

Perspective on Benefit in Lunar and Space Resources Development

MVA Webinar Series:

Governance of Global Moon Exploration and Settlement

Episode 3 – Sharing the Benefits of Lunar Activities

September 8, 2020

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A Busy Time for the Moon...

Projected Exploration Missions (2020-2030)

Data include announced missions, with dates as announced, and projected missions (likely missions such as typical supply missions to space stations), with estimated dates.



International Space Station

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SpaceX Cargo	3	3	1								
Northrop Grumman Cargo	2	1	2								
Sierra Nevada Corp.	1	1									
Cargo TBD		1	4	4	4	4	4	4	4	4	4
Boeing Embellavor	1										
Boe-OST 2	1										
Boe-CT	1										
Crew TBD	1	2	2	2	2	2	2	2	2	2	2
Service Crew	4	2	2	2	2	2	2	2	2	2	2
Orb Crew											
Progress	2	2	2	2	2	2	2	2	2	2	2
HTV	1	1	1	1	1	1	1	1	1	1	1
ExoM				1	1	1					

150 Crew and cargo missions to LEO

Chinese Space Station

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Shenzhou	1	1	1	1	1						
HG Shenzhou	1	1	1	1	1	1	1	1	1	1	1
Tianhe 1		1									
Wentian		1									
Mengtian		1									
Yuzhen			1								
Tianzhou	1	1	1	1	1	1	1	1	1	1	1

USA - First crewed landing since 1972

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Artemis		1	1	1	1	1	1	1	1	1	1
Human Landing System (HLS)				4	4	4	4	4	4	4	4
Lunar Gateway PPE and HALO			1								
Lunar Gateway Hab											
Lunar Gateway JAXA Logistics Habitat								1			
Lunar Gateway JAXA Pressurized Rover										1	
Gateway Logistics Services (GLS)					1	1	1	1	1	1	1
Artemis Base Camp Foundation Habitat									1		
Artemis Base Camp Mobility Habitat										1	
Artemis Base Camp Logistics Mission											1
Commercial Lunar Payload Services (CLPS)		2	2	2	2	2	2	2	2	2	2
CAMPSTONE		1									

USA - Missions to Mars

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mars 2020	1										
NASA MBG Sampler Return Mission							1				
NASA MBG Mission TBD 1									1		
NASA MBG Mission TBD 2										1	



China - Missions to the Moon

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Change 5	1										
Change 6			1								
Change 7					1						
Change 8							1				

95 Missions to the Moon

Russia - Missions to the Moon

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Luna 25	1										
Luna 26				1							
Luna 27					1						
Luna 28 (sample return)							1				
Luna 29								1			
Orb (crewed circumnavigation)				1							
Orb (crewed circumnavigation)					1						
Orb (crewed landing)									1		

Europe - Missions to the Moon

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
HERMES ELS (ESA, JAXA, CSA)									1		
Moon Cruiser 1 Logistics Mission (with ESPRIT)										1	
PTScientists ALINA			1				1				
Spacecraft Mission 1				1							
Changfeng-1					1						
Prakso-R Mission 1					1						
Prakso-R Mission 2						1					
JAXA SUM											
KARI Pathfinder Lunar Orbiter											1
Lunar Surface Access Services (LSAS)											1
SpaceX Starliner Project						1					

China - Missions to Mars

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Tianwen 1 Rover	1										

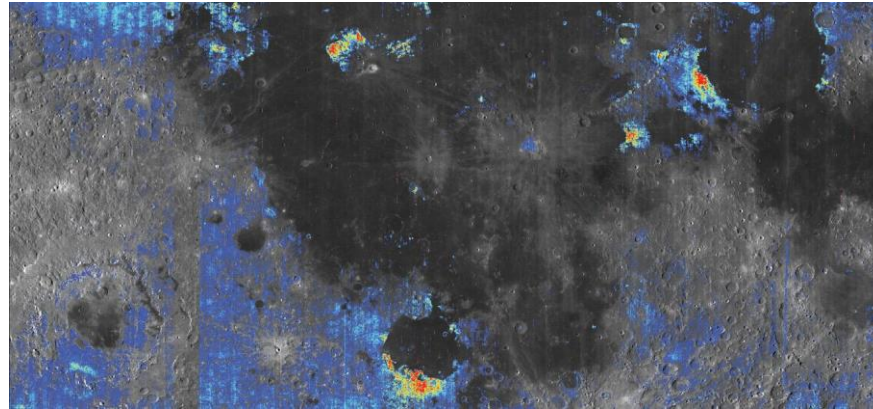
Europe - Missions to Mars

Mission	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ExoMars 2022				1							
Mangalyaan-2						1					
JAXA TEREK 1							1				
JAXA TEREK 2								1			
JAXA IMOX									1		
ESA Hope	1										

As of August 31, 2020

Space Resources – Opportunity and Need

- Living in space for long periods of time will require making use of available resources
- Both the Moon and asteroids contain useable deposits of water and other natural resources which can support exploration activities
- Water can be processed into rocket fuel while other resources can be used to support other infrastructure development
- Fuel sourced from in-space resources offers the potential to lower the cost of in-space applications and enable broader and more sustained exploration activities



Space resource utilization is a gateway capability for human space exploration and a sustained human presence beyond low Earth orbit

Observations on Industry Positions

- Commercial or private lunar exploration & space resources industry segments are new and in-early stage
 - Most activity in the near-medium term will be closely associated with government programs & government customers
- Companies are under pressure to demonstrate technical viability and to fly successful technology demonstration missions
 - Companies also responding to investor pressure – need to demonstrate progress towards executing business plans
- Profit motivated – of course – but also a motivation of expanding humanity's access to space
 - Industry concerns about benefit being defined in purely monetary terms
- Industry actors looking for regulatory certainty – but concerned about too much regulation. Need for adaptive governance
- Industry actors interested in broad partnerships, but may be uncertain about the best ways to partner with emerging space countries



But What About:

Space mining could become a real thing — and it could be worth trillions

PUBLISHED TUE, MAY 15 2018-12:39 AM EDT | UPDATED TUE, MAY 15 2018-7:00 AM EDT

Andrew Wong

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KEY POINTS

- Minerals that lie in the belt of asteroids between Mars and Jupiter hold mineral wealth equivalent to about \$100 billion for every individual on Earth.
- Quickly evolving technology is making landing on asteroids an increasing likelihood.



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NASA planning mission to an asteroid worth \$10,000 quadrillion

Sean Rossman USA TODAY

Published 7:18 a.m. ET Jan. 18, 2017 | Updated 1:48 p.m. ET Jan. 18, 2017

Goldman predicts the world's first trillionaire will mine asteroids

GLOBAL investment banking, securities and investment management firm Goldman Sachs believes it knows the key to becoming the richest person alive.



Matthew Dunn [@mattydunn11](#) 1 comment

news.com.au APRIL 25, 2018 12:51PM

Business and technical plans for returning resources to Earth are very speculative. And the economic assumptions require further analysis...

Benefit From Space Resources & Lunar Development

The Outer Space Treaty

- Preamble: “Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,…”
 - ARTICLE I: “The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.”
- What is benefit? How do we define it? How do we communicate it?
 - *Need not be – should not be monetary – in nature*
 - Participation of, and impact on, emerging or developing space states
 - Identification of responsible and sustainable space resources utilization practices
 - Can we leverage experience/examples from other domains: e.g. Nagoya Protocol on Access and Benefit-sharing
 - Hague International Space Resources Governance Working Group – Building Block on Benefit
 - MVA Principles - #2 on Benefit Sharing

Benefit Sharing Topics - Broadly



SocioEconomic Panel

Capacity Building for Space Resources

- Increase participation and engagement by stakeholders whom are not directly involved in or space resources activities.
- Includes policy, technical, and business awareness
- Partnerships and data sharing
- Successful models in particular in Earth observation segment

Five Analysis Topics

1. Social License to Operate
2. International Cooperation Models
3. Principles for Responsible Investment
4. Capacity Building for Space Resources
5. Data Sharing and Lessons Learned

Principles for Responsible Investment

- Recommend that separate set of principles be created specifically for Responsible Investment in Space Resources activities
- Informing factor for the future development of industry operator focused best practices and/or standards
- Helps to consider sustainability

Key Issues Moving Forward

- Identification and/of description of **global benefits** from space resources & lunar development
- **Resource access rights** – balancing “non-appropriation” vs. “freedom of exploration and use”
 - International claim and registration system?
 - Historic/heritage sites / sites of scientific interest?
 - Balancing commercial use vs. scientific use
- Establishing **safe operations** practices / principles for lunar activities
 - Lunar dust mitigation
 - Cis-lunar SSA
 - Safety zones?
- **Coordination** of various national laws/regulations/policies

General need for increased communication and dialogue between space resources development & the international policy/legal communities

Thank You

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Direction of Private Sector Programs

Secure World Foundation