

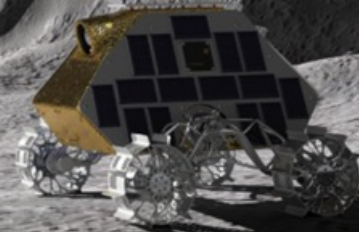


# CLC: Cislunar Logistics Center

## AFWERX STTR Phase II

Presented by Joseph Kenrick

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Sterling Lozalee, Elizabeth Scott, Jerry Drew



# Agenda

- CLC Overview
- Cislunar Space Challenges
- Cislunar Space Opportunities
- CLC Phases
- Next Steps
- Conclusion
- Questions

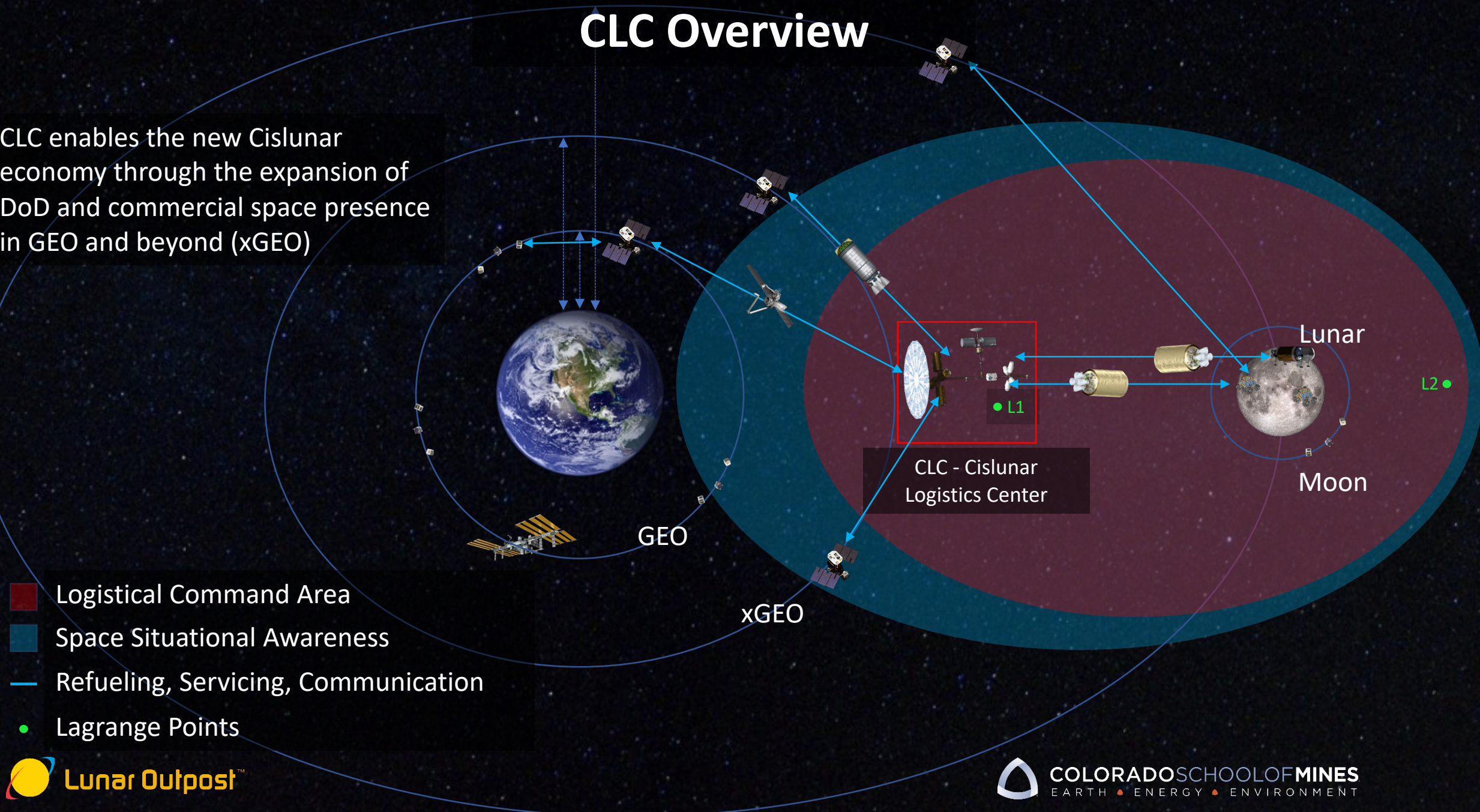


**“The line between disorder and order lies in logistics...”** – Sun Tzu



# CLC Overview

CLC enables the new Cislunar economy through the expansion of DoD and commercial space presence in GEO and beyond (xGEO)





# CLC System Elements

## CLC Capabilities:

Spacecraft Servicing

Fuel & Supply Depot

Space Domain Awareness

Information Relay

High-Bandwidth  
Direct to Earth  
Communications

Water Storage

Cryogenic Fuel  
Storage Tanks

Modular  
Configurations

Sunshield with  
Solar Power

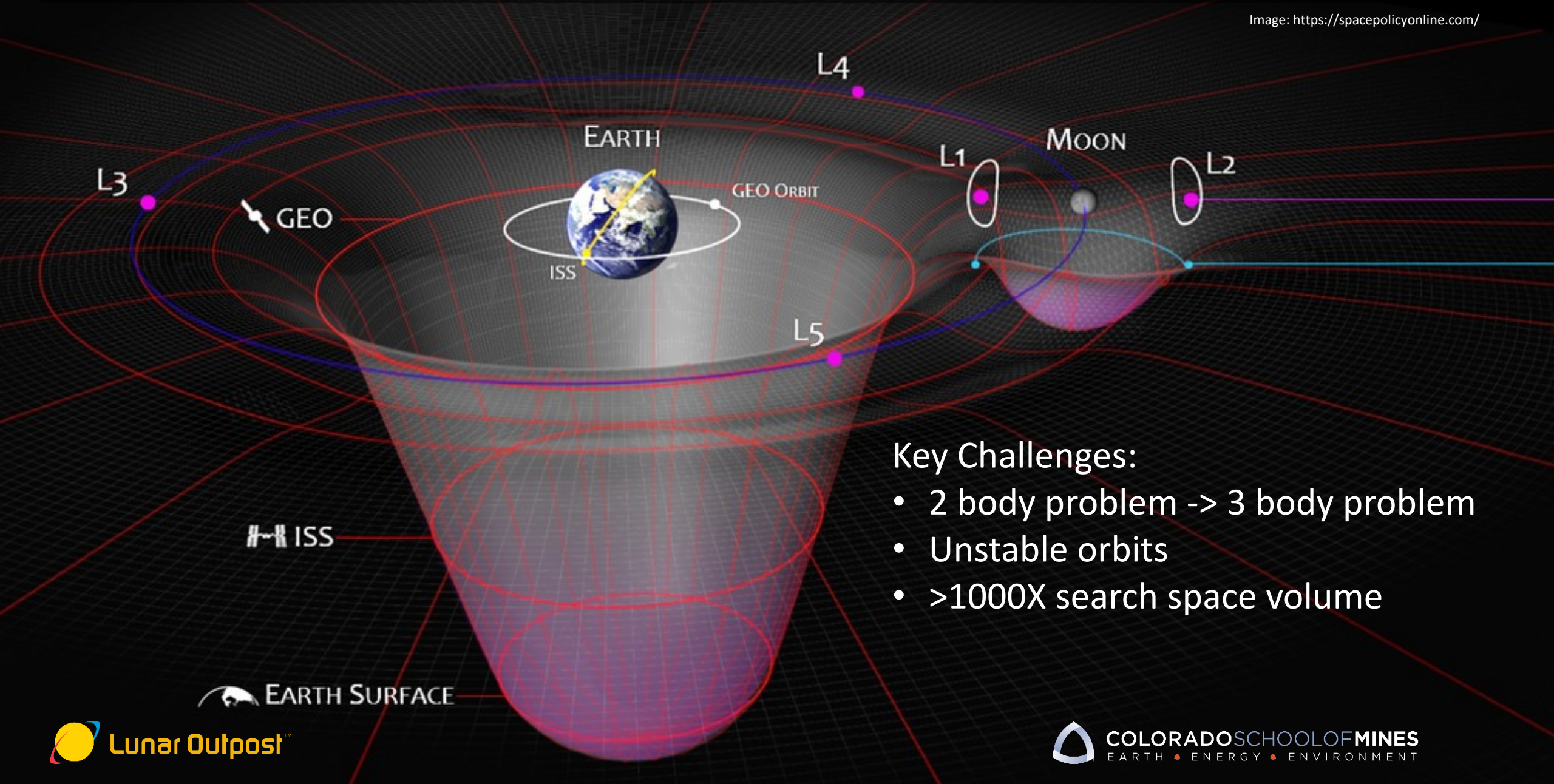
Electrolysis/  
Reverse  
Electrolysis  
Module

Servicing Bays



# Cislunar Space Primer

Image: <https://spacepolicyonline.com/>



## Key Challenges:

- 2 body problem -> 3 body problem
- Unstable orbits
- >1000X search space volume

# Significance of Opportunity

## Growing existing markets

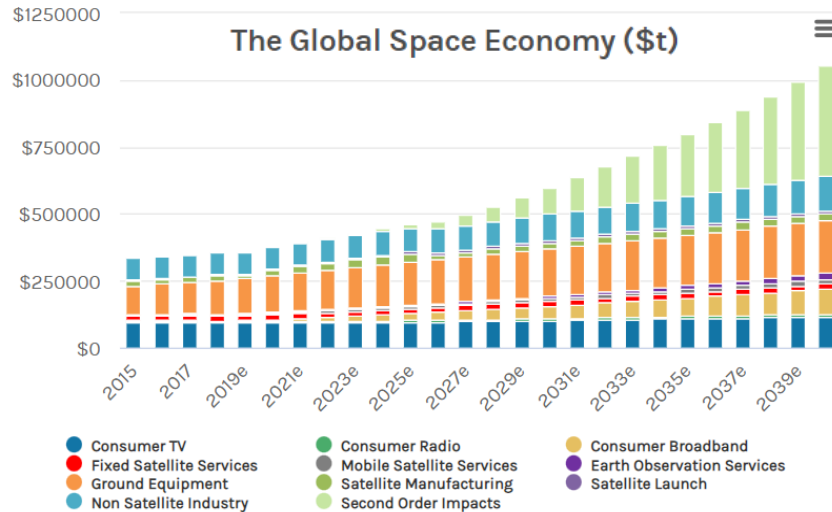


Image: <https://www.morganstanley.com/>

## Cost reduction enabling new markets

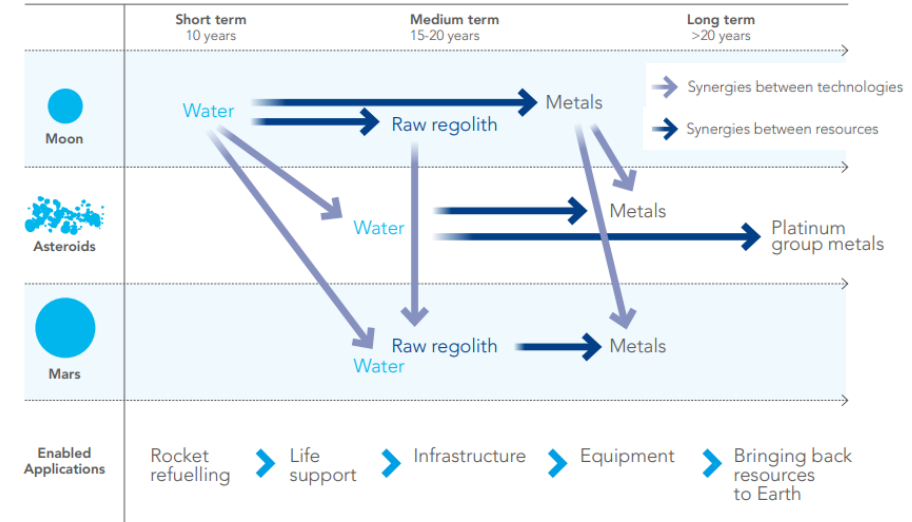


Image: <https://space-agency.public.lu/>

Space Mining Market - Growth Rate by Region (2022 - 2036)



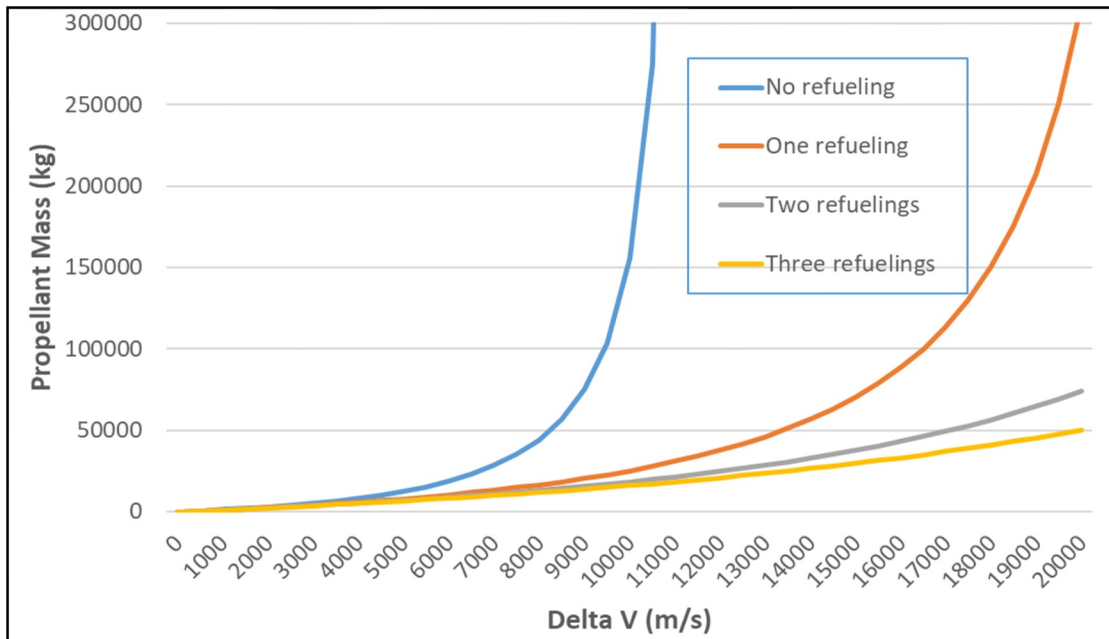
Image: <https://www.researchandmarkets.com/>

## International competition

# Significance of Refueling

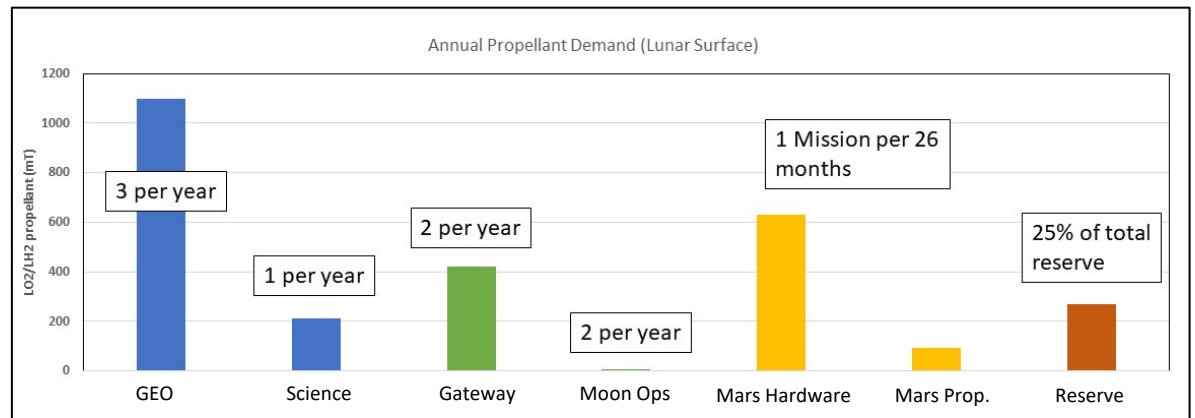
**All** beyond LEO missions benefit from lunar propellant (via refueling)

- Transition to water based propulsion (steam, plasma, LO<sub>2</sub>/LH<sub>2</sub>)



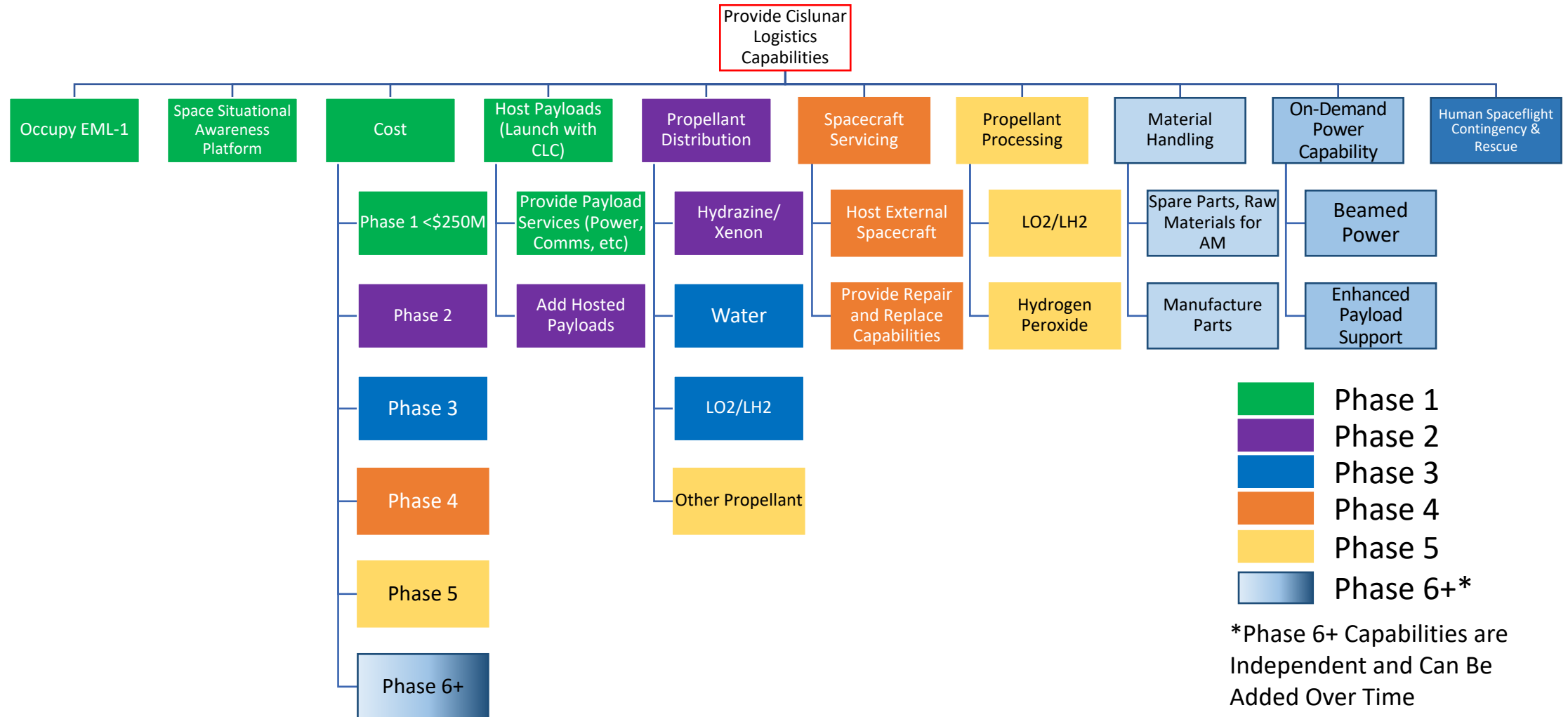
U.S. Missions Impacted Per Year (Current and Emerging): Up to 30

- LO<sub>2</sub>/LH<sub>2</sub> Propellant Demand Estimate: 2500 mT/year



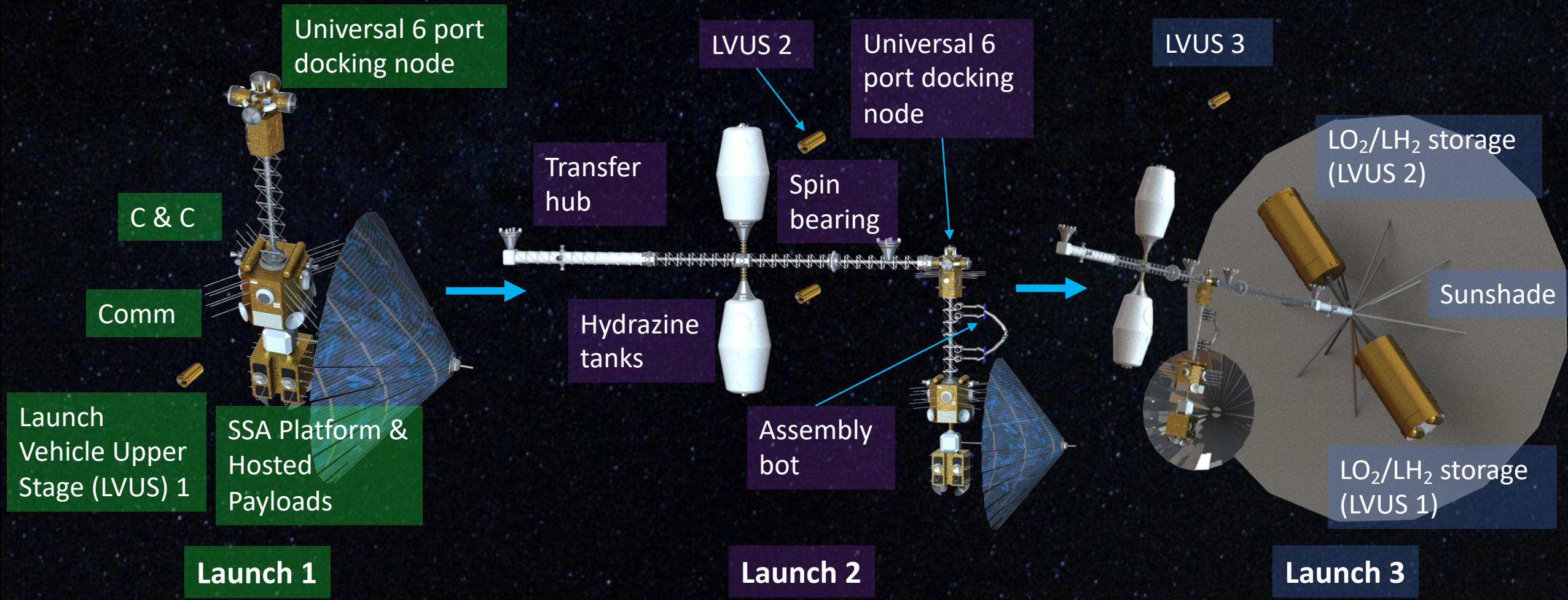


# Phased System Objectives





# Phased Integration





# Stages of Growth

## Phase 1: Establish Cislunar Infrastructure

Cislunar Spacecraft Support  
PNT  
Space Weather Monitoring  
High-bandwidth Secure Communications

## Phase 2: Enable New Capabilities

Fuel Distribution Center  
Enable GEO and beyond  
Satellite Servicing

## Phase 3: Space Resources

Act as the logistical control point for resources extracted in space

**Logistical Control Through all Stages of the New Cislunar Paradigm**



# Next Steps

- Small-scale Prototype
  - Logistics supplier
    - Digital and physical
- Partnerships
  - Situational Awareness
  - Attitude Control
  - Refueling
  - Communications
  - Interfaces
  - Payloads

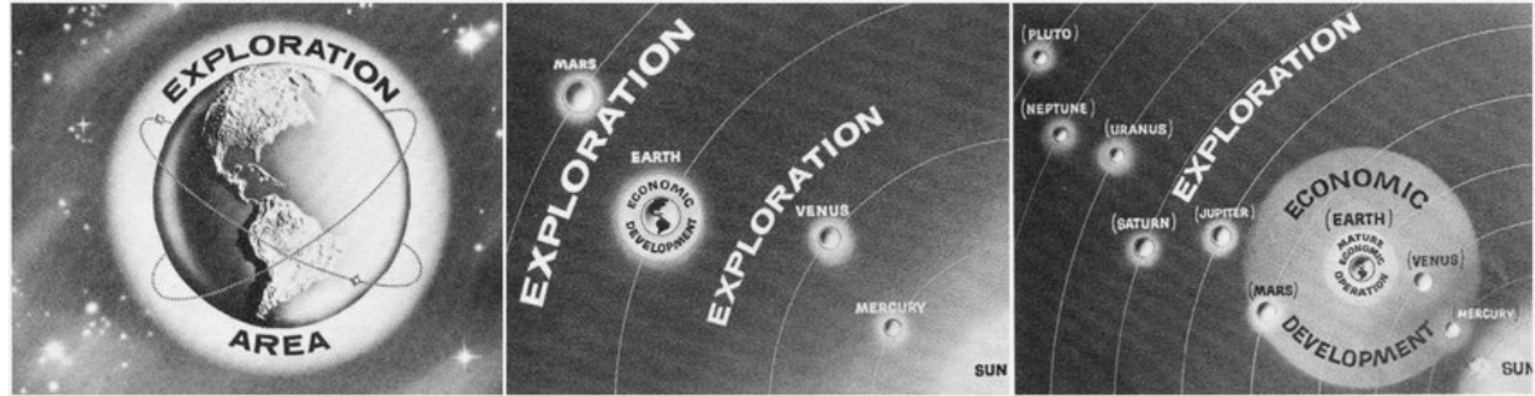


Image: Ralph Cordiner

**“I think this is the next big game changer [for space operations]”** – Dr. Joel B. Mozer, United States Space Force Director of Science, Technology, and Research

# Conclusion

- **Water exists at the lunar poles and on NEAs**
  - NASA, ESA, and the private sector has the knowledge and processes to extract and process water derived propellants
- **Markets for propellant exist today**
  - Dramatically lowers the cost of all beyond LEO transportation
  - Distribution of propellant (water or LO<sub>2</sub>/LH<sub>2</sub>) benefits civil, commercial and national security activities
- **A logistics node at EML1 is a crucial future infrastructure element**



A photograph of an astronaut in a white spacesuit standing on the lunar surface. To the left is a lunar rover with large, treaded wheels and various instruments. An American flag is planted in the ground between the rover and the astronaut. The background shows the dark, cratered horizon of the moon under a black sky.

# THANK YOU!

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# Backup

