Applied Science Investigations for National Security Objectives

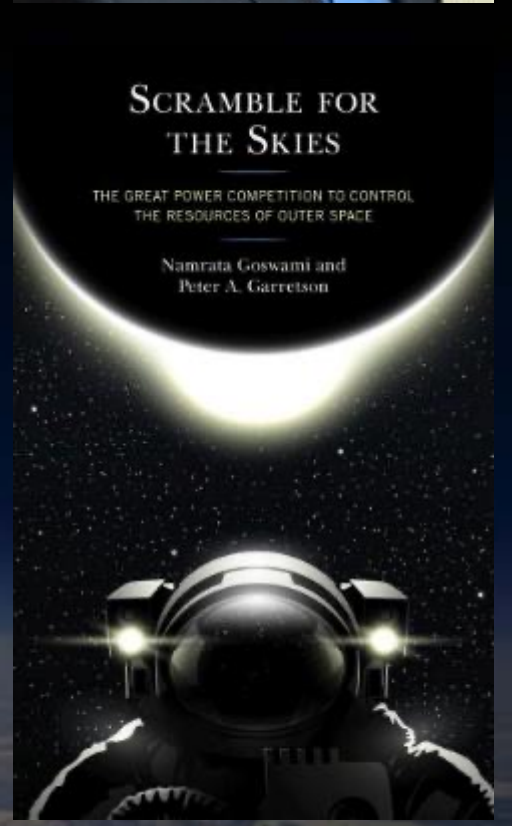
Peter Garretson

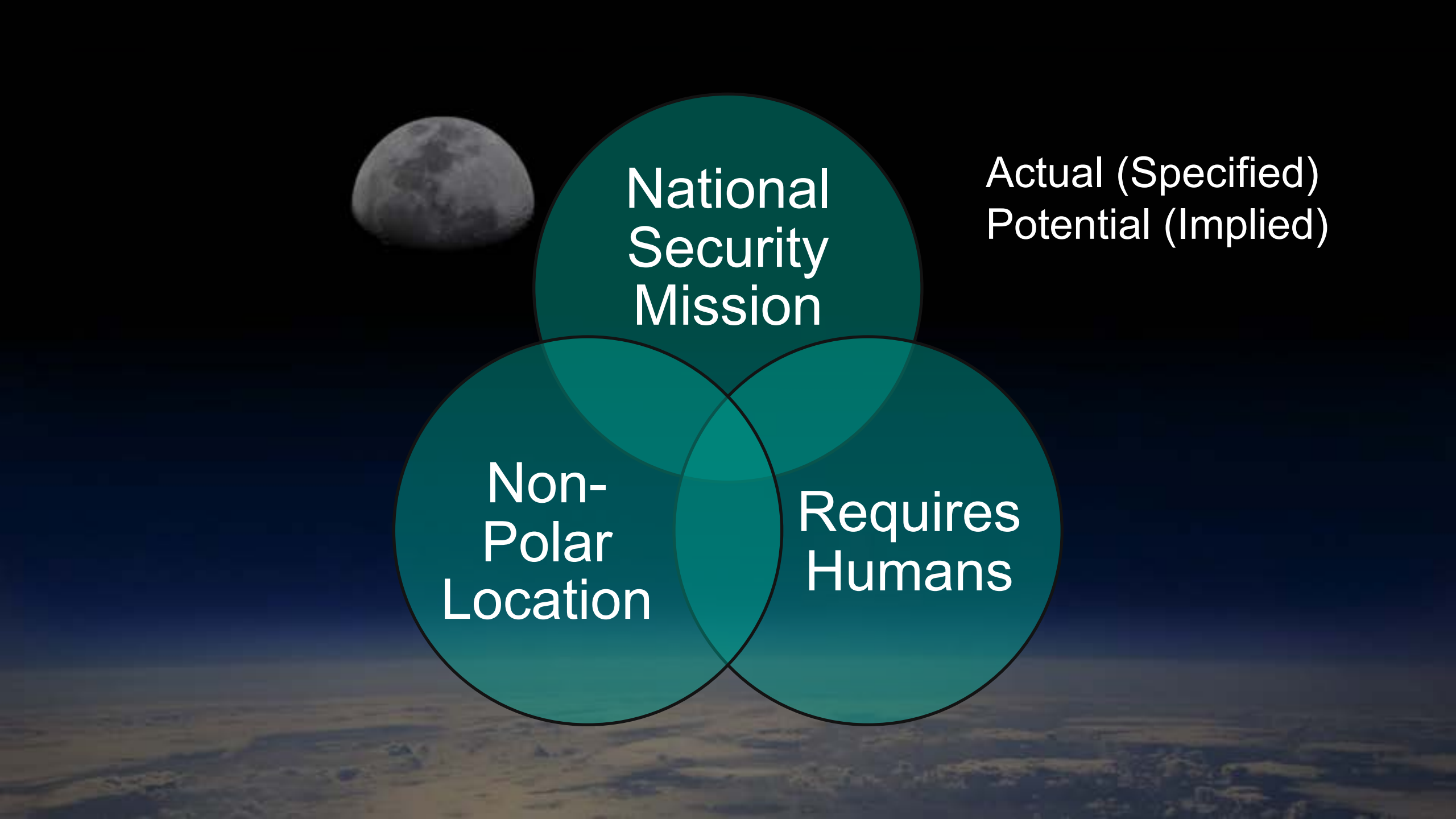
Lunar Applied Sciences Panel

Irvine, CA August 12, 2025

Who are your speakers?

- PETER GARRETSON
- Senior Fellow in Defense Studies, co-director of Space Policy Initiative, American Foreign Policy Council
- Strategy Consultant, Government & Industry
- Former Director Space Horizons Task Force; Deputy Director and Co-Founder Schriever Scholars Strategy Seminar; Air University Faculty
- Former Strategy & Policy Advisor to Air Force Chief of Staff
- Former Chief of Future Technology, HQ USAF
- Author, *Scramble for the Skies: The Great Power Competition to Control the Resources of Outer Space*




National Security Mission
Non-Polar Location
Requires Humans
Actual (Specified)
Potential (Implied)

Disclaimer

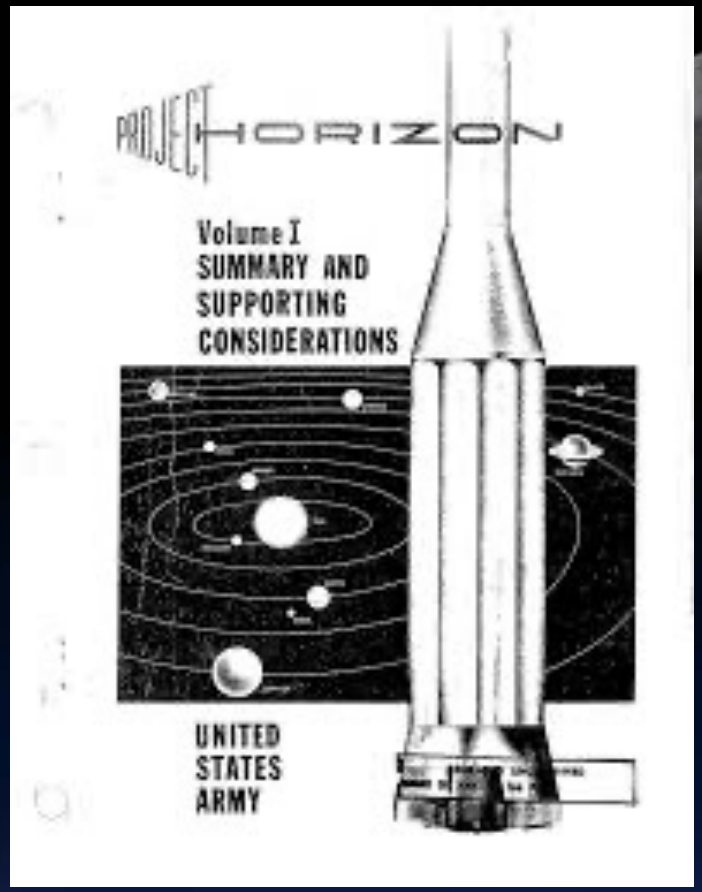
- I am not a National Security Officer (anymore)
- My views are not official views
- I am a national security thinker who attempts to affect policy
- My views are controversial
- I will try my best to tell you what is accepted, contested & explorational

You might not get much

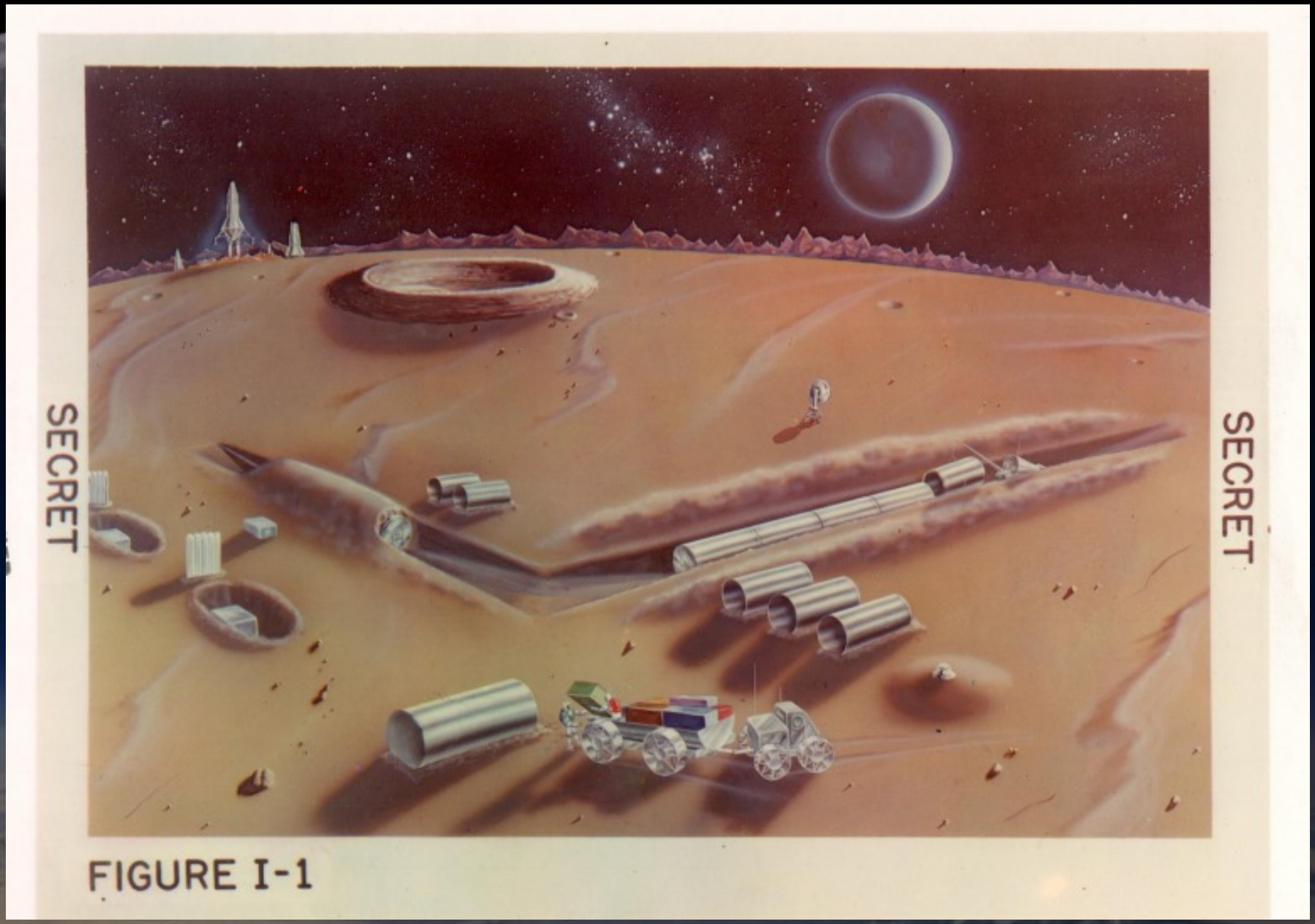
- Focus is GEO & Below
- Biden Admin wanted DoD to be in the background
- This Administration may see things differently
- The USSF has not committed to a vision of Guardians in Space
- Much of the potential utility is embryonic and exploratory


Early Military
Nukes
Project Horizon

Project Horizon



Presence: Territorial
Scout & Survey: Secure



National Security Motivations for Lunar Industrial Development

National Space Policy

The Secretary of Defense shall:

- Defend the use of space for United States national security purposes, the United States economy, allies, and partners;
- Protect freedom of navigation and preserve lines of communication that are open, safe, and secure in the space domain;
- Detect, characterize, warn, attribute, and respond to, in coordination with the Secretary of State and other relevant agencies, space-related behaviors and activities that threaten the space interests of the United States, its allies, or partners, international peace and security, or the long-term sustainability of the space environment;

US Grand Strategy

- US Grand Strategy is to engage in Great Power Competition / Strategic Competition for economic dominance in the solar system, and to secure access to resources on the Moon and build an off-Earth industrial base and vibrant in-space economy using those resources. That is the race:.

- The race to extract and use the resources for economic dominance.
- The Artemis program is the chosen instrument of this Cold War 2.0 / Space Race 2.0 to achieve our peacetime strategic offensive, and all of you are the new Cold Warriors to make it happen.

National Space Policy

- **Extend human economic activity into deep space by establishing a permanent human presence on the Moon,** and, **in cooperation with private industry** and international partners, develop infrastructure and services that will enable science driven exploration, space resource utilization, and human missions to Mars.
- Beginning with missions beyond low Earth orbit, the **United States will lead the return of humans to the Moon for long-term exploration and utilization**,
- **Lead a program to land the next American man and the first American woman on the Moon by 2024, followed by a sustained presence on the Moon by 2028**,

Space Development

- Since 2006 it has been the policy of the United States to "**incorporate the solar system into our economic sphere**"
- It **subordinates space exploration to the primary goals of scientific, security, and economic interests**… this kind of thinking is from the arguments that motivated America's first great space vision, the Apollo program
- the Moon "and other intermediate destinations" **will "serve national and international interests" other than science, but including science as an important objective**
- **Exploration by a few is not the grandest achievement. Occupation by many is grander.** Not necessarily in the sense of permanent human occupation, but in the sense of **routine access to resources.**
- If the architecture of the exploration phase is not crafted with sustainability in mind, we will look back on a century or more of huge expenditures with nothing more to show for them than a litter of ritual monuments scattered across the planets and their moon

Cislunar S&T Strategy

- This document provides a **first interagency strategy to guide** the actions of the U.S. government in advancing scientific, exploration, and **economic development activities in Cislunar space**. This Cislunar Science & Technology Strategy directly supports the United States Space Priorities Framework, which states that the United States will "**advance a robust Cislunar ecosystem.**"
-
- **Objective 1: Support research and development to enable long-term growth in Cislunar space.**
  - **U.S. government organizations will leverage collaborations with private entities to enable capabilities for large-scale ISRU and advanced manufacturing at the Moon**, consistent with the U.S. National Strategy for In-space Servicing, Assembly, and Manufacturing.
  - **The United States will create an environment that energizes our industry to create innovative commercial approaches** that will carry and sustain our next generation of explorers and **entrepreneurs on the Moon** and then on to Mars and beyond.

Trump Vision

- This vision is one in which there is a **sustainable human and robotic presence across the solar system — an expanding sphere of commercial, non-governmental activities in which increasing numbers of Americans live and work in space**. This vision begins with **a campaign** to utilize Earth's orbital environment, the surface and **resources of the Moon, and cis-lunar space** to develop the critical technologies, operational capabilities, and commercial space economy necessary for a sustainable human presence on the Moon, Mars, and beyond.
- the United States will seek to **land Americans on the Moon's South Pole by 2024**, establish a **sustainable human presence on the Moon by 2028**, and chart a future path for human Mars exploration. NASA's lunar presence will focus on science, **resource utilization**, and risk reduction for future missions to Mars.
- it **the policy of the United States to encourage international support for the public and private recovery and use of resources in outer space**.
- **Lunar regolith**, especially areas containing water ice at the poles, has yet to be fully characterized, but we know it **harbors resources that can provide energy, life support, and spacecraft propellant**. Learning how to e**xtract, process, and use these resource**s will enable explorers to reduce the mass required to support lunar and, subsequently, Martian logistics. This ability to partially, and perhaps one day fully, "live off the land" will be integral to a sustained presence on the Moon and Mars.

M2M Objectives on 2050 Timeline

Global Times
https://www.globaltimes.cn › content

China mulls $10 trillion Earth-moon economic zone

Nov 1, 2019 — China is mulling of establishing an Earth-moon space economic zone by 2050, with insiders expecting the zone to generate $10 trillion a year.

SpaceNews
https://spacenews.com › from-a-farside-first-to-cislunar-...

From a farside first to cislunar dominance? China appears ...

Feb 15, 2020 — China wants to establish "space economic zone" between the Earth and the moon capable of generating $10 trillion a year for China by 2050.

Missing: mulls | Show results with: mulls

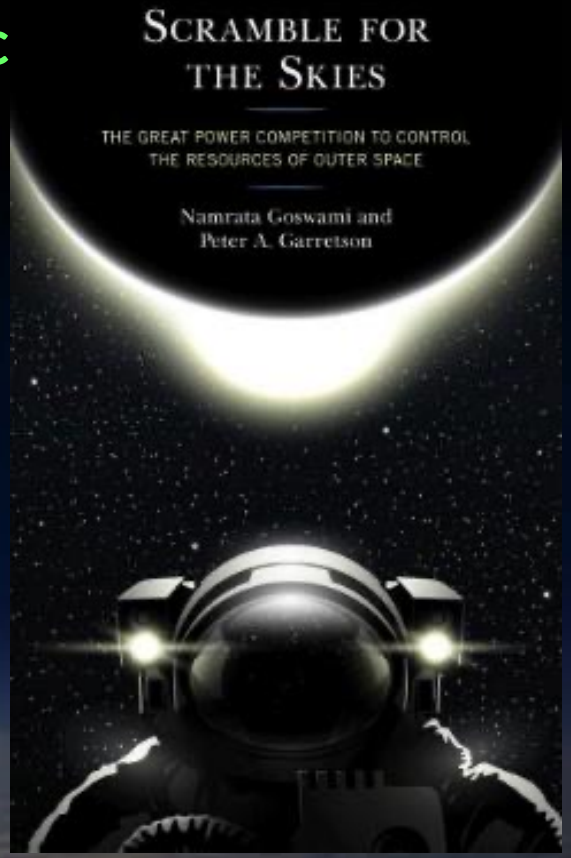
RT-9: Commerce and Space Development: **foster the expansion of the economic sphere beyond Earth orbit to support U.S. industry and innovation.**

Lunar Infrastructure (LI) Goal: Create an interoperable global lunar utilization infrastructure where U.S. industry and international partners can maintain continuous robotic and human presence on the lunar surface for a robust lunar economy without NASA as the sole user, while accomplishing science objectives and testing for Mars.

LI-1[L]:	Develop an incremental lunar power generation and distribution system that is evolvable to support continuous robotic/human operation and is capable of scaling to global power utilization and industrial power levels.
LI-2[L]:	Develop a lunar surface, orbital, and Moon-to-Earth communications architecture capable of scaling to support long term science, exploration, and industrial needs.
LI-3[L]:	Develop a lunar position, navigation and timing architecture capable of scaling to support long term science, exploration, and industrial needs.
LI-4[L]:	Demonstrate advanced manufacturing and autonomous construction capabilities in support of continuous human lunar presence and a robust lunar economy.
LI-5[L]:	Demonstrate precision landing capabilities in support of continuous human lunar presence and a robust lunar economy.
LI-6[L]:	Demonstrate local, regional, and global surface transportation and mobility capabilities in support of continuous human lunar presence and a robust lunar economy.
LI-7[L]:	Demonstrate industrial scale ISRU capabilities in support of continuous human lunar presence and a robust lunar economy.
LI-8[L]:	Demonstrate technologies supporting cislunar orbital/surface depots, construction and manufacturing maximizing the use of in-situ resources, and support systems needed for continuous human/robotic presence.
LI-9[L]:	Develop environmental monitoring, situational awareness, and early warning capabilities to support a resilient, continuous human/robotic lunar presence.

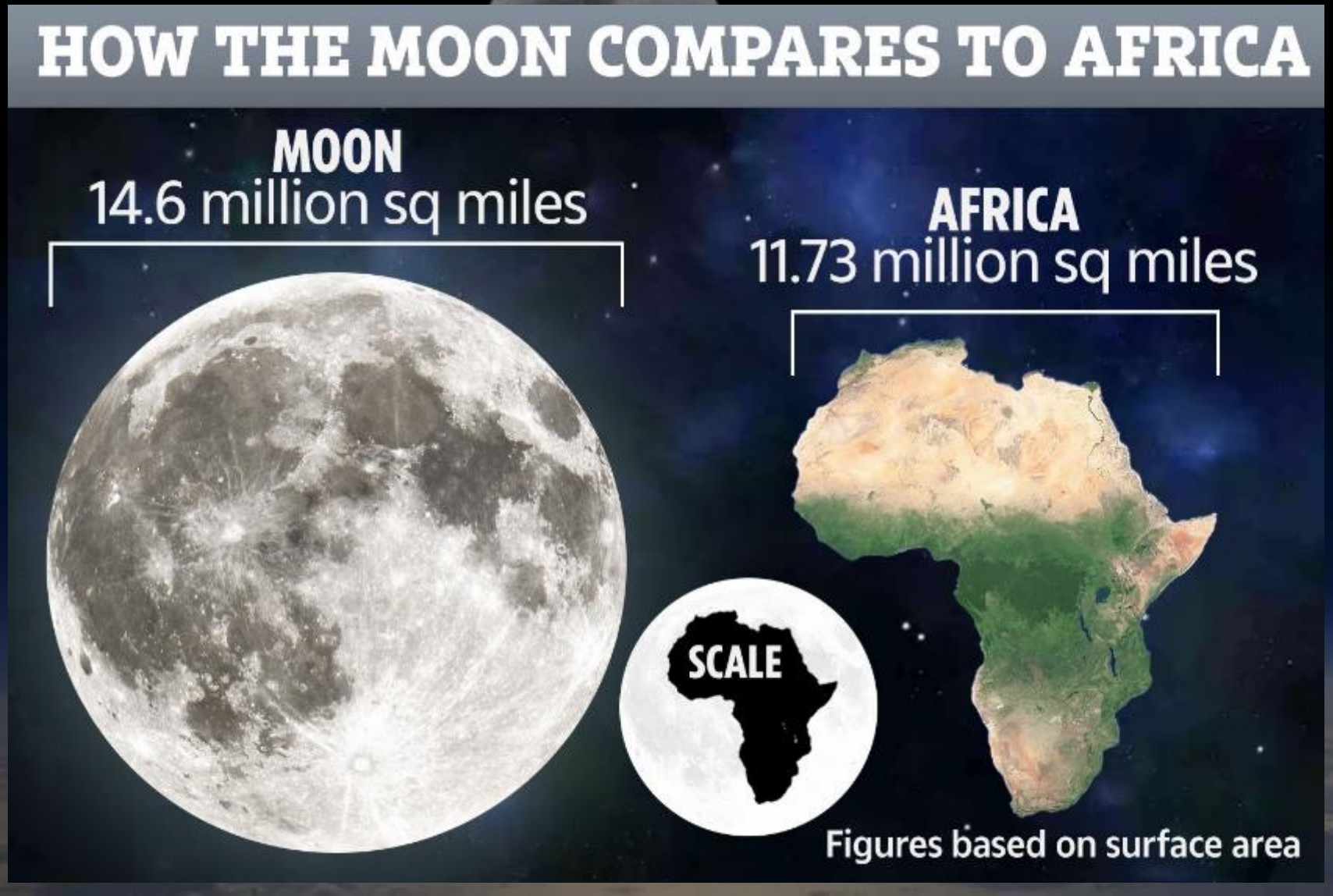
THE POTENTIAL TO IMPACT RELATIVE ECONOMIC POWER: A NEW WEALTH OF NATIONS?

- Central to the balance of power is **relative economic growth**.
- Kenneth Waltz laid out five criteria by which to rank great powers: "**size of population** and **territory**, **resource endowment**, **economic capability**, **military strength**, political stability and competence."
- Production includes: **land** (including natural resources), **labor** (including population and human capital), and **capital** (machinery, tools, buildings, and infrastructure), the **energy** to transform it, markets that create demand, and entrepreneurs

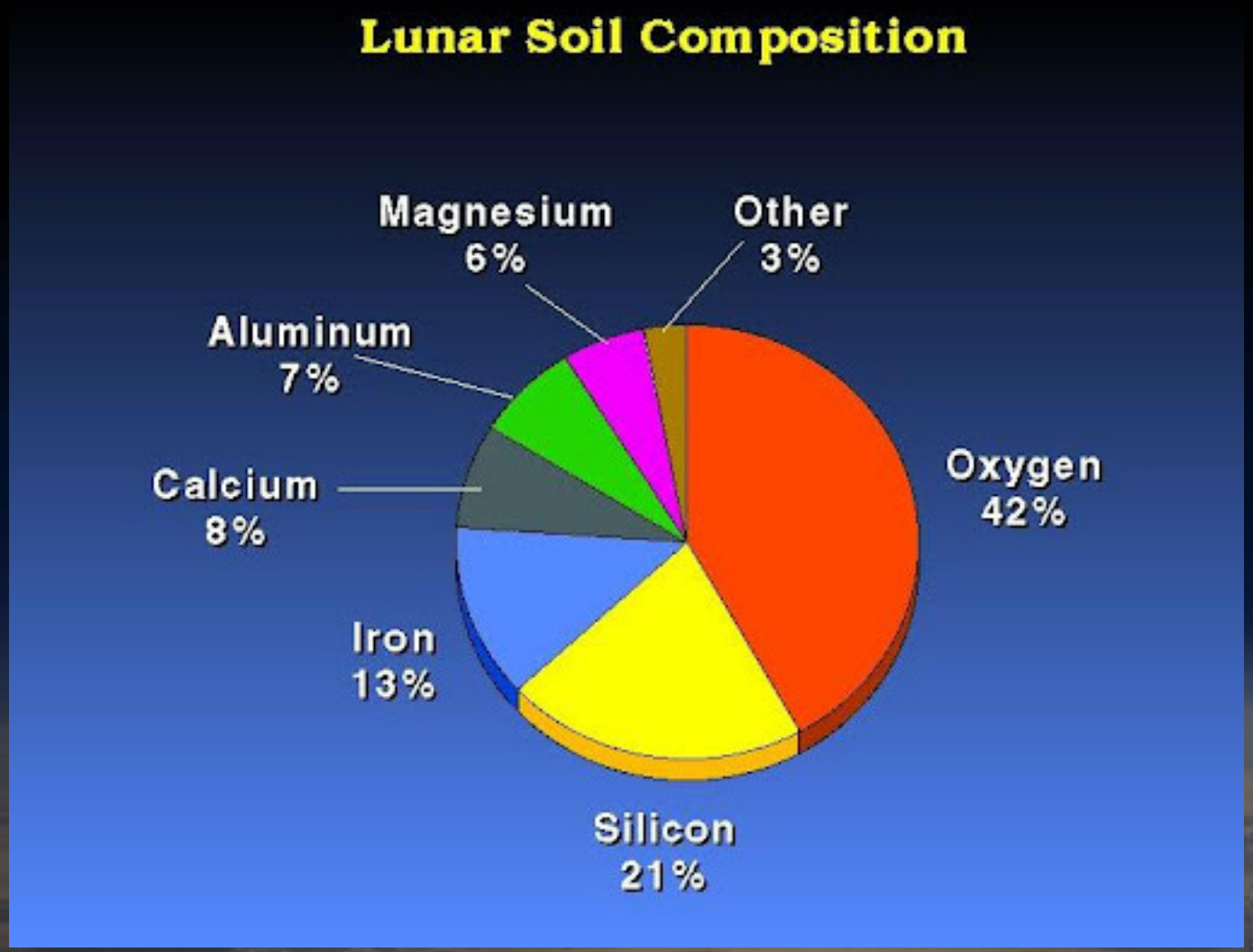


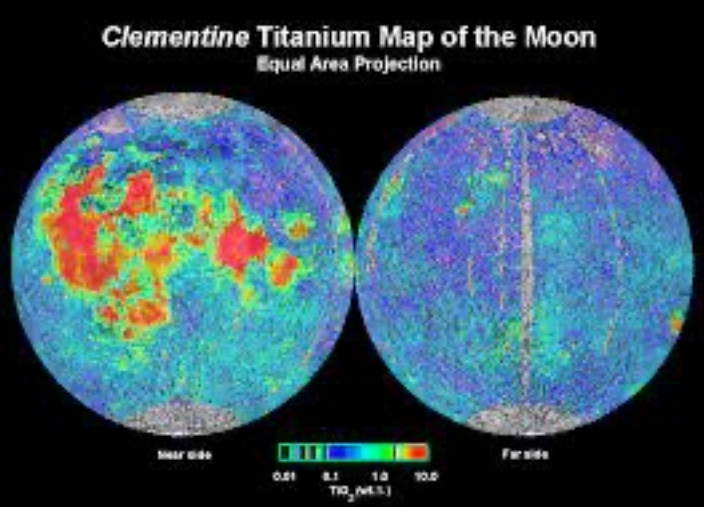
- **The resources of the solar system offer states the opportunity to change the size of their population and territory, their resource endowment, their economic capability, and as a result their military strength.**

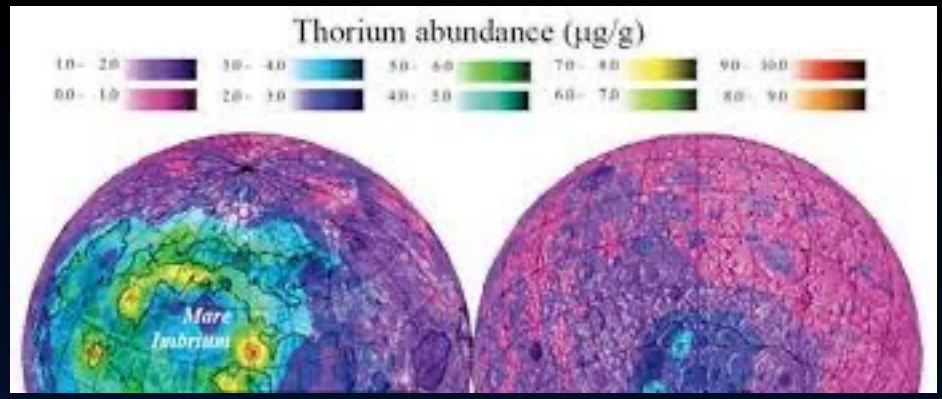
The Moon is the 8th Continent

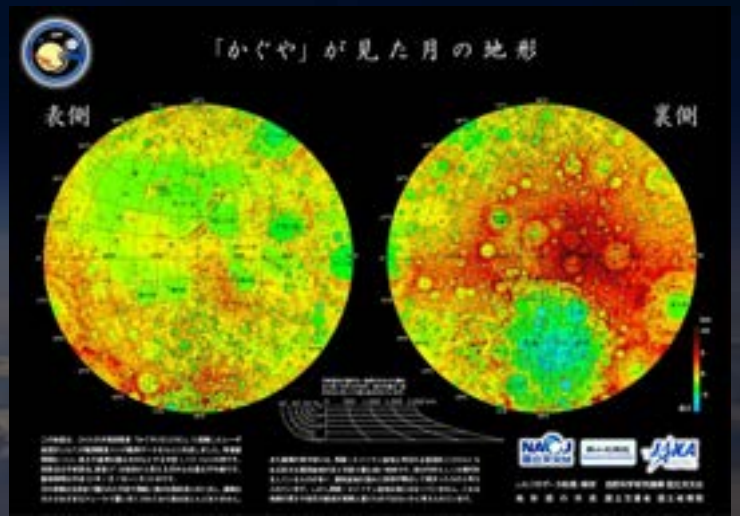


Structural Materials

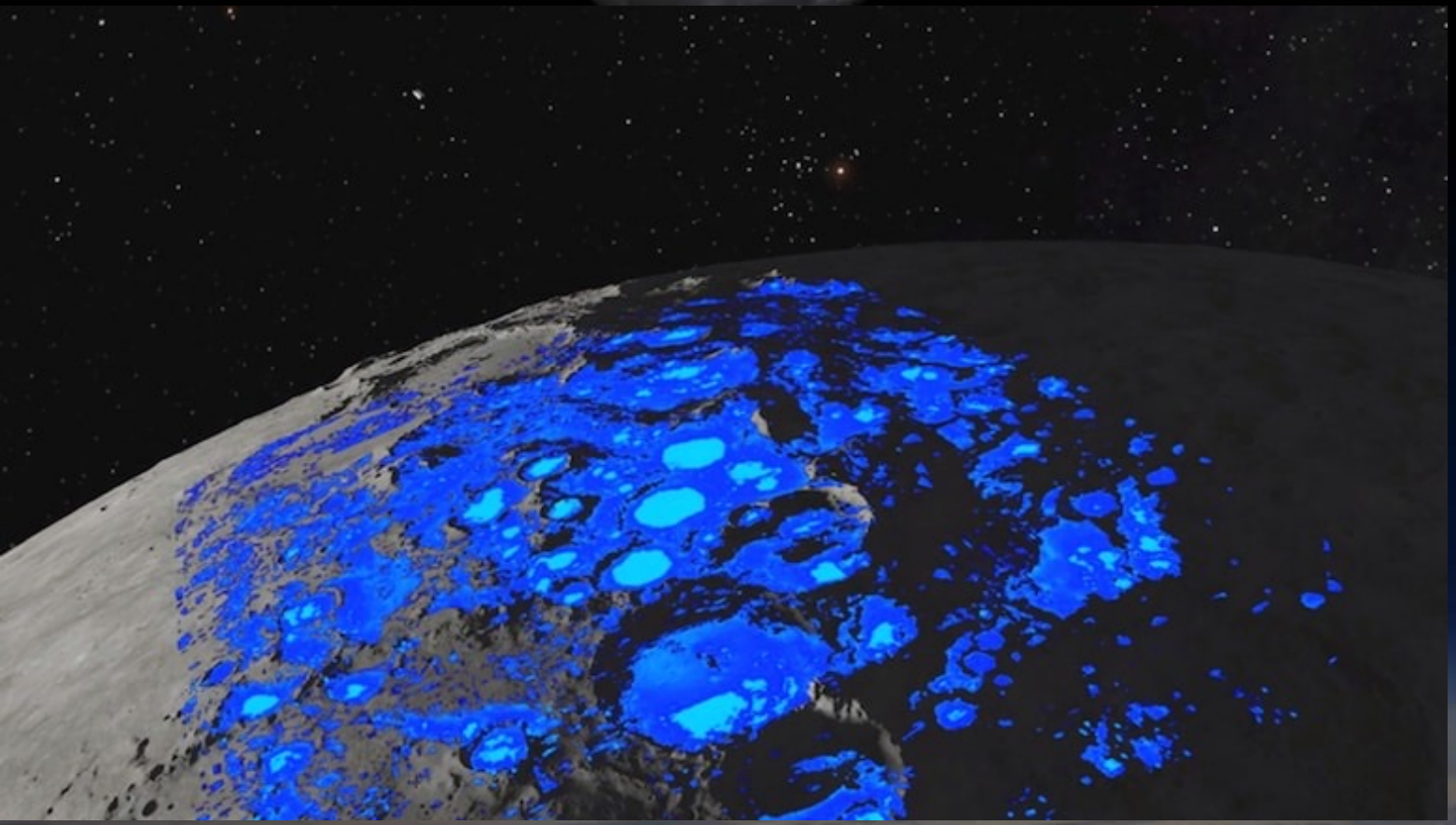


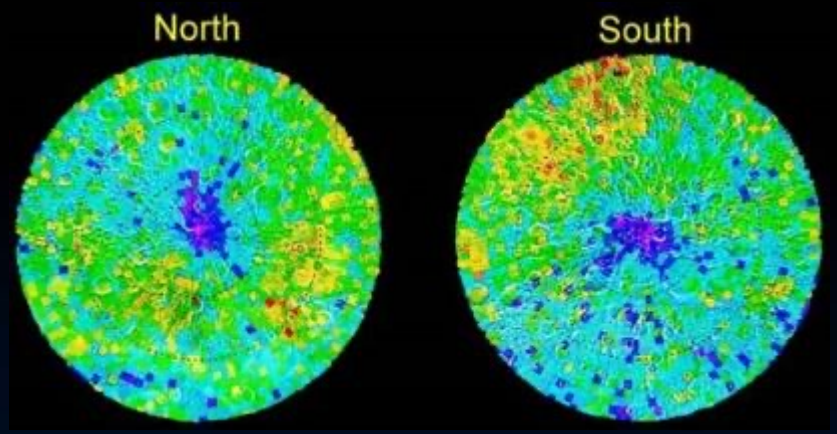






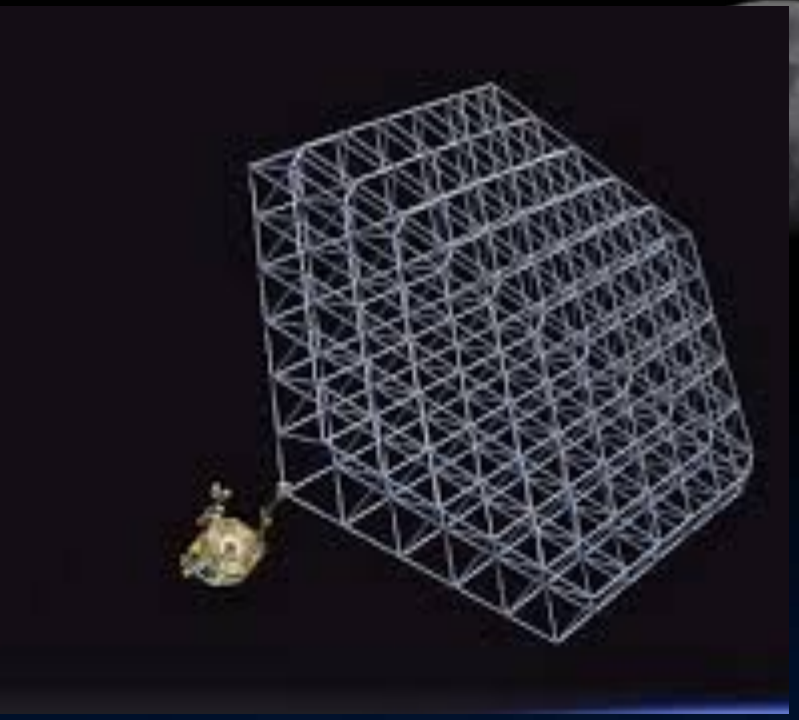
Water is the Gold of Space

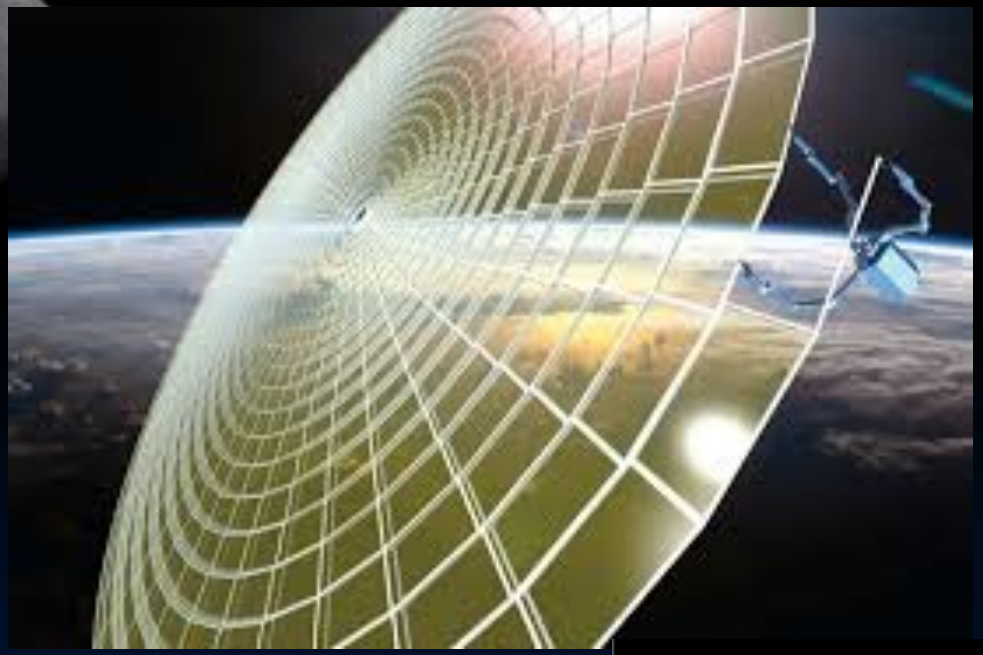


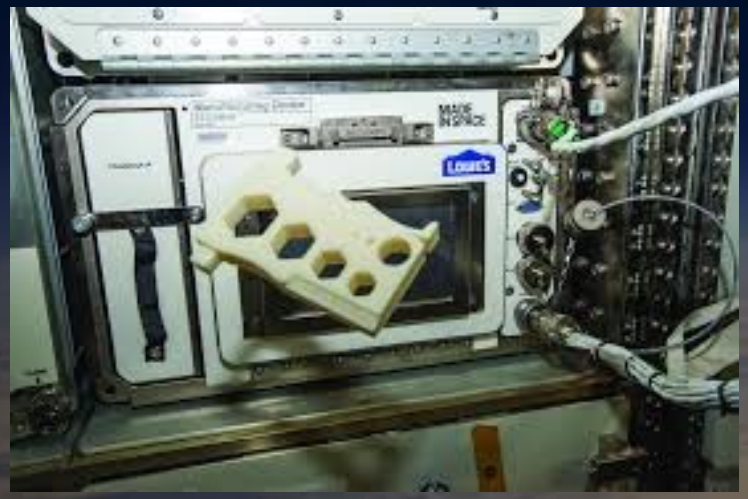


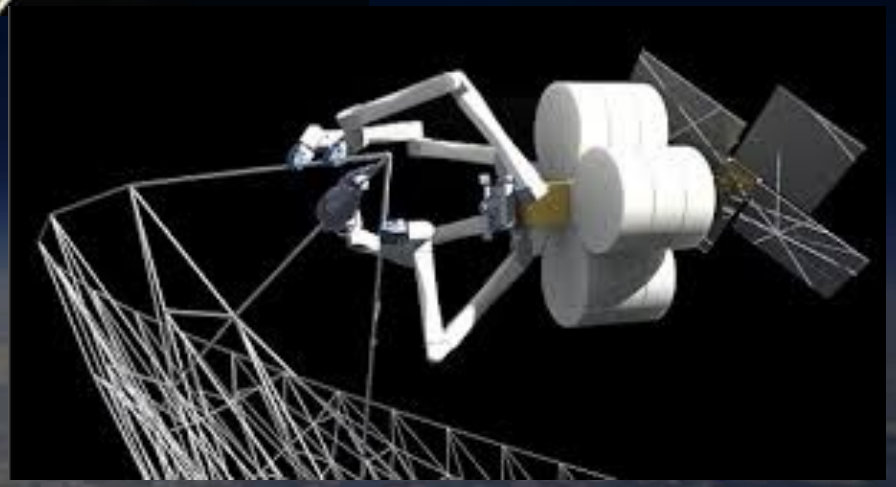
Based on remote observations by radar instruments aboard Chandrayaan-1 and LRO, the lunar poles have **over 600 billion kilograms of water ice**. That's enough to fill at least 240,000 Olympic-sized swimming pools. – Planetary Society

In-Space Manufacturing



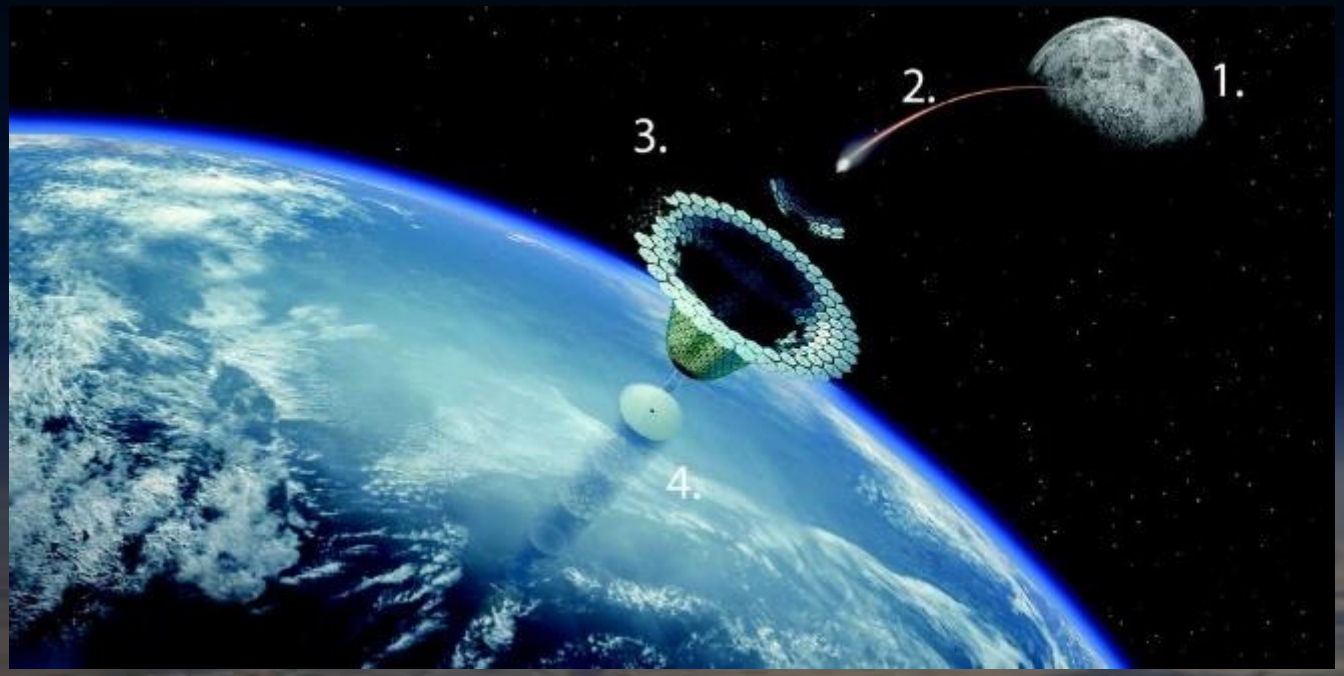




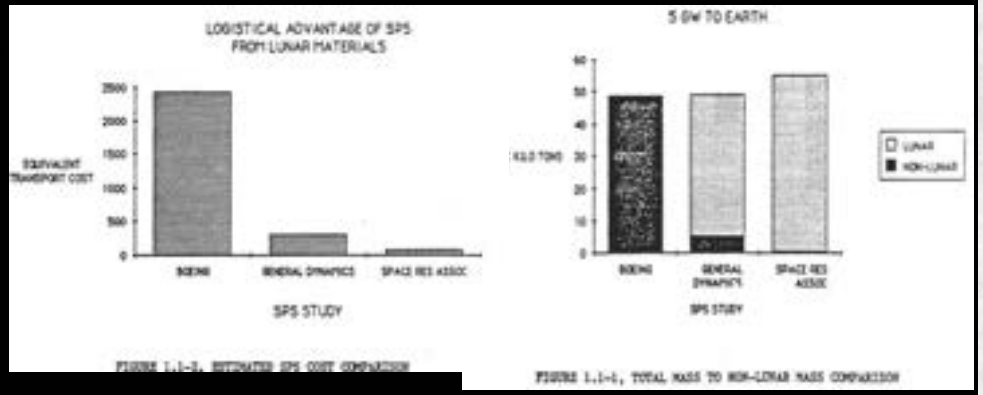


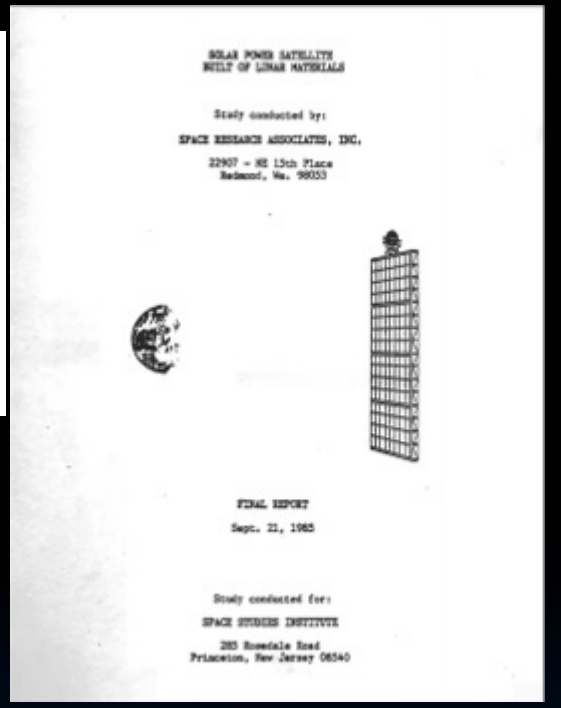
The Competitive Vision:

- Power to enable Lunar Mining in order to build GEO Satellites at Scale
- 55TW of Green Energy Grows the Global Economy 10x

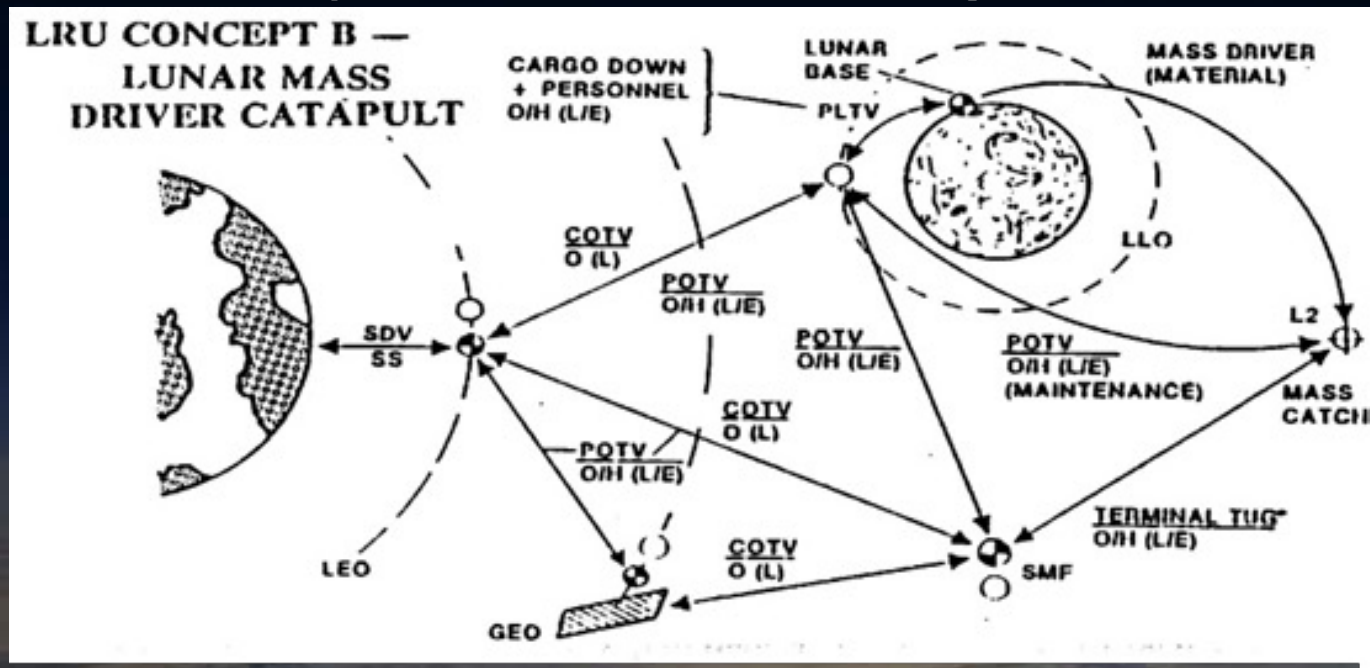


To build 55 TW…11,000 aircraft carrier-sized 5GW solar power satellites would require just one ten-millionth of one percent of the mass of the Moon!





- 99% Lunar Materials…The **energy required to transport lunar material to GEO is less than 8% of that for Earth material**. In addition, launch from the Moon should be more efficient than launch from Earth due to low lunar gravity and the effective lack of a lunar atmosphere. 'nius, the cost of delivering materials **from the Moon to GEO might be about one-fiftieth of the cost to deliver equivalent materials from Earth**. [Mass Driver 600,000MT/yr = 300 GW/yr]



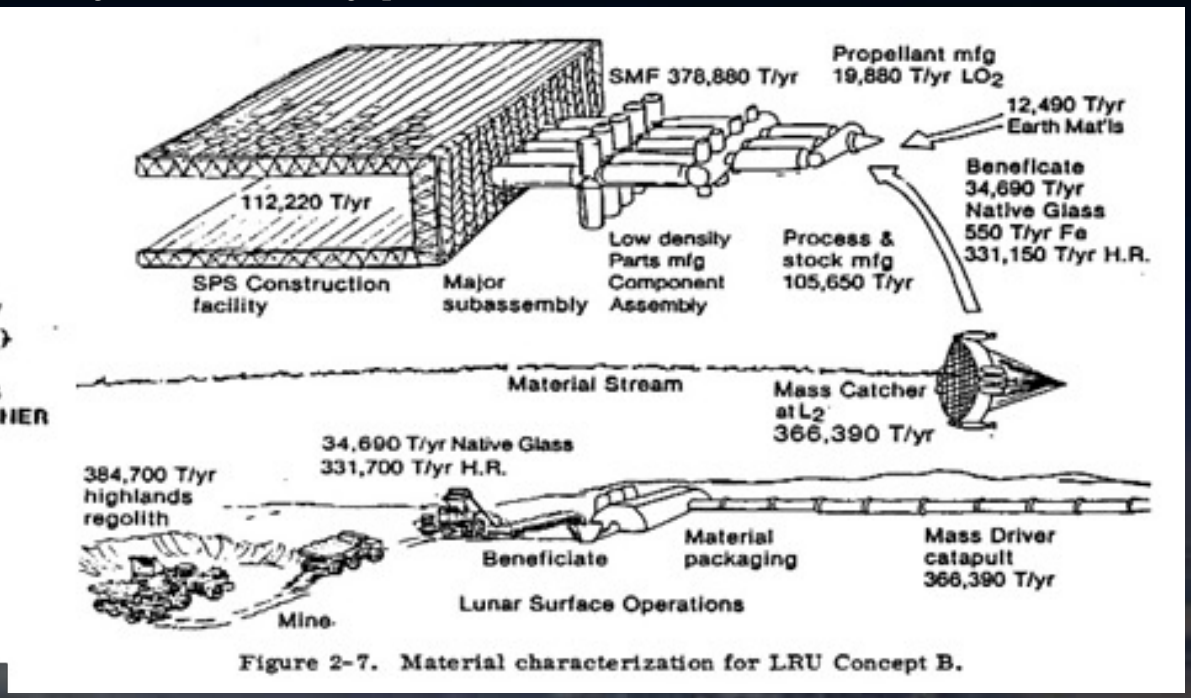
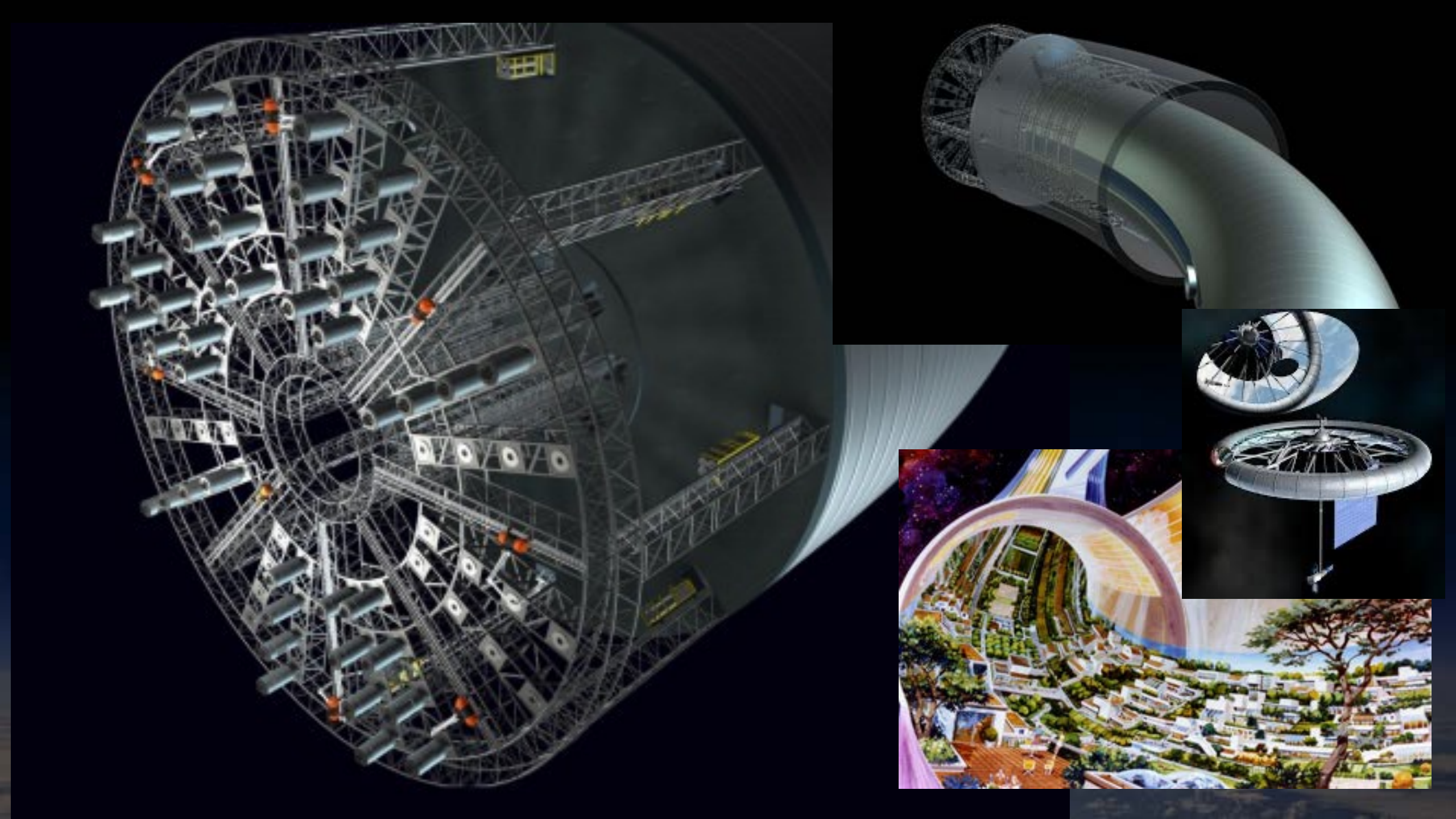
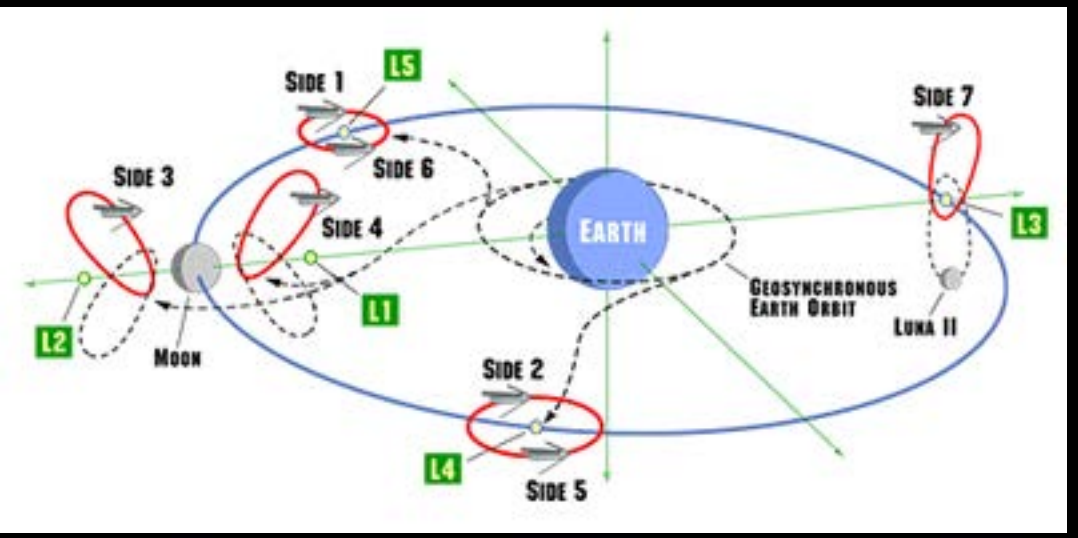


Figure 2-7. Material characterization for LRU Concept B.

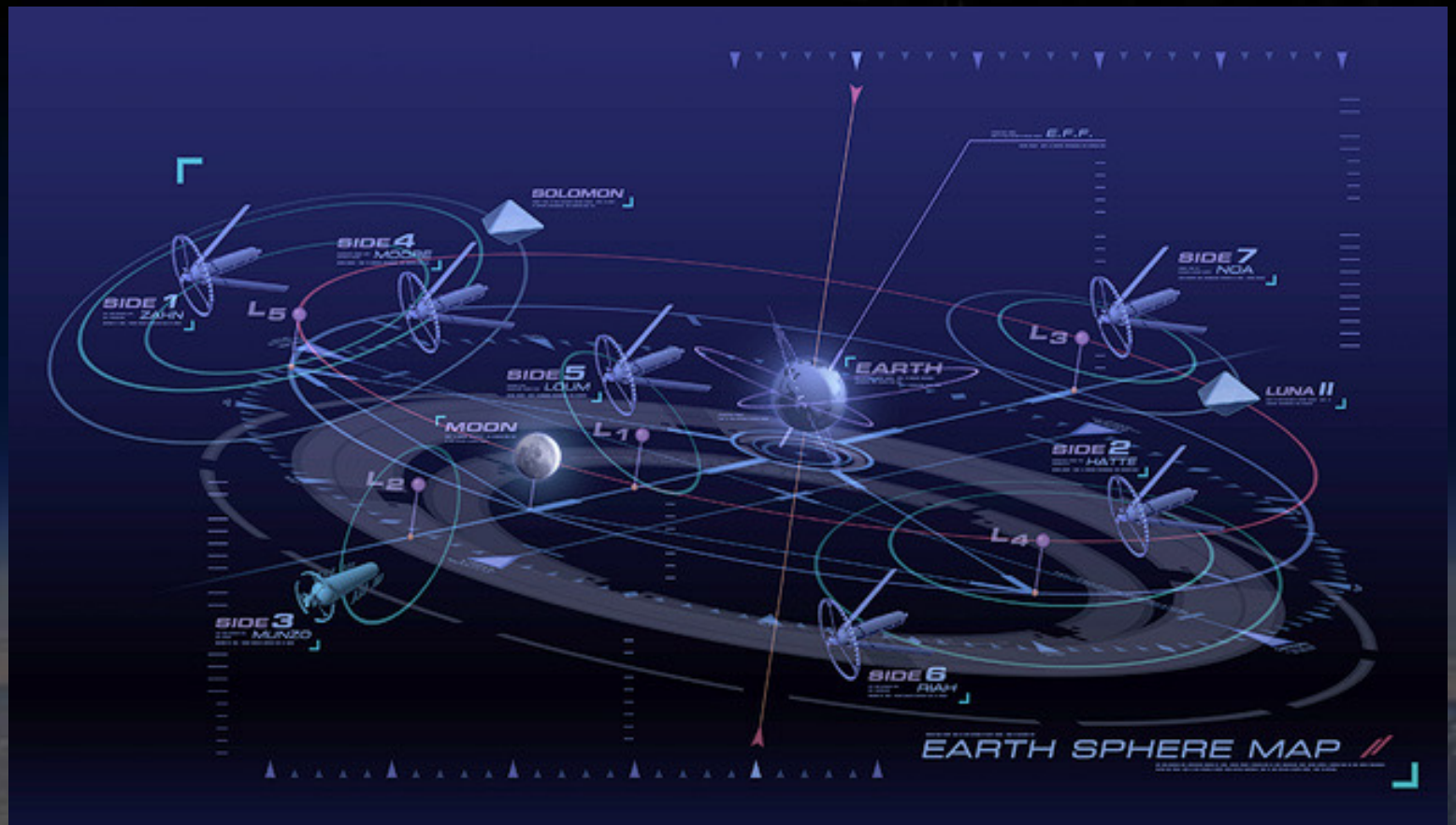
Trillions of people living and working in Space—1000 Einsteins and Mozarts

- One-Millionth the mass of the Moon to construct habitats for 100 Billion people




SIDE 1
L5
SIDE 7
SIDE 3
SIDE 6
SIDE 4
EARTH
L3
GEOSYNCHRONOUS
EARTH ORBIT
L2
MOON
L1
LUNA II
SIDE 2
L4
SIDE 5


U.C.0079
SIDE 7
L3
SIDE 1
SIDE 4
SIDE 5
L5
Luna 2
Solomon
L1
SIDE 3
SIDE 2
L2
L4
Pegun
A Baoa Qu
SIDE 6

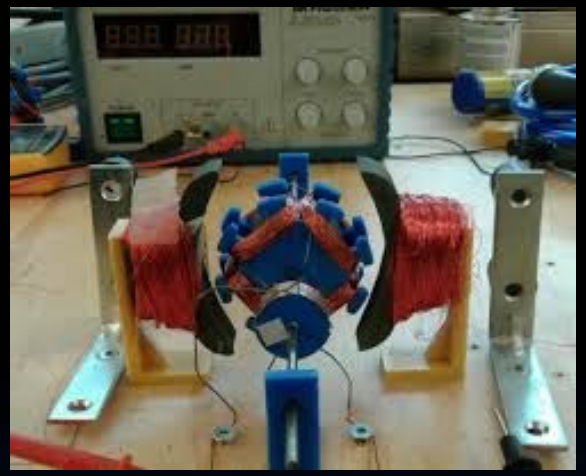

SOLOMON
SIDE 4
MOORE
SIDE 1
ZAHN
L5
SIDE 7
NOA
L3
EARTH
SIDE 5
LOUM
LUNA II
MOON
L1
SIDE 2
HATTE
L2
L4
SIDE 3
MUNZO
SIDE 6
RAH
EARTH SPHERE MAP

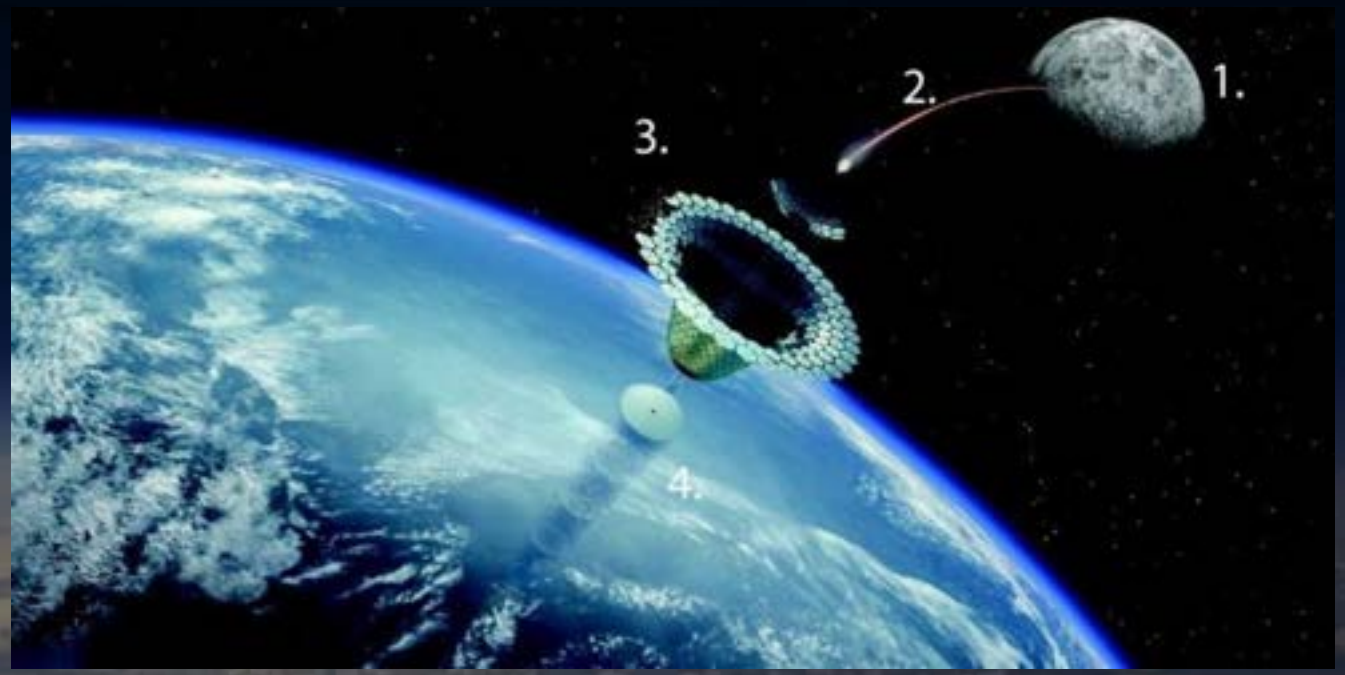
Exponential industrialization of space

nextBIG FUTURE

Exponential industrialization of space is more important than combat lasers and hypersonic fighters

Brian Wang · October 26, 2017





Exponential industrialization of space

Preprint. To appear in Journal of Aerospace Engineering.

Affordable, rapid bootstrapping of space industry and solar system civilization

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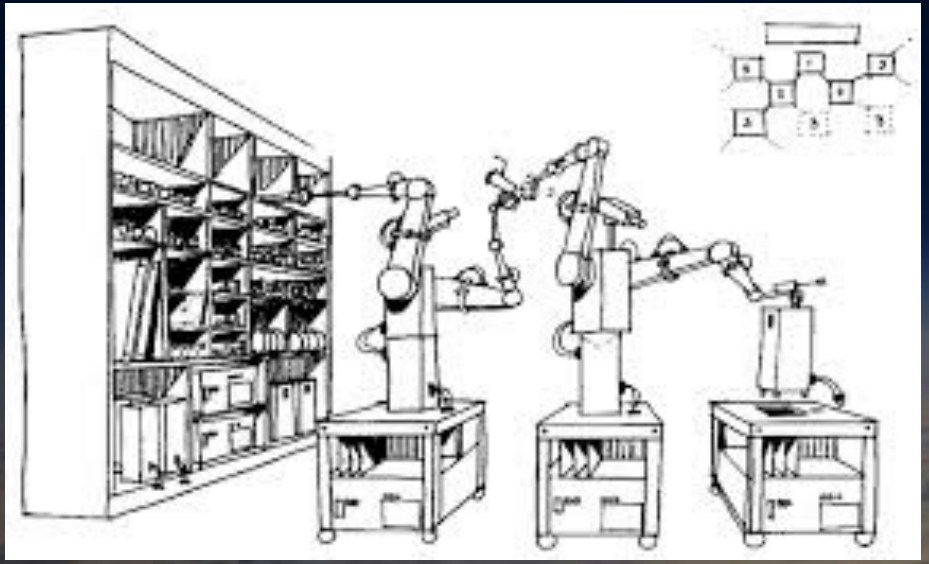
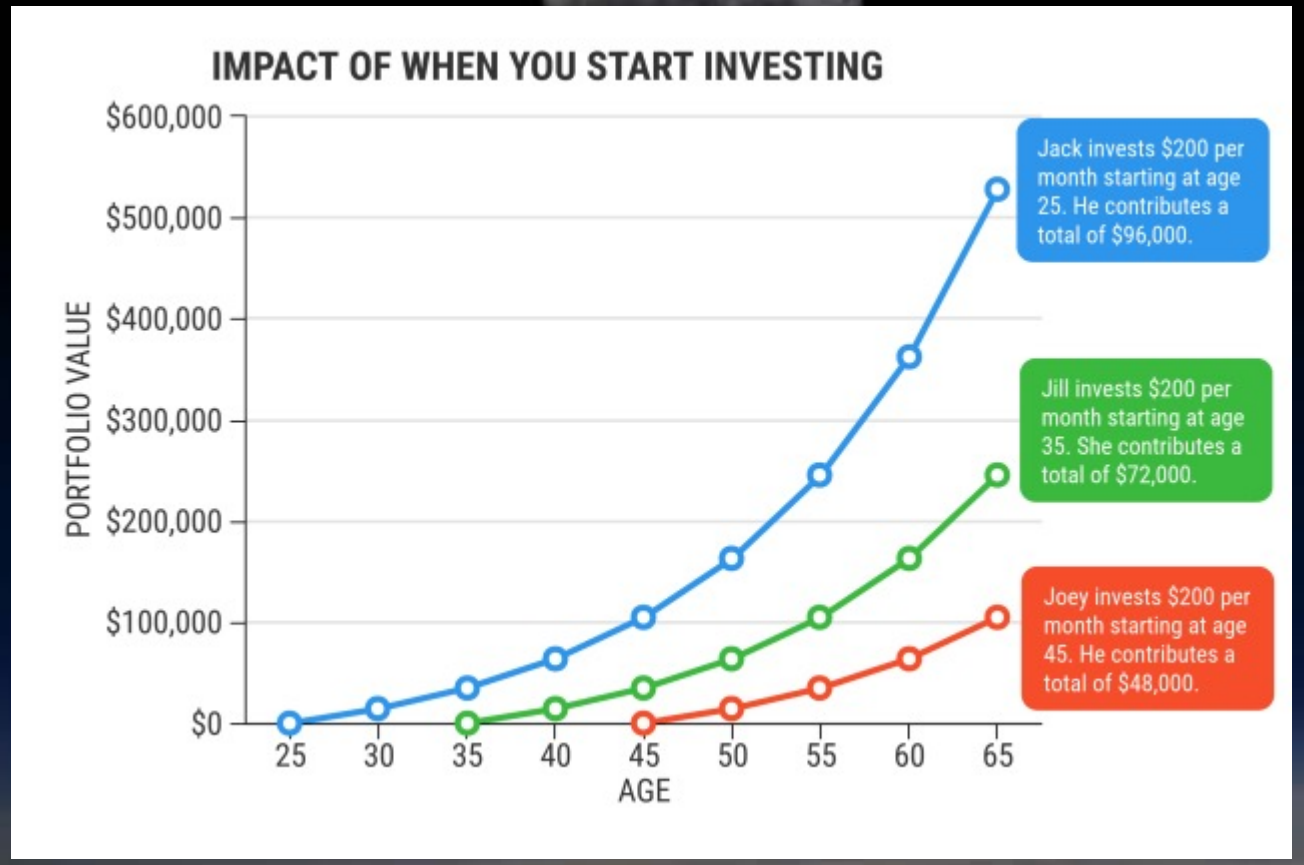
Abstract:



- The asteroid belt has everything necessary: water, carbon, silicates, metals, oxygen, solar energy …*There, the billion- fold greater resources could allow the industry to expand exponentially until it dwarfs that of the entire Earth within just a few decades* . . . Multiplying this by a factor of 3 per year, it would exceed the energy usage of the US within 11 more years. *After 12 more years it would exceed the US economy by a factor of a million. After another decade it would exceed the US economy by a factor of a billion.*
- "The modeling also indicates a significant national security risk. On Earth, the industry of a nation is limited by its resources …a robotic industry occupying a solar system, the resources and real estate are a billion times greater… Until this industry begins to feel the limits of the entire solar system, it can grow exponentially. If any nation initiates and controls such an industry first, then it will have a perpetual lead in industrial power over another nation that initiates the same capability second.

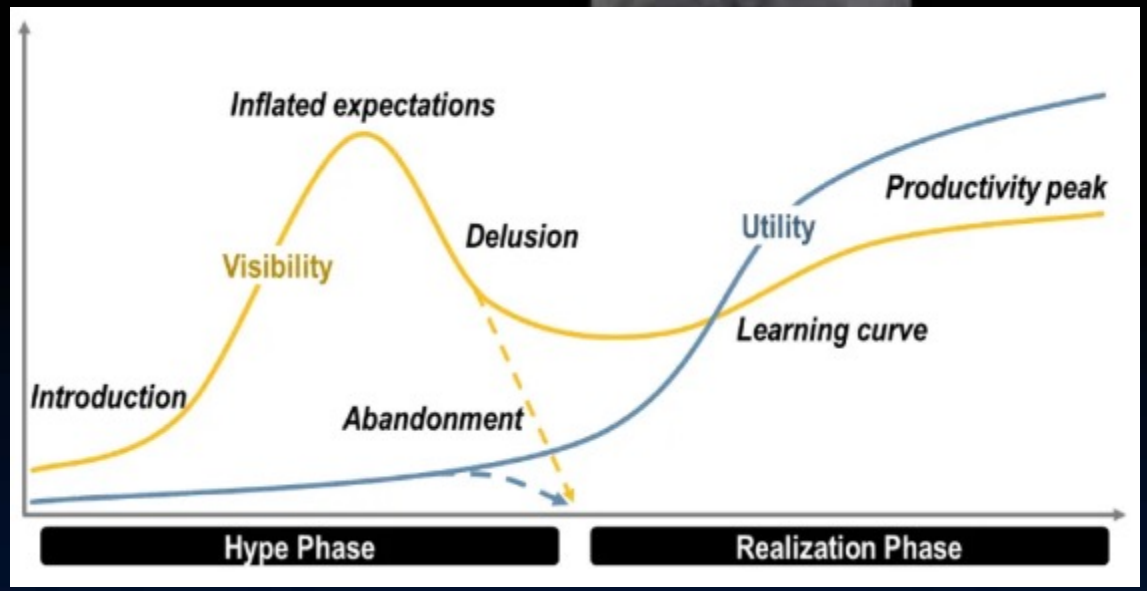

IMPACT OF WHEN YOU START INVESTING
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
PORTFOLIO VALUE
25
30
35
40
45
50
55
60
65
AGE
Jack invests $200 per month starting at age 25. He contributes a total of $96,000.
Jill invests $200 per month starting at age 35. She contributes a total of $72,000.
Joey invests $200 per month starting at age 45. He contributes a total of $48,000.


COMPOUND INTEREST:
WHO WILL EARN MORE?
This example shows how the earlier a person takes advantage of compound interest, the more time that money has to grow.
$787,180
at age 65
$611,730
at age 65
INVESTOR 1:
-Starts at 25
-Sets aside $5,000 a year for 10 years in a row.
-No more investments after age 34.
INVESTOR 2:
-Starts at 35
-Invests $5,000 each year for 30 years in a row until reaching age 65.
$800,000
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
25
30
35
40
45
50
55
60
65
NOTES: Assumes an 8 percent interest rate, compounded annually. Balances shown are approximate.
SOURCE: Author's calculations.
FEDERAL RESERVE BANK of ST. LOUIS

Applied Science Objectives to:

- Rapidly get us to Megawatts and Megatons
- Create positional / logistical advantage

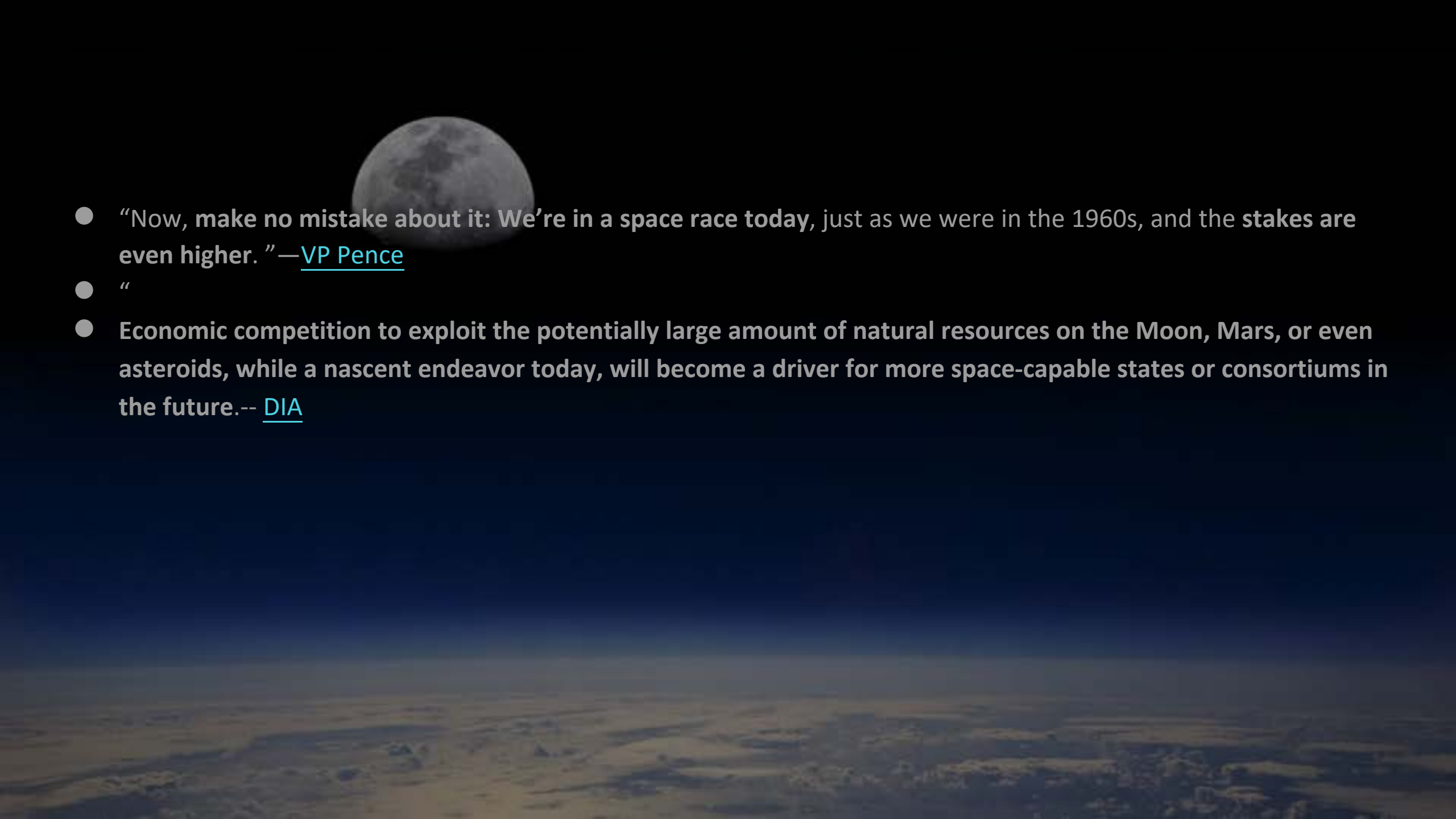
DO SUCH PROJECTIONS DESERVE TO BE TAKEN SERIOUSLY?



- .U.S. Sen. Thomas Benton of Missouri on TCR“an imposture, a humbug; it could have emanated only from a madman . . . Why sir, it’s madness!” . . . “You are one hundred years before your time. “
- “The flying machine which will really fly might be evolved by the combined and continuous efforts of mathematicians and mechanicians in from one million to ten million years
- Arthur C. Clarke warned us, “if we have learned one thing from the history of invention and discovery, it is that, in the long run—and often in the short one—the most daring prophecies seem laughably conservative.”

USCC

- **China views space as critical to its future security and economic interests due to its vast strategic and economic potential**. Moreover, Beijing has specific plans not merely to explore space, but to **industrially dominate the space within the moon's orbit of Earth. China has invested significant resources in exploring the national security and economic value of this area**, including its potential for space-based manufacturing, resource extraction, and power generation,
- **China's space program is not merely exploration but rather "industrial and economic dominance of the cislunar system**.
- **A key component of China's plan to support its activity in cislunar space and beyond is the establishment of permanent facilities on the moon.**
- **Cislunar space will also play an important role in China's plans for space-based solar power, a futuristic power source that China aims to fully deploy by 2050**,



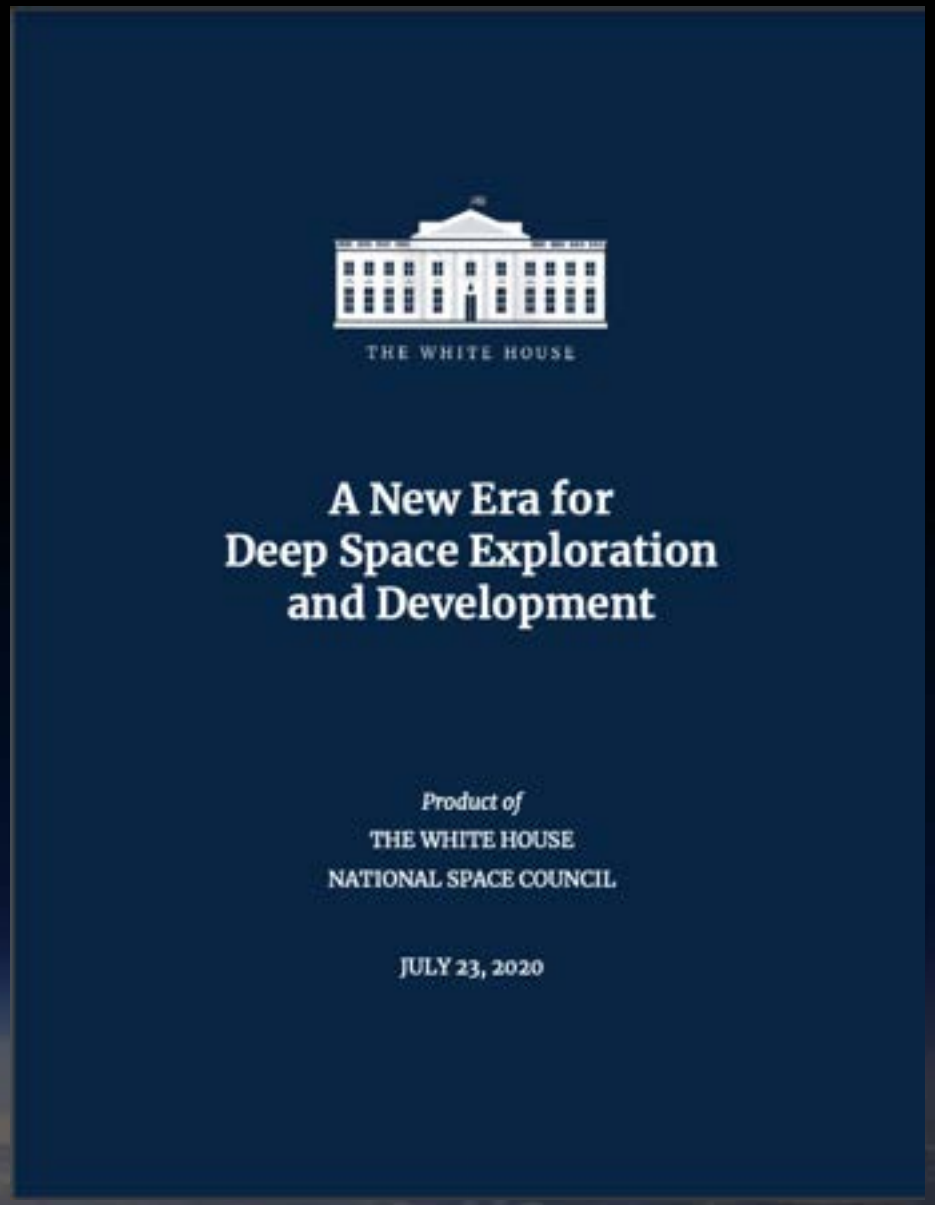
- “Now, **make no mistake about it: We’re in a space race today**, just as we were in the 1960s, and the **stakes are even higher**. ”—VP Pence
- “
- **Economic competition to exploit the potentially large amount of natural resources on the Moon, Mars, or even asteroids, while a nascent endeavor today, will become a driver for more space-capable states or consortiums in the future**.-- DIA

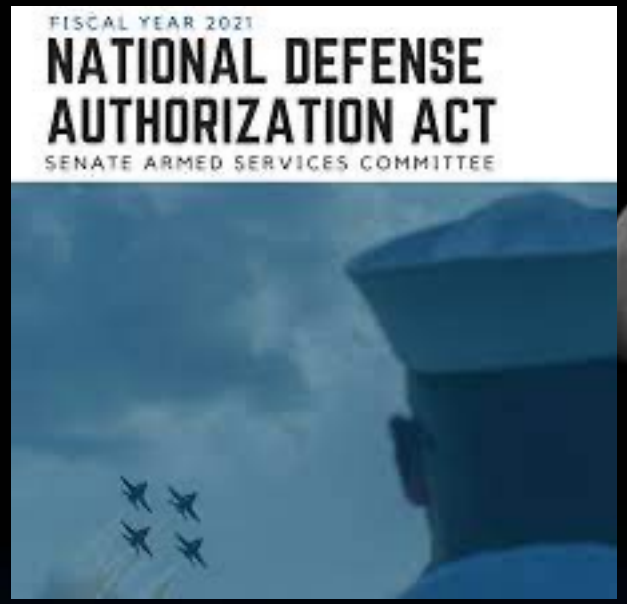
The Purpose of Our Lunar Program

- Occupation is greater, Exploration in service to others
- Expand and exploit
- Pictures: Great Inversion, Mass Drivers, SPS, O'Neil…POWER!
- Prospecting Science
- Megatons and Gigawatts (Planning assumptions for Space Force)

“This vision begins with a campaign to utilize Earth’s orbital environment, the surface of the Moon, and cislunar space to develop the critical technologies, operational capabilities, and commercial space economy necessary for a sustainable human presence on the Moon, Mars, and beyond

…The United States Space Force (USSF) does not have a direct role in the civil exploration and development of space per se – its responsibilities focus on organizing, training, and equipping the forces needed to support combatant commands and ensure unfettered access to and the use of space by the United States and its allies and partners. However, activities such as space transportation and logistics, power, communication, navigation, and space domain awareness, are of dual-use value to all space sectors – civil, national security, and commercial.”



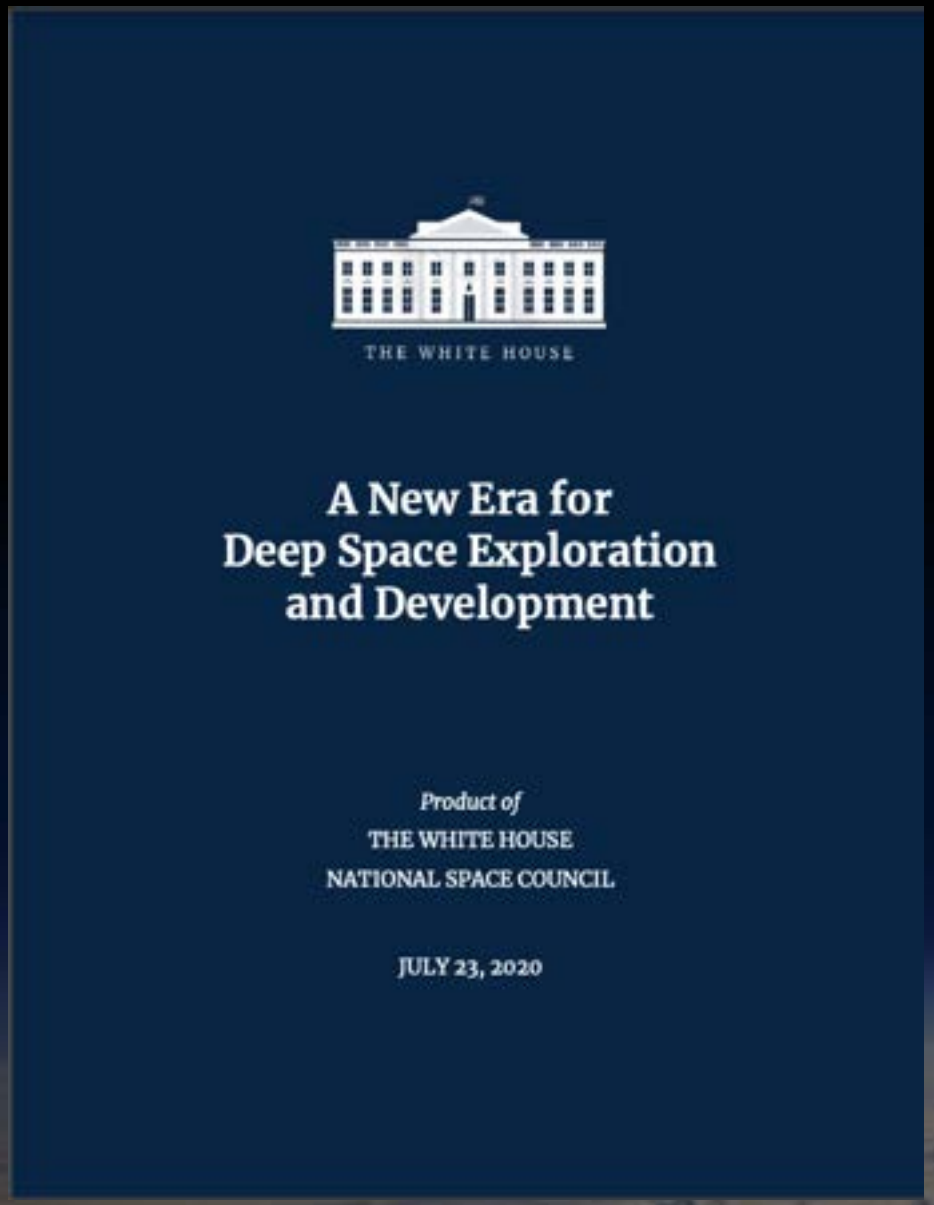


"the National space Council shall submit to the appropriate congressional committees an interagency assessment of the ability of the United States to compete with the space programs of China"
Including:
"A comprehensive assessment between the United States and China on—
(1) Human exploration and spaceflight
(2) The viability and potential environmental impacts of extraction of space-based precious minerals, on-site exploitation of space-based natural resources, and the use of space-based solar power.
(3) The strategic interest in and capabilities for cislunar space; and
(4) Current and future space launch capabilities
(B) The extent of foreign investment in the commercial space sector…
(C) An assessment of the ability, role, costs, and authorities of the Department of Defense to mitigate the threats to commercial communications and navigation in space from the growing counterspace capabilities of China.

National Security Missions (General)

- USSPACECOM:
- US Space Force:
- NRO:
- DARPA:

U.S. Grand Strategy Context



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However, activities such as space transportation and logistics, power, communication, navigation, and space domain awareness,

are of dual-use value to all space sectors – civil, national security, and commercial."

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND
THE UNITED STATES SPACE FORCE

When established in December 2019, USSF was tasked with defending and protecting U.S. interests in space. Until now, the limits of that mission have been in near Earth, out to approximately geostationary range (22,236 miles). With new U.S. public and private sector operations extending into cislunar space, the reach of USSF's sphere of interest will extend to 272,000 miles and beyond – more than a tenfold increase in range and 1,000-fold expansion in service volume. USSF now has an even greater surveillance task for space domain awareness (SDA) in that region, but its current capabilities and architecture are limited by technologies and an architecture designed for a legacy mission.

COOPERATIVE AREAS

NASA and USSF look forward to continuing their fruitful partnership in existing areas of collaboration, as well as establishing new relationships, in the following areas:

1. Deep space survey and tracking technologies to support extended SDA and NEO detection beyond geosynchronous orbit;
2. Detection and data collection on bolides caused by natural objects entering Earth's atmosphere, to provide timely reporting to the public and the scientific community;
3. Capabilities and practices enabling safe, sustained near-Earth and cislunar operations such as communications; navigation; space structure servicing, assembly, and manufacturing; and interoperability among those capabilities to support resilience for functions in this remote region;
4. Search, rescue, and recovery operations for human spaceflight;
5. Launch support;
6. Space logistical supply and support;
7. Ride shares and hosted payloads to and beyond Earth orbit;
8. Establishing standards and best practices for safely operating in space, to include conjunction assessment, space situational awareness sharing, orbital debris mitigation, and space systems protection;
9. Interoperable spacecraft communications networks for Earth orbit and beyond;
10. Fundamental scientific research and technology development cooperation; and
11. Developing and sharing a talent pool of premier space professionals and expertise.

https://www.nasa.gov/sites/default/files/atoms/files/nasa_ussf_mou_21_sep_20.pdf

Space Domain Awareness (SDA)

Spacecraft in xGEO are much harder to track and characterize, and could threaten U.S. or allied high-value satellites. Adversaries could also place operational or reserve satellites in deep space so they are much harder to monitor for later use in lower orbits

-- DIA Challenges to Security in Space

Col. Eric Felt, the director of AFRL's Space Vehicles Directorate, said the document aims to "educate and inspire." "Operating spacecraft beyond geosynchronous Earth orbit poses unique challenges," Felt said in a statement. "As commerce extends to the moon and beyond, it is vital we understand and solve those unique challenges so that we can provide space domain awareness and security."

https://spacenews.com/report-space-force-has-to-prepare-for-operations-beyond-earths-orbit/

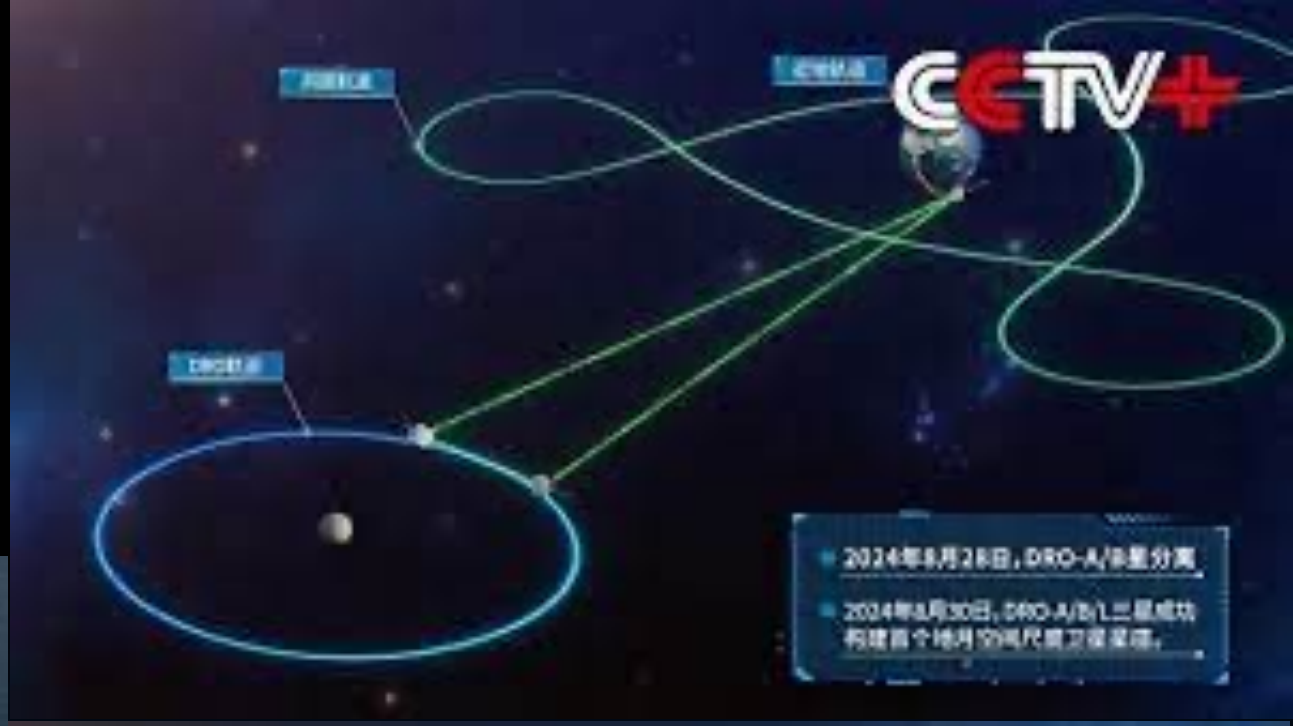
"If you look at the National Space Strategy that was signed .. in December ... it actually commits us—commits the Space Force and the Department of Defense—to ... monitoring what's going on out there," Hammett said. "And if somebody is a bad actor in the international realm: to monitor, detect, and respond."

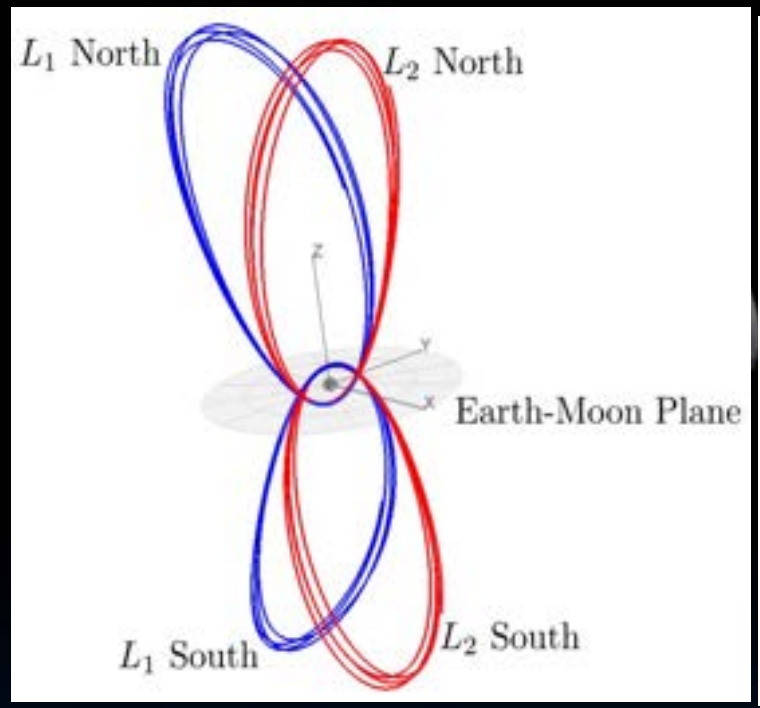
https://www.airforcemag.com/space-war-like-the-cold-war-is-all-risk-no-reward/

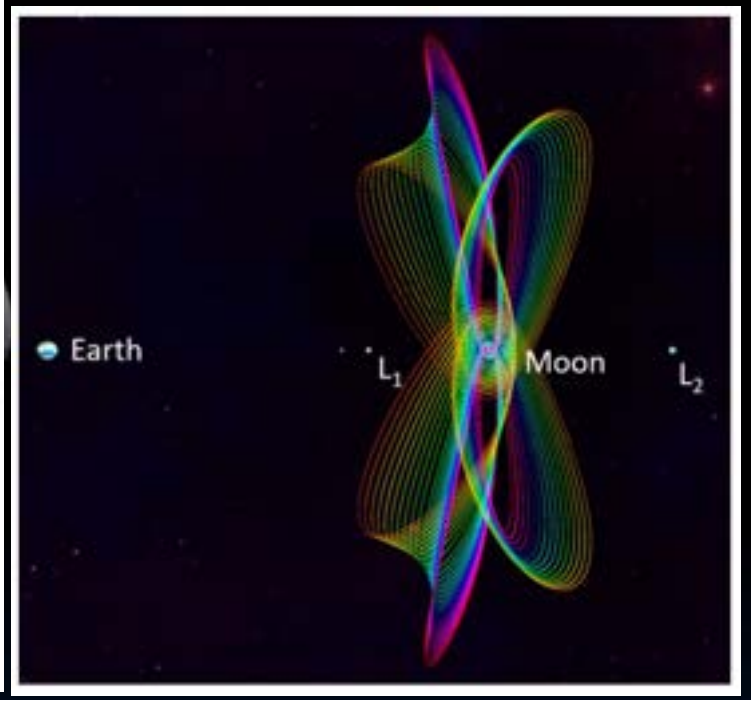
FAR-SIDE SATELLITE

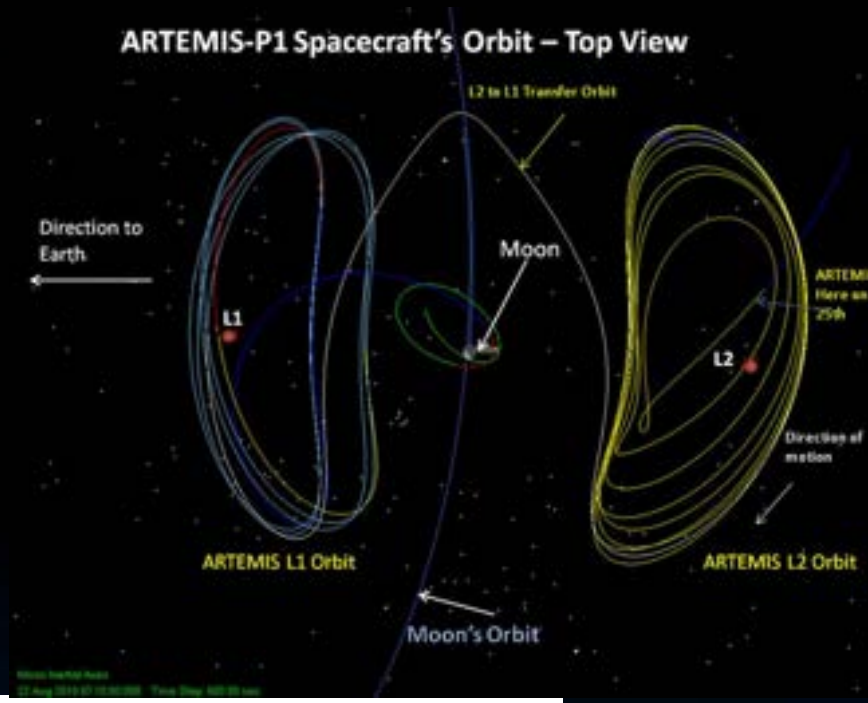
China's Queqiao satellite, which will track the Moon from a gravitationally stable point called Earth–Moon L2, will act as a communications station for the future Chang'e-4 lander, which should become the first probe to land on the far side of the Moon later this year.

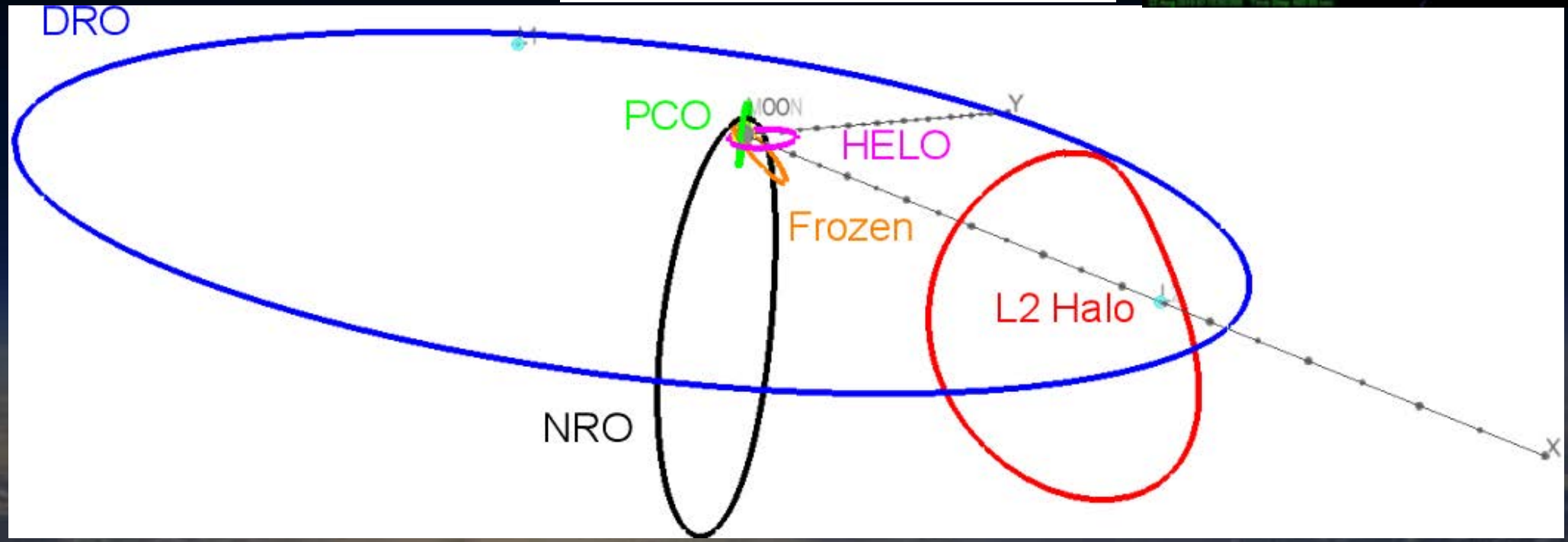
©nature

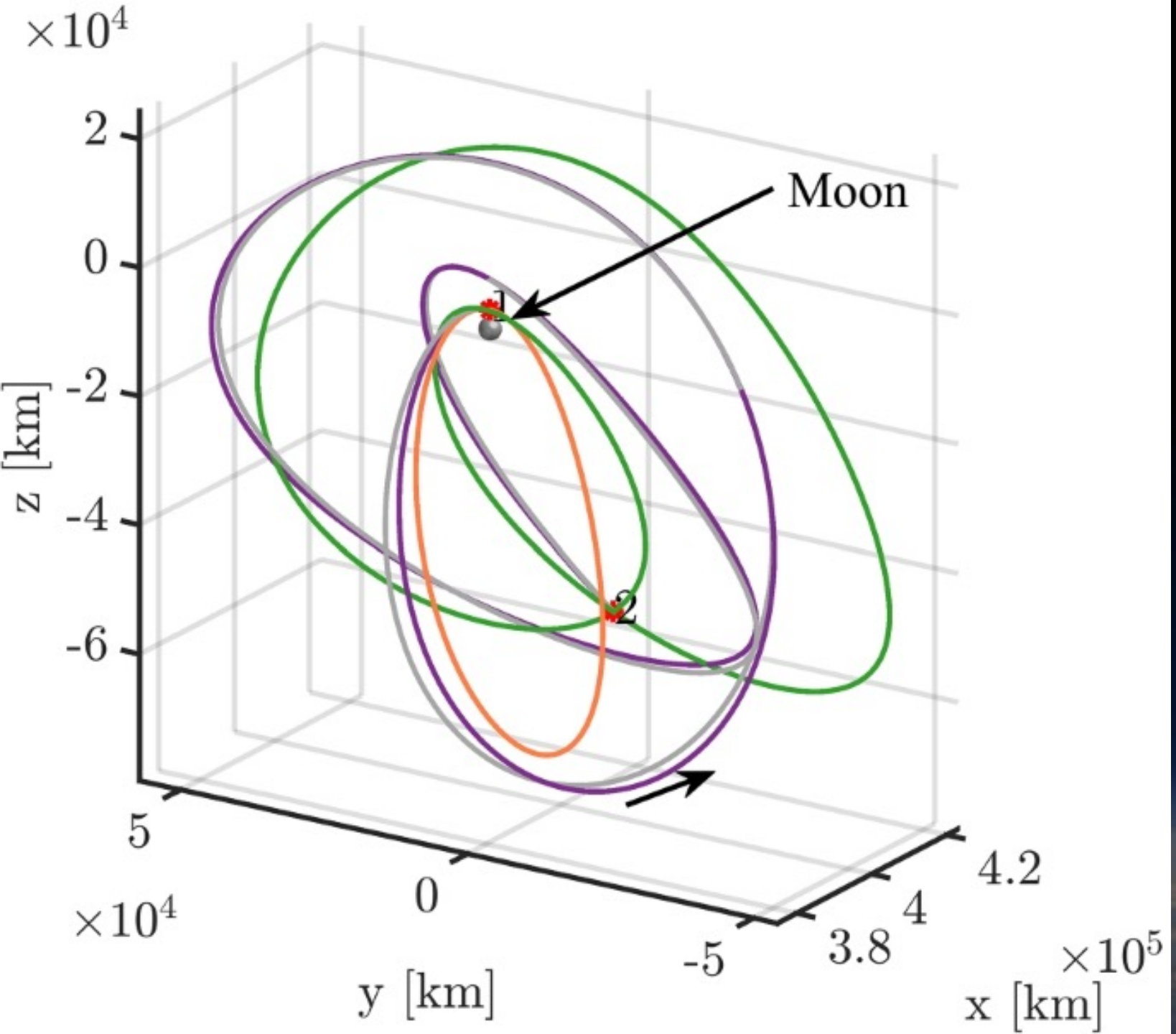


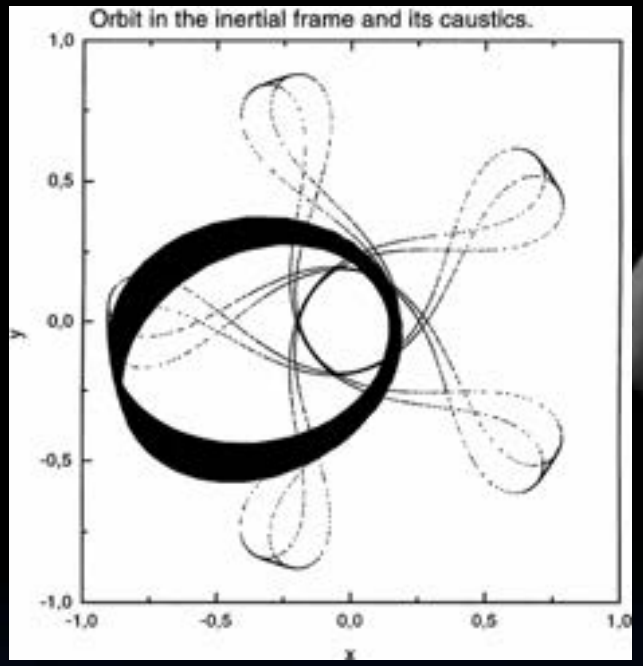

L_1 North
L_2 North
Earth-Moon Plane
L_1 South
L_2 South

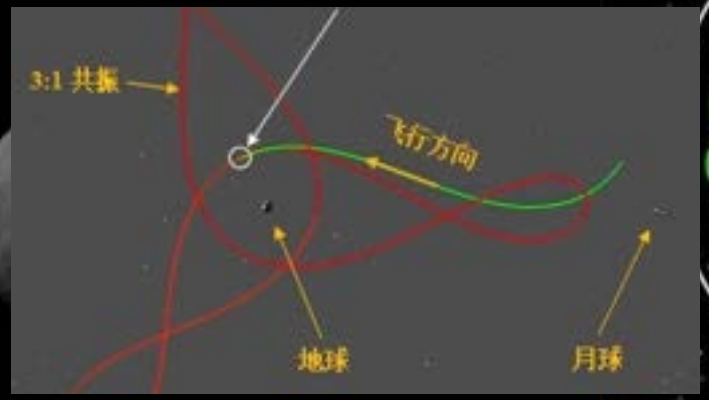

Earth
L_1
Moon
L_2

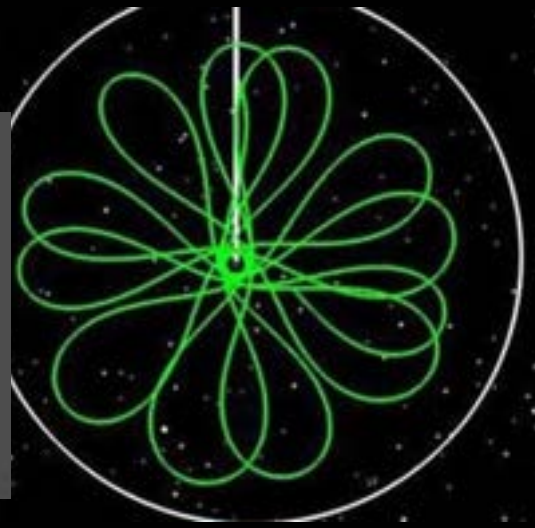

ARTEMIS-P1 Spacecraft's Orbit – Top View
L2 to L1 Transfer Orbit
Direction to Earth
Moon
L1
L2
ARTEMIS L1 Orbit
ARTEMIS L2 Orbit
Moon's Orbit

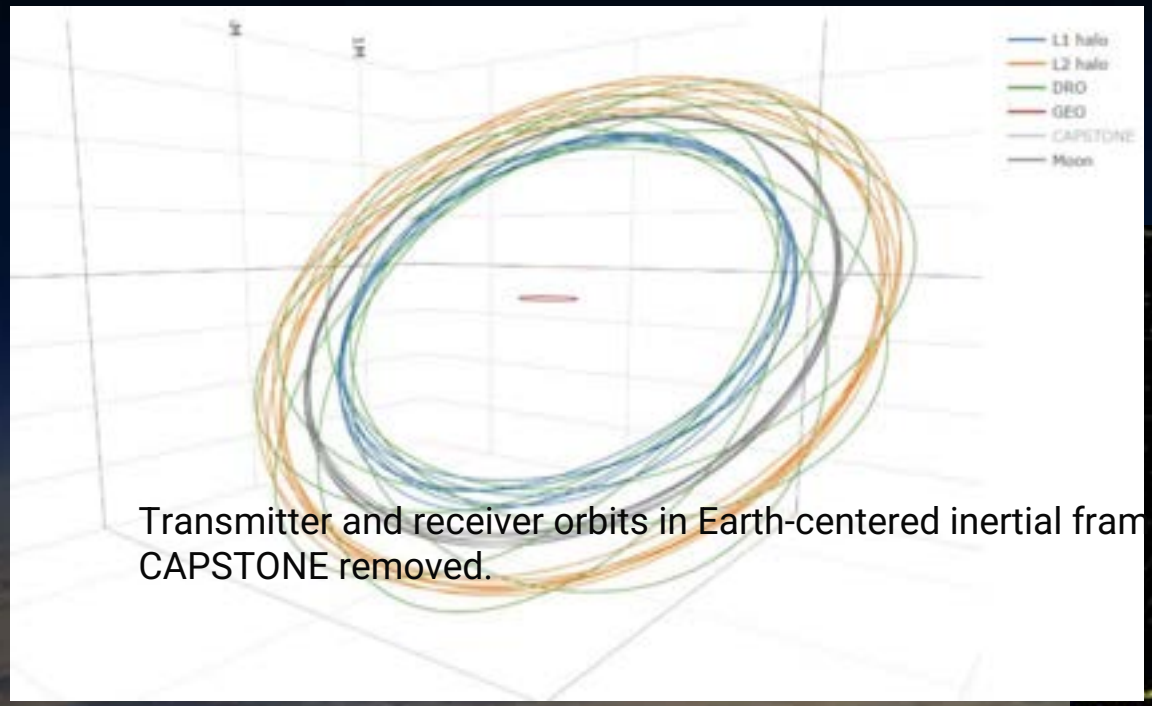

DRO
PCO
MOON
Y
HELO
Frozen
L2 Halo
NRO
X


×10^4
2
0
-2
-4
-6
z [km]
Moon
1
2
5
0
-5
×10^4
y [km]
4.2
4
3.8
×10^5
x [km]





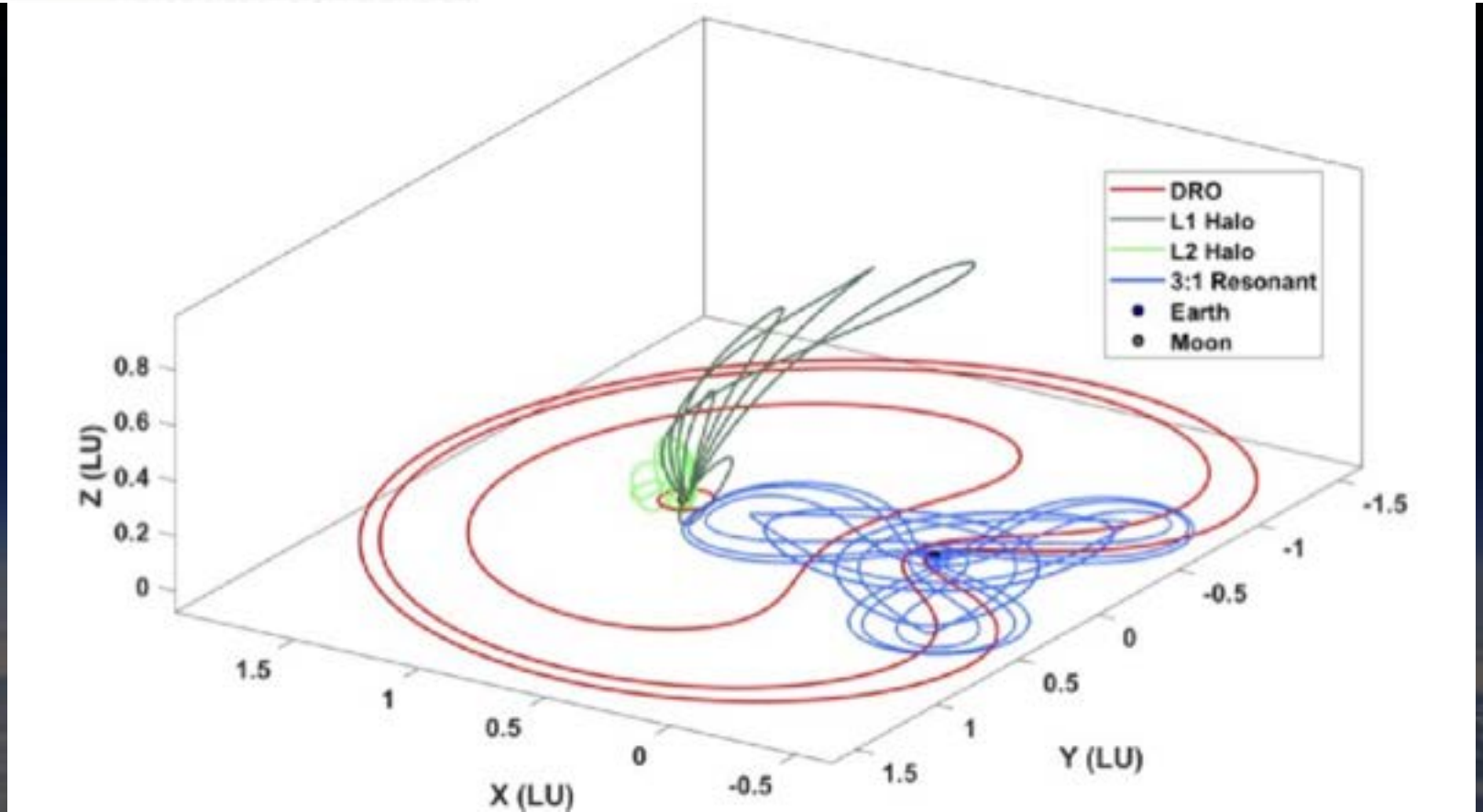


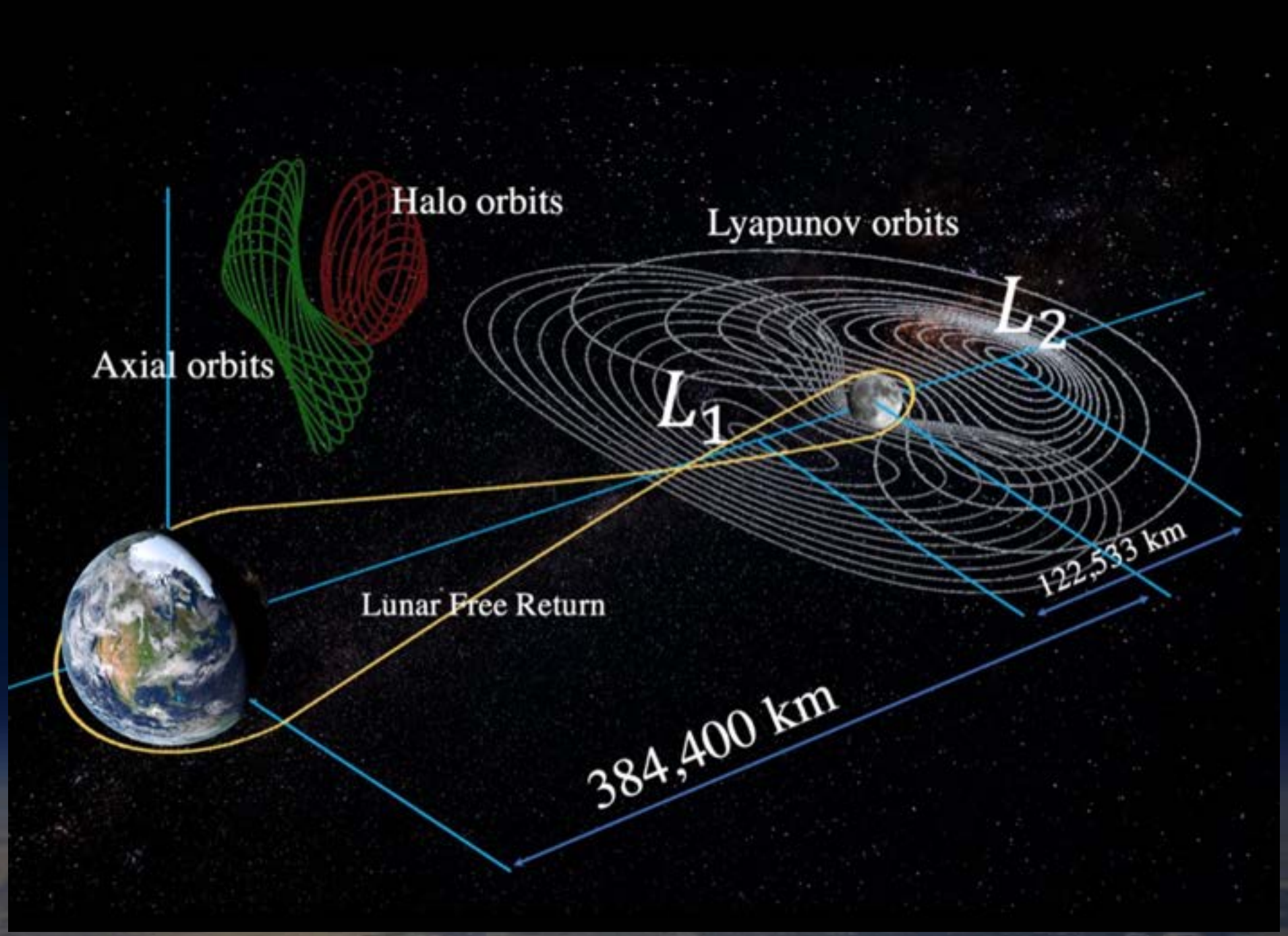


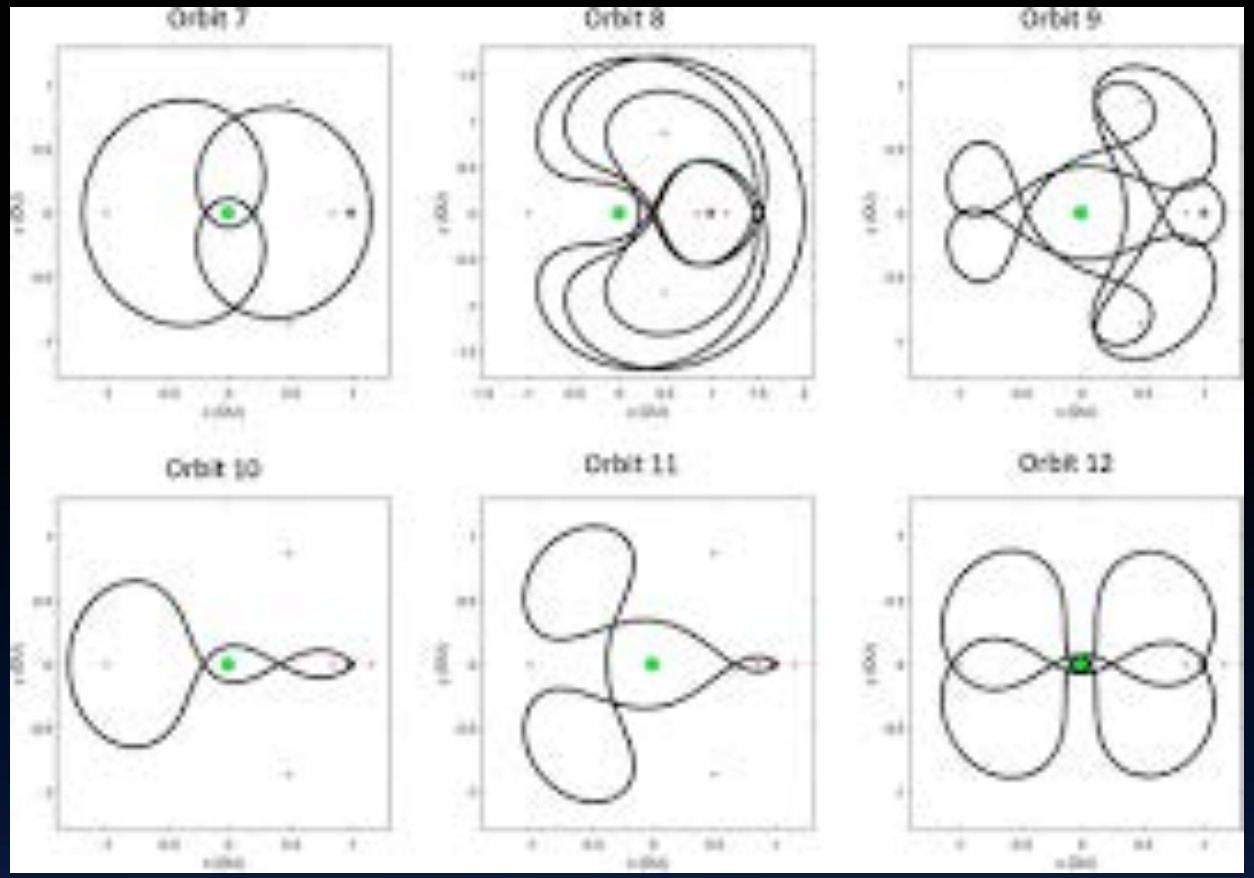
Transmitter and receiver orbits in Earth-centered inertial fram
CAPSTONE removed.

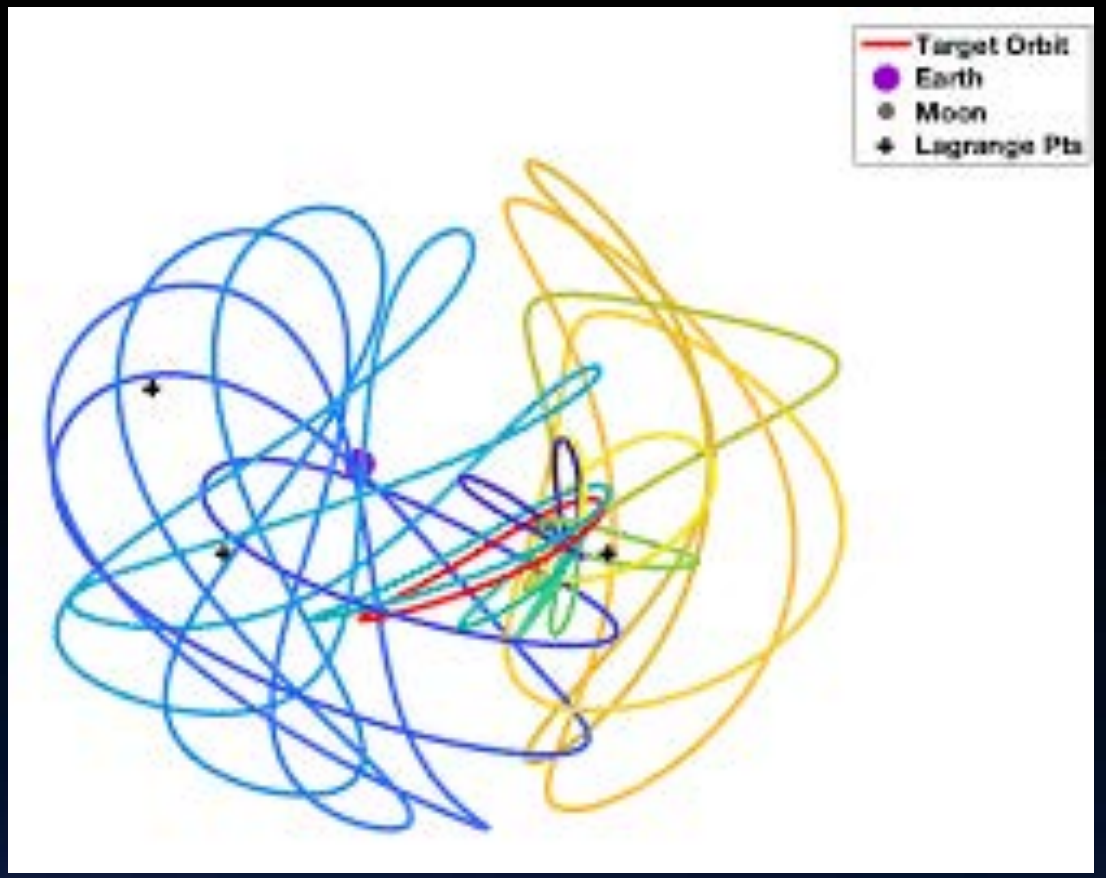
L1 Halo
L2 Halo
L3 Lyapunov
L4 Lyapunov
L5 Lyapunov
Distant Retrograde Orbit

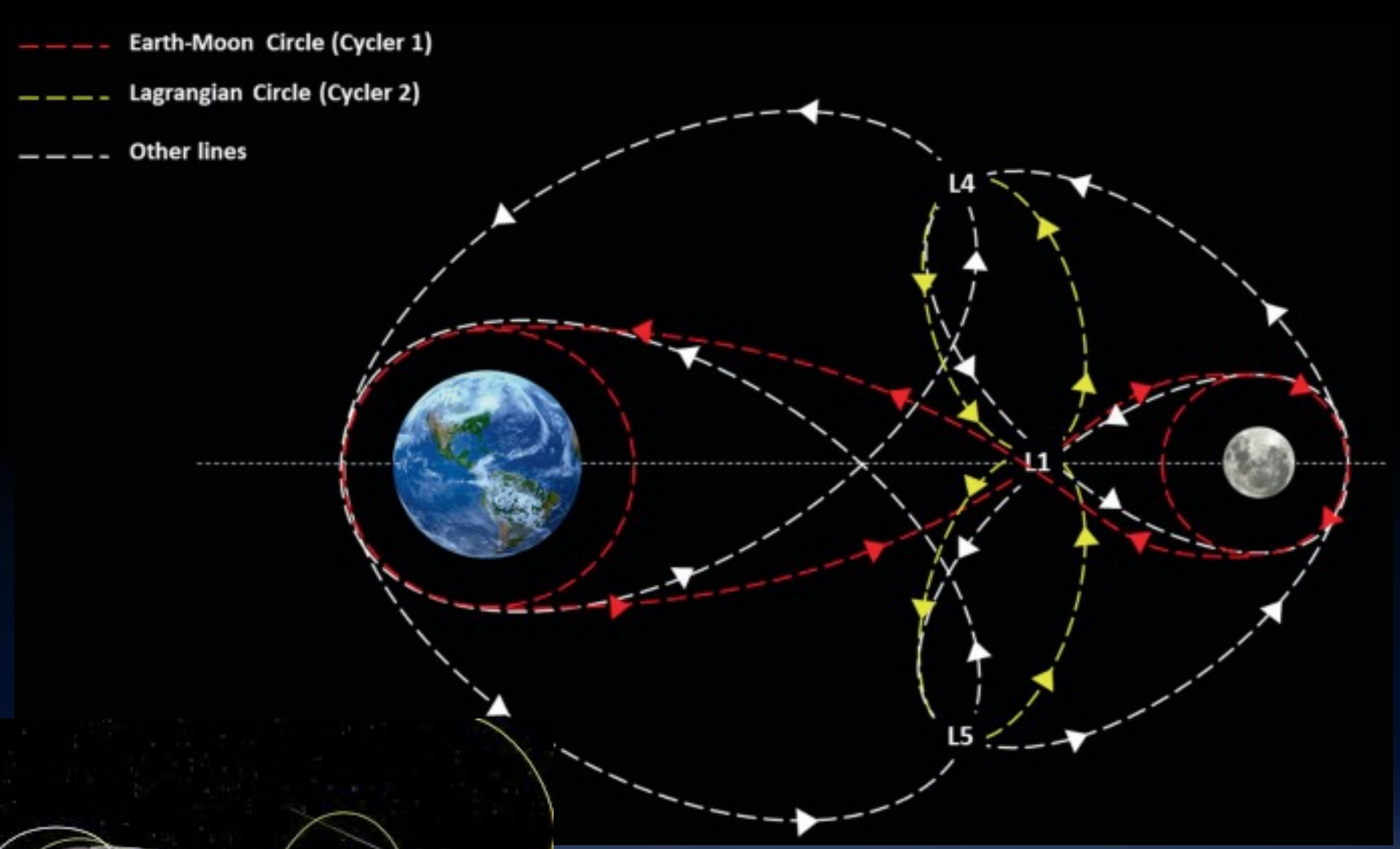
Halo orbits (examples shown here in blue and orange about L1 and L2, respectively) exhibit motion above and below the moon's orbit plane, which enables visibility to the lunar poles. L2 halo orbits offer a unique location for a communication relay, with continuous visibility to both Earth and the far side of the moon.

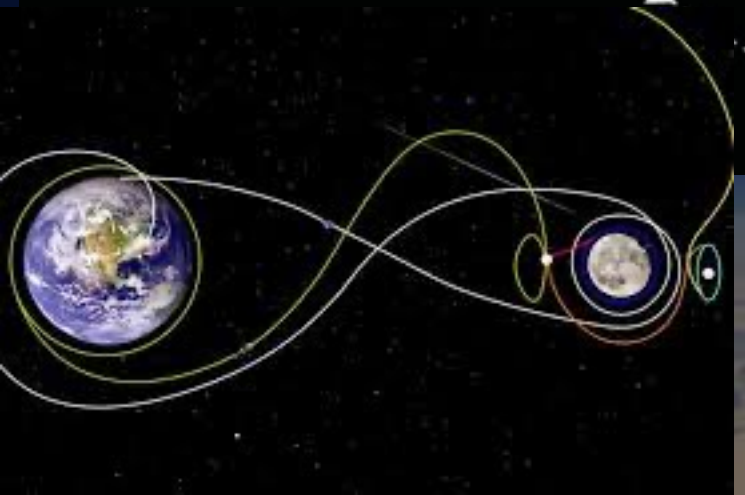


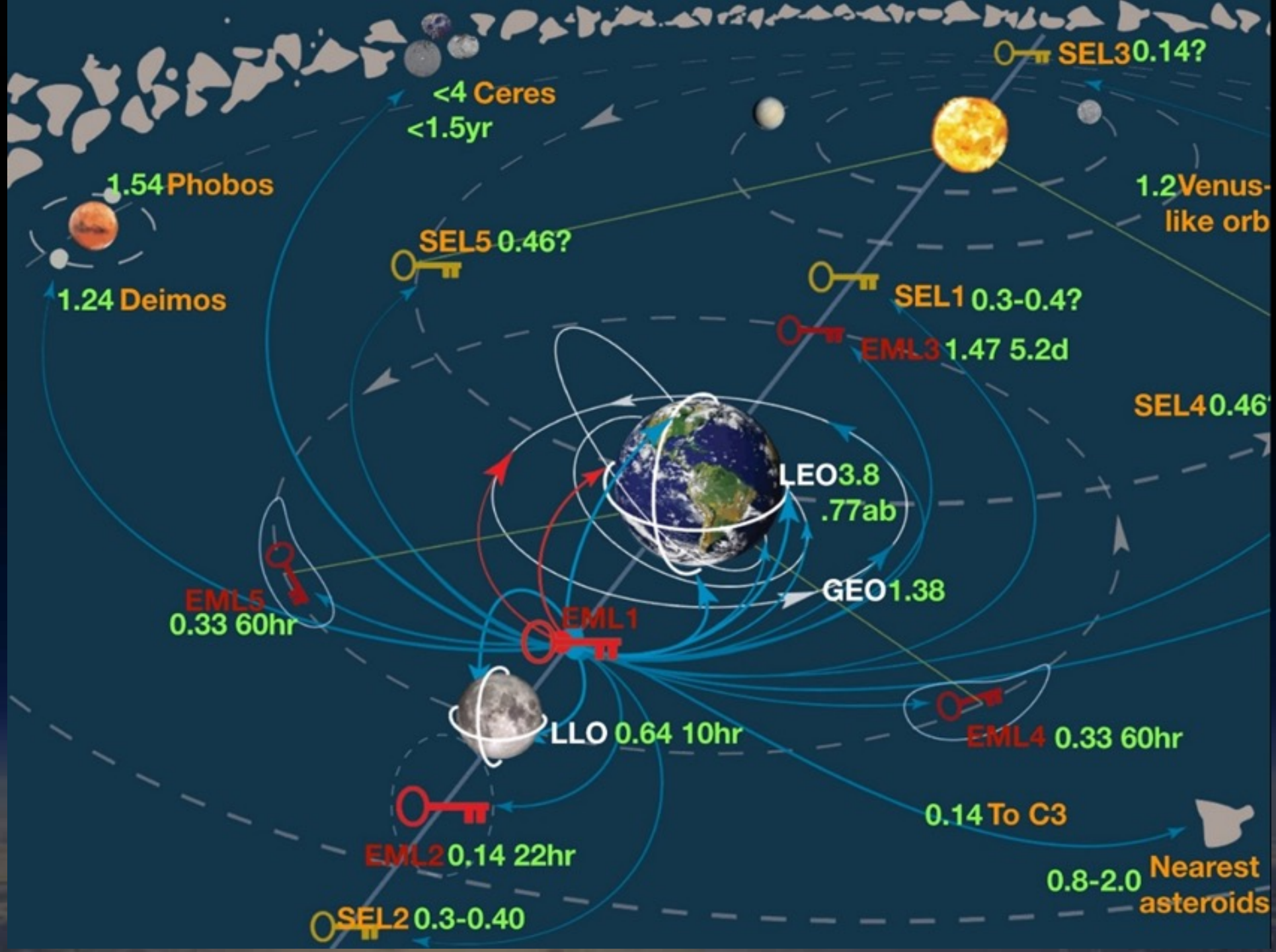

Halo orbits
Lyapunov orbits
Axial orbits
L_2
L_1
122,533 km
Lunar Free Return
384,400 km


Orbit 7
Orbit 8
Orbit 9
Orbit 10
Orbit 11
Orbit 12


Target Orbit
Earth
Moon
Lagrange Pts


Earth-Moon Circle (Cycler 1)
Lagrangian Circle (Cycler 2)
Other lines
L4
L1
L5




SEL3 0.14?
<4 Ceres
<1.5yr
1.54 Phobos
1.2 Venus-
like orb
SEL5 0.46?
1.24 Deimos
SEL1 0.3-0.4?
EML3 1.47 5.2d
SEL4 0.46
LEO 3.8
.77ab
GEO 1.38
EML5
0.33 60hr
EML1
LLO 0.64 10hr
EML4 0.33 60hr
0.14 To C3
EML2 0.14 22hr
0.8-2.0 Nearest
asteroids
SEL2 0.3-0.40

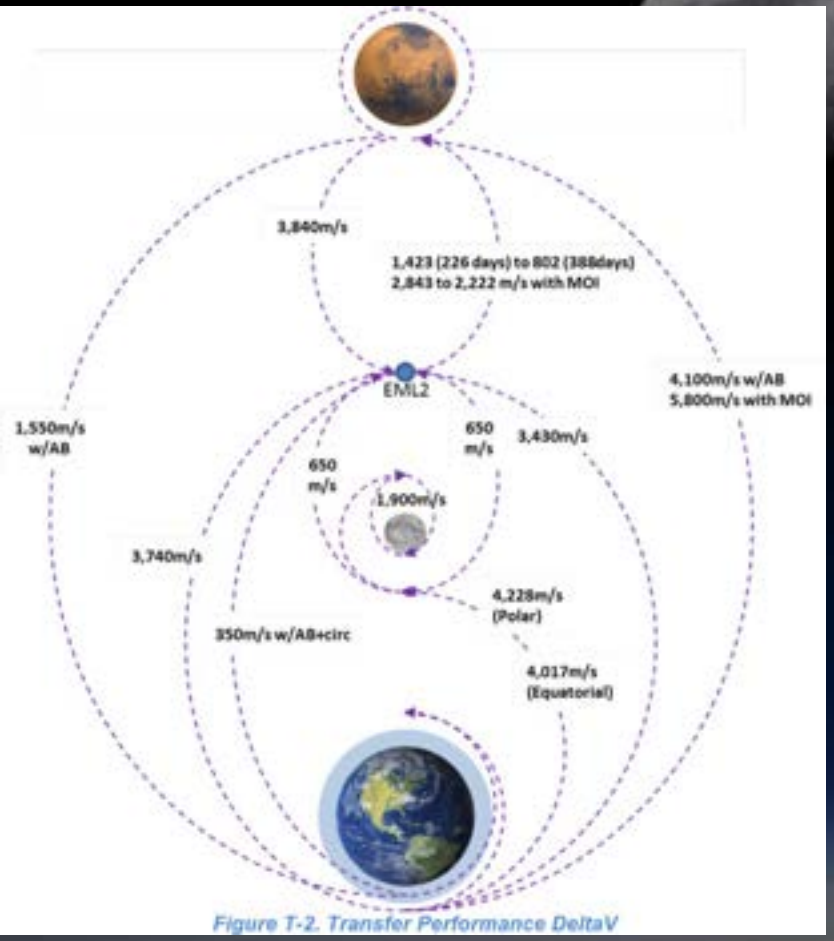
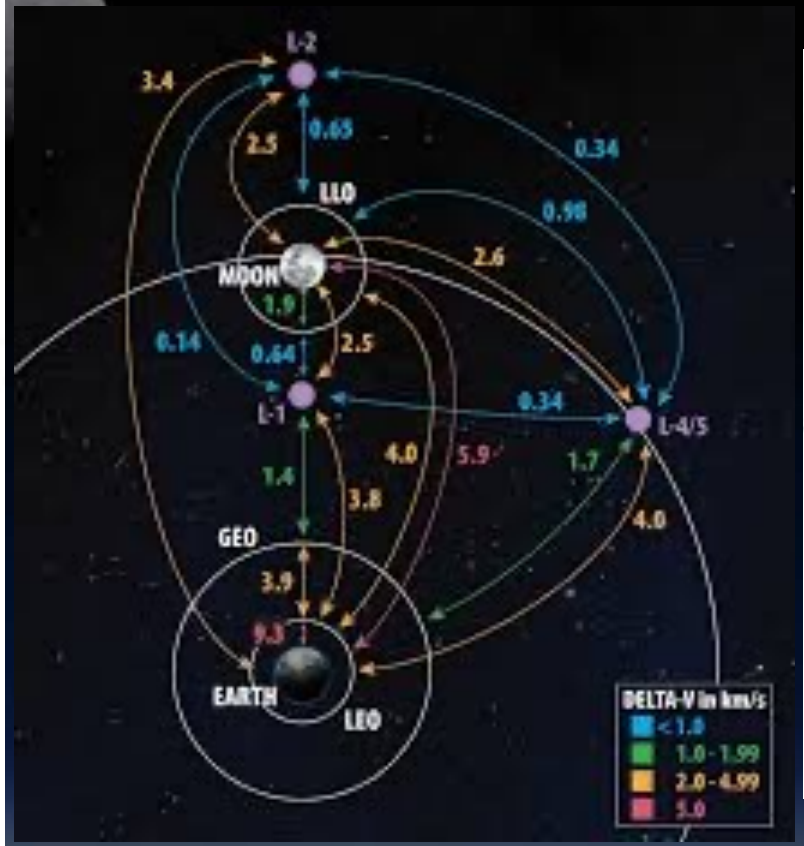
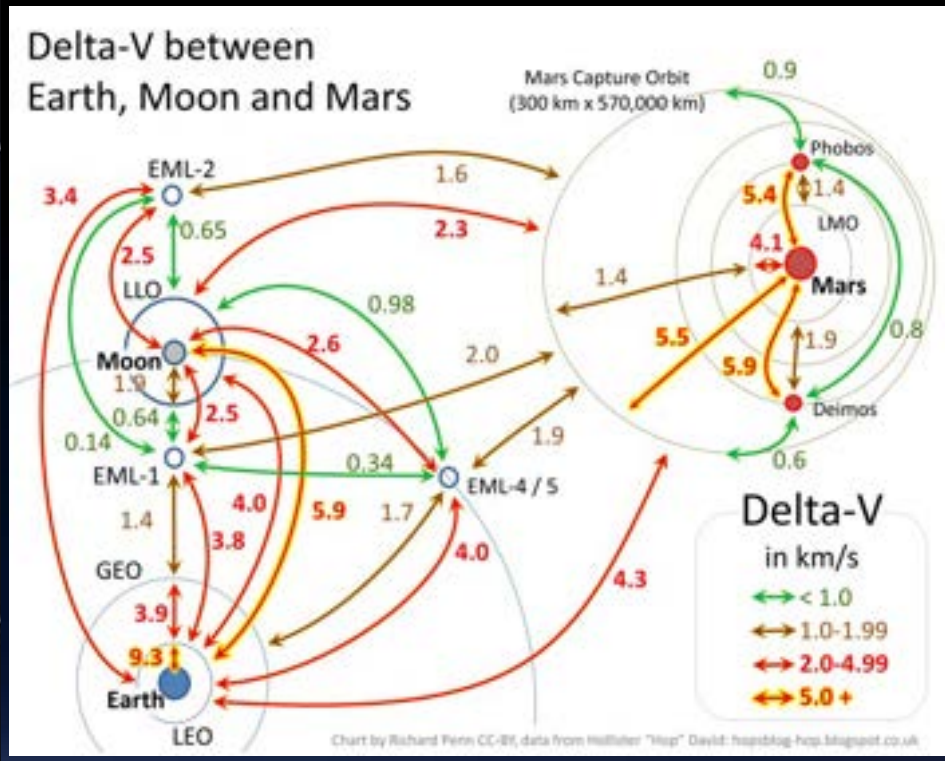
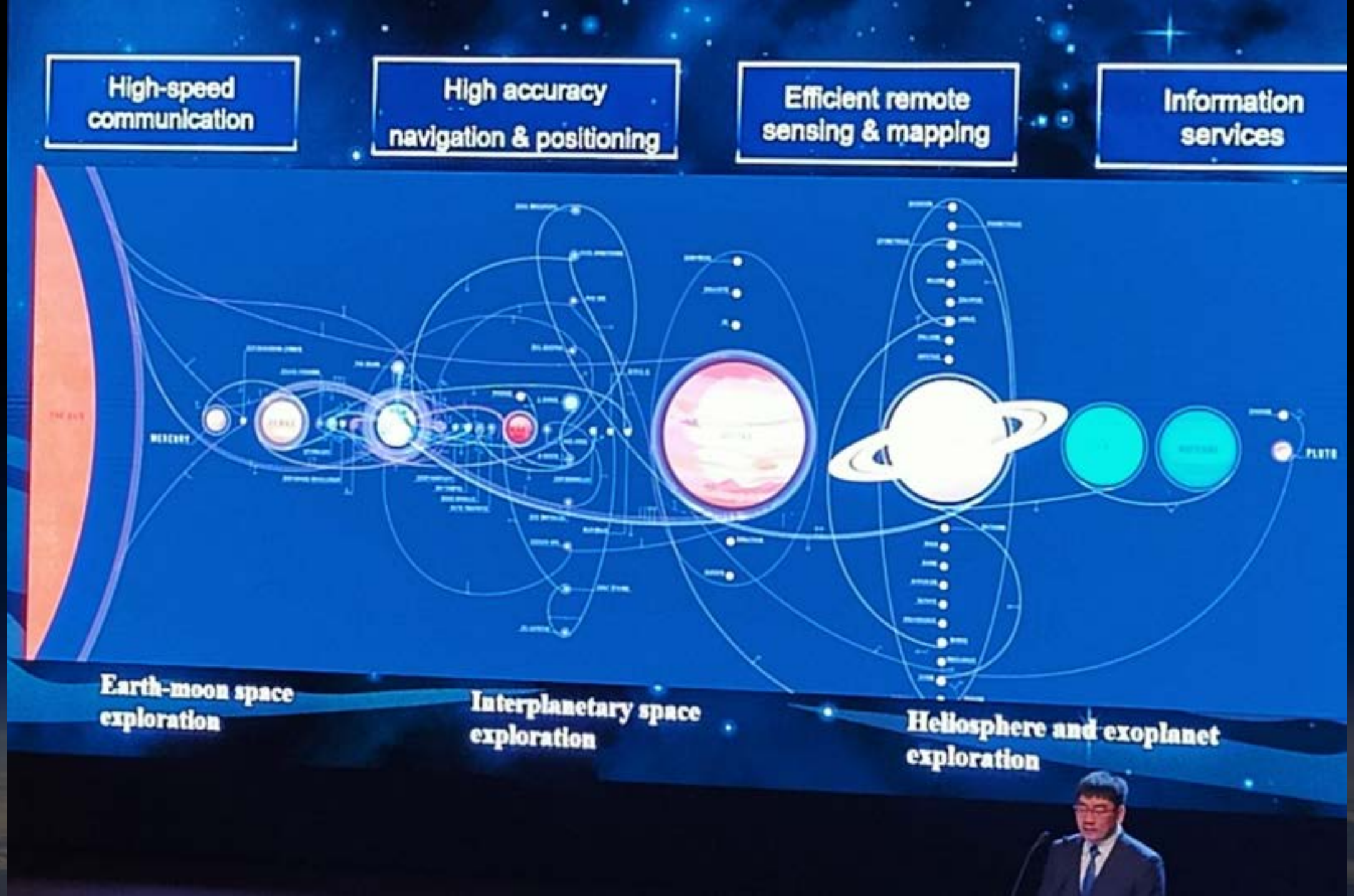


Figure T-2. Transfer Performance DeltaV

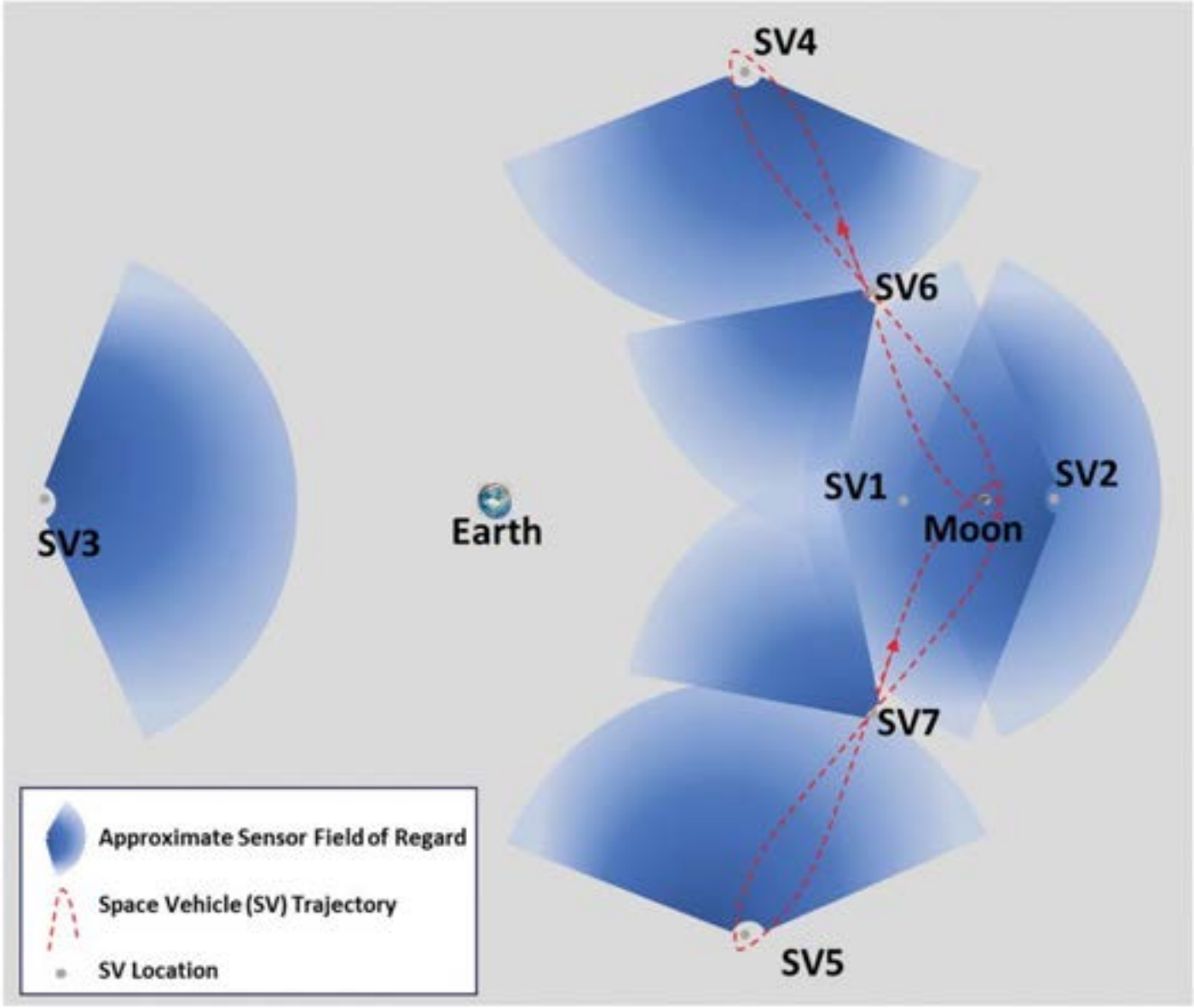




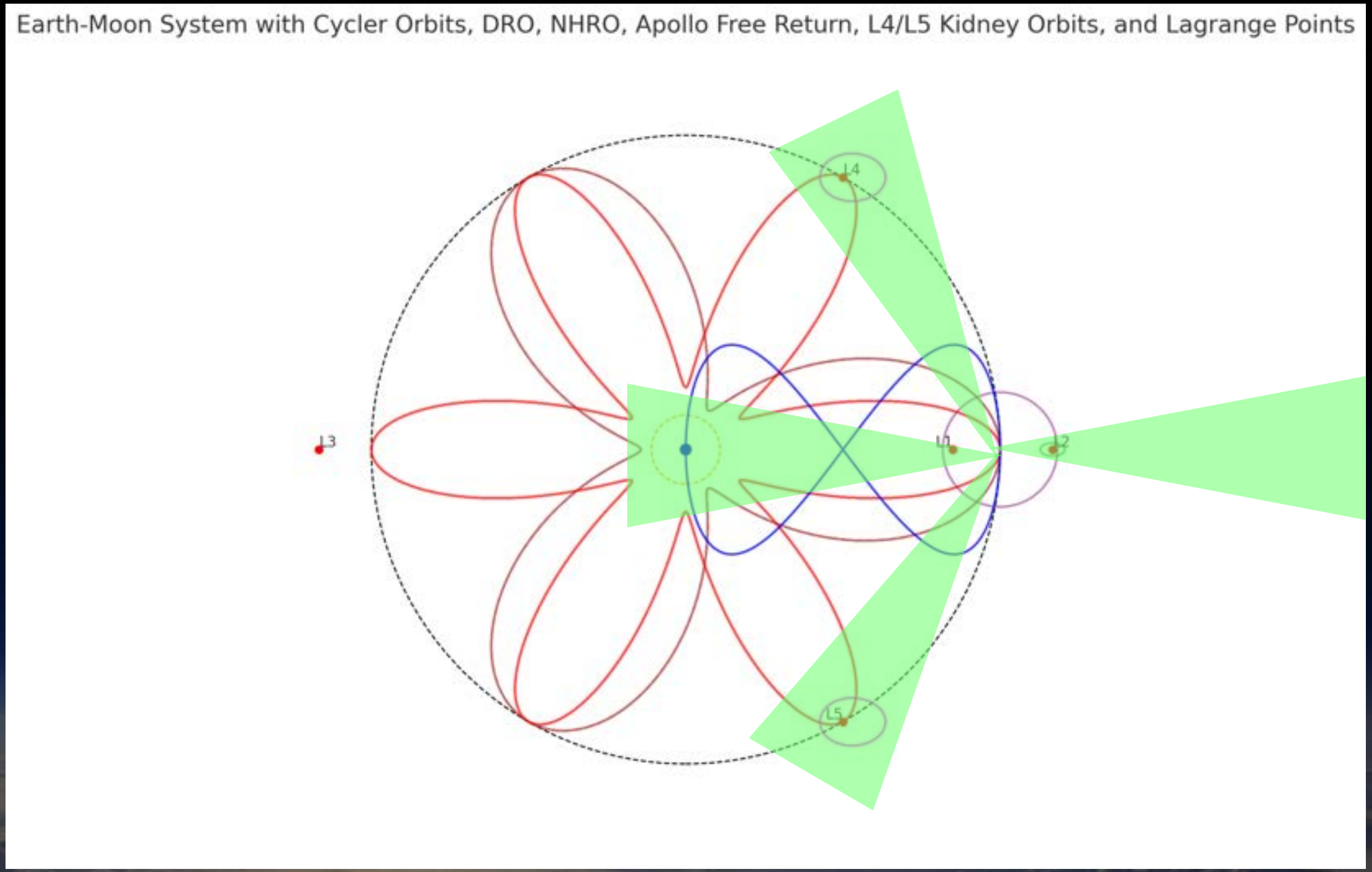

High-speed communication
High accuracy navigation & positioning
Efficient remote sensing & mapping
Information services
Earth-moon space exploration
Interplanetary space exploration
Heliosphere and exoplanet exploration

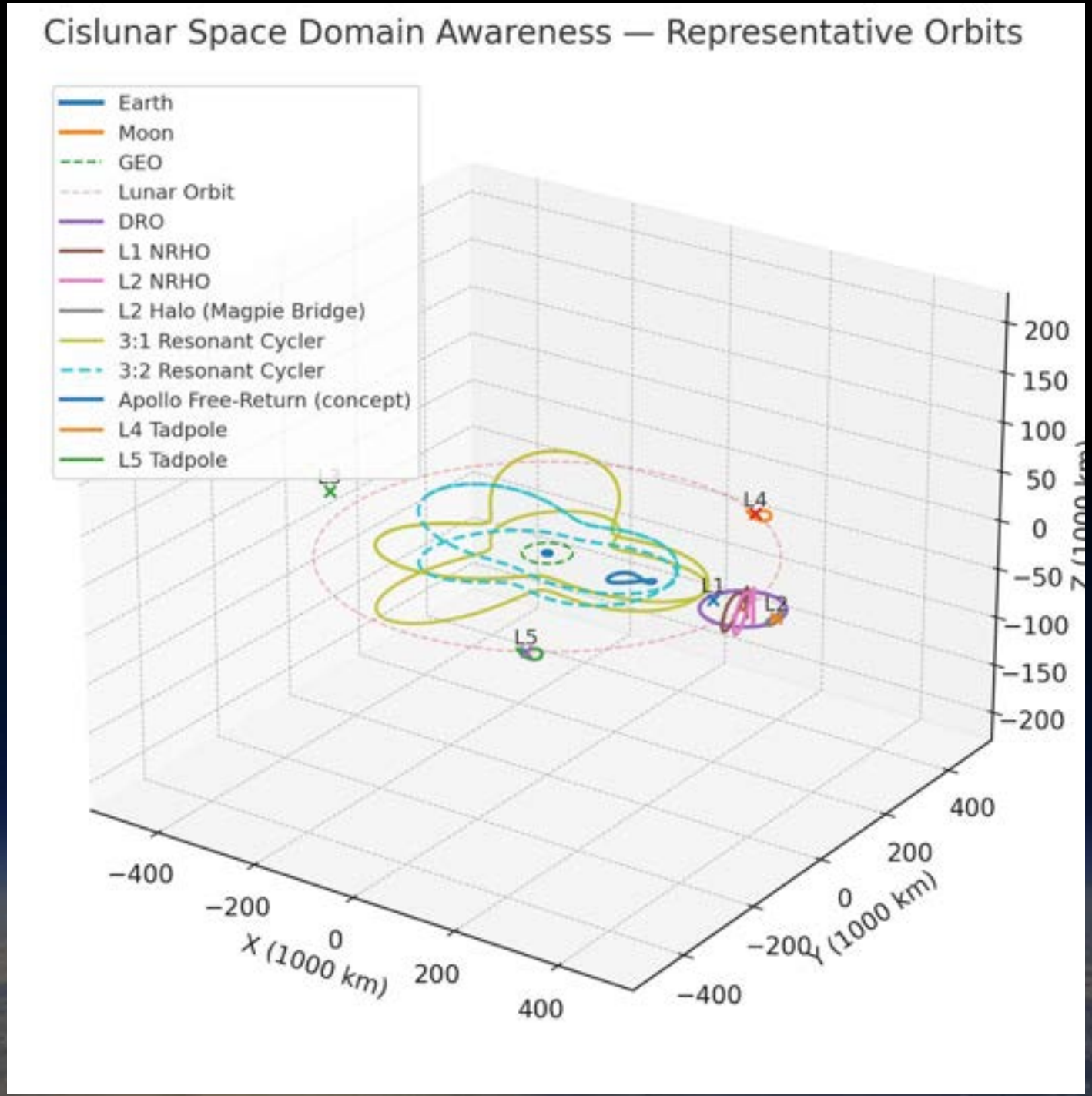
Eyes on the Prize

To ensure full situational awareness in the cislunar region, the Space Force would need sensors aboard space vehicles with wide fields of regard.



Mitchell Institute


Earth-Moon System with Cycler Orbits, DRO, NHRO, Apollo Free Return, L4/L5 Kidney Orbits, and Lagrange Points
L4
L3
L1
L2
L5


Cislunar Space Domain Awareness — Representative Orbits
Earth
Moon
GEO
Lunar Orbit
DRO
L1 NRHO
L2 NRHO
L2 Halo (Magpie Bridge)
3:1 Resonant Cycler
3:2 Resonant Cycler
Apollo Free-Return (concept)
L4 Tadpole
L5 Tadpole
L4
L1
L2
L5
X (1000 km)
Y (1000 km)
Z (1000 km)
−400
−200
0
200
400
200
150
100
50
0
−50
−100
−150
−200

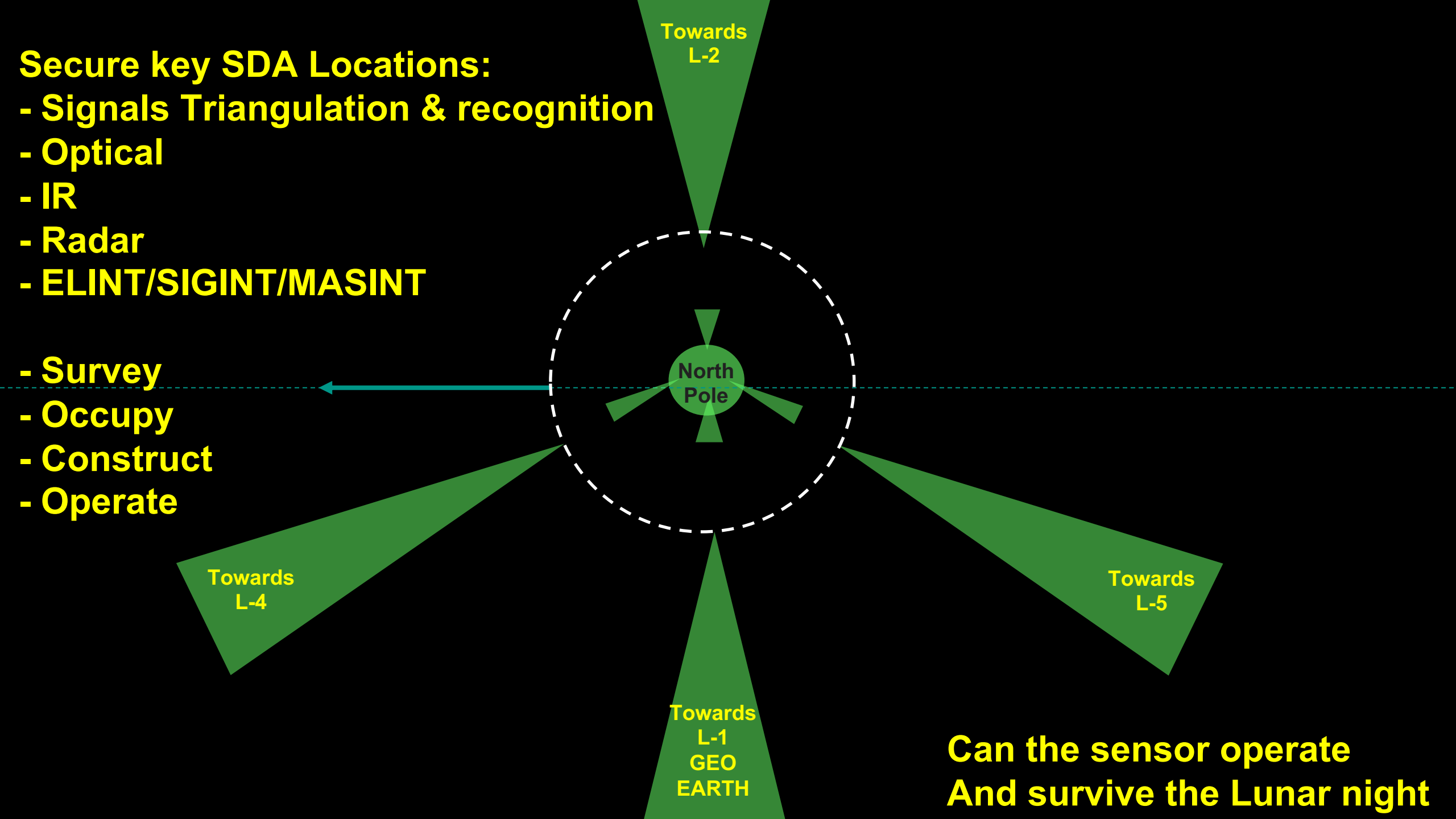
Key Takeaways

Types of sensors

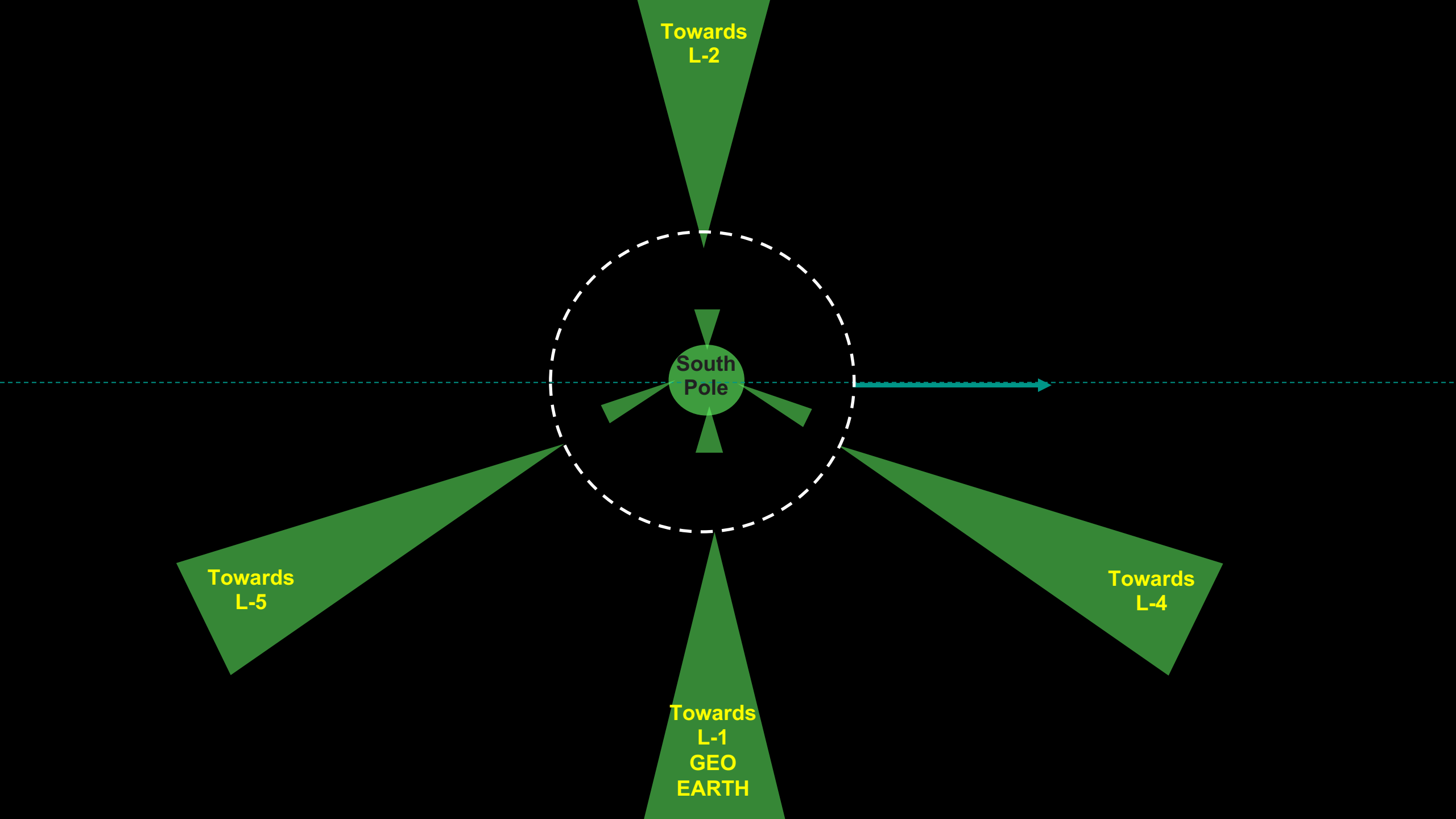
- Passive EO systems (e.g., telescopes) can have substantial utility, if the object is sufficiently illuminated.
- Active EO systems (e.g., laser ranging) may not be as useful, because they are extremely sensitive to minor pointing errors and their beams rapidly lose strength at long distances.
- Passive RF systems (e.g., antenna) can have substantial utility, if the object is transmitting directly towards a receiver.
- Active RF systems (e.g., radar) may not be as useful, because they require tremendous power to be effective outside of short distances.

Secure key SDA Locations:
- Signals Triangulation & recognition
- Optical
- IR
- Radar
- ELINT/SIGINT/MASINT

- Survey
- Occupy
- Construct
- Operate



Can the sensor operate
And survive the Lunar night


Towards
L-2
South
Pole
Towards
L-5
Towards
L-4
Towards
L-1
GEO
EARTH

Comm & PNT

Extending the “Transport Layer”

Precision Navigation

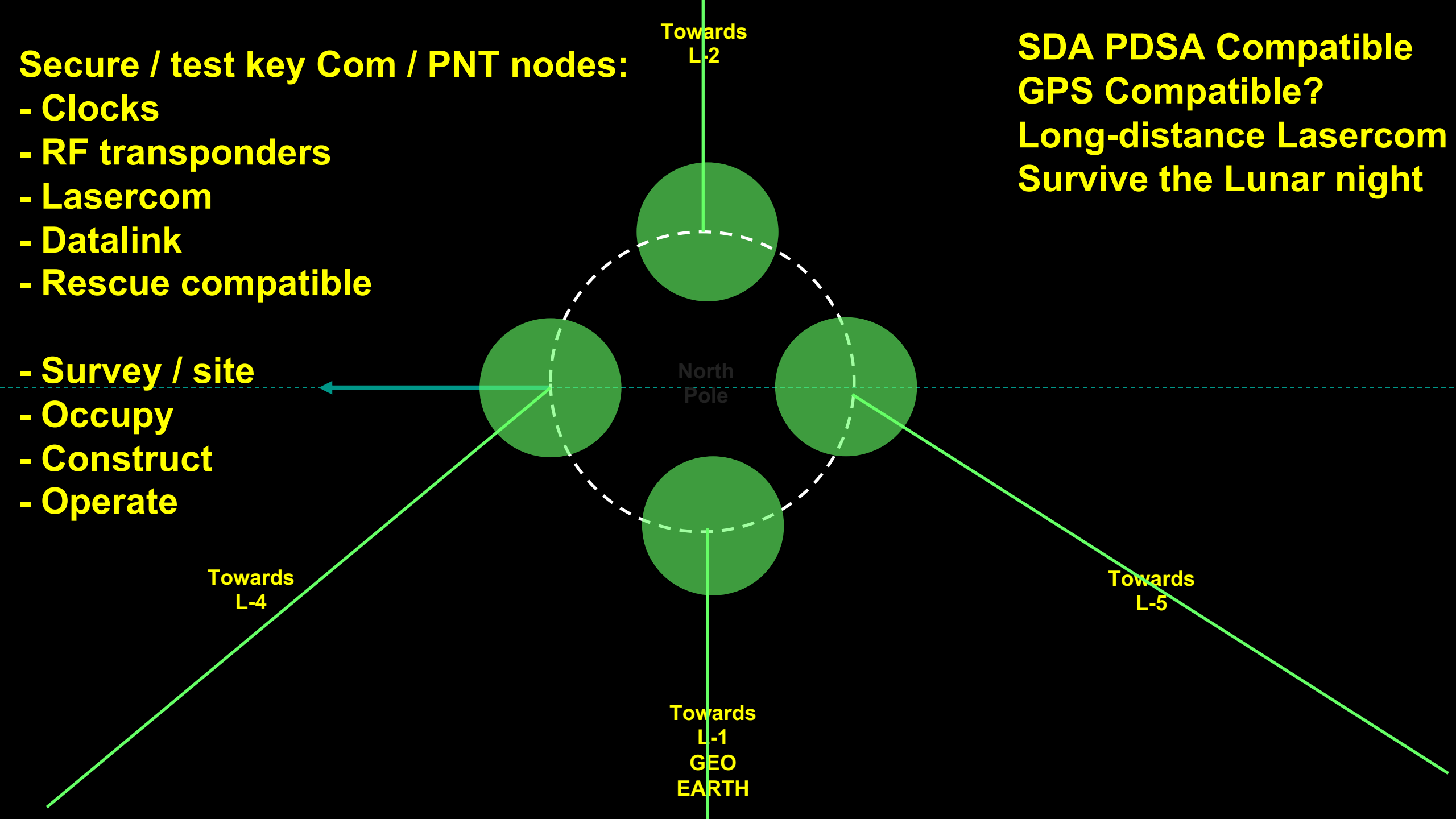
Timing

Lunar-Cislunar Location

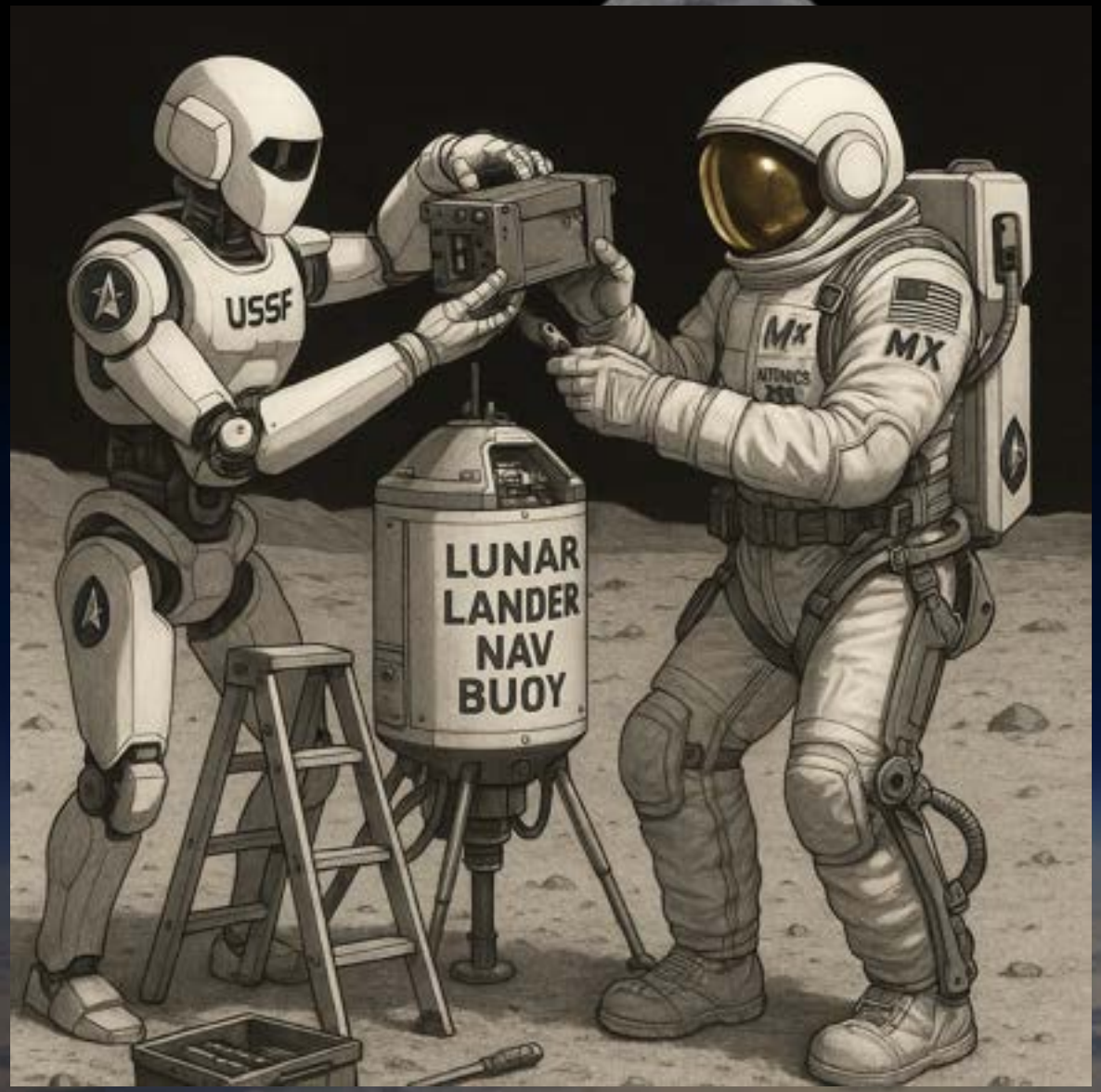
Secure / test key Com / PNT nodes:
- Clocks
- RF transponders
- Lasercom
- Datalink
- Rescue compatible

- Survey / site
- Occupy
- Construct
- Operate

SDA PDSA Compatible
GPS Compatible?
Long-distance Lasercom
Survive the Lunar night



Validate Maintenance for Multi-Use Remote Beacons



- Validate maintenance (line replaceable units) on:
- A mass producible multi-function hopper / lander
  - Power
  - Navigation & Timing
  - Communication
  - SDA sensors
  - Precision Landing (beacon, reflectors)
  - Autonomous local grading, piling, melting/sintering (for pads)
  - Autonomous vehicle or rail manufacture

Validate Maintenance Procedures

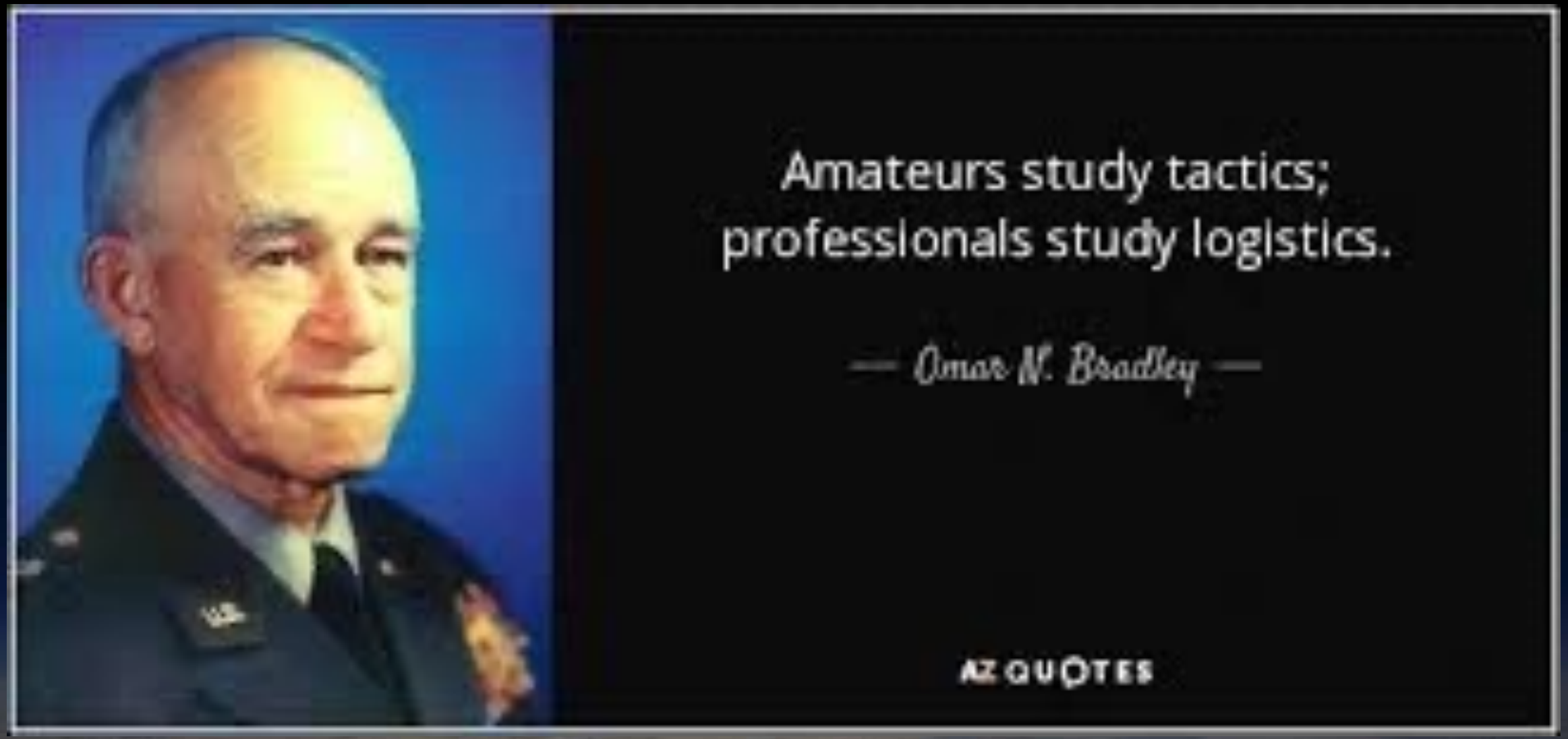
Space Mobility and Logistics (SML)

Sustained Maneuver

Dynamic Space Operations (DSO)

Servicing

Logistics

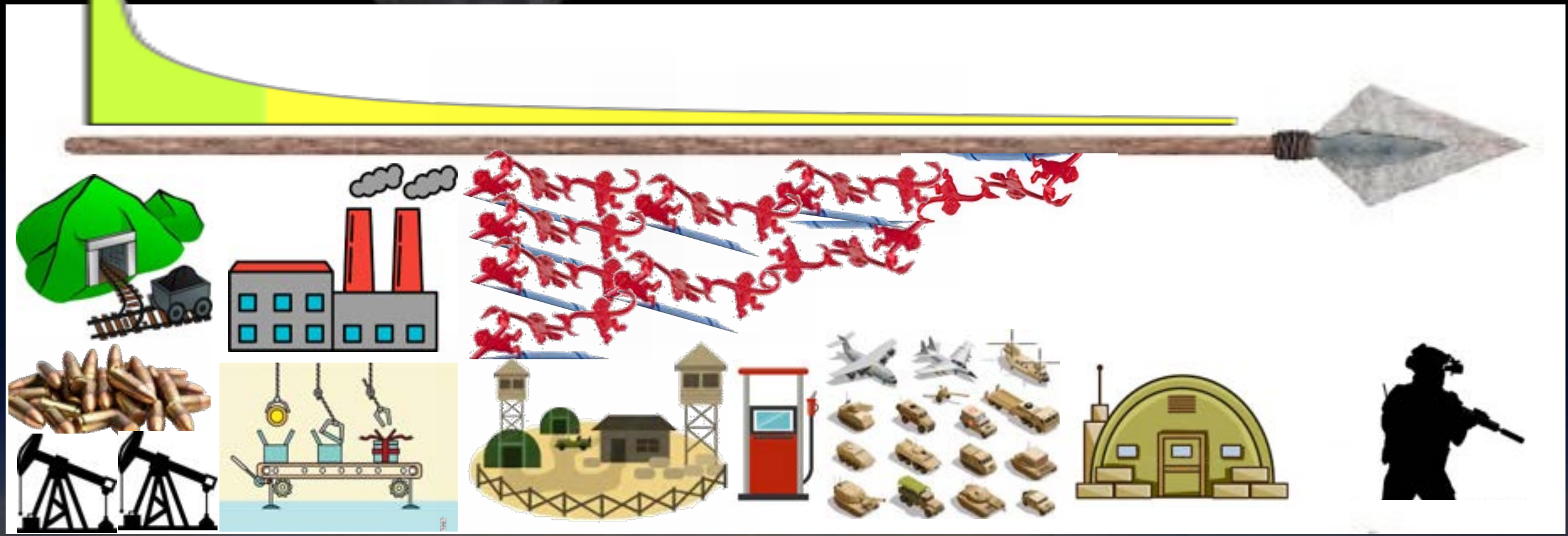

Amateurs study tactics;
professionals study logistics.
— Omar N. Bradley —
AZ QUOTES

The Long Tail…The Rocket Equation for Military Power Projection

Industrial Might
"Arsenal of Democracy"
"Freedom's Forge"

Logistics
System
"Long Tail"

Fielded Forces
"Tip of the Spear"



Mines

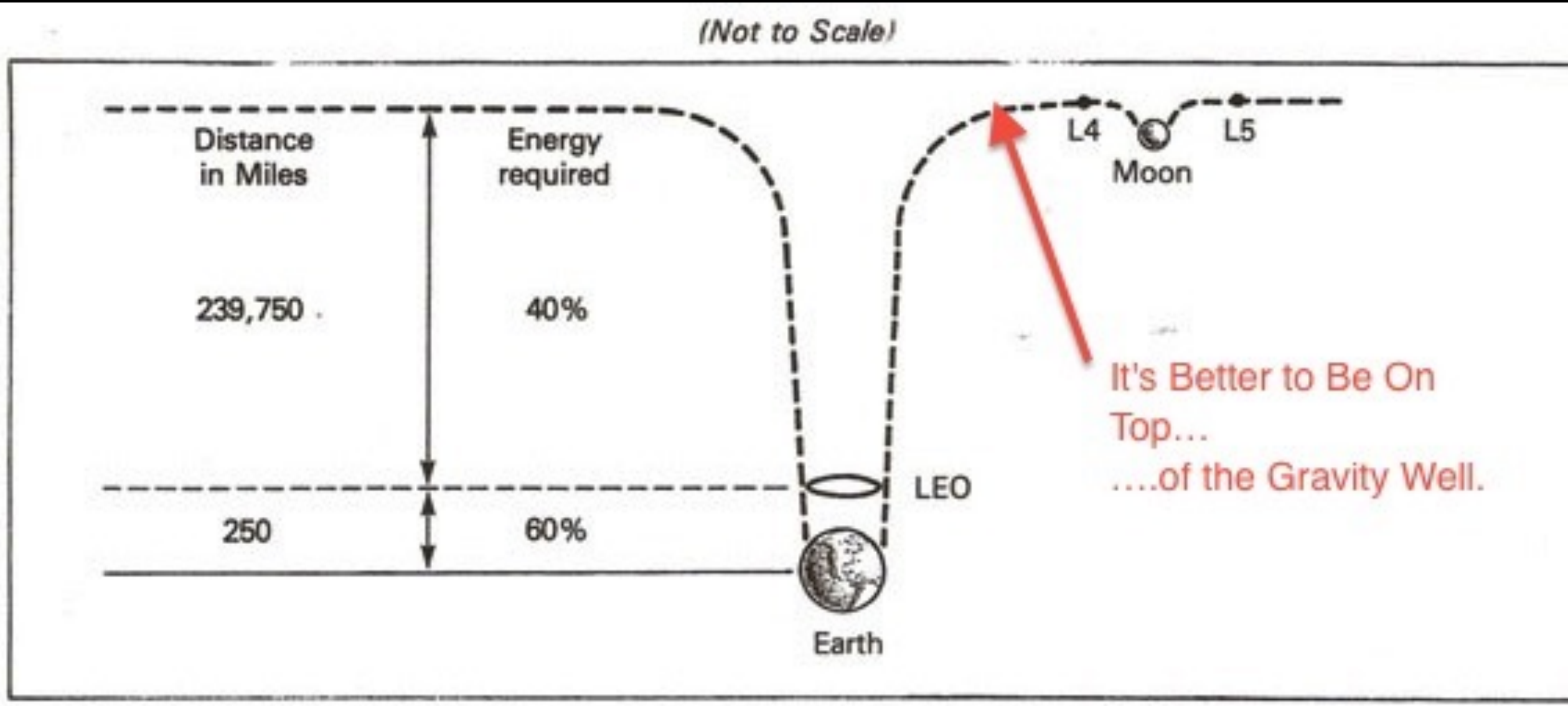
Factories
Refineries

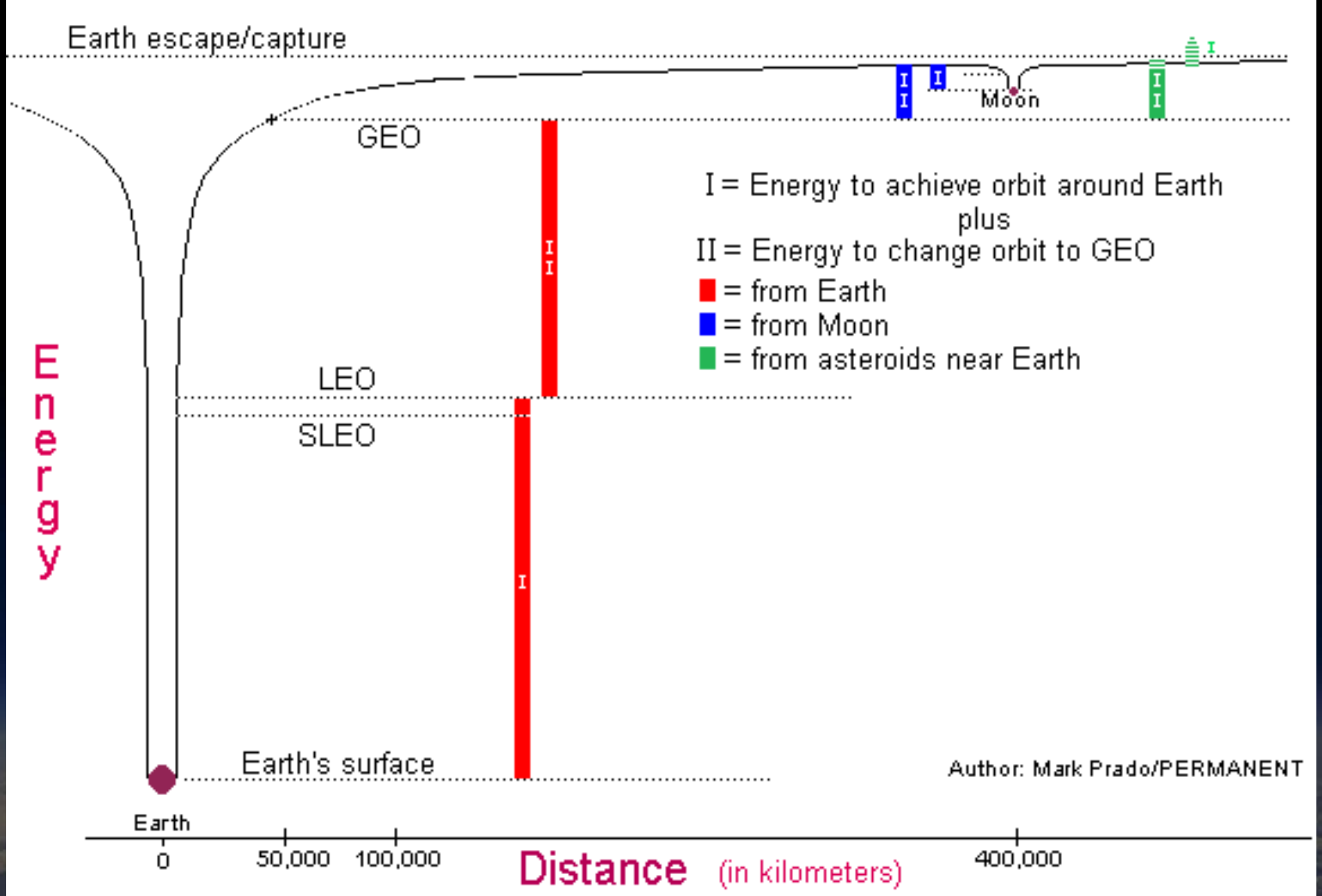
Bases

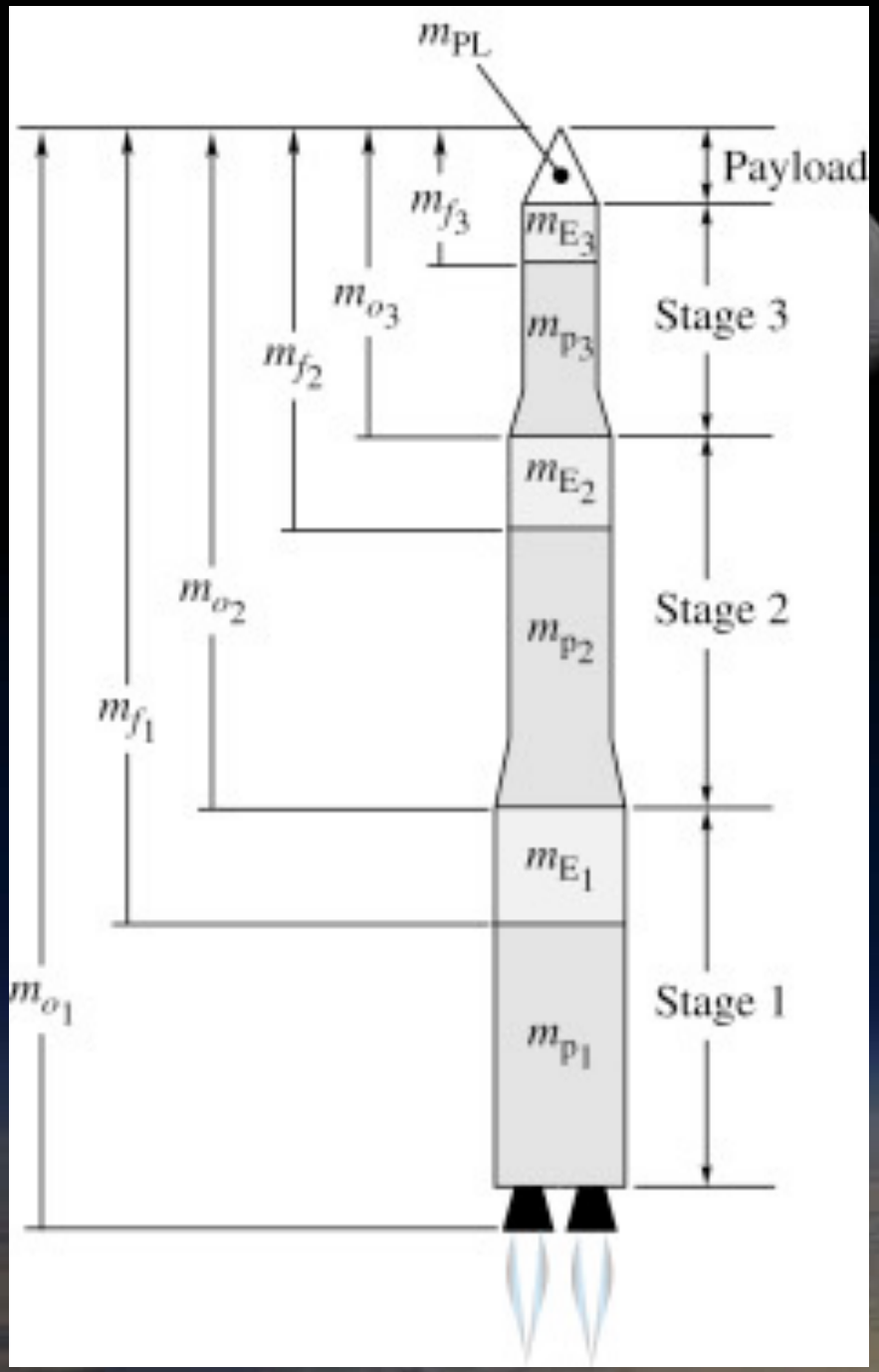
Stored
Energy

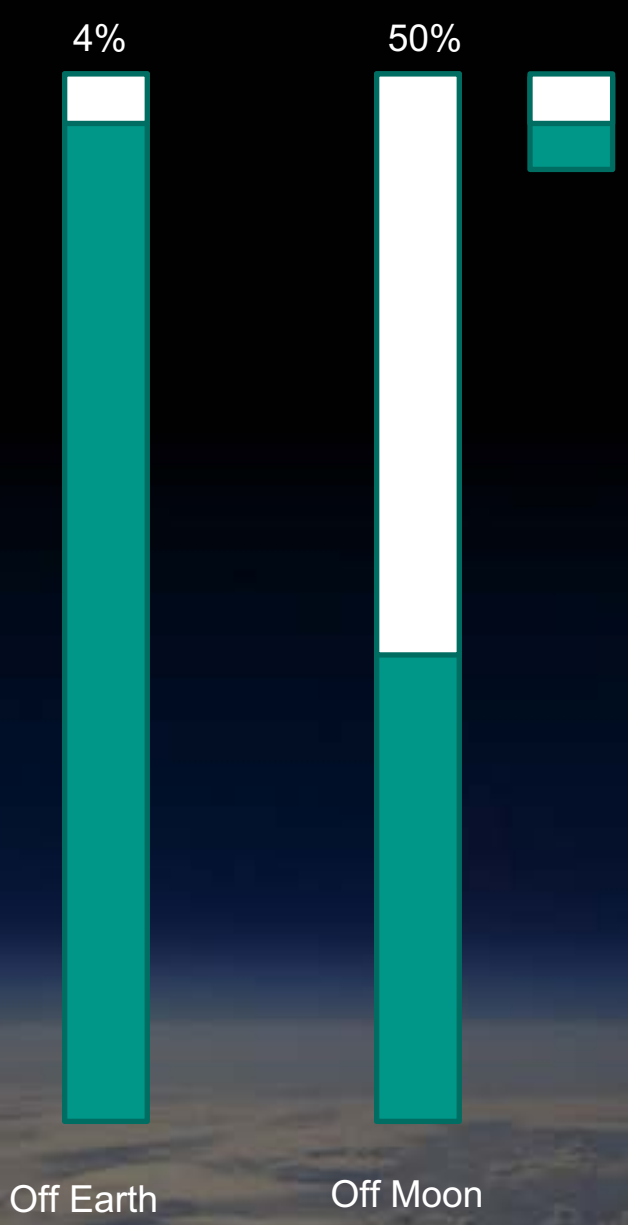
Transportation
System

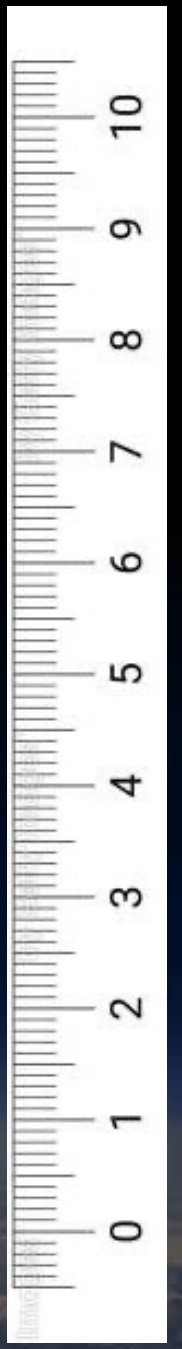
Forward
Base
Camp

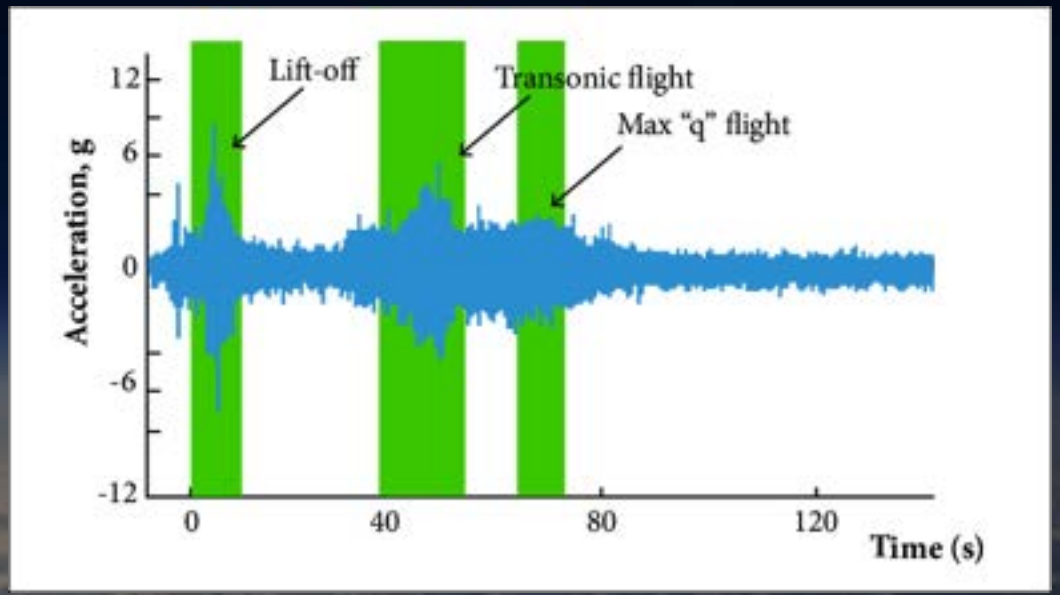

(Not to Scale)
Distance in Miles
Energy required
239,750
40%
250
60%
LEO
Earth
L4
Moon
L5
It's Better to Be On Top…
….of the Gravity Well.


Earth escape/capture
Moon
GEO
LEO
SLEO
Earth's surface
I = Energy to achieve orbit around Earth
plus
II = Energy to change orbit to GEO
= from Earth
= from Moon
= from asteroids near Earth
Energy
Earth
0
50,000
100,000
400,000
Distance (in kilometers)
Author: Mark Prado/PERMANENT

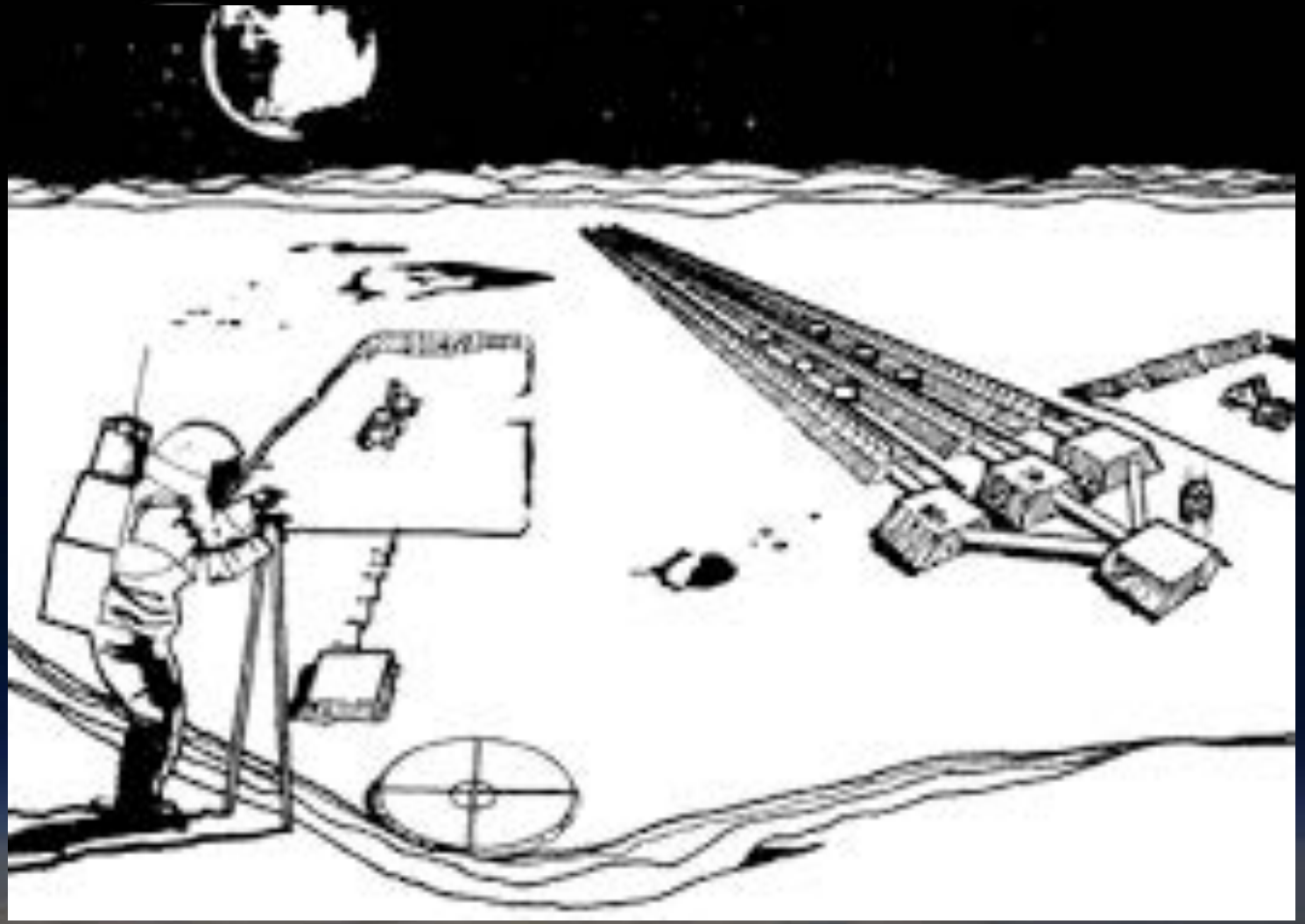

m_{PL}
Payload
m_{f_3}
m_{E_3}
m_{o_3}
m_{p_3}
Stage 3
m_{f_2}
m_{E_2}
m_{o_2}
m_{p_2}
Stage 2
m_{f_1}
m_{E_1}
m_{o_1}
m_{p_1}
Stage 1


4%
50%
Off Earth
Off Moon

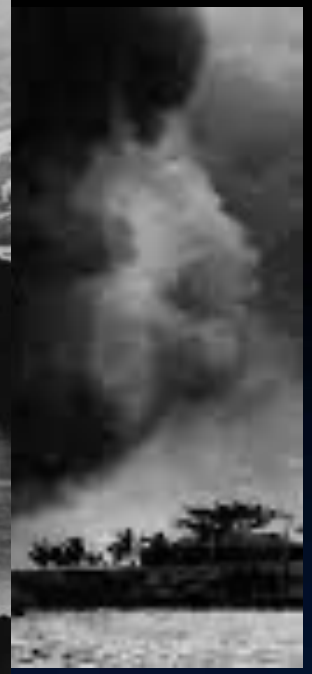

0
1
2
3
4
5
6
7
8
9
10


Lift-off
Transonic flight
Max "q" flight
12
6
0
-6
-12
Acceleration, g
0
40
80
120
Time (s)


INST.
ROCKET
FUEL

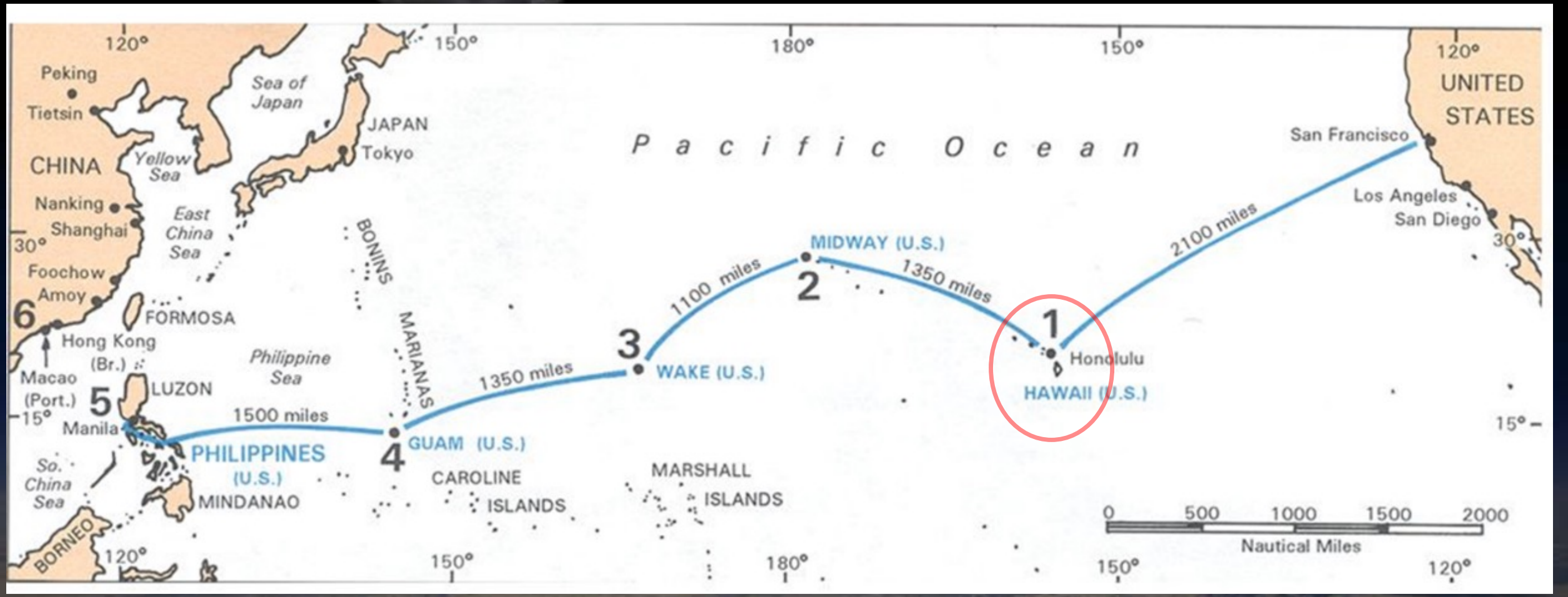


A Pearl Harbor in Space

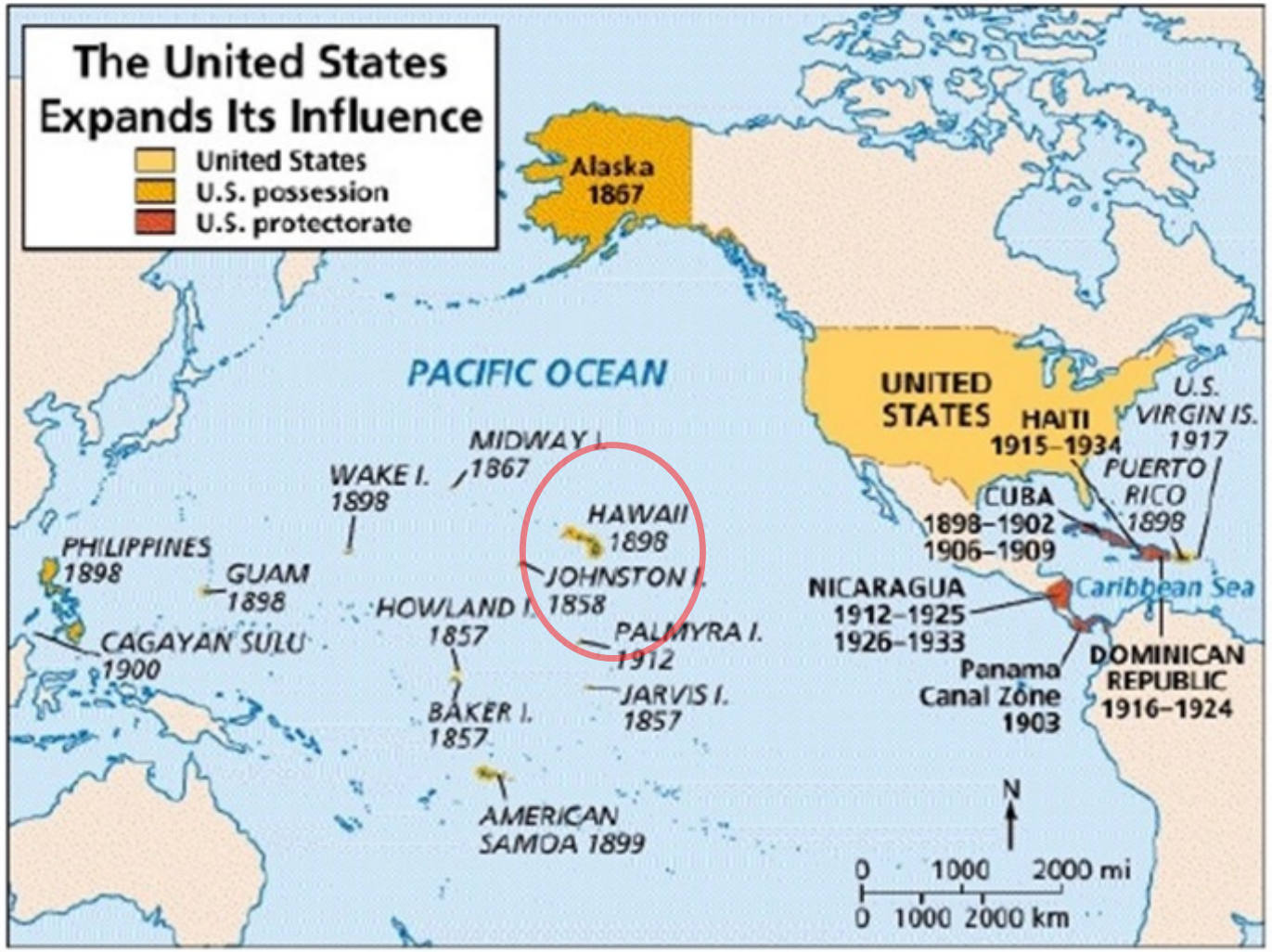



Matson
EDITORIAL USE ONLY

American Pacific Territories
Coaling Stations for Ships

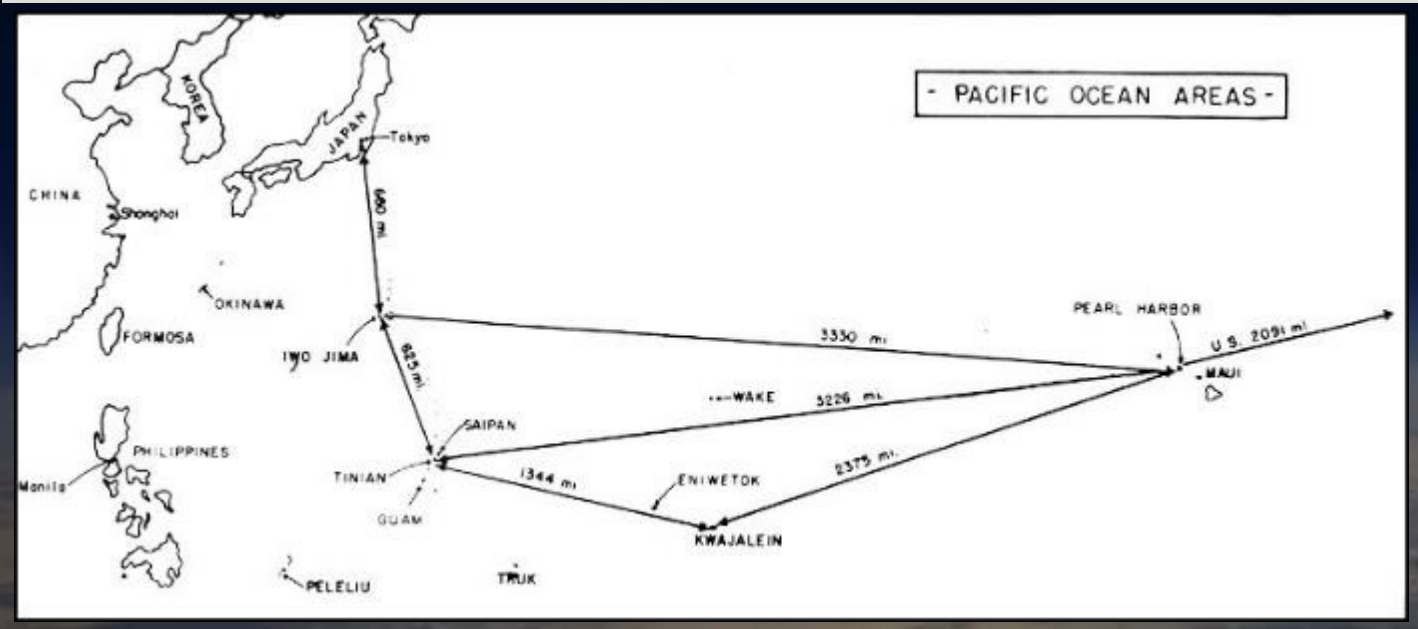


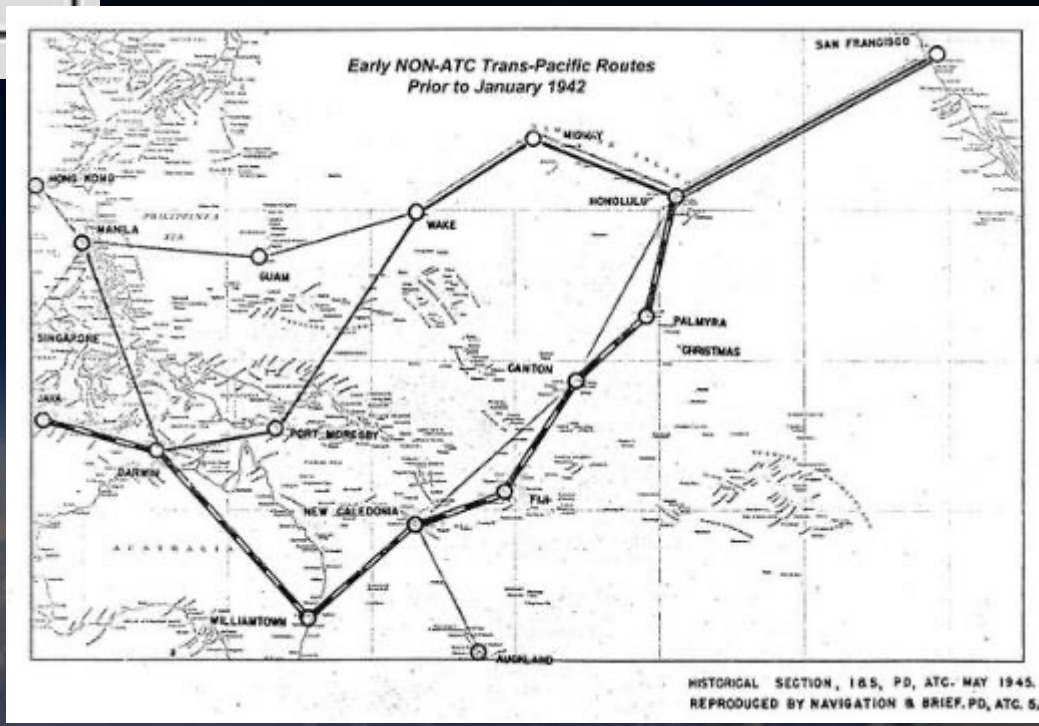
2. Military/Strategic Interests



Alfred T. Mahan → *The Influence of Sea Power on History: 1660-1783*

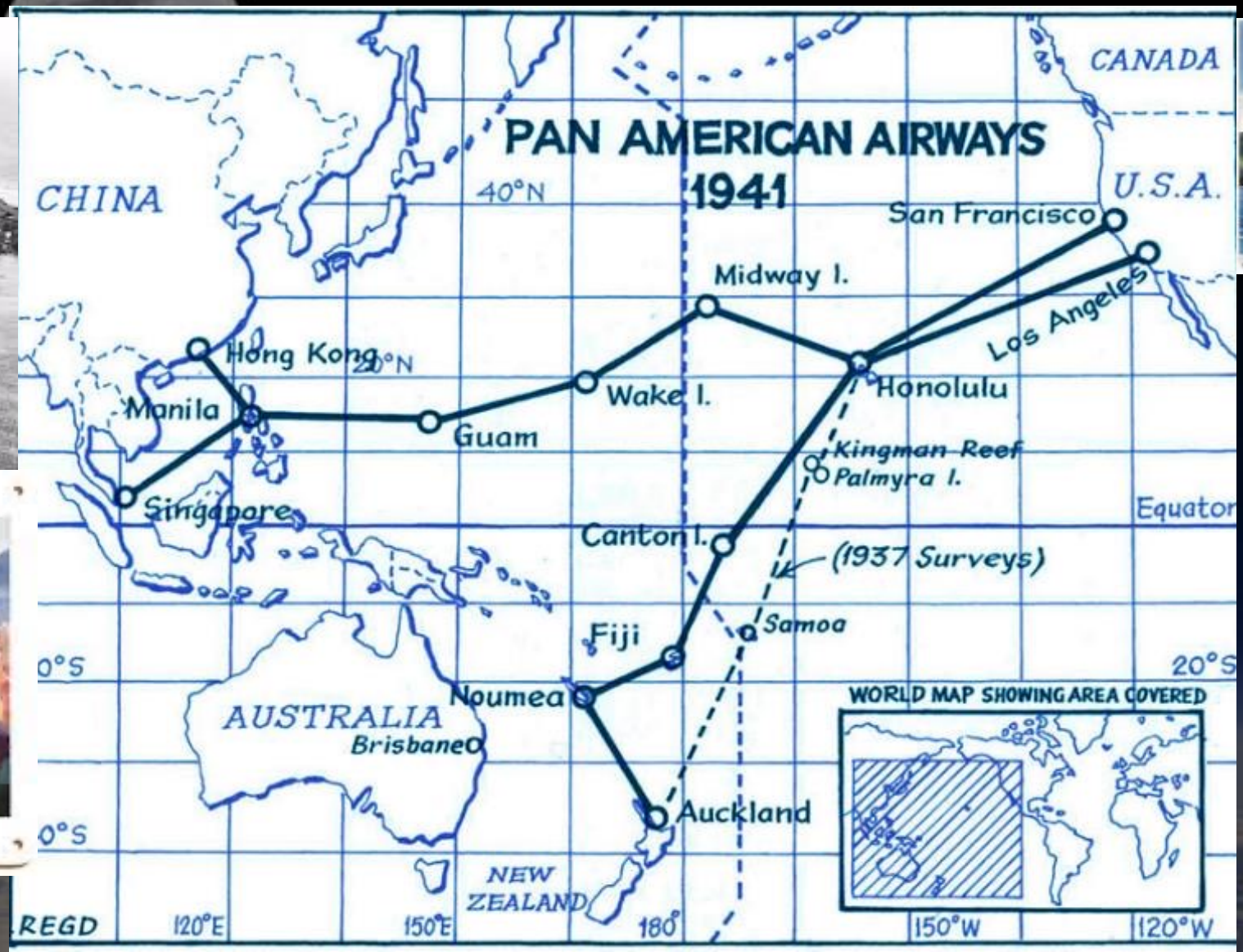
America as a Pacific Power


- PACIFIC OCEAN AREAS -
KOREA
JAPAN
Tokyo
CHINA
Shanghai
OKINAWA
FORMOSA
IWO JIMA
680 mi
825 mi
3330 mi
U.S. 2091 mi
PEARL HARBOR
MAUI
WAKE 3226 mi
SAIPAN
PHILIPPINES
Manila
TINIAN
GUAM
1344 mi
ENIWETOK
2375 mi
KWAJALEIN
PELELIU
TRUK


Early NON-ATC Trans-Pacific Routes
Prior to January 1942
SAN FRANCISCO
MIDWAY
HONOLULU
HONG KONG
MANILA
WAKE
GUAM
PALMYRA
CHRISTMAS
SINGAPORE
CANTON
JAVA
PORT MORESBY
DARWIN
NEW CALEDONIA
FIJI
AUSTRALIA
WILLIAMTOWN
AUCKLAND
HISTORICAL SECTION, I&S, PD, ATC- MAY 1945.
REPRODUCED BY NAVIGATION & BRIEF. PD, ATC. 5/

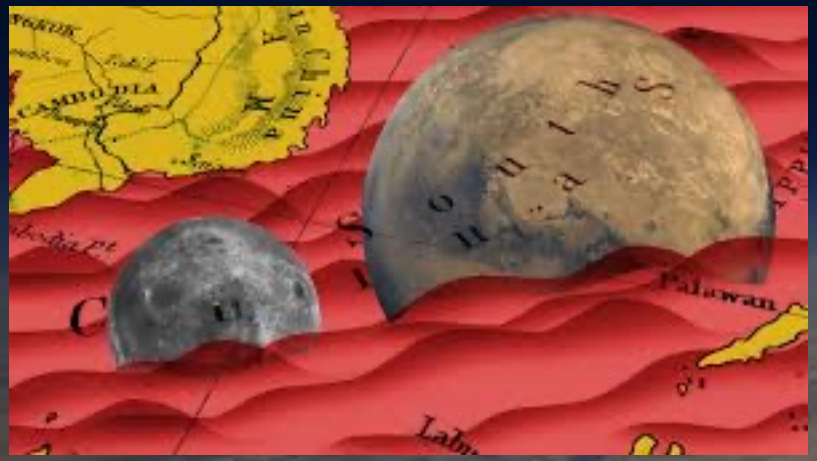
HAWAII BY FLYING CLIPPER

PAN AMERICAN AIRWAYS SYSTEM




JAPAN $200.9
VIETNAM $36.3
SINGAPORE $47.0
BRUNEI $0.6
MALAYSIA $43.6
AUSTRALIA $37.3
NEW ZEALAND $8.2
CANADA
$658.2
MEXICO
$534.5
PERU $16.2
CHILE $26.1
Total trade labeled in $billions
Positive trade balance
Negative trade balance
Trans-Pacific Partnership Countries

Senkaku and Scarborough Shoal

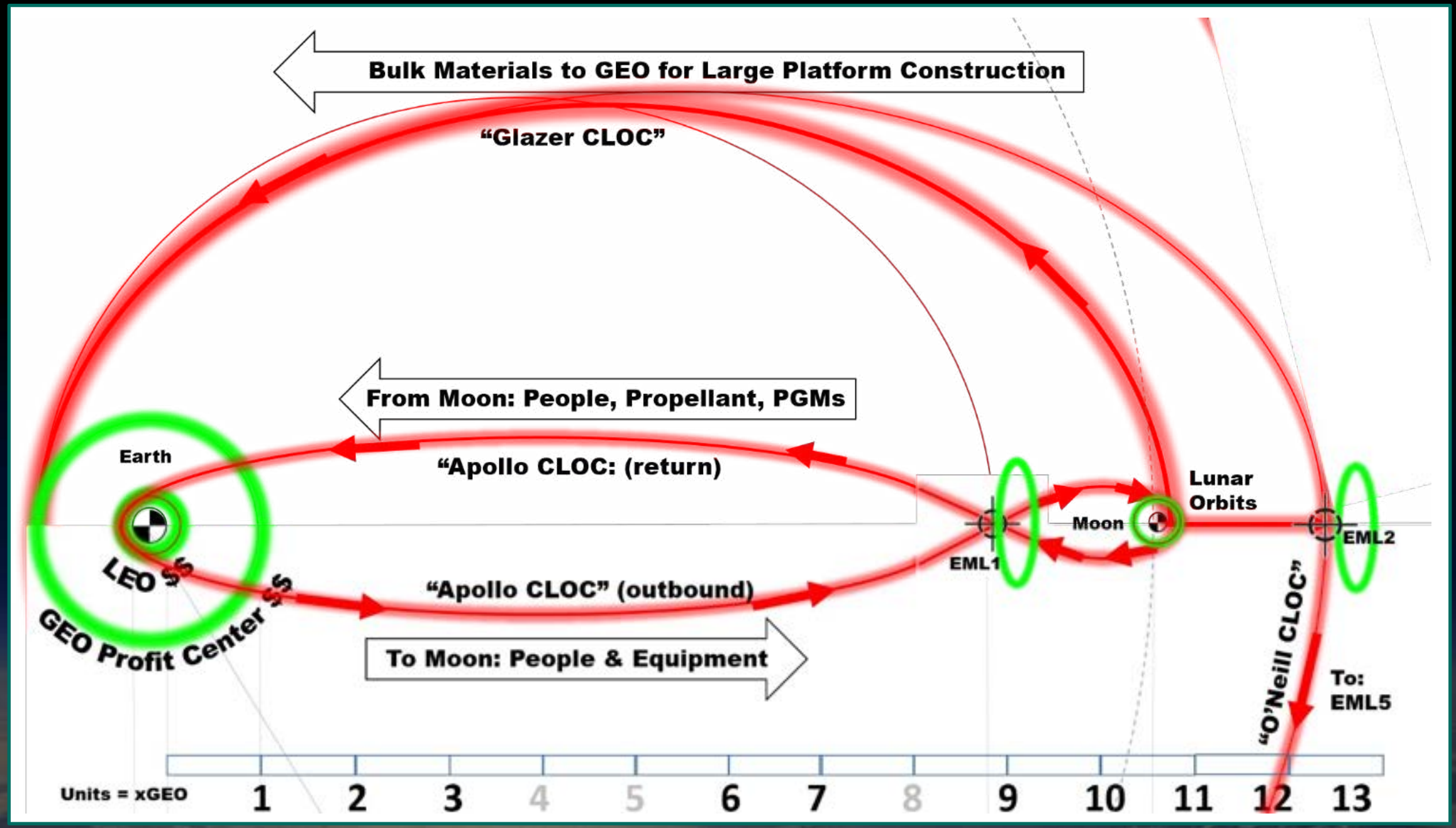


“The universe is an ocean, the moon is the Diaoyu Islands, Mars is Huangyan Island…If we do not go there now even though we can, then we will be blamed by our descendants…If others go there, then they will take over, and you will not be able to go even if you want to. This is reason enough.”
-- Ye Peijiann, head of China’s lunar exploration program

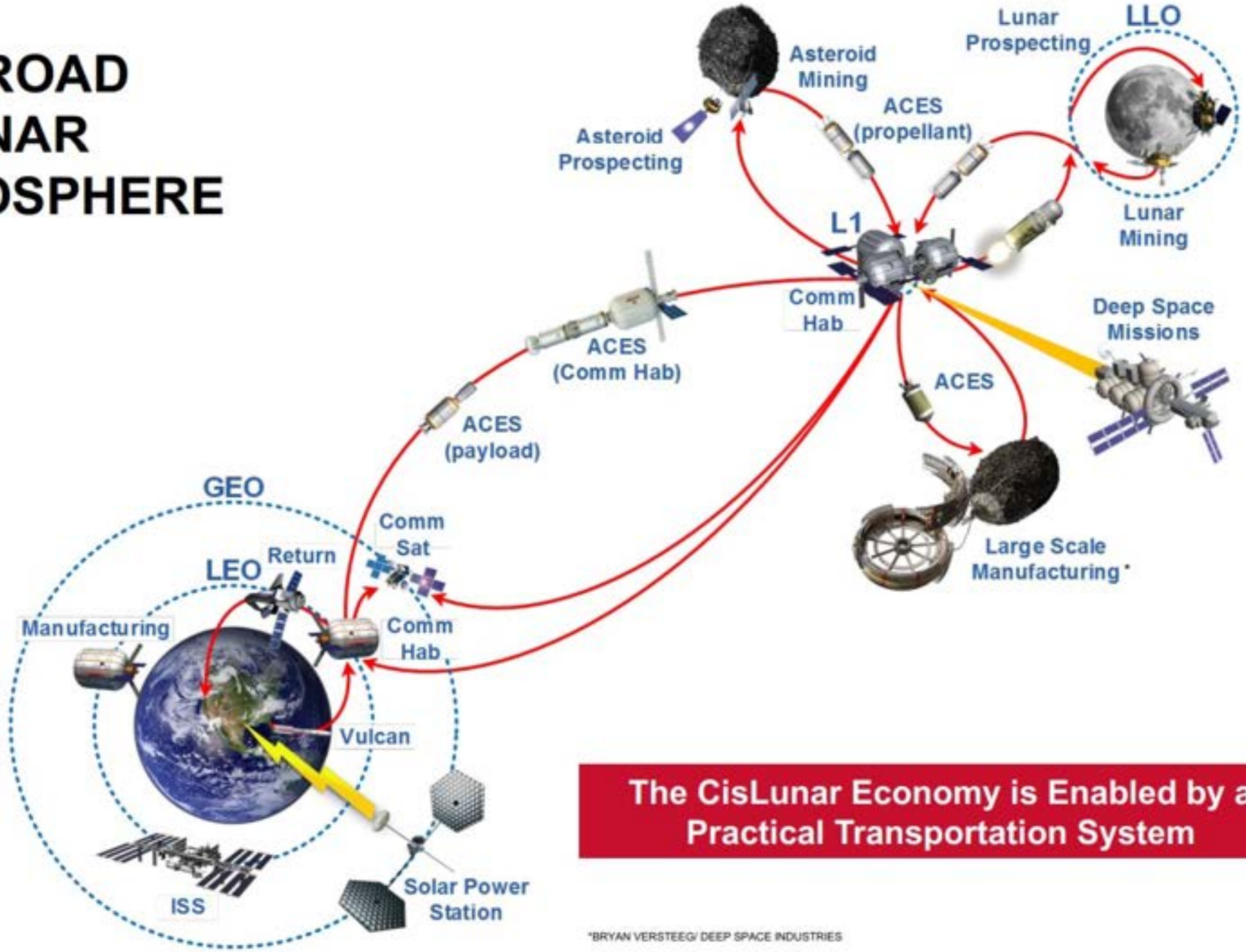
Don’t Screw Up

=

Spratly Islands


Bulk Materials to GEO for Large Platform Construction
"Glazer CLOC"
From Moon: People, Propellant, PGMs
Earth
"Apollo CLOC: (return)
LEO $$
GEO Profit Center $$
"Apollo CLOC" (outbound)
To Moon: People & Equipment
EML1
Moon
Lunar Orbits
EML2
"O'Neill CLOC"
To: EML5
Units = xGEO
1
2
3
4
5
6
7
8
9
10
11
12
13

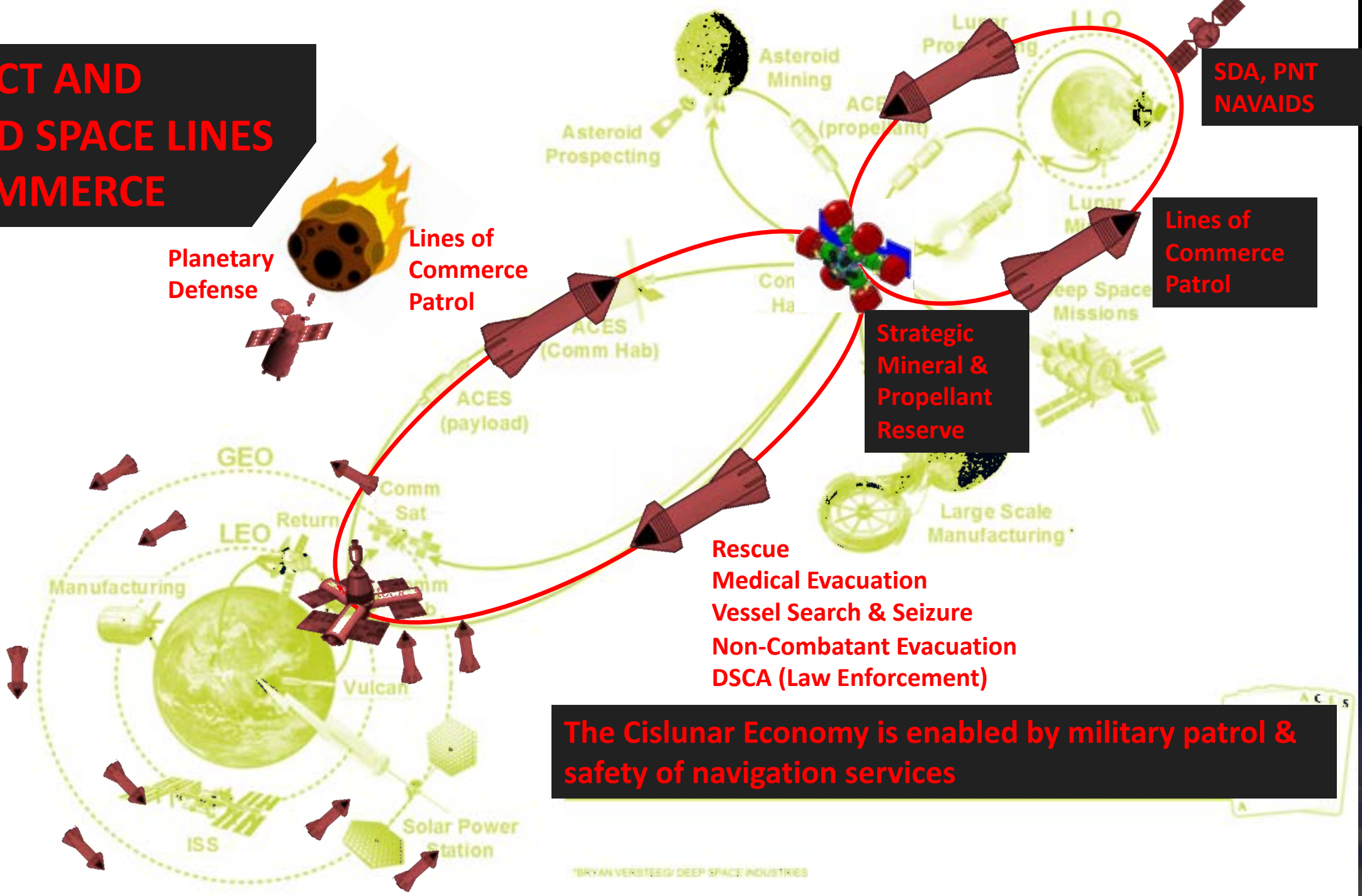
THE BROAD CISLUNAR ECONOSPHERE



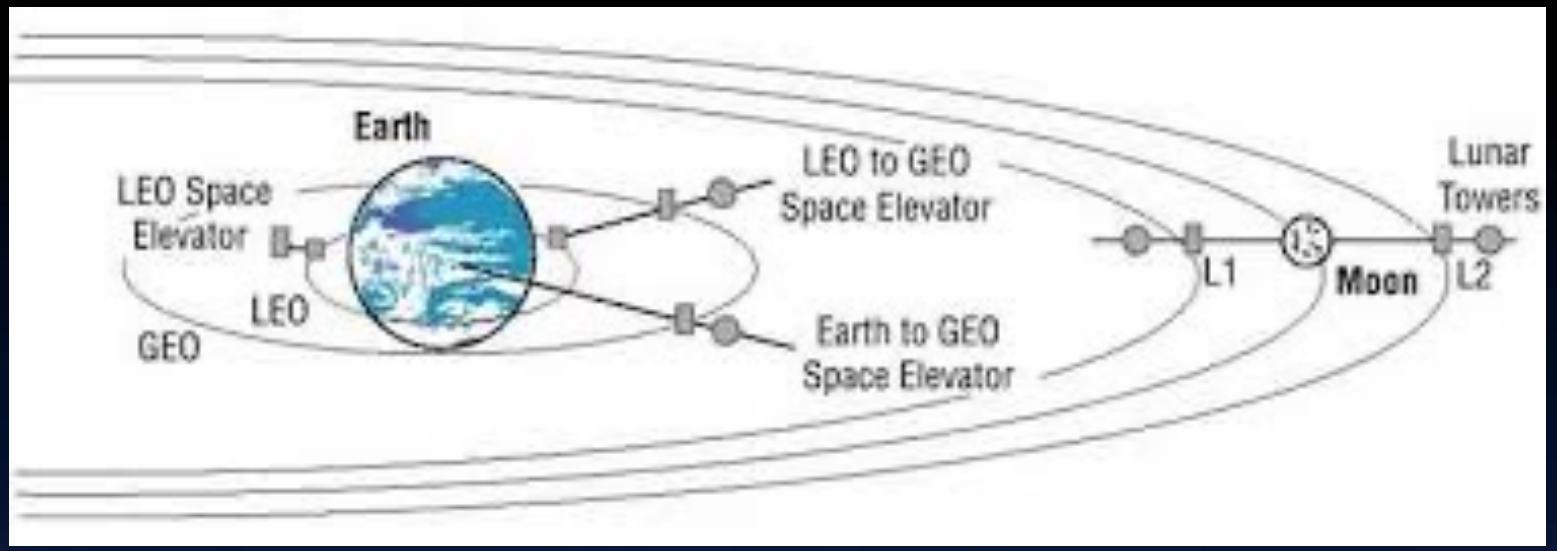
The CisLunar Economy is Enabled by a Practical Transportation System

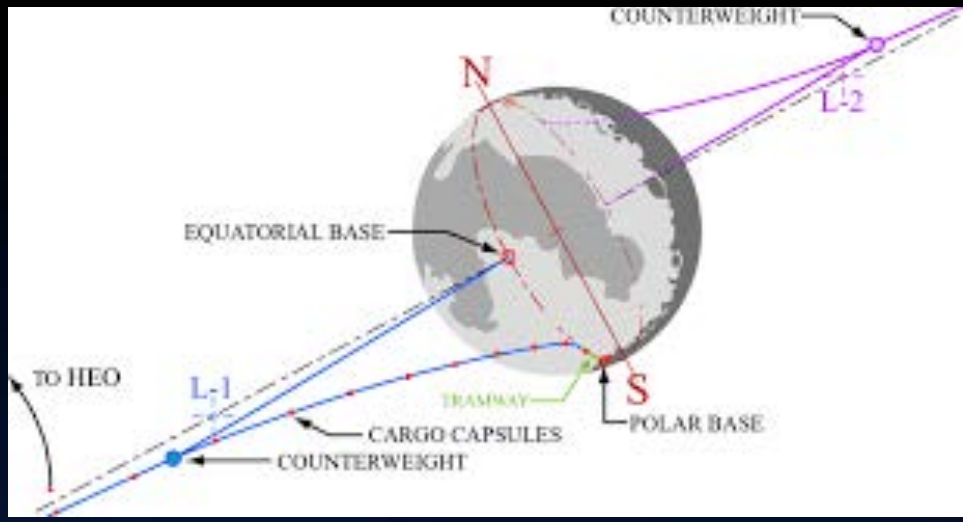
*BRYAN VERSTEEG/ DEEP SPACE INDUSTRIES

PROTECT AND DEFEND SPACE LINES OF COMMERCE

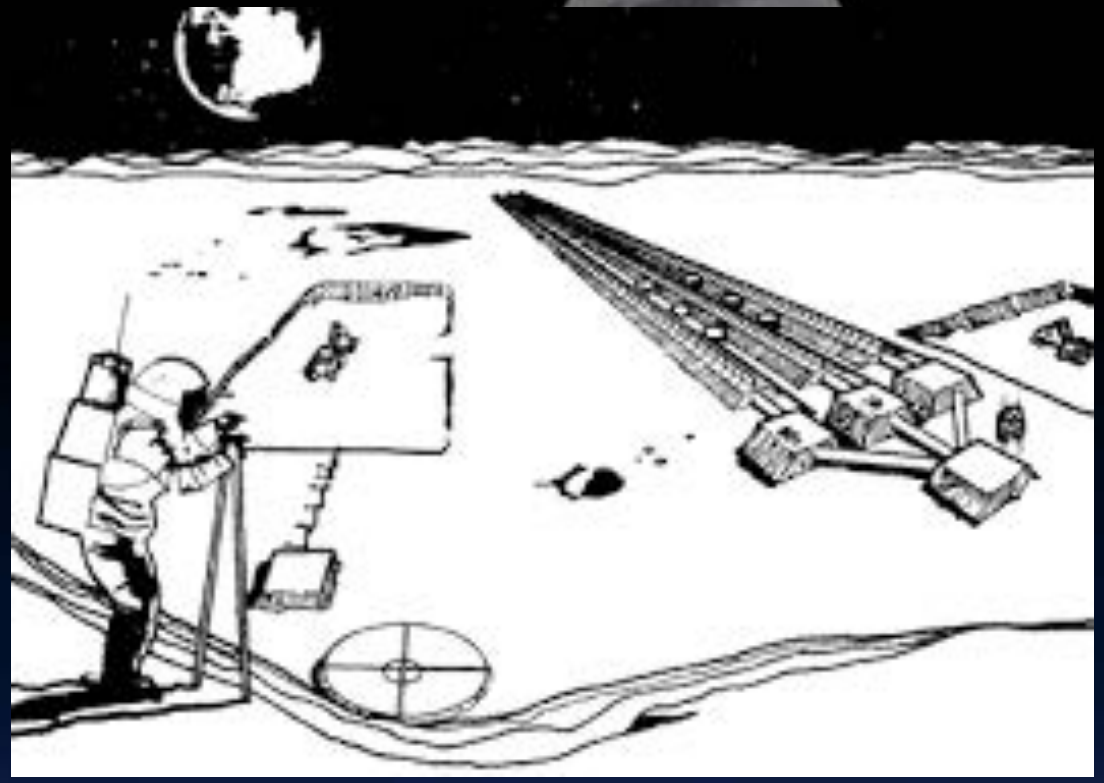


The Cislunar Economy is enabled by military patrol & safety of navigation services


Earth
LEO Space Elevator
LEO
GEO
LEO to GEO Space Elevator
Earth to GEO Space Elevator
L1
Moon
Lunar Towers
L2


COUNTERWEIGHT
N
L2
EQUATORIAL BASE
TO HEO
L1
TRAMWAY
S
POLAR BASE
CARGO CAPSULES
COUNTERWEIGHT

Lunar Mass Driver



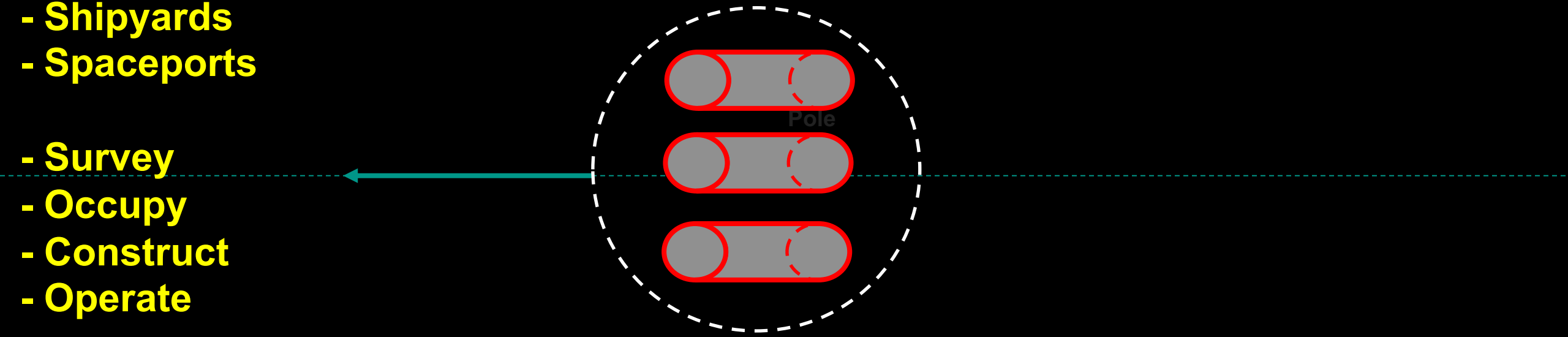
- It is now believed that a lunar mass driver several kilometers long, designed conservatively with present technology, should be able to **deliver 600,000 tons a year to L-5**, or more easily to L-2, **at a cost of about $1 per pound**, assuming only ten years of operation.

Towards
L-2

Secure Mass Transportation Locations:

- Space Elevators
- Mass Drivers
- Shipyards
- Spaceports

- Survey
- Occupy
- Construct
- Operate



Towards
L-4

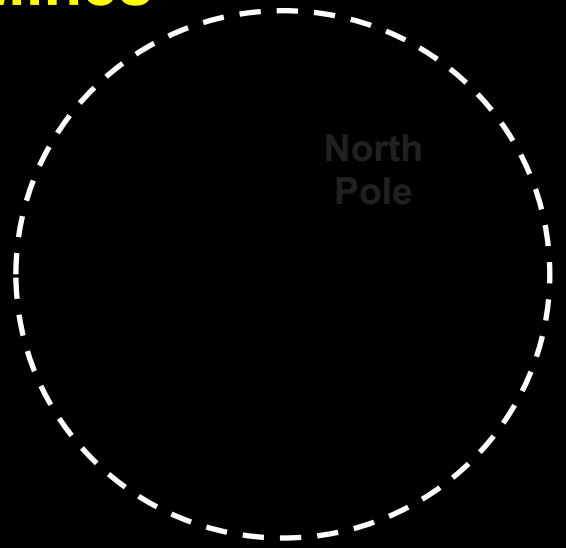
Towards
L-5

Towards
L-1
GEO
EARTH

Find & Secure Key Resources:

- Unique Resource-Rich Locations
  - -- PGMs, Fissile, Hydrocarbon Volatiles
  - -- Structural Metals
  - -- Location for productive Mines
  - -- Locations for factories

- Survey
- Occupy
- Construct
- Operate



Can this applied science prospecting be faster executed by humans?

Which non-polar locations have unique NatSec resources?

Applied Science Questions

- What locations convey strategic advantage?
- Does this location convey strategic advantage?
- Can I use science to occupy and secure it?
- Is this a good location to surveil competitor activities
- Can I build a base here? Roads, Landing Pads
- Can I build a mass driver here? Space Elevator here
- Does this have a unique resource or location? (Hydrocarbons, metals, PGMs)
-
- Can I process this stuff / how do I process this stuff into:
    - Volatiles
    - Structural materials
    - Functional Materials
    - Structures

2-D, 3-D Construction Validation

- Do we know how to build logistics-relevant structures:
- Can we build 2D Civil Engineering Structures
- Landing Pads, Berms, Roads, Trenches
- Can we Build 3D Vertical Civil engineering structures
- Hangars, Bunkers, Habitat Shielding
- Can we build functional logistics systems
- Cranes, Refueling tanks and pipes

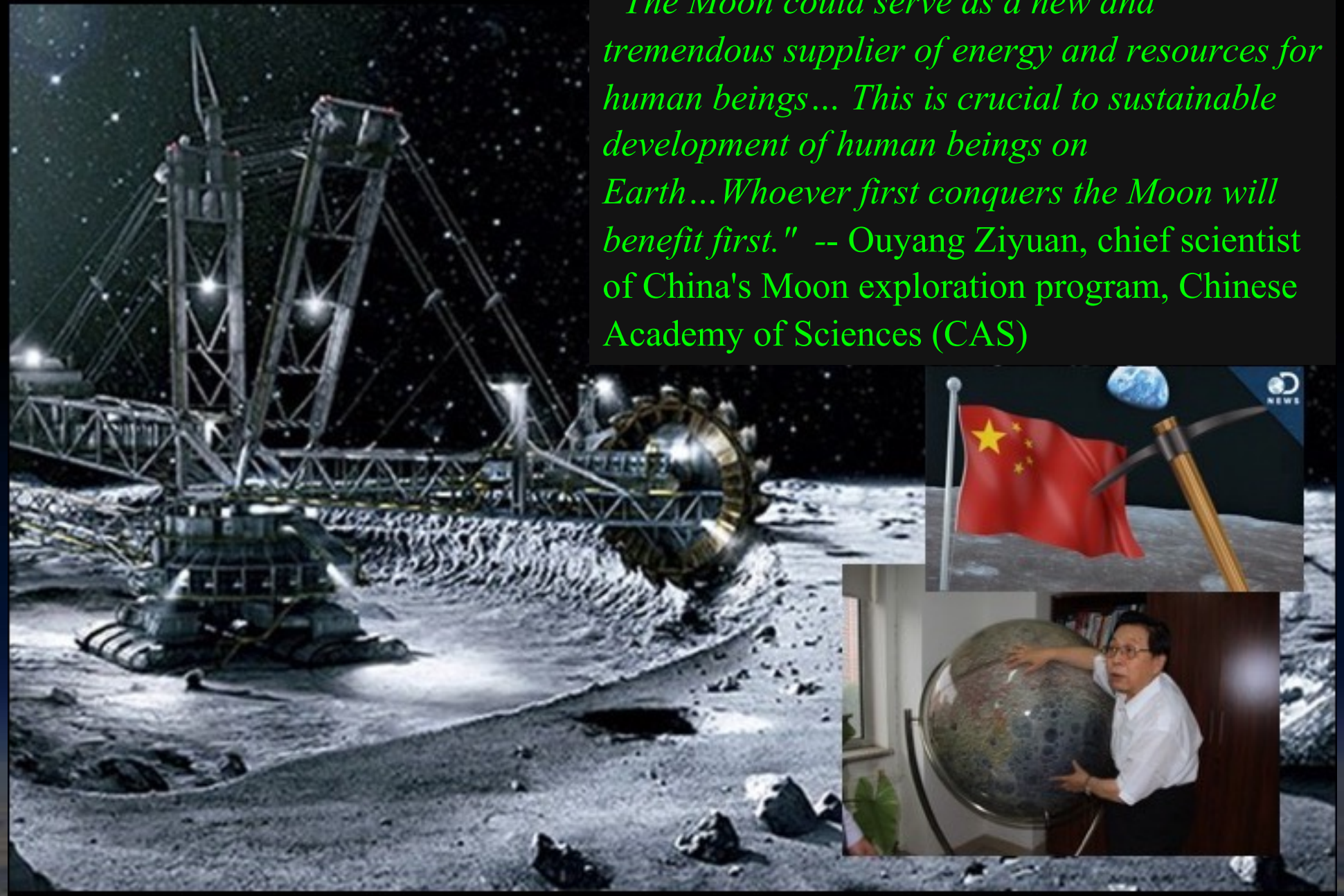
Validate Tech Tree For In-Space Supply Chains

- Survey
  - Extract
    - Volatiles
      - Propellant
      - Life Support
      - Lubricants
    - Minerals
      - Silicon
        - ICs
        - PVs
          - Power
        - Structural Glass
        - Ceramics
    - Metals
      - Structural Metals
        - Trusses
        - Pressure Vessels
          - Habitats
          - Rockets
        - Nozzles
        - Wheels
          - 2D Construct
      - Fissile Metals
        - Reactors
          - Power
          - Rockets
      - Critical minerals
        - Doping Agents
          - ICs, Optics
        - Magnets
          - Motors

Can this applied science tech tree be faster executed by humans?

Can it be faster executed in a non-polar location?

"The Moon could serve as a new and tremendous supplier of energy and resources for human beings… This is crucial to sustainable development of human beings on Earth…Whoever first conquers the Moon will benefit first." -- Ouyang Ziyuan, chief scientist of China's Moon exploration program, Chinese Academy of Sciences (CAS)



"China would next begin to exploit Earth-Moon space for industrial development. The goal would be the construction of space-based solar power satellites that would beam energy back to Earth…The earth-moon space will be strategically important for the great rejuvenation of the Chinese nation." – Lt Gen Zhang Yulin, CMC

https://www.youtube.com/watch?v=XhgJwnpYRGc

https://www.youtube.com/watch?v=XhgJwnpYRGc

Rotational Mass Driver

Science *China / Science*

Chinese scientists planning rotating launch system on the moon

The magnetic system would operate in the same way as an Olympic hammer thrower to send lunar resources back to Earth

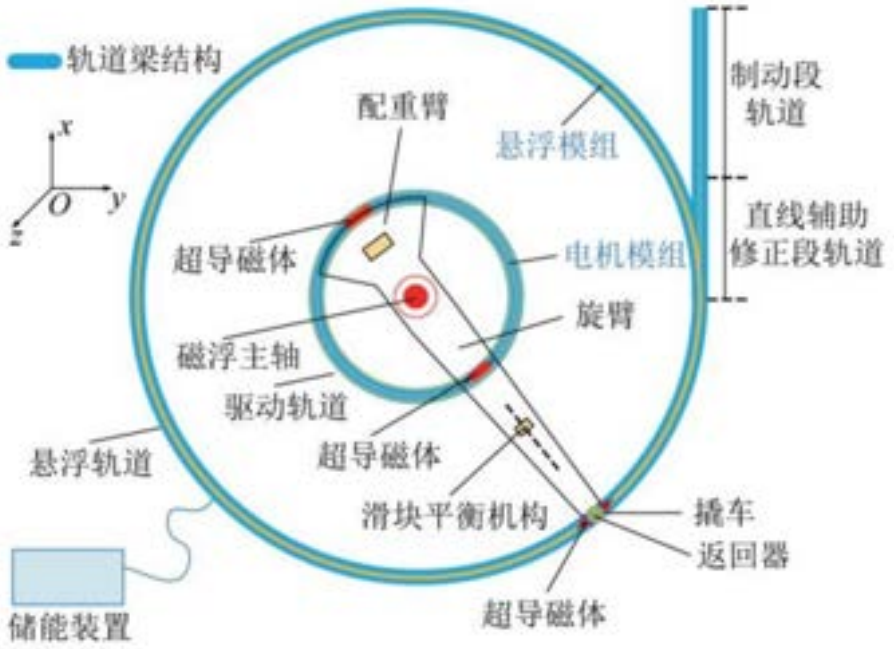


Figure 6 Technical solution of magnetic levitation rotary projectile device

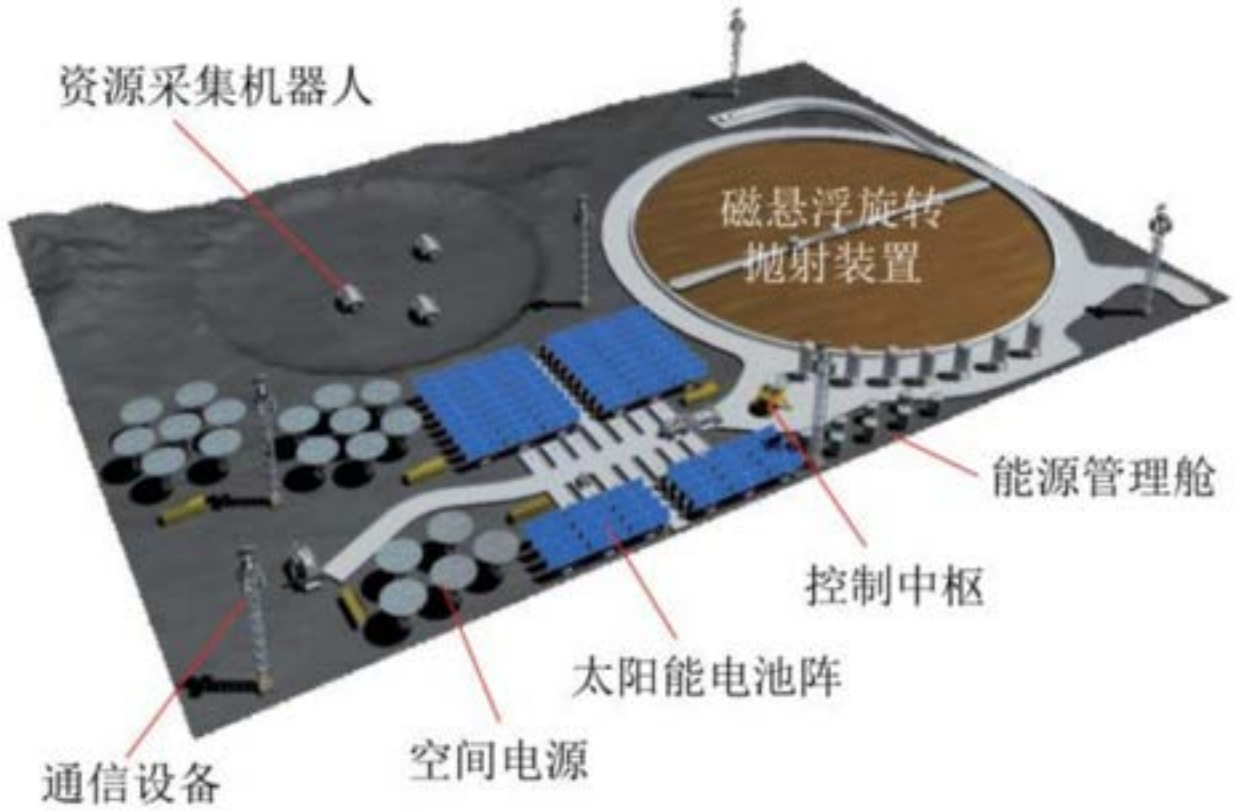


Figure 4 Concept of lunar resource development system


Power
Generation
Transmission
Beaming
Storage
Thermal Management

Power for:

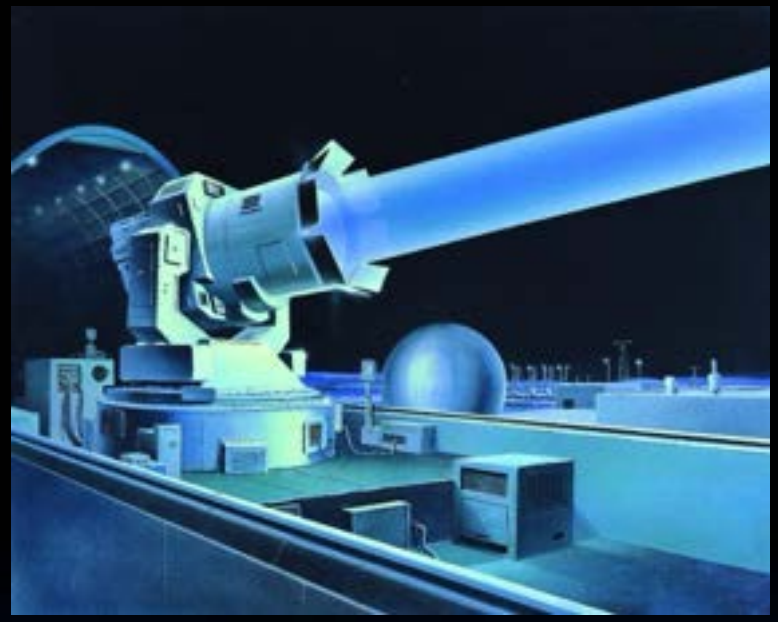
- Industrial processes that create & enable:
- in-space production capacity (Defense Industrial Base in Space)
- High throughput transportation system (Leverageable logistical network)
- High volume exportable storable energy (fuels, propellant)
- Exportable Power Systems (Lunar manufactured PVs, Reactors)
- Portable Contingency power at forward locations
- Beamed Power to forward locations

Validate Power Infrastructure

Counterspace? Strategic Strike?

Location, Location, Location?


ICBM
ICBM



TREATY OUTER SPACE

The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes.
The establishment of **military bases**, installations and **fortifications**, the **testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden**.
The use of **military personnel** for scientific research or for any other **peaceful purposes shall not be prohibited**. The use of **any equipment or facility necessary for peaceful exploration of the Moon** and other celestial bodies **shall also not be prohibited**.

The Outer Space Treaty may have but the brakes on more ambitious human exploration and development of space. (credit: NASA)

Still crazy after four decades: The case for withdrawing from the 1967 Outer Space Treaty

by John Hickman
Monday, September 24, 2007

Reuters
https://www.reuters.com › world › which-countries-are-...

Which countries are quitting a key landmine treaty and why?

Jun 30, 2025 — All European countries bordering Russia have announced plans to quit the global treaty, apart from Norway which has only a 200 km (125 mile) ...

ANZSIL Perspective
https://anzsilperspective.com › saudi-arabias-withdrawal...

Saudi Arabia's Withdrawal from the Moon Agreement

On 5 January 2023, Saudi Arabia gave notice to the United Nations of its withdrawal from the Agreement Governing the Activities of States on the Moon and Other ...

"We don't know the future of the Outer Space Treaty"
-- Dr. P.S. Goel, former Secretary of India's Ministry of Earth Sciences and Chair of the Indian National Committee for Space Research

But, treaties survive…until they don't…until someone withdraws…or someone violates…then the rules change
Then: "The only rules that really matter are these: what a man can do and what a man can't do."—Jack Sparrow

"It must be stated that constitutionally, the U.S. government is required to provide for the common defense. This includes defending American military assets in space AND commercial assets in space, many of which have and will have a dual role of providing commercial and military capabilities.

The U.S. government must establish a legal framework and be prepared to defend private and corporate rights and obligations all within keeping the Outer Space Treaty. And to enable freedom of action, the United States must have cis-lunar situational awareness, a cis-lunar presence, and eventually must be able to enforce the law through cis-lunar power projection."

https://okgrassroots.com/?p=642815

Indications and Warnings?

”Boots on the Moon” might want to confirm/model:

- Ballistics
- Kick, Stabilization
- Ranging
- Penetration
- Ejecta
- Shielding

A 1989 CRS report to Congress explored the potential surface use of: **Guns: Gas, Grenade, mortars, Missiles**

Hoppers, Unattended Ground Sensor Darts, percussive or hypervelocity prospecting, meteor ejecta characterization

Potential Missions

Potential Missions

- Public Works Construction (Army Corps of Engineers)
- Rescue and Personnel Recovery (PR)
- Medical Evacuation (Medevac), Non-Combatant Evacuation (NEO)
- Humanitarian Assistance (HUMRO)
- Logistics Support to Other Government Agencies (Antarctic Ice Mission)
- Defense of Commerce
- Planetary Defense
- Lunar Military Logistics (a Peaceful (non-aggressive) Purpose)

Protect and Defend Space Lines of Commerce

Rescue
Medical Evacuation
Vessel Search & Seizure
Non-Combatant Evacuation
DSCA (Law Enforcement)

The Cislunar Economy is enabled by military patrol & safety of navigation services.

Noncombatant Evacuation Ops

Medevac

Testing Emergency Rescue Gear

Space Traffic Management Ops

Noncombatant Evacuation Ops

Prospecting

Our national security interest is in finding the good stuff

Validate Construction

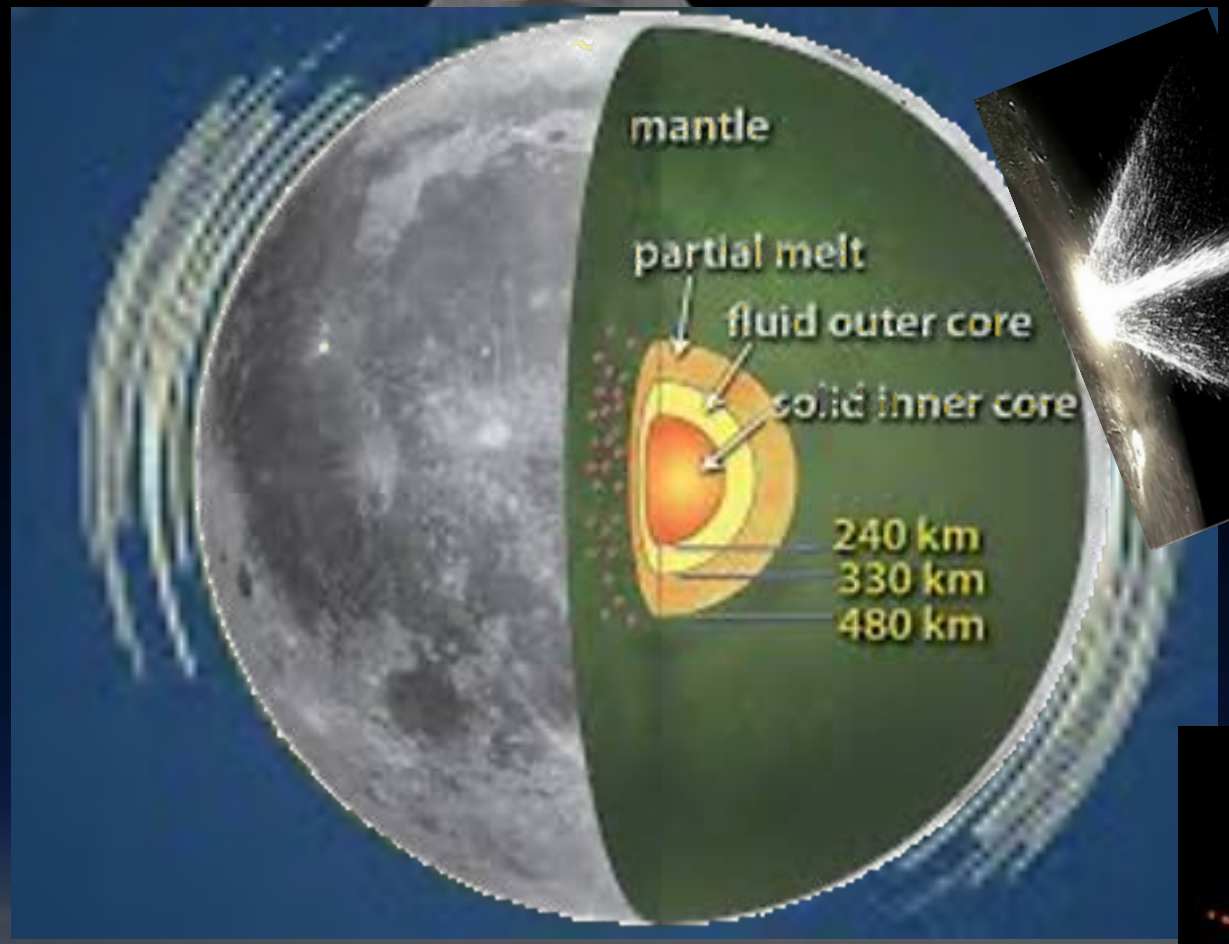
- Think “Army Corps of Engineers”
- Roads
- Grading
- Pads
- Trenches
- Cables

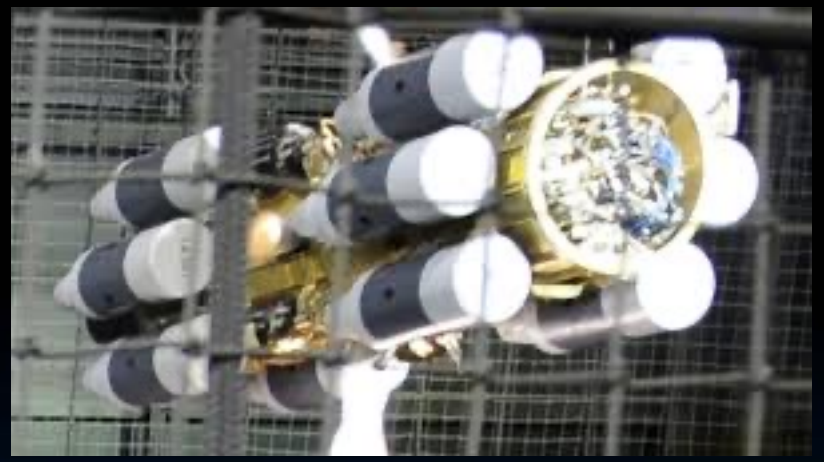
Planetary Defense

Of the Moon

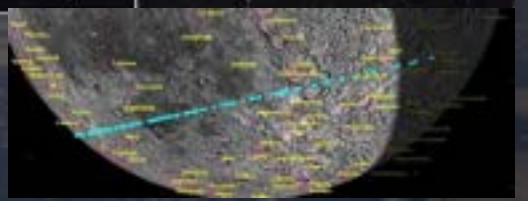
From the Moon

Seismic Mapping / Planetary Defense
Impact Ejecta Characterization

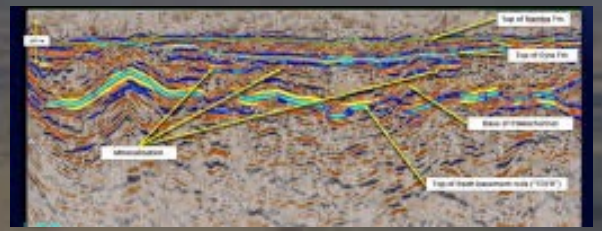




Example: asteroid 2024 YR4, is no longer a threat to Earth, there's a small chance it could impact the moon in 2032



Safety might favor non-polar location for impact / ejecta testing




Defense of
Commerce
On the Moon
To & From & Around the Moon

2019

REPORT TO CONGRESS

of the

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

ONE HUNDRED SIXTEENTH CONGRESS
FIRST SESSION

NOVEMBER 2019

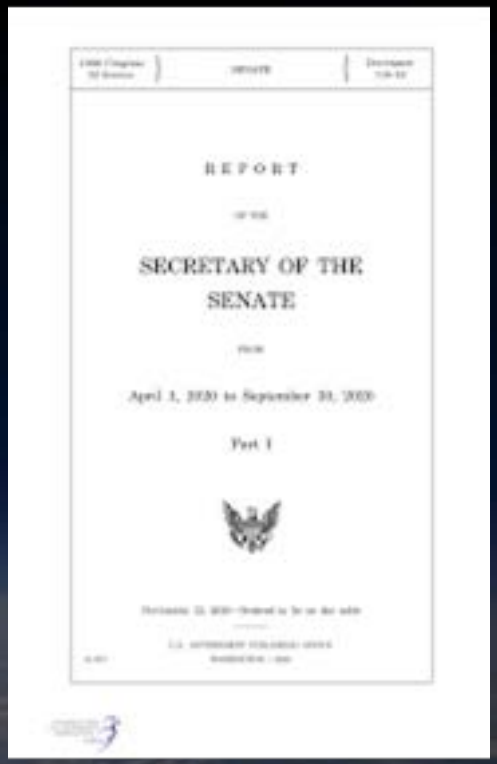
Printed for the use of the
U.S.-China Economic and Security Review Commission
Available online at: *https://www.uscc.gov*

"**Beijing has specific plans not merely to explore space, but to *industrially dominate the space within the moon's orbit of Earth***. China has invested significant resources in exploring the national security and economic value of this area, including *its potential for space-based manufacturing, resource extraction, and power generation.*"

"**Ensure U.S. Space Command and any future space-oriented service are responsible for protecting freedom of navigation and keeping lines of communication open, safe, and secure** in the space domain, as the U.S. Navy does for U.S. interests in the maritime commons."

Public Law 116-19 (NDAA 2020)

Tasks the Space Force with the functions of organize, train and equip to provide
(1) freedom of operation for the United States in, from, and to space; and
(2) prompt and sustained space operations"
with specified duties to:
(1) *protect the interests of the United States in space*;
(2) deter aggression in, from, and to space; and
(3) conduct space operations."

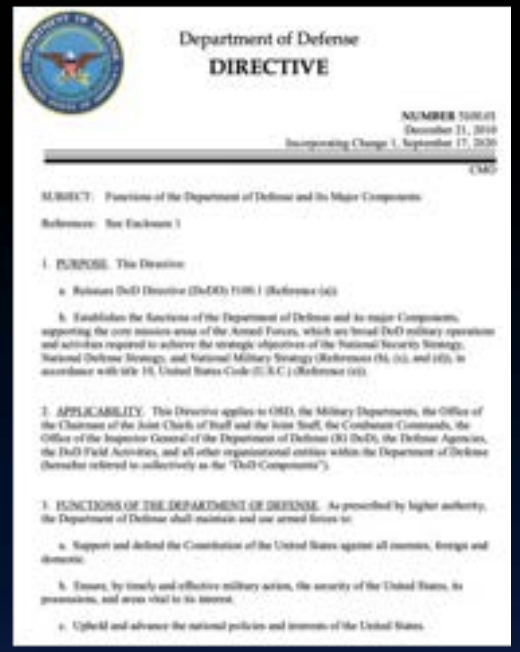


REPORT

SECRETARY OF THE SENATE

Part 1

DoD 5100.01 Functions of the Space Force.



Department of Defense
DIRECTIVE

NUMBER 5100.01
December 21, 2010
Incorporating Change 1, September 17, 2020

CMO

SUBJECT: Functions of the Department of Defense and Its Major Components

References: See Enclosure 1

1. PURPOSE. This Directive:

a. Reissues DoD Directive (DoDD) 5100.1 (Reference (a)).

b. Establishes the functions of the Department of Defense and its major Components, supporting the core mission areas of the Armed Forces, which are broad DoD military operations and activities required to achieve the strategic objectives of the National Security Strategy, National Defense Strategy, and National Military Strategy (References (b), (c), and (d)), in accordance with title 10, United States Code (U.S.C.) (Reference (e)).

2. APPLICABILITY. This Directive applies to OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense (IG DoD), the Defense Agencies, the DoD Field Activities, and all other organizational entities within the Department of Defense (hereafter referred to collectively as the "DoD Components").

3. FUNCTIONS OF THE DEPARTMENT OF DEFENSE. As prescribed by higher authority, the Department of Defense shall maintain and use armed forces to:

a. Support and defend the Constitution of the United States against all enemies, foreign and domestic.

b. Ensure, by timely and effective military action, the security of the United States, its possessions, and areas vital to its interest.

c. Uphold and advance the national policies and interests of the United States.

¼ vs full page
For other services

- In addition to the common military service functions listed in Paragraphs 2.a. through 2.n. of this enclosure, the Space Force, within the Department of the Air Force, shall develop concepts, doctrine, tactics, techniques, and procedures and organize, train, equip, and provide forces to perform the following specific functions:
- (1) **Provide freedom of operation** for the United States in, from, and to space.
- (2) Provide prompt and sustained space operations.
- (3) **Protect the interests of the United States in space**.
- (4) **Deter aggression in, from, and to space**.
- (5) Conduct space operations

Spacepower Capstone Doctrine

Today, the entirety of economic and military space activities is confined to the geocentric regime; however, commercial investments and **new technologies have the potential to expand the reach of vital National space interests to the cislunar regime and beyond in the near future. As technology marches forward, U.S. military spacepower must harmonize with the other instruments of power to protect, defend, and maintain the Nation's strategic interests in space.**
--Spacepower: Doctrine for Space Forces

Space Security protects these interests by establishing conditions for the safe and secure access to space for civil, commercial, Intelligence Community (IC), and multinational partners. **Space Security is a presence mission that helps assure partners that the U.S. military is positioned to monitor and protect their interests.** Ultimately, Space Security seeks to encourage partners, not compel an adversary; however, if necessary, Space Security includes **protecting these mission partners from dangerous or illicit actions.** In this regard, combat forces provide a deterrent role for Space Security. Space Security may also **include sharing information and domain awareness**, developing self-protection capabilities, coordinating anomaly resolution support, maneuver de-confliction, EMS monitoring, launch vehicle ridesharing, **protecting lines of communication and national space commerce**, and building partner capacity through combined training and exercises.

https://apps.dtic.mil/sti/pdfs/AD1101899.pdf

- The U.S. should establish space settlement and human presence as a primary driver of the nation's civil space program to determine the path for large-scale human space settlement and ensure America is the foremost power in achieving that end. Accordingly, civil space programs must be assessed as to their utility to further space settlement goals.
- The U.S. must continue to lead in developing a rules-based, democratic international order for space. The U.S. must commit to **having a military force structure that can defend this international space order and defend American space interests, to include American space settlements and commerce.**
- The U.S. must recognize that in the world of 2060, space will be a significant engine of national political, economic, and military power for whichever nations or nation best recognize(s) the potential of space and organizes and operates to exploit and maximize that potential.
- The Department of Defense (DoD) is a critical partner in such a whole-of-government approach to national space strategy and action. The DoD must embrace its role as an executing agent for this national strategy. It must commit to advancing American progress along all three space futures axes and its mission of defending U.S expanded military, civil, and commercial space interests. DoD programs must be assessed as to their military utility and strategic utility within the national space strategy.
- The U.S. military must define and execute its role in promoting, exploiting, and defending the expanded commercial, civil, and military activities and human presence in space driven by industry, NASA, and other nation-states.


Humans Raise the Stakes
Humans Have Rights
Defense Science May be Its own Reward

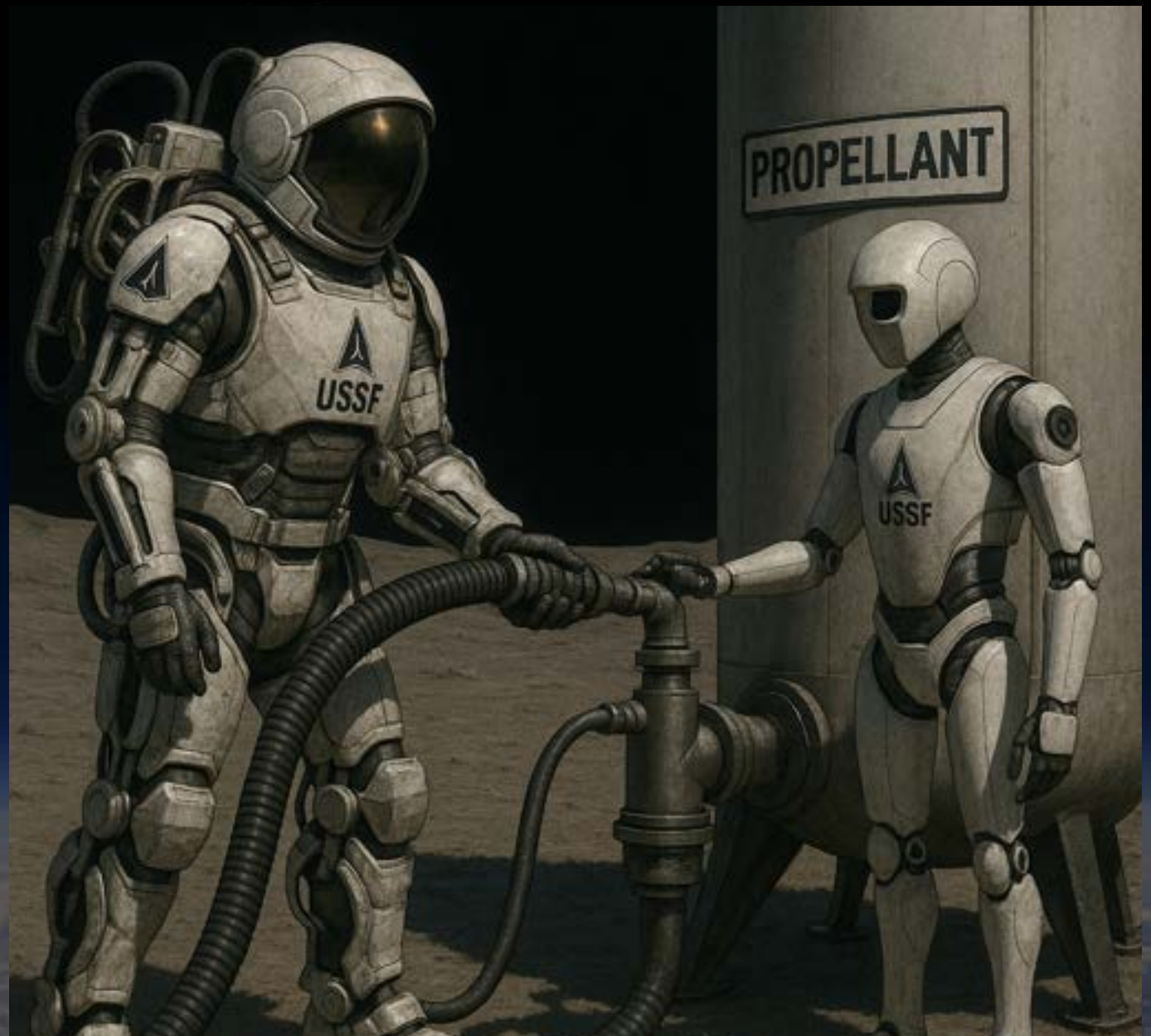
Assert US Treaty Rights

Article IV

The use of **military personnel** for scientific research or for any other **peaceful purposes shall not be prohibited**.

The use of **any equipment or facility necessary for peaceful exploration of the Moon** and other celestial bodies **shall also not be prohibited**.

Exoskeleton and Humainoid Robotic Testing



Prospecting for National Interests
Claiming rights to non-interference

Article 1
Outer space, **including the moon** and other celestial bodies, **shall be free for exploration and use by all States**

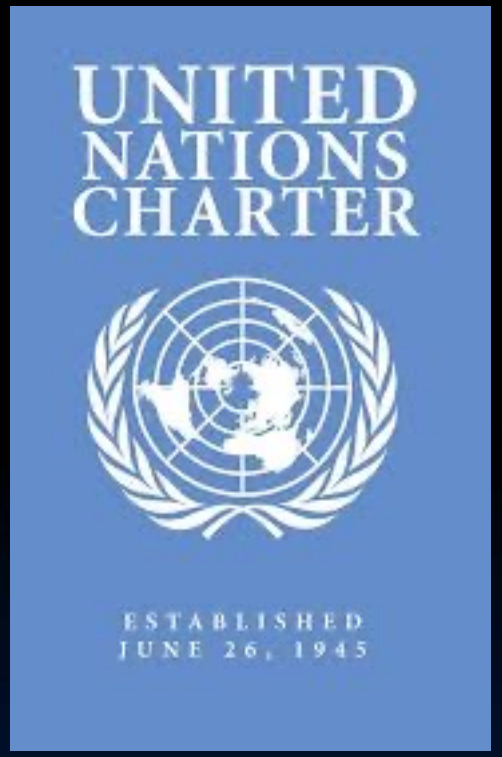
Article XII
maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.

Looking for Contraband
Counter-proliferation
Arms Control
Agreements

Assert US Treaty Rights

Article 1
Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and **there shall be free access to all areas of celestial bodies.**

Human Tripwires Raise the Stakes



Article III
States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, **in accordance with international law, including the Charte**r of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.

Article 51
Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations

Assert US Treaty Rights

Article IV

The use of **military personnel** for scientific research or for any other **peaceful purposes shall not be prohibited**.

The use of **any equipment or facility necessary for peaceful exploration of the Moon** and other celestial bodies **shall also not be prohibited**.

Assert US Inspection Rights

Article II

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

Article IV

The Moon and other celestial bodies shall be used by all States Parties to the Treaty **exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden**.

Article XII

All stations, installations, equipment and space vehicles on the Moon and other celestial bodies **shall be open to representatives of other States Parties to the Treaty** on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal

So, are there compelling national security applied science objectives at non-South Pole locations in the near term?

Diverting resources from South Pole Build-up should face a very high bar

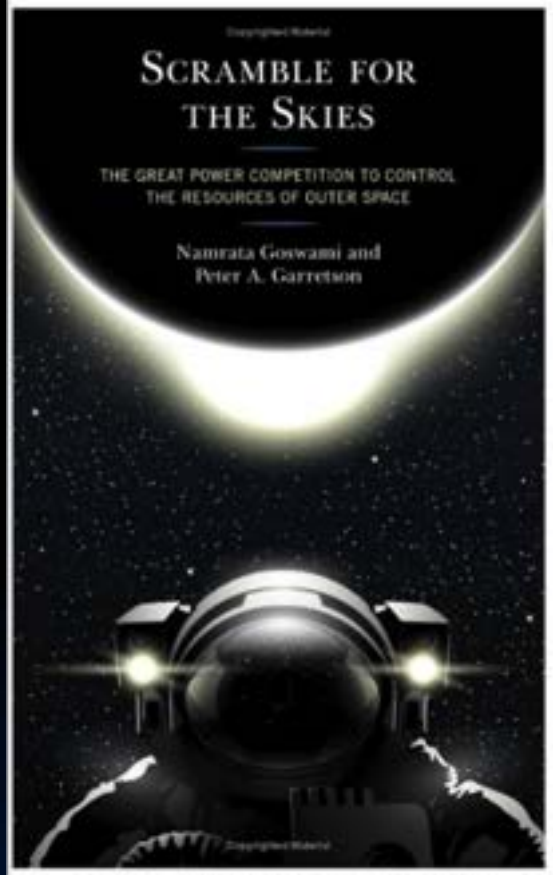
Most National Security Relevant Applied science likely does not require humans and likely could be done at the poles

Bottom Line

- Most current National Security Relevant Applied Science likely does not require humans (SDA, PNT, COM)
- Most long-term National Security Relevant Applied Science (ISRU, ISM) could most likely could be done at the South Pole
- The most compelling case is the **verification, siting and demarcation of unique non-polar sites that have long-term strategic relevance for large-scale industrial and transportation systems**
    - Unique materials and resources (fissile, defense critical minerals (PGMs)
    - Space Elevator anchors
    - Mass Driver sites
    - On-site Civil Engineers might be more efficient than robotic sortie
    - The urgency to lock in non-interference might justify near-term visit

	National Security Mission	Requires Non-Polar Site	Requires Humans
Official (Specified)	SDA	Maybe	Probably NOT or ancillary
	PNT / COM	Maybe	Probably NOT or ancillary
	Civil Engineer Construction (Siting)	Probably	Probably
	Validate Scalable Production Technology	Maybe	Possibly
Potential (Implied)	Defense of Commerce / Stability Operations	Only if US interests present	Possibly
	Rescue, Personnel Recovery, Medevac	Only if US interests present	Likely for operations Not for pre-positioning equipment
	Planetary Defense	Unclear	Probably NOT
	Assert OST Rights	Unclear or NOT YET	YES

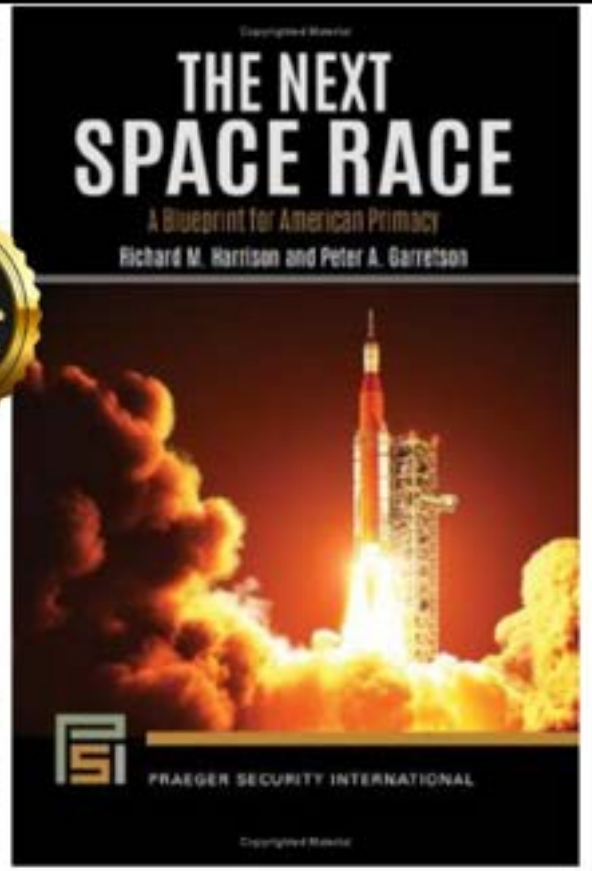

Supports a National Security Mission
~~Space Control / Combat Power~~
~~Strategic Strike / Force Application~~
Defense of Commerce
Planetary Defense
SDA
PNT
Com
SML
ISRU
Space Security
Prospecting
Secure Unique Mega Infrastructure Siting
Rescue
Assert OST Rights
Requires Non-Polar Location
Requires Humans to do right

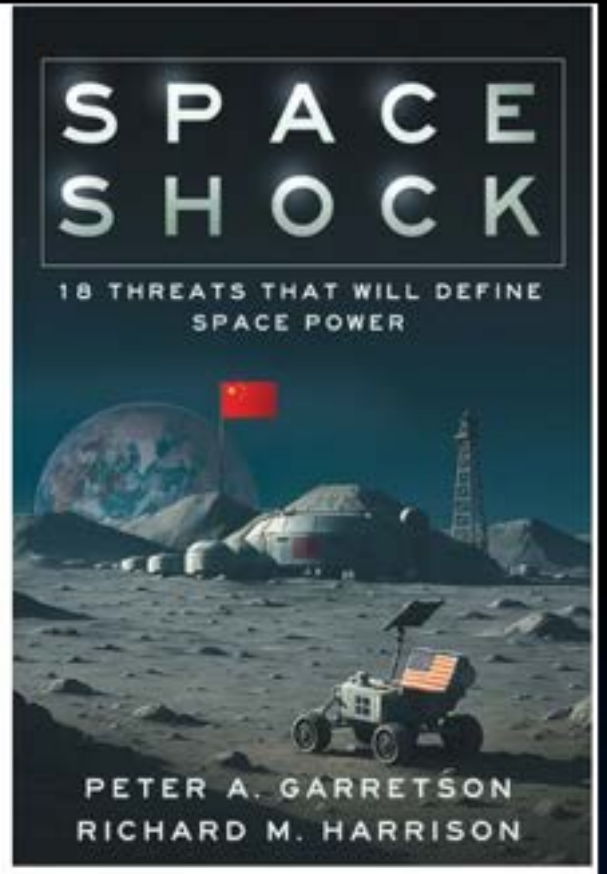


Apple Podcasts

Space Strategy
Space Pod

Government
★★★★★ 5.0

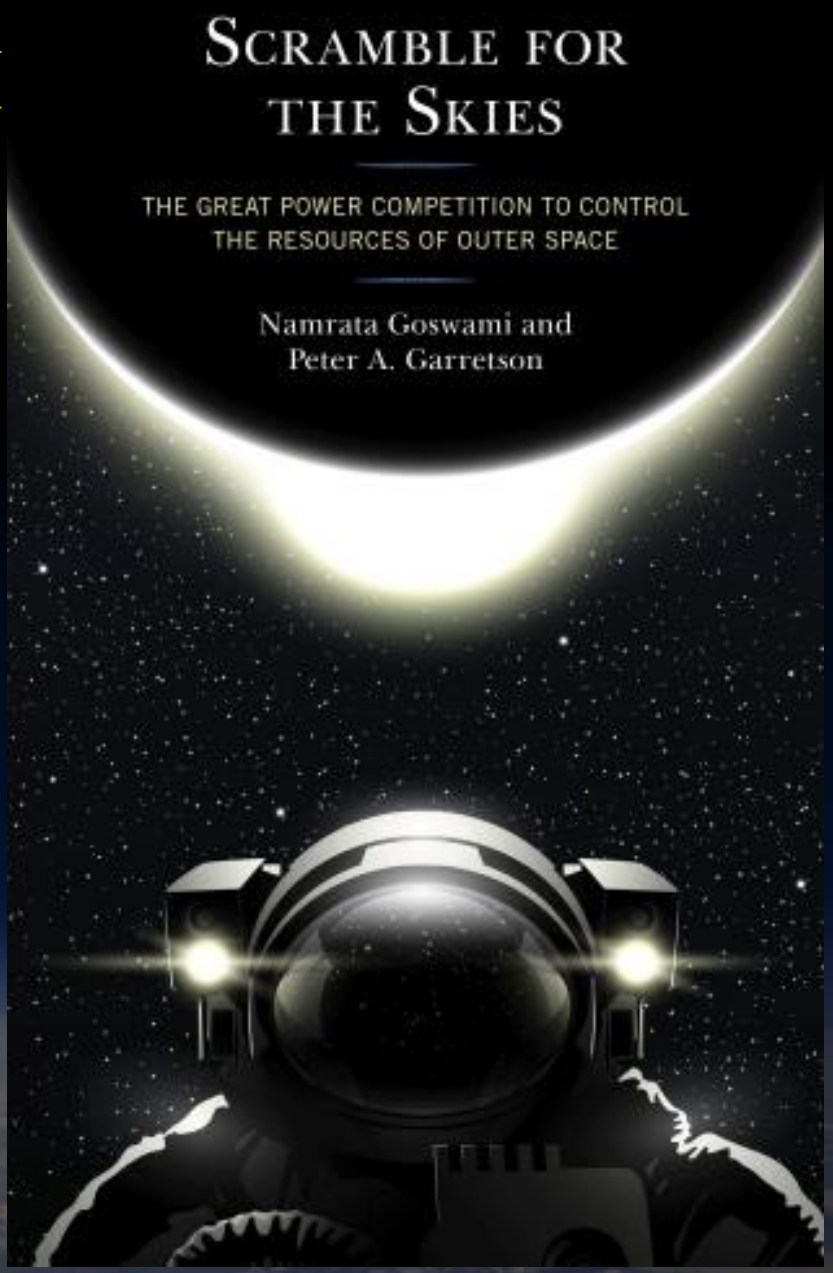




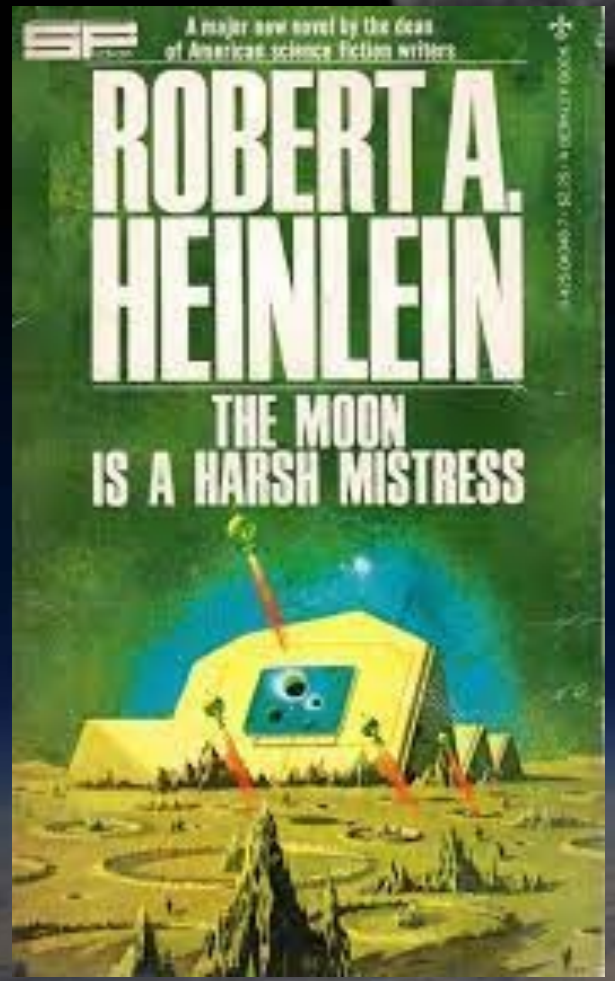
Available Fall 2025

An Overview of our Book

- Discount Code: **LEX30AUTH21**
- https://**rowman.com**/ISBN/9781498583114/Scramble-for-the-Skies-The-Great-Power-Competition-to-Control-the-Resources-of-Outer-Space
- THESIS: The great powers are beginning to compete for space resources.
- WHY: Because they have an expectation it might alter the relative balance of power

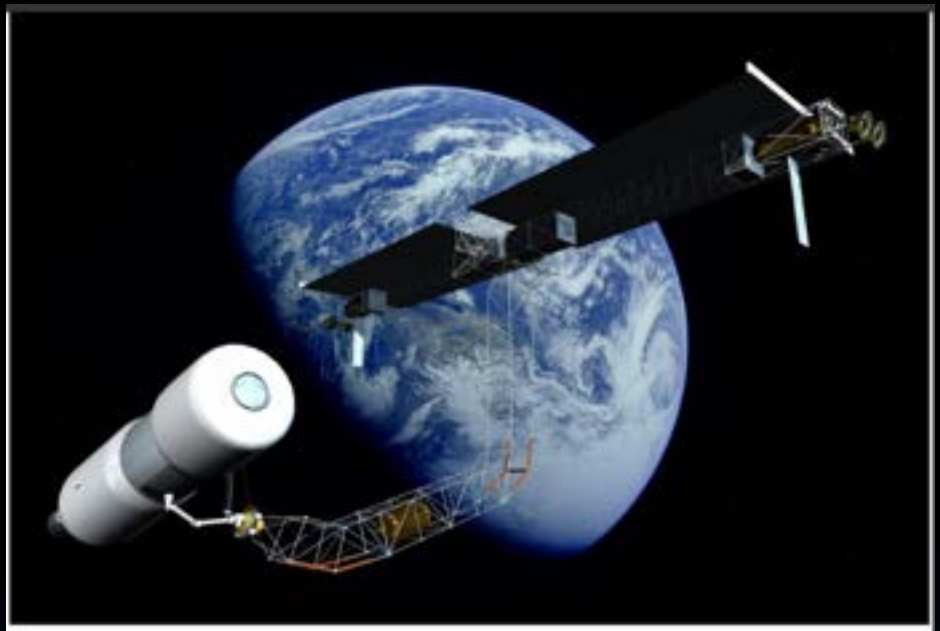



Backups



- “Uh—” I started to round off in head. Mike’s “head” works faster; he answered, “The concussion of a hundred-tonne mass on Terra approaches the yield of a two-kilotonne atomic bomb.”

- “Mike had computed what would happen if a freighter grossing 100 tonnes (or same mass of rock) falls to Terra, unbraked. Kinetic energy as it hits is 6.25 x 10^12 joules—over six trillion joules.”



STATE OF THE SPACE INDUSTRIAL BASE 2020

A Time for Action to Sustain US Economic & Military Leadership in Space

Summary Report by:

Brigadier General Steven J. Butow, Defense Innovation Unit
Dr. Thomas Cooley, Air Force Research Laboratory
Colonel Eric Felt, Air Force Research Laboratory
Dr. Joel B. Mozer, United States Space Force

July 2020

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Expanding the role of the USSF - An increasing US presence within an expanded cislunar economy will require security and a stabilizing military presence. Clarifying the USSF role in protecting and enabling US commerce across cislunar space is critical. As we emerge from the period of strategic redefinition and changing focus, the USSF can address our eroding competitive military advantage and reinforce our traditional tools of diplomacy. This will enhance the US ability to negotiate from a position of strength, ensure the balance of power remains in our favor, and advance an international order that supports our security and prosperity. A Space Force that presents forces, capabilities, and doctrine for national space power with the **clearly defined mission to enable and protect US space commerce** will project confidence and lower the perception of risk by providing **stabilizing presence, surveillance, aids to navigation, and help when required.**

https://cdn.afresearchlab.com/wp-content/uploads/2020/07/27223753/State-of-the-Space-Industrial-Base-2020-Report_July-2020_FINAL.pdf

A Primer on Cislunar Space

This primer aims to familiarize the reader with “cislunar space.” It is targeted at military space professionals who will answer the call to develop plans, capabilities, expertise, and operational concepts. Cislunar space has recently become prominent in the space community and warrants attention, as reflected in the recent Memorandum of Understanding (MOU) between the National Aeronautics and Space Administration and the United States Space Force

This MOU reflects the increasing importance of cislunar space, as articulated in national level guidance, including the National Space Council’s A New Era for Deep Space Exploration and Development [2], the Future of Space 2060 & Implications for U.S. Strategy [3], State of the Space Industrial Base 2020 [4], and Spacepower: Doctrine for Space Forces [5]. To realize the ambitious roles and missions outlined in Spacepower, the activities articulated in A New Era for Deep Space Exploration and Development5, and the NASA-USSF MOU,6 a better understanding of this complex domain is required.

In this article, we build a fundamental understanding of this complicated environment and provide foundational terminology. The article aims to provide an overview for educational purposes and is not intended to be an exhaustive literature study; some omissions are made in the interest of brevity and clarity.

https://www.afrl.af.mil/Portals/90/Documents/RV/A%20Primer%20on%20Cislunar%20Space_Dist%20A_PA2021-1271.pdf?ver=vs6e0sE4PuJ51QC-15DEfg%3D%3D

MENU

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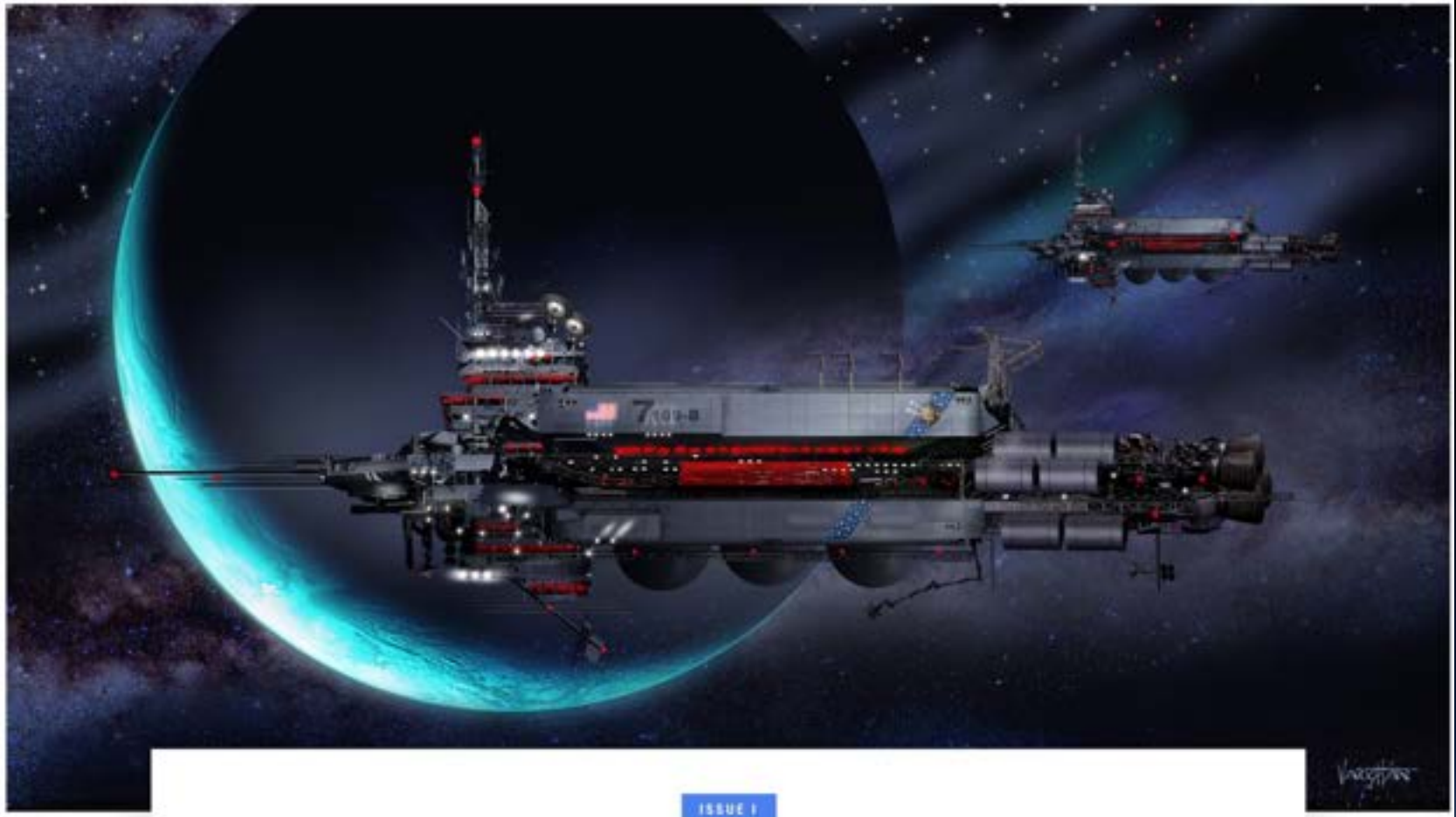


ISSUE 1

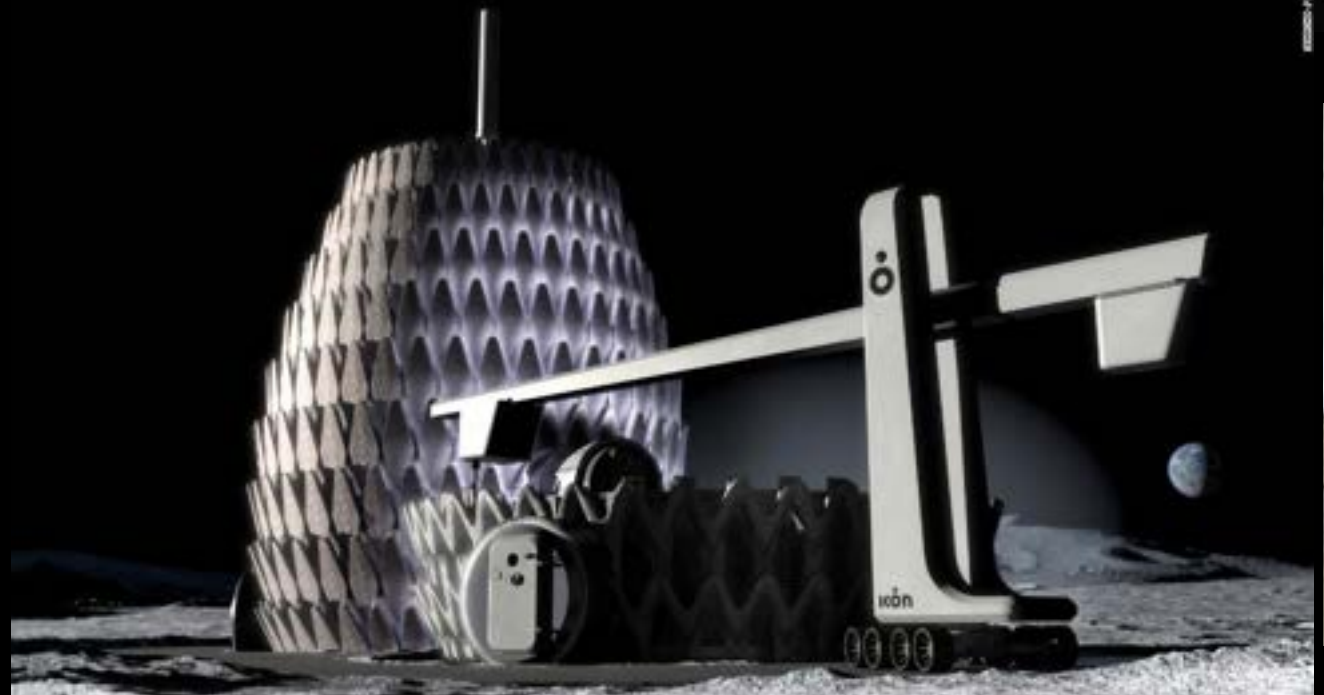
Posturing Space Forces for Operations Beyond GEO

JANUARY 31, 2021 - BY SFJ

The U.S. military must undertake the necessary preparations to secure U.S. interests beyond geostationary orbit (GEO). As U.S. space activities expand into deep space, threats to economic and security interests are likely to emerge. There are technical challenges of operating beyond GEO (XGEO). The United States must begin investing to ensure U.S. space forces will be capable of such operations.

https://spaceforcejournal.org/posturing-space-forces-for-operations-beyond-geo/

ICON



Location location location

- Think at Scale
- Logistics of “force extension”
- Logistics of [Energy] Costs or “Force multipliers]
- Control of Trade Routes

Posturing Space Forces for Operations Beyond GEO

By David Buehler, Eric Felt, Charles Finley, Peter Garretson, Jaime Stearns, and Andy Williams

The U.S. military must undertake the necessary preparations to secure U.S. interests beyond geostationary orbit (GEO).

READ IT!

Cislunar Spacepower, The New Frontier

By Laura Duffy and James Lake

Establishing spacepower in the cislunar space environment is important due to economic, political, technological, and military competition among great powers.

READ IT!

Orbital Sustainment and Space Mobility Logistics Using Space Resources

By Alexander Jehle and George Sowers

Water is the "oil" of space. Water, H2O - two parts hydrogen and one part oxygen, can be used as a steam or plasma propellant for spacecraft and space tugs and be split into hydrogen and oxygen as a chemical rocket propellant.

READ IT!

Cislunar Mission Concepts for the Department of Defense

By Tyler Bates

Four Space Force lunar and cislunar mission concepts may support civil, national, commercial, and international partners throughout the Earth-Moon system.

READ IT!


BACKUPS

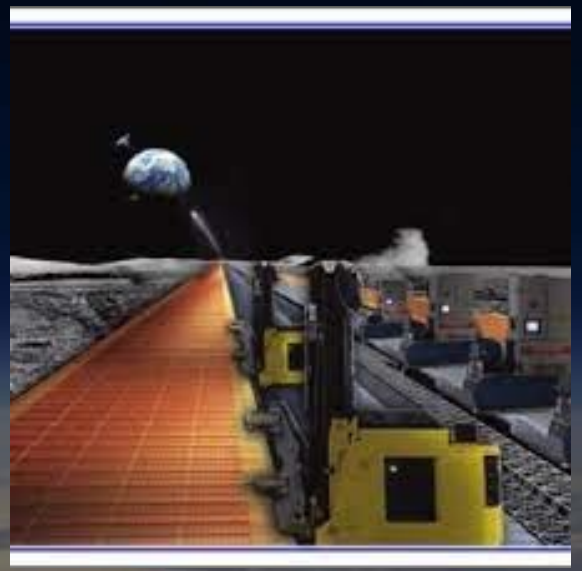
SITUATIONAL SCENARIOS

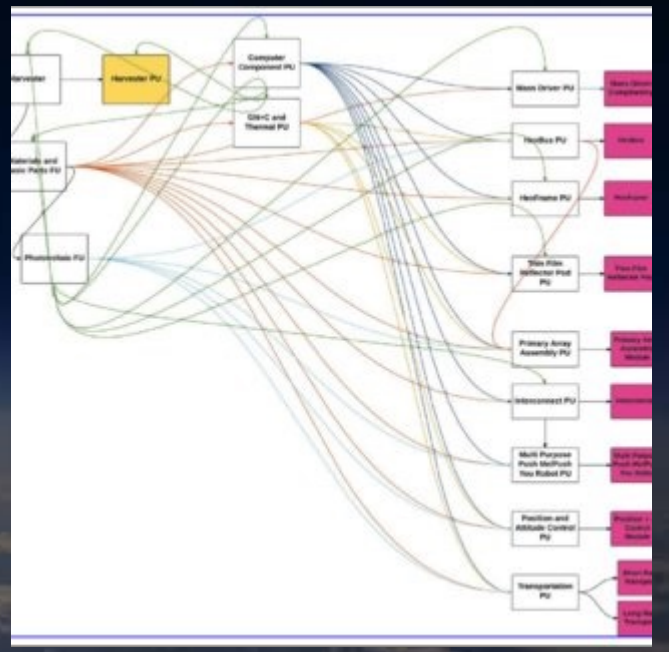
- Claim Disputes
- Trafficking
- Unsafe Practices
- Piracy
- Defection of Citizens or Facilities
- False Promises via Lawfare
- “Over-fishing”
- One-Sided National Lawfare
- Cartographic Aggression
- Infrastructure Aggression
- Limitations on Innocent Passage
- Defense Identification Zones
- Deniable Duel-Use Infrastructure
- Malicious funding of competitors
- Hostile financial takeover
- Claim Jumping
- Facility Blockage
- Blockade
- Impounding
- Impressment
- Hostage Taking
- Tourism Aggression
- Tourism Aggression
- Economic Punishment
- Privateering
- Deliberate Harmful Interference
- Sabotage
- Issuing Private Law

VOICES OF THE NEW SPACE GENERATION

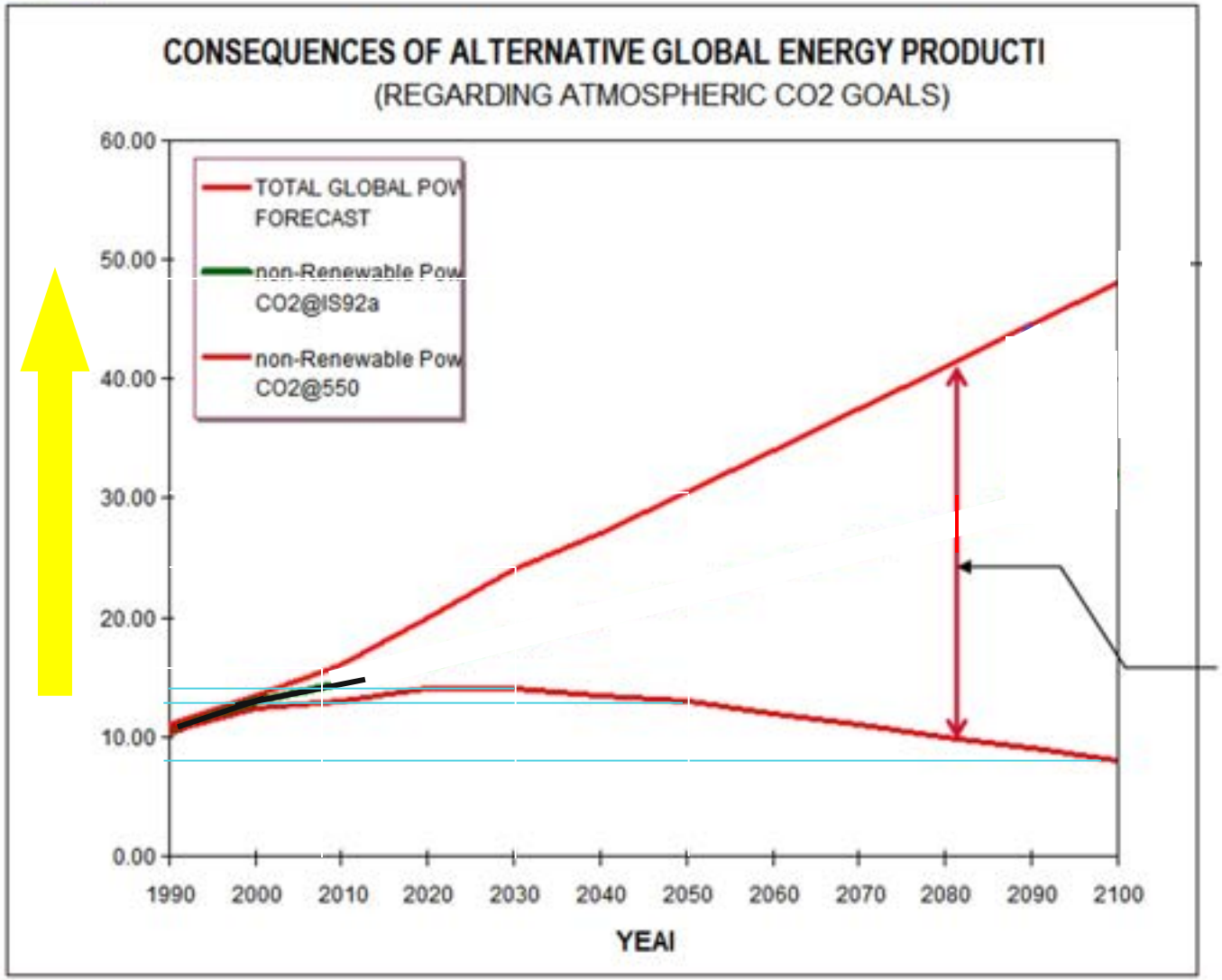
Lunar-Based Self-Replicating Solar Factory

- By the laws of exponential population growth, global energy demand will likely be fulfilled in less than 1 year and almost certainly less than 5 years.





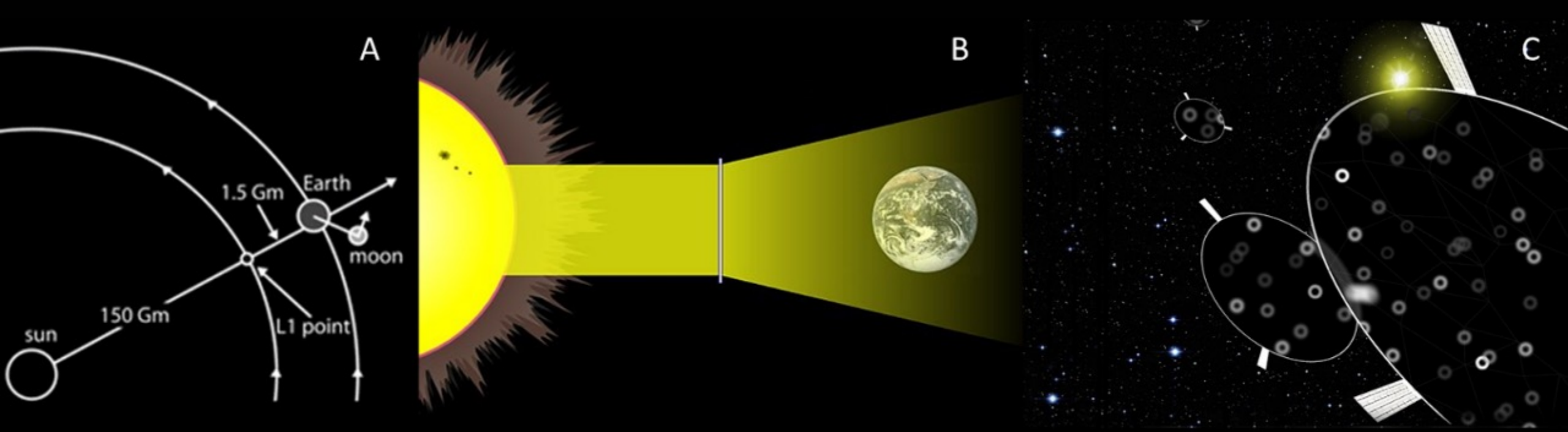
CO_2 Levels in the Atmosphere



Of the 50 TW needed by 2100, **no more than 10TW can come from fossil sources**

~ 40 TW

Carbon-Neutral Power Generation Capacity Required to Stabilize *at 2x* pre-industrial levels



A) L1 point where the gravitational influence of the Sun and Earth are neutrally stable

B) Effect of a space sunshade at L1 on the Earth

ible design of a 'flyer' which could be placed at L1