soliciting payloads and subsequent landers to go to the lunar surface with a cadence of roughly two deliveries per year to characterize the Moon's surface and enable future human and robotic exploration. Watch for PRISM announcements for payload and instrumentation opportunities





# Commercial Lunar Payload Services Vendors



# Artemis Base Camp Buildup

First lunar surface expedition through Gateway; external robotic system added to Gateway; Lunar Terrain Vehicle delivered to the surface

Sustainable operations with crew landing services; Gateway enhancements with refueling capability, additional communications, and viewing capabilities

Pressurized rover delivered for greater exploration range on the surface; Gateway enables longer missions

Surface habitat delivered, allowing up to four crew on the surface for longer periods of time leveraging extracted resources. Mars mission simulations continue with orbital and surface assets.

Lunar Terrain Vehicle (LTV)

Crew Landing Services

Pressurized Rover

Fission Surface Power

ISRU Pilot Plant

Surface Habitat

## **SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION**

MULTIPLE SCIENCE AND CARGO PAYLOADS | U.S. GOVERNMENT, INDUSTRY, AND INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS



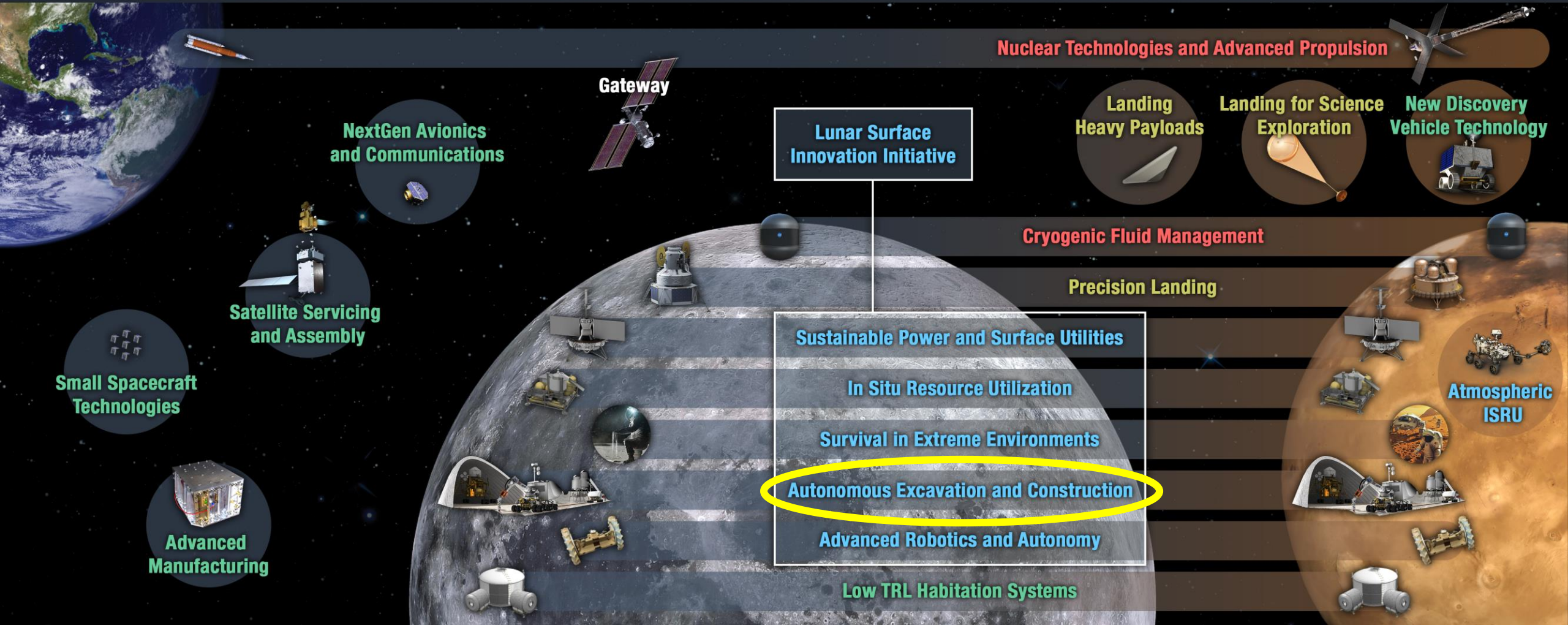
# TECHNOLOGY DRIVES EXPLORATION

Rapid, Safe, and Efficient  
Space Transportation

Expanded Access to Diverse  
Surface Destinations

Sustainable Living and Working  
Farther from Earth

Transformative Missions  
and Discoveries



2020

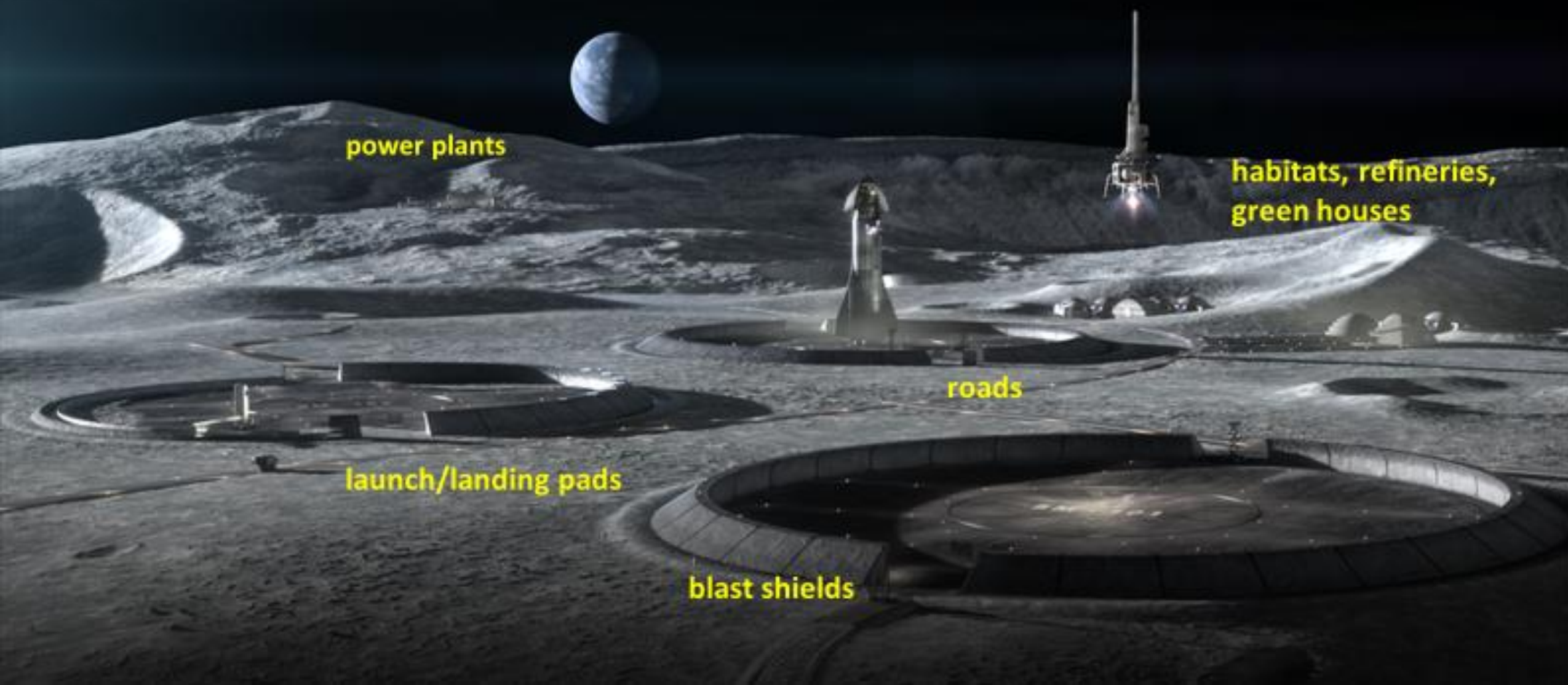
GO | LAND | LIVE | EXPLORE

203X



# Building a Sustainable Presence on the Moon

- What infrastructure are we going to need?





# Autonomous Construction Visions for the Lunar Outpost

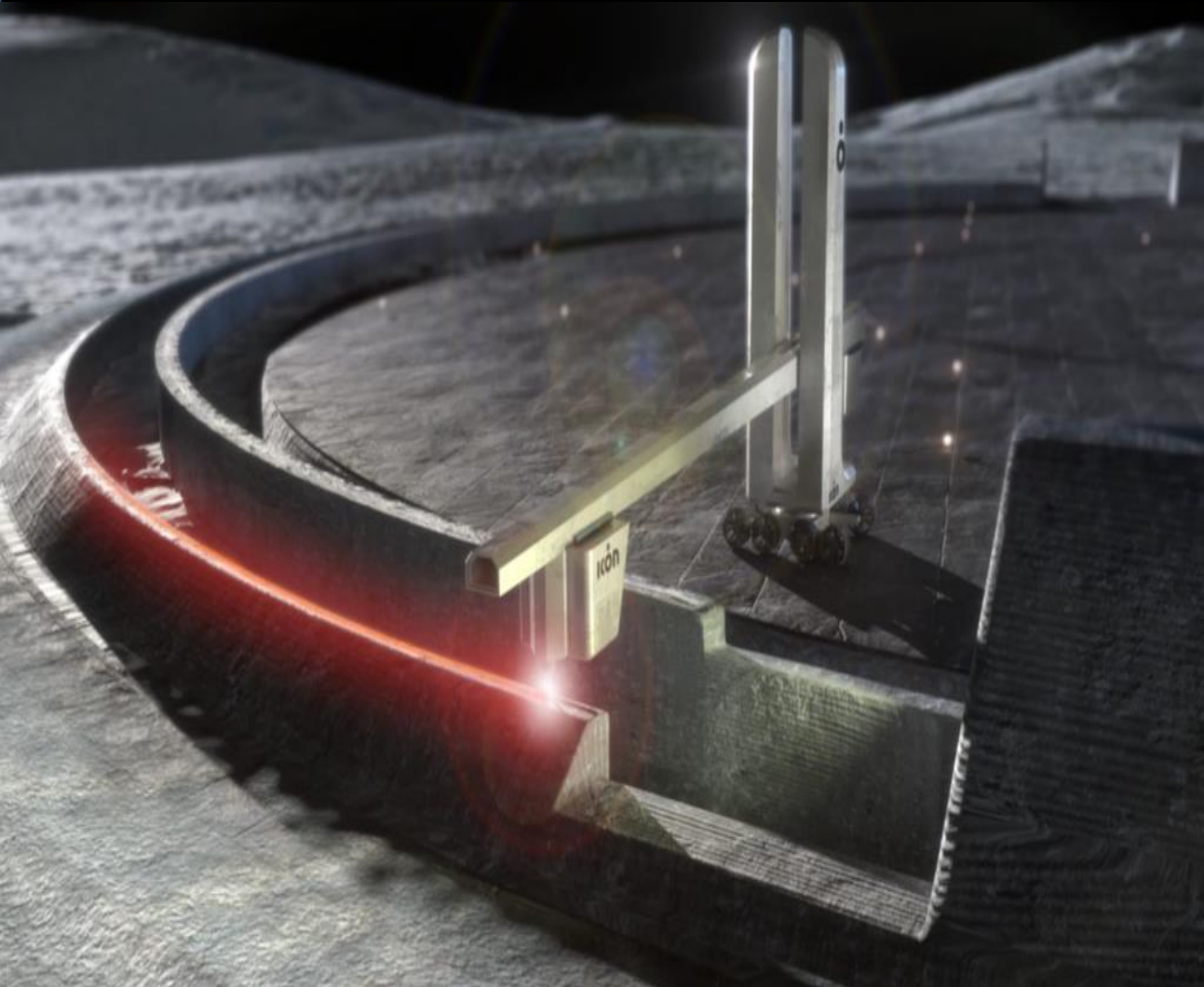


Image courtesy of ICON

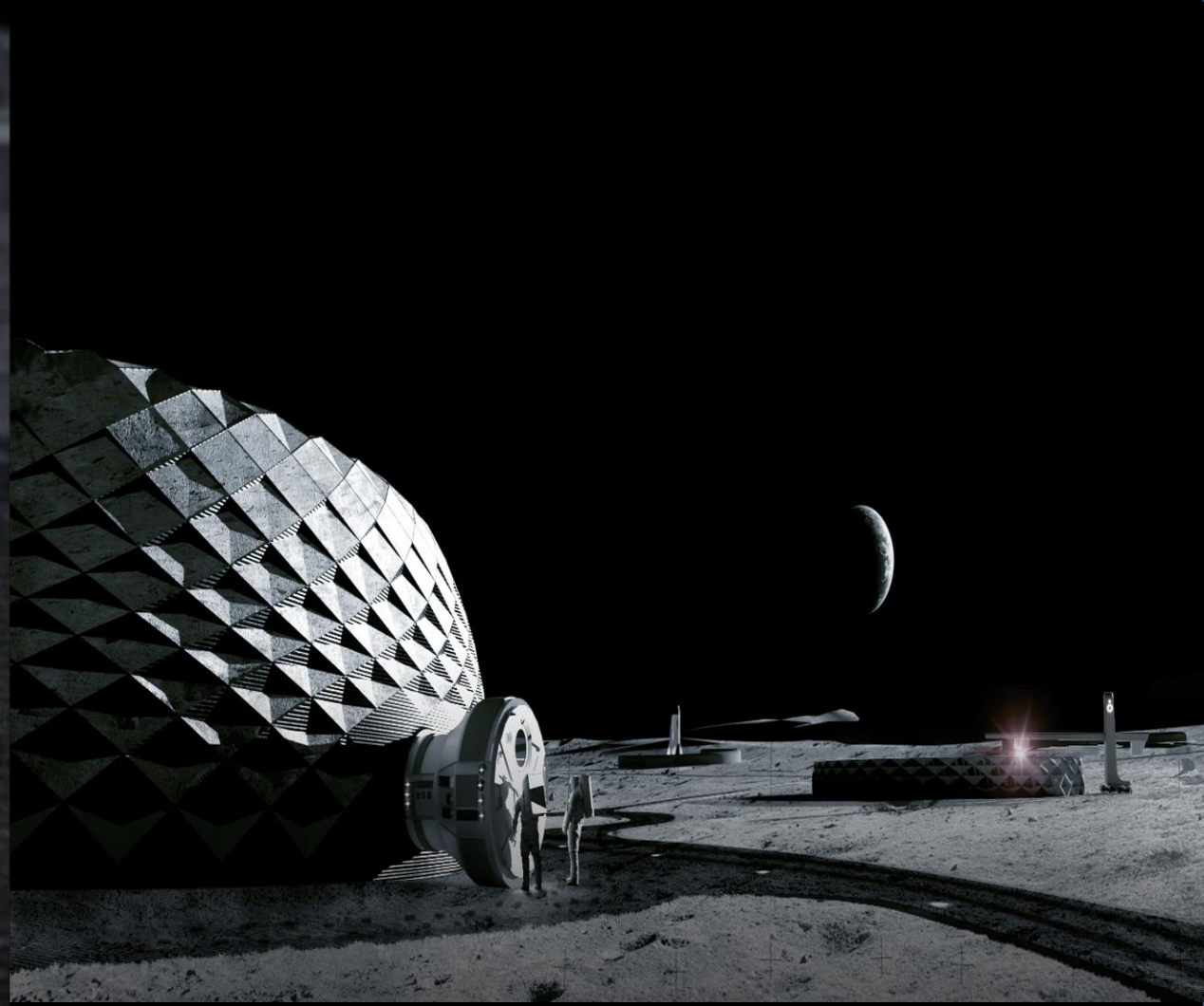


Image courtesy of Bjarke Ingels Group

# MMPACT – Current Partners

## NASA Centers

- MSFC
- LaRC
- KSC
- JPL

## OGA Leveraging

Potential:

- Innovation Unit US Air Force (AF)

Contributing:

- AF Civil Engineering Center
- AF Special Operations Command
- Defense Innovation Unit
- Texas Air National Guard
- USAF

## Public/Private Partnerships

- Dr. Holly Shulman
- ICON Build
- Radiance Technologies
- RW Bruce Associates, LLC
- Blue Origin
- Jacobs Space Exploration Group
- JP Gerling
- Logical Innovations
- Microwave Properties North
- MTS Systems Corp.
- Southeastern Universities Research Association
- Southern Research
- Space Exploration Architecture (SEArch+)
- Space Resources Extraction Technologies
- Sioux Tribes
- Astroport

## Technology Providers/ Contributing Partners: Academia

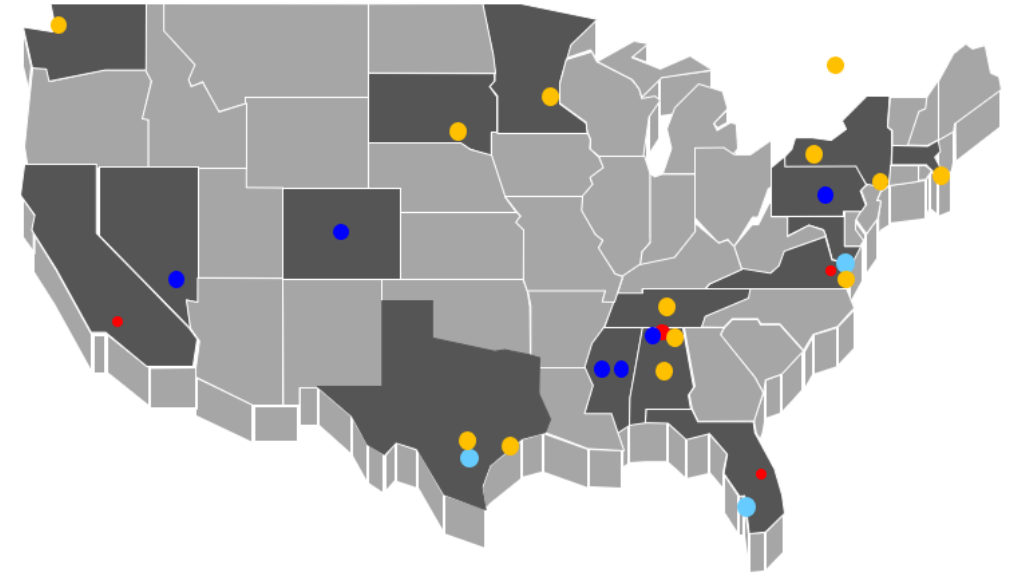
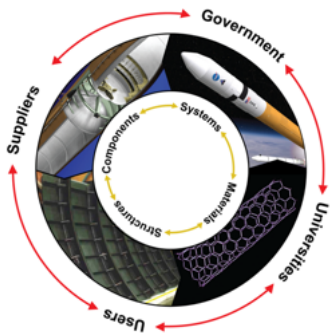
- Colorado School of Mines
- Drake State
- Mississippi State University
- Pennsylvania State University
- University of Mississippi
- University of Nevada Las Vegas

## SBIR/STTR

- Construction Scale Additive Manufacturing Solution

## Potential Customer

- Artemis



Collaborative multidisciplinary partnerships to leverage fiscal resources, ideas, knowledge & expertise.



New Story - Tabasco, Mexico



# World's First 3D-Printed Community

In partnership with housing nonprofit, New Story, the world's first 3D-Printed Community uses the 500 sq. ft. homes for impoverished families. 3D-Printed two at a time, this community has rapidly grown and survived a major 7.4 earthquake with no visible damage.





# MSFC Partnerships and Formulation Office



**Reginald Alexander**  
**Manager, Partnerships & Formulation**  
**Email: [reginald.alexander@nasa.gov](mailto:reginald.alexander@nasa.gov)**

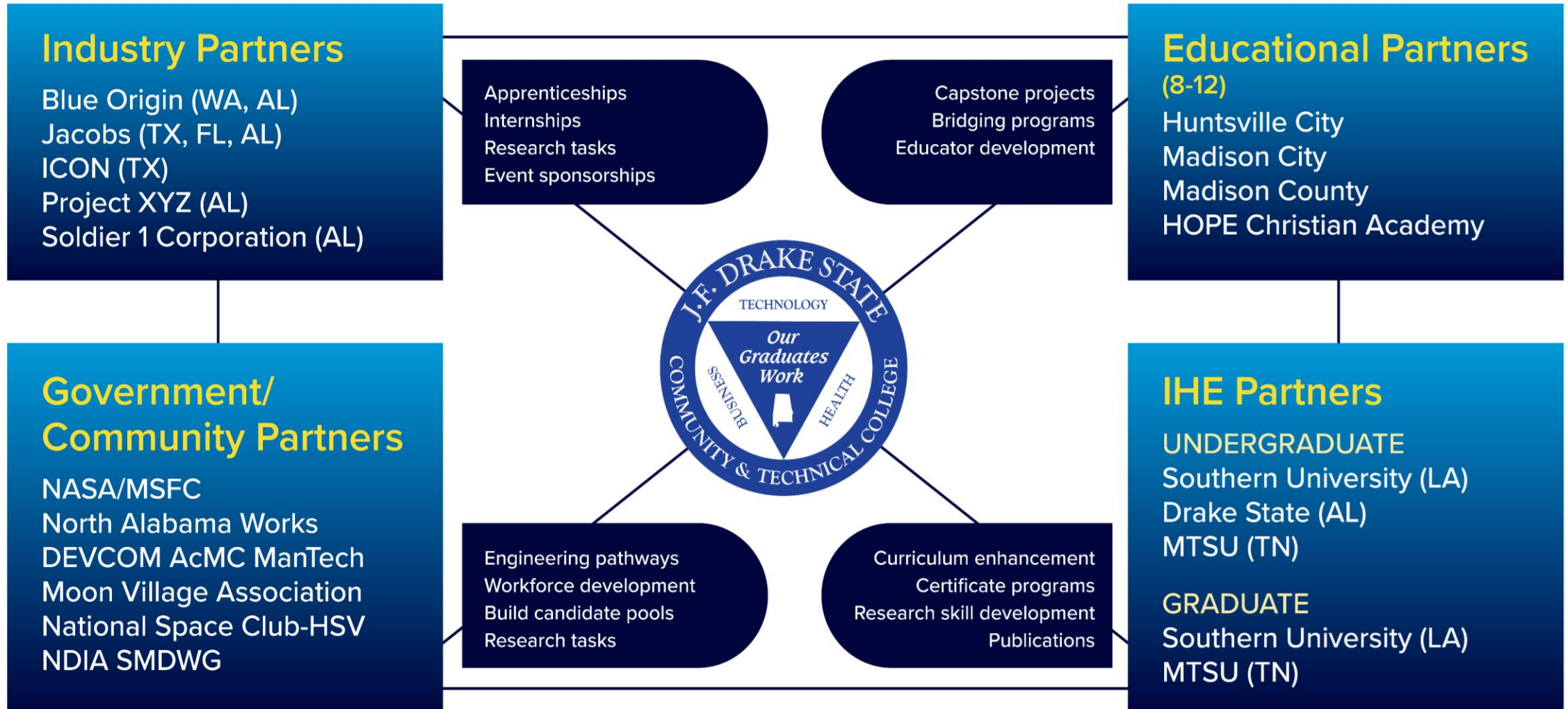


- Cooperative Agreement Notice (CAN)
- SBIRs and STIRs
- Space Act Agreements (SAA)
- Public Private Partnerships
  - Procurements
  - Announcement of Opportunities (AOs)
  - Broad Area Announcements (BAA's)



## Partnership Mechanisms

# Drake State Leveraging and Partnership Development Via MSFC Cooperative Agreement





- STMD's Solicitations and Opportunities:  
<https://www.nasa.gov/directorates/spacetech/solicitations>
- STMD Lunar Surface Innovation Consortium (Johns Hopkins University Applied Physics Laboratory. POC Dr. Rachel Klima, [SES-LSIC-Director@jhuapl.edu](mailto:SES-LSIC-Director@jhuapl.edu))
- Sam.gov
- NSPIRES (NASA Solicitation and Proposal Integrated Review and Evaluation System)



**Explore Opportunities**



[www.nasa.gov/spacetech](http://www.nasa.gov/spacetech)

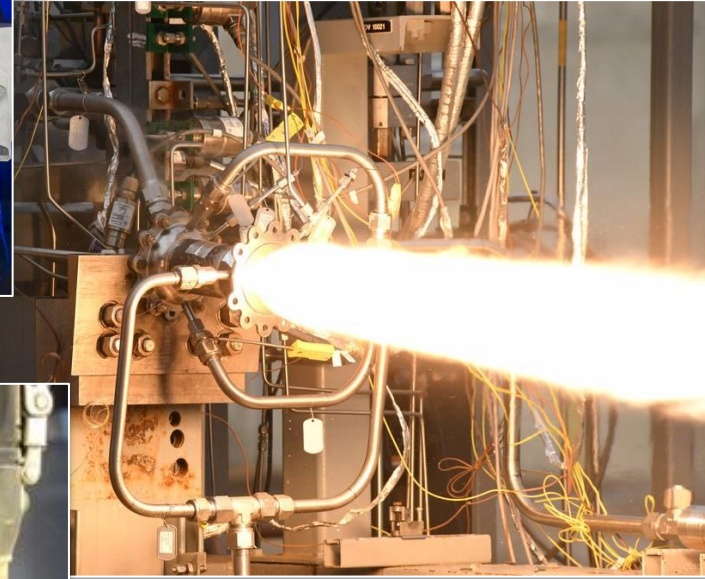
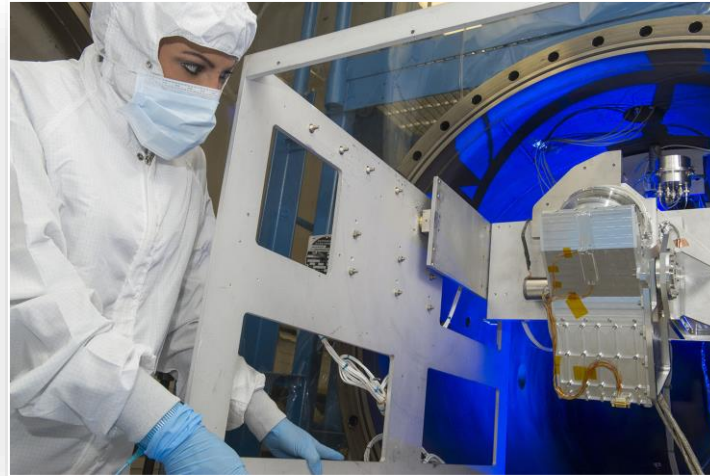




# EXPLORE MARSHALL

MAKING HUMAN SPACE EXPLORATION POSSIBLE

- **Propulsion**
- **Materials and Manufacturing**
- **Advanced Concepts**
- **Space Transportation Systems**
- **Space Systems**
- **Specialized Test Capabilities**
- **Scientific Research & Test**
- **Payload & Mission Operations**



**MSFC Areas of Expertise**





# MMPACT

MOON TO



**MARS** PLANETARY AUTONOMOUS CONSTRUCTION TECHNOLOGY



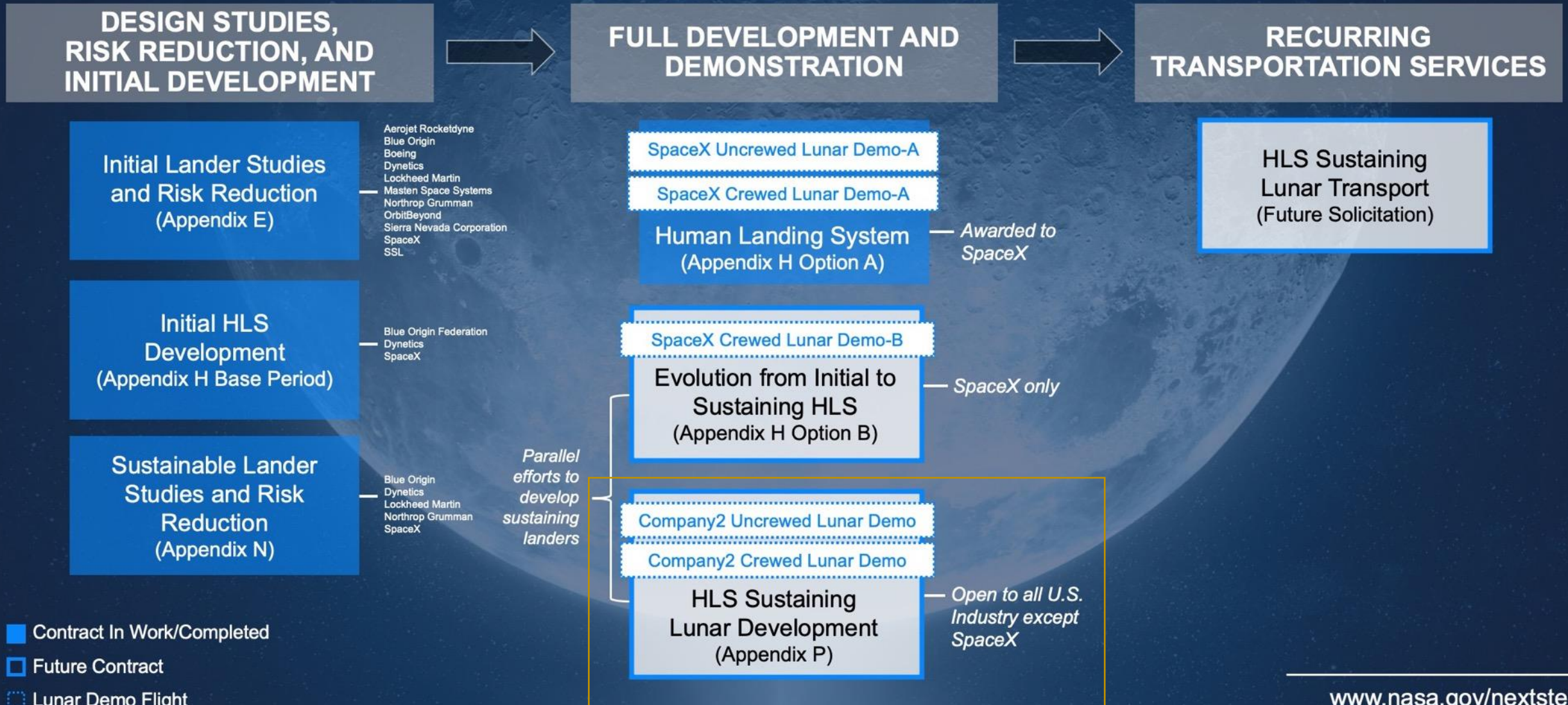


## What is Artemis?

- Space Launch System Rocket
- Orion Crew Spacecraft
- Exploration Ground Systems
- Commercial Lunar Payload Services
- First Woman and First Person of Color on the Lunar Surface
- The Gateway in Lunar Orbit
- Artemis Base Camp
- Global Community on Earth, in Low-Earth Orbit, and in the Lunar Environment



# Human Landing System (HLS) Procurement Path



The CAN is a dual-use technology development opportunity: advancing the partner's technology objective and meeting a specific NASA/MSFC mission need

Solicit, competitively select, and support the accomplishment of collaborative, resource-sharing project partnerships:

1. The Partner is developing a technology primarily for its own public purposes
2. The proposed technology complements the technology development interests of Marshall
3. NASA/Marshall can provide financial support and/or other in-kind assistance

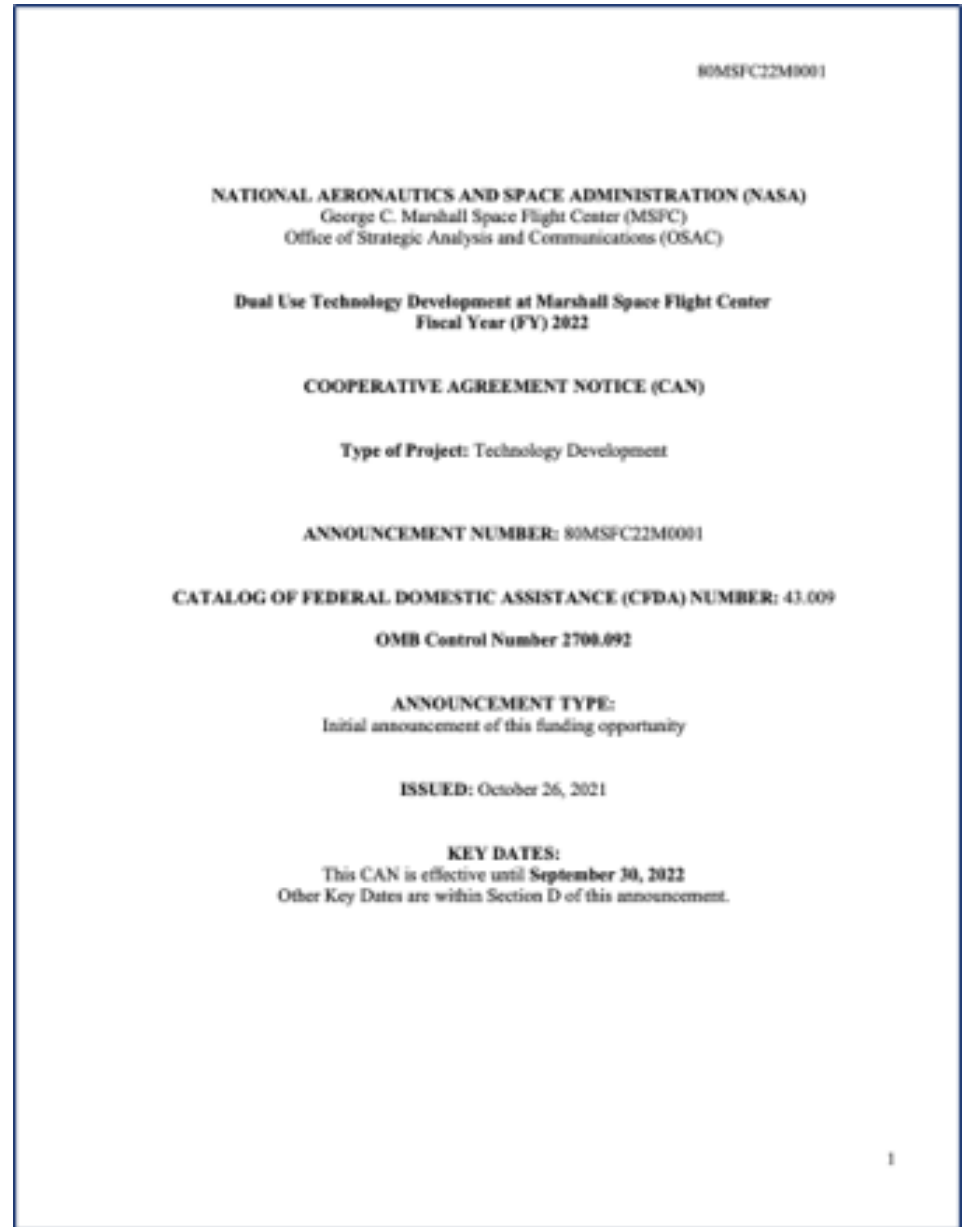


**Cooperative Agreement Notice (CAN)**

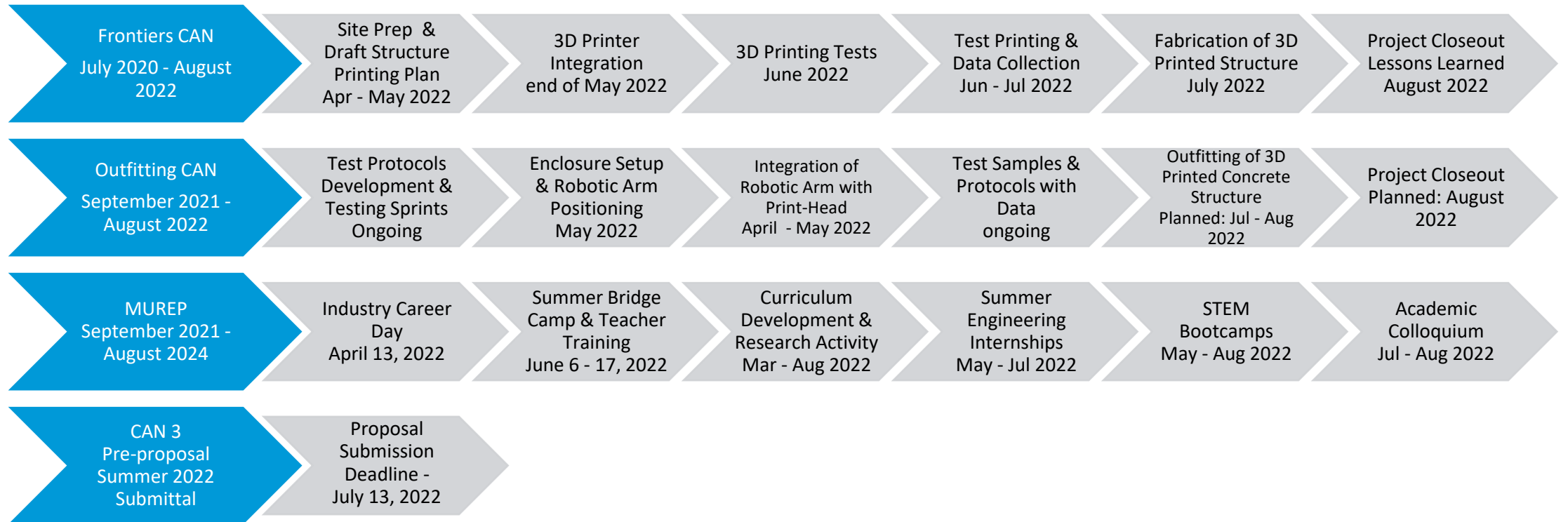


# New CAN Opportunity

- NASA MSFC Cooperative Agreement Notice (CAN) for 2022 – released on 26 October 2021
- Purpose: Identify candidate technology partnerships with US industry and academic / non-profit organizations that complement the technology development interests of NASA
- Two rounds of proposal due dates; second round due date: 13 July 2022



# Frontiers Program Integrated Short Schedule Present – July 2022





## Small Business Innovation Research (SBIR) & Small Business Technology Transfer (STTR) Program

These two programs fund the research, development, and demonstration of innovative technologies via annual solicitations and have significant potential for successful commercialization.

- For small business concern (SBC) with 500 or fewer employees or a non-profit research institution (RI) such as a university or a research laboratory
- Phase 1: Idea Generation
- Phase 2: Prototype Development
- Phase 3: Infusion with NASA Mission and/or commercialization

Solicitations posted at <https://sbir.nasa.gov/solicitations>



**SBIRs and STIRs**

## What is an SAA?

SAA's are agreements that empower NASA to work with external entities (Industry, Academia, Other Government Agencies) as authorized in the National Aeronautics and Space Act as an "other transaction," or OTA.

## Agreement Types

- Space Act Agreement (SAA)
- Inter-Agency Agreement (IAA)
- Memorandum of Understanding (MOU)
- Memorandum of Agreement (MOA)
- Letter Agreements

## Three Funding Options

- **Reimbursable**  
Partner pays NASA to use NASA resources to advance its interests
- **Non-reimbursable**  
NASA and the Partner fund their own collaborative activities  
May also be called MOU or MOA
- **Funded**  
NASA pays a Partner to accomplish a goal consistent with NASA's mission but not done to satisfy a NASA requirement (not common)