Lunar Governance & Space Resource Utilization (SRU)

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Topic overview

1. Lunar Activities as an Emerging Operational Domain
2. Growing Role of Commercial Actors
3. Key Lunar Activities (SRU, ISAM, agriculture/biotech, data centers, energy activities, surface infrastructure, habitation)
4. International Documents (Outer Space Treaty and other treaties; non-binding international guidelines and policies)
5. "Regional" Governance Models (Artemis, ILRS)
6. National Space Resource Utilization Laws
7. US licensing and Mission Authorization for Lunar Activities
8. Areas of Concern (e.g., environment, interferences, conflicts)
9. Evolution of Lunar Legal Practice in the Coming Decade

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Strategic Value of the Moon

A. Economic significance
– Water ice and volatiles
– Minerals and manufacturing inputs
B. Geographic advantage
– Proximity to Earth
– Anchor of the cislunar economy and gateway to deep space
C. Security and geopolitical relevance
– Defensive and offensive strategic positioning
– Control of access corridors

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National and Multinational Lunar Strategies

A. China
– Chang'e program (2007).
– Human lunar missions
– Resource extraction plans
–International Lunar Research Station (ILRS), a plan to jointly construct and operate lunar base under a cooperative framework

B. United States and Partners
– Artemis Program
(see next slide)

C. Commercial and Technological Ecosystem
A. Private sector role in SRU
B. Global company participation
C. Market-driven development pathways

Artemis

– Artemis Program (launched 2020)
– Goal: sustainable human presence by late 2020s
– Lunar orbital station (Gateway)
– Artemis Base Camps at the lunar south pole
– Shackleton Crater as strategic site
– Potential site: Shackleton Crater

Artemis Accords:
– Legal and operational coordination framework among partner states
- 60 signatories (not China or Russia)
- Norm-setting function for lunar activity

Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, NASA (Oct. 13, 2020).

From Fiction to Near-Term Reality 1/2

- Realistic lunar future increasingly mirrors science fiction (e.g., The Expanse)
- The Moon envisioned as a hub for:
  - Scientific research
  - Human habitats and settlements
  - Resource extraction (water ice, minerals)
  - Manufacturing and trade
- Strategic value due to proximity to Earth
- Potential site for economic, political, and military competition

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From Fiction to Near-Term Reality 2/2

Transition from exploration to sustained lunar presence, followed by semi-permanent and ultimately permanent habitation. How?

- At first, robotic hybrid operations
- Then, more sustained human and robotic presence
- Expansion of ISAM (in-space servicing, assembly, and manufacturing) activities, including:
  - Local resource extraction and utilization
  - On-site assembly
  - Maintenance and servicing
  - Construction using local materials.

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Space Resource Utilization (SRU) and In-Space Construction and Manufacturing (ISAM)

Key Lunar Activities of the near future:

- SRU
- ISAM
- agriculture/biotech
- data centers
- energy
- surface infrastructure
- habitation

- SRU as a foundational enabler of ISAM
  Why? Use of local lunar resources for:
  – Construction and assembly
  – Life support logistics
  – Propellant production
- SRU and ISAM are inherently complementary systems

SRU Ecosystem

- Active Commercial Development of Space Resource Utilization (SRU)
- Ecosystem shaped by:
  - Supply capabilities
  - Market demand
- Resource development timeline:
  - Short term: water extraction and volatile harvesting
  - Medium term: regolith processing and metal extraction and use
  - Long term: extraction of platinum group metals (PGMs), limited by technical and economic complexity

Lunar Refueling Infrastructure

- The Moon is expected to serve as a strategic logistics hub for deep-space missions, as launches from the lunar surface benefit from lower gravity.
- Lunar refueling will reduce reliance on Earth-launched fuel.
- A network of orbital and surface “gas stations” will store fuel produced from lunar water.
- Infrastructure will include:
  – Resource extraction sites
  – Refining and processing facilities
  – Surface and orbital fuel depots
  – Tugs and transport vehicles to move fuel from extraction sites and depots
  – Pipelines and transfer systems
  – Maintenance and support operations

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Nuclear Power on the Moon

- Energy demands for ISAM activities expected to require nuclear power
- NASA's Fission Surface Power (FSP): nuclear fission reactor designed to provide stable baseload power in permanently shadowed and remote lunar regions to support Artemis
- Expected electrical output of approximately 100 kilowatts (i.e., enough to power 80–100 average homes simultaneously)
- February 2024, first phase of the reactor design completed
- 2025: NASA accelerated the FSP program due to strategic competition concerns, with a target deployment by 2030.
- Nuclear systems introduce risks of contamination.

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Nuclear Power on the Moon 2/2

- 2009 Safety Framework for Nuclear Power Source (NPS) Applications in Outer Space (launch and Earth-based safety regimes for nuclear systems).
- 2019 U.S. Presidential Memorandum on the Launch of Spacecraft Containing Space Nuclear Systems (safety procedures for nuclear-powered spacecraft).
- Neither is directly applicable to the Moon, but both may be applied by analogy.

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Moon Legal Governance

Outer Space Treaty (OST)
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.

Rescue Agreement
Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, **Jan. 16, 1968** (implementing Article V of the OST).

Liability Convention
Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 (implementing Article VII of the OST).

• **Registration Convention**
Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 (implementing Article VIII of the OST).

Moon Agreement
Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 18 I.L.M. 1434, 1363 U.N.T.S. 3.

Balancing Resource Use, Non-Appropriation, and Operational Coordination

Article II OST

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 I OST

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.

Solution? Norm-building through practice

The U.S. Space Resource Utilization Law (SPACE Act) 1/4

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- Enacted in 2015
- Aimed at encouraging private investment in commercial space
- Intends to create stable and predictable regulations
- Most innovative feature: Title IV (SRU)
  - Codified at 51 U.S.C. Chapter 513
  - Known as the “U.S. Space Resource Utilization Law”
  - Dual objectives:
    - Promote growth of space mining
    - Clarify the U.S. position on international law

The U.S. Space Resource Utilization Law (SPACE Act) 2/4

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- Applies to “United States citizens,” defined broadly:
  - U.S. individuals
  - U.S. organized entities
  - Foreign entities controlled by U.S. persons
  - Foreign ownership of controlling interest allowed in some cases
- Government obligations:
  - Facilitate exploration and recovery of space resources
  - Discourage regulatory barriers
  - Protect against harmful interference
  - Ensure licensing and supervision

The U.S. Space Resource Utilization Law (SPACE Act) 3/4

Title IV explicitly recognizes property rights in space resources. Why?

- Creates legal certainty
- Encourages long-term private investment

Key rights under 51 U.S.C. § 51303:

- Possess
- Own
- Transport
- Use
- Sell recovered space resources

The U.S. Space Resource Utilization Law (SPACE Act) 4/4

- Common law influence:
  - "Bundle of sticks" approach
  - No claim of sovereignty over celestial bodies
  - No exclusive jurisdiction asserted

Unresolved issues:

- No current licensing procedure
- No comprehensive authority
- Further legislation or agency rulemaking needed to fully implement Title IV

Other national laws 1/2

Luxembourg
Law of 20 July 2017 on the Exploration and Use of Space Resources (Space Resources Law)

United Arab Emirates (UAE)
Federal Law No. 12 of 2019 (UAE General Space Law, including Space Resource Utilization Provisions)
Cabinet Resolution No. 19 of 2023 (UAE Space Resources Regulations) defines *"Space Resources Activities"* to include "owning, purchasing, selling, trading, transporting or storing Space Resources."

Japan
Act on Promotion of Business Activities Related to the Exploration and Development of Space Resources Law No. 83 of Dec. 23, 2021

Other national laws 2/2

General space framework, not SRU-specific

Brazil: Law No. 14,946/2024 (General Space Activities Law)
– Expressly includes the “exploration of space resources”
– Treats space resource utilization (SRU) as a regulated space activity subject to licensing and governmental oversight

Italy: Law of 13 June 2025, No. 89 (Space Economy Law)
– Article 2(1)(a) expressly covers the “exploration, extraction, and use” of space resources
– Subjects SRU to national authorization and international obligations under the Outer Space Treaty

Authorization and Supervision

- Article VI of the OST requires national authorization and supervision
- States implement this obligation through licensing systems
- Multiple federal agencies oversee different aspects of satellite missions
- Core question: how these authorizations apply to the Moon?

Overview of Required U.S. Authorizations

To launch and operate a space object (e.g., a satellite), the U.S. generally requires:

- FAA Launch License (Commercial Space Launch Act)*
- FAA Payload Review
- FCC Frequency License
- NOAA Remote Sensing License (if Earth observation involved)

*The license is requested by launch provided

FAA Launch License (Commercial Space Launch Act)

- Required for any launch (also to the Moon)
- Applies to launches from:
  - U.S. territory
  - Or by U.S. persons abroad (outside foreign territory)
- Statutory basis: 51 U.S.C. § 50901 et seq.

Definition of “launch” includes placement:

- Into suborbital space
- Earth orbit
- Or “otherwise in outer space”

FAA Authority and Institutional Structure

- Oversight authority: Secretary of Transportation
- 1984: Office of Commercial Space Transportation (AST)
  1995: AST transferred to the Federal Aviation Administration (FAA)
- FAA now issues launch licenses and permits
- Conclusion: Lunar launches clearly fall within FAA jurisdiction

Payload Review: Scope and Purpose

- All off-world payloads require FAA payload review
- Applies to lunar satellites and lunar missions
- Objective:
  - Verify compliance with U.S. law
  - Confirm regulatory approvals

Regulatory basis: 14 C.F.R. § 450.43

Limits of Payload Review for Lunar Activities

Problems with current framework:

- FAA authority mostly focused on launch safety
- Responsibility ends after:
  - Earth orbit insertion, or
  - Outer space trajectory

Current process may be inadequate for lunar supervision

A more specific mission authorization framework is needed

FCC Frequency License 1/2

- Space objects (e.g., satellites) require radio frequencies
- Functions:
  - Uplink (Earth → satellite)
  - Downlink (satellite → Earth)

Legal basis: Communications Act of 1934

FCC licenses:

- Space stations
- Earth stations

Lunar satellites must obtain FCC authorization

FCC Frequency License 2/2

Two primary FCC authorization models:

1. Part 5 (Experimental)
    - No protected spectrum rights
2. Part 25 (Commercial Satellites)
    - Designed for Earth-orbit satellites
    - Categories based on:
        - GEO
        - NGSO

Problem: FCC framework is Earth-orbit centric, not lunar-specific

NOAA Remote Sensing License

Remote sensing licensing:

- Governed by the Land Remote Sensing Policy Act of 1992 and 15 C.F.R. Part 960
- Authority exercised by the National Oceanic and Atmospheric Administration (NOAA) (U.S. Dep't of Commerce)

Issue for the Moon:

- "Remote sensing" defined only as Earth observation

➔ Under current rules, lunar remote sensing does not require a NOAA license

Lack of a U.S. Lunar Licensing Framework

- The United States currently has no dedicated system for licensing lunar activities
- During the Biden Administration, proposals to centralize authority in the Department of Commerce or divide it with the Department of Transportation were advanced but never enacted.
- Regulatory gap for novel lunar and deep-space activities
- Mission authorization framework still needed

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QUESTIONS?

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