

THE STAKES ARE OUT OF THIS WORLD: HOW TO FIX THE SPACE ACT OF 2015

*Hunter Sutherland**

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I. INTRODUCTION

Traveling faster than five times the speed of sound, approximately two hundred million miles away from Earth, you will find an asteroid that has not changed since the solar system was formed.¹ Japan's Aerospace Exploration Agency (JAXA) launched Hayabusa-2, a sample return mission, equipped with two small robots to the dark and dry surface of Ryugu.² These robots, no bigger than a temporary spare tire, hop around the low-gravity, half-mile wide surface of the asteroid.³ Ryugu, and asteroids like it, not only hold great scientific value, but their minerals have great monetary value.⁴

The estimated value of Ryugu and four of the other most cost-effective asteroids for mining is \$164 billion.⁵ Other asteroids, albeit further away and less cost-effective to mine, are estimated to be worth more than \$100 trillion.⁶ Private companies, entrepreneurs, the United States, and other countries are preparing to land on and eventually mine resources from space.⁷ Neil DeGrasse Tyson believes that the first trillionaire in the world will be

* J.D. Candidate, May 2021, Vermont Law School. I would like to extend a sincere thanks to Professor Greg Johnson, Vermont Law School, for providing the guidance necessary to make this Note a possibility. I would also like to thank the Staff of Volume 22 of the *Vermont Journal of Environmental Law* for their dedication to excellence during the process of editing this and other articles of Volume 22. Finally, I would like to thank my partner, Jenna Kasza, for her constant encouragement and support—without her, I would be lost.

1. See Katyanna Quach, *Bouncing Robots Land on Asteroid 180M Miles Away Amid Mission to Fetch Sample for Earth*, REGISTER (Sept. 21, 2018), https://www.theregister.co.uk/2018/09/21/jaxa_hayabusa2_ryugu_asteroid_landing/ (discussing the asteroid Ryugu's hypothesized unchanged state since the solar system's formation); see also *Asteroid 162173 Ryugu (1993 JU3) Information*, SKY LIVE, <https://theskylive.com/ryugu-info> (providing orbital parameters for the referenced asteroid) (last visited Dec. 7, 2020).

2. Mike Wall, *Hop, Don't Roll: How the Tiny Japanese Rovers on Asteroid Ryugu Move*, SPACE.COM (Sept. 26, 2018), <https://www.space.com/41941-hayabusa2-asteroid-rovers-hopping-tech.html>.

3. *Id.*

4. See Ian Webster, ASTERANK, <http://www.asterank.com> (showing chart approximating value, accessibility, and profits for 600,000 asteroids with data from world markets and scientific papers) (last visited Jan. 25, 2021).

5. *Id.* (inferring from chart which provides each asteroid's estimated profits).

6. *Id.* (showing Ryugu at the top of the chart, indicating that it is the most cost effective and profitable asteroid to mine, with estimated profits at \$30.08 billion).

7. See Tiffany Terrell, *Physicist Says Asteroid Mining Ventures Will Spawn First Trillionaire*, GLOBE NEWSWIRE (Jan. 30, 2018), [https://www.globenewswire.com/news-release/2018/01/30/1314279/0/en/Physicist-Says-](https://www.globenewswire.com/news-release/2018/01/30/1314279/0/en/Physicist-Says-Asteroid-Mining-Ventures-Will-Spawn-First-Trillionaire.html#:~:text=Astrophysicist%20Neil%20DeGrasse%20Tyson%20says,iron%2C%20nickel%2C%20and%20platinum)

[Asteroid-Mining-Ventures-Will-Spawn-First-Trillionaire.html#:~:text=Astrophysicist%20Neil%20DeGrasse%20Tyson%20says,iron%2C%20nickel%2C%20and%20platinum](https://www.globenewswire.com/news-release/2018/01/30/1314279/0/en/Physicist-Says-Asteroid-Mining-Ventures-Will-Spawn-First-Trillionaire.html#:~:text=Astrophysicist%20Neil%20DeGrasse%20Tyson%20says,iron%2C%20nickel%2C%20and%20platinum)

(stating space innovation is dominated by private companies like Elon Musk's SpaceX); See Anthony Cuthbertson, *China to Launch Asteroid-Mining Robot*, DIPLOMAT (Sept. 24, 2020), <https://www.independent.co.uk/life-style/gadgets-and-tech/asteroid-mining-robot-china-origin-space-b572318.html> (describing China's plans to mine resources from space).

someone who mines asteroids.⁸ It is no wonder that the stakes are, quite literally, out of this world.

The Commercial Space Launch Competitiveness Act of 2015 (Space Act)⁹ provides the beginning framework for mining but does not provide enough guidance for private companies and the international community for mining. The following argument addresses the deficiencies of current domestic asteroid mining laws. The United States has given one stick, the right to space resources obtained, out of a bundle of rights that it does not possess.¹⁰ Further, the Space Act leaves out considerations of the environmental and economic impact of mining resources from asteroids.¹¹ New domestic laws or amendments to the Space Act of 2015 are needed in order to bridge this gap.

The Artemis Accords represent the next iteration of the United States's plan for space exploration and utilization—namely returning to the moon to stay.¹² On October 13, 2020, NASA released the full Accords that highlight the ten principles they hope to “[govern] the civil exploration and use of outer space.”¹³ NASA is developing the Accords through a series of bilateral agreements with international partners.¹⁴ The United States established the Accords with like-minded nations, such as Australia, Canada, Japan, Italy, Japan, the United Kingdom, and the United Arab Emirates, but notably not Russia.¹⁵ The Accords show that the United States plans to reaffirm parts of existing international space law, while pushing new interpretations forward in the areas of resource extraction and the development of “safety zones.”¹⁶

8. *Id.*

9. U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, 129 Stat. 704, 704 (2015) (codified at 51 U.S.C. § 10101).

10. See Reed E. Loder, *Asteroid Mining: Ecological Jurisprudence Beyond Earth*, 36 VA. ENV'T L. J. 275, 277, 287 (2018) (explaining how the terms of the OST prohibit granting or owning property rights in space).

11. See discussion *infra* Sections III.C.4, III.C.5 (arguing the Space Act was intended to allow wealthy, private companies to exploit asteroid resources).

12. See Press Release, Sean Potter & Cheryl Warner, Nat'l Aeronautics & Space Admin., NASA, International Partners Advance Cooperation with First Signings of Artemis Accords (Oct. 13, 2020), <https://www.nasa.gov/press-release/nasa-international-partners-advance-cooperation-with-first-signings-of-artemis-accords> (last updated Jan. 4, 2021) [hereinafter NASA Press Release] (planning to send “the first woman and next man” to the moon in 2024).

13. NAT'L AERONAUTICS & SPACE ADMIN., THE ARTEMIS ACCORDS § 1, at 1 (Oct. 13, 2020), <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>; *The Artemis Accords, Principles for a Safe, Peaceful, and Prosperous Future*, NAT'L AERONAUTICS & SPACE ADMIN., <https://www.nasa.gov/specials/artemis-accords/index.html> (last visited Jan. 26, 2021) [hereinafter *Artemis Principles*].

14. NASA Press Release, *supra* note 12.; NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 13, at 2.

15. NASA Press Release, *supra* note 12.; NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 13, at 8–18.

16. NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 13, § 11, at 5–6.

The Accords have an opportunity to mend the inconsistencies between the Space Act and the Outer Space Treaty.

This note will outline the Outer Space Treaty, the Space Act, and the Artemis Accords and will highlight their inconsistencies. Further, it will provide solutions to bridge the gap between the Act, and environmental and economic concerns. Part II (A) discusses the moon, asteroids, and why their resources are so sought after. Part II (B) discusses the various treaties and domestic laws that set out the fundamental guidelines for asteroid mining. Part II (C) addresses the environmental concerns of asteroid mining and the potential benefits of asteroid mining on the Earth. Part III begins the analysis of the Artemis Accords, Space Act, and the Outer Space Treaty, starting with the history and relevant provision of both pieces of law, and concludes with the flaws of the Space Act in Part III (C). Finally, Part IV offers two solutions to reconcile the United States's interest in promoting commercial development of space and its obligations under international law.

II. BACKGROUND

A. Composition of the Moon and Other Asteroids

Asteroids are mainly either Type C (carbonaceous), Type S (stony), or Type M (metal).¹⁷ Each of these types are rich in respective minerals and resources. Type C consist of stone and clay silicate rocks.¹⁸ Type S are made of mainly nickel-iron and silicate.¹⁹ Type M contain metals and are reddish in color.²⁰

The resources derived from asteroids can be used to further human exploration into the solar system.²¹ Water collected from a Type C rock could sustain humans, animals, and plants living or traveling in space.²² Rocket fuel can be produced from asteroid water by separating the hydrogen and oxygen from the water molecules.²³ Water could be used as a shield from radiation on space crafts.²⁴ The biggest benefit from mining asteroids would be the profits from mining Type S and M asteroids, as they contain iron, gold, and

17. Stephen Shaw, *Asteroid Mining – Know Everything About It*, ASTRONOMY SOURCE (Aug. 21, 2012), <https://astronomysource.com/2012/08/21/asteroid-mining-2/>.

18. Victor Kripop, *What are Asteroids Made Of?*, WORLD ATLAS (Mar. 15, 2019), <https://www.worldatlas.com/articles/what-are-asteroids-made-of.html>.

19. *Id.*

20. *Id.*; Shaw, *supra* note 17.

21. JOHN S. LEWIS, ASTEROID MINING 101: WEALTH FOR THE NEW SPACE ECONOMY 8 (2015).

22. *Id.* at 148–49.

23. *Id.* at 151.

24. *Id.* at 144, 149.

platinum.²⁵ Extraction of minerals on Earth requires invasive drilling, but on asteroids, similar minerals are close to the surface because of the difference in gravity.²⁶

The moon has many valuable resources available on its surface that would aid extended human residence. Lunar rocks are composed of around 40% oxygen, and with significant development could be used in an oxygen-producing facility.²⁷ Solar wind has deposited hydrogen, helium, and other elements in the lunar soil.²⁸ One of most important resources the moon offers is *water ice*.²⁹ The ice could serve multiple purposes, as drinking water, breathable oxygen, and even rocket propellant.³⁰ The lunar poles also offer areas of both continuous darkness and sunlight. The sunlight can be harnessed to provide heat and electric power.³¹

B. Treaties and Domestic Laws

1. The Outer Space Treaty of 1967

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, otherwise known as the Outer Space Treaty (OST), is the foundation of space law.³² The OST sets forth that all of humankind's activities in space are to be "for the benefit and in the interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."³³ While the OST does not explicitly define "celestial bodies," it refers to asteroids as such.³⁴ Legal commentators are split on whether asteroids should be included as celestial bodies, or if they should be

25. See Denise Chow, *Mission to Rare Metal Asteroid Could Spark Space Mining Boom*, NBC NEWS (July 10, 2019), <https://www.nbcnews.com/mach/science/mission-rare-metal-asteroid-could-spark-space-mining-boom-ncna1027971> (discussing potential value and composition of metallic asteroid under NASA's exploration). *But cf.* LEWIS, *supra* note 21, at 154–55, 160–61 (explaining why extracting certain elements from asteroids is only viable as a byproduct activity).

26. LEWIS, *supra* note 21, at 14–16.

27. James D. Burke, *Lunar Resources*, ENCYC. BRITANNICA, <https://www.britannica.com/place/Moon/Lunar-resources> (last updated Apr. 8, 2020).

28. *Id.*

29. *Id.*

30. *Id.*

31. *Id.*

32. Christopher D. Johnson, *The Outer Space Treaty*, OXFORD RES. ENCYCLOPEDIAS, PLANETARY SCI. (Jan. 24, 2018), <https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-43?rskey=FOV6h8&result=1>; G.A. Res. 2222 (XXI), annex, Outer Space Treaty, (Dec. 19, 1966) [hereinafter OST].

33. OST, *supra* note 32, art I.

34. See *id.* (discussing "the moon and other celestial bodies. . .").

reclassified as chattels because they are moveable property.³⁵ Classifying asteroids as chattels would simplify property law in outer space.³⁶ These commentators suggest that while planets and moons cannot be moved, asteroids can be captured, slowed down, and relocated—making asteroids worthy of the chattel classification.³⁷

2. The Moon Agreement of 1984

The Moon Agreement gives jurisdiction over celestial bodies to the international community.³⁸ In many ways, it is a failed treaty because the agreement has not been ratified by any state that launches crewed space exploration missions.³⁹ While this treaty is not binding on the United States, it may be useful for framing future legislation, as Article 11, Paragraph 3 provides a barrier to the goal of asteroid mining companies.⁴⁰ It states:

Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof.⁴¹

In Article 11, Paragraph 6, the agreement requires that States shall inform the United Nations, the public, and the international scientific community of any natural resource discoveries.⁴² Paragraph 7(d) commands that State Parties share the benefits derived from those resources equitably with developing nations and those who have contributed directly or indirectly to the

35. See, e.g., Andrew Tingkang, *These Aren't the Asteroids You Are Looking for: Classifying Asteroids in Space as Chattels, Not Land*, 35 SEATTLE U. L. REV. 559, 580 (2012) (providing key reasons to deviate from existing classifications of asteroids).

36. *Id.* at 563.

37. *Id.* at 580.

38. G.A. Res. 34/68, annex, arts.1–2 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Dec. 5, 1979) [hereinafter Moon Agreement].

39. Michael Listner, *The Moon Treaty: Failed International Law or Waiting in the Shadows?*, SPACE REV. (Oct. 24, 2011), <https://www.thespacereview.com/article/1954/1>.

40. Matthew Feinman, *Mining the Final Frontier: Keeping Earth's Asteroid Mining Ventures from Becoming the Next Gold Rush*, 14 PITT. J. TECH. L. & POL'Y 202, 217–18 (2014). See Moon Agreement, *supra* note 38, art. 11, ¶ 3 (establishing that equipment placement does not create an ownership).

41. Moon Agreement, *supra* note 38, art. 11, ¶ 3.

42. *Id.* art. 11, ¶ 6.

exploration of the moon.⁴³ The Moon Agreement is not binding on non-parties.⁴⁴ The United States and other spacefaring nations are not party to the Moon Agreement, thus, not subjecting private mining companies to the restrictions contained within.⁴⁵

3. The Space Act of 2015

The U.S. Commercial Space Launch Competitiveness Act (Space Act) of 2015 attempts to open the door for commercial recovery of space resources by private companies.⁴⁶ The Space Act states:

A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.⁴⁷

The Act goes on to state that the United States “does not . . . assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body.”⁴⁸ As an initial matter, some scholars contend that the Space Act is inconsistent with the requirements of the OST, discussed *infra* Part III.⁴⁹

4. Space Policy Directive-1: Reinvigorating America’s Human Space Exploration Program

The crew of Apollo 17 were the last to leave footsteps on the moon in December 1972.⁵⁰ After 45 years, the United States announced their plans to

43. *Id.* art. 11, ¶ 7(d).

44. Feinman, *supra* note 40, at 217–18.

45. Listner, *supra* note 39.

46. See U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90, 129 Stat. 704, 721 (2015) (codified at 51 U.S.C. § 51302) (outlining commercial-government relationship).

47. § 51303, 129 Stat. at 721.

48. § 403, 129 Stat. at 722.

49. See Loder, *supra* note 10, at 287 (“Although the Space Act declares several times that its provisions are in accordance with international law and obligations, saying this, even multiple times, does not make it so. A United States grant of exclusive property rights in extracted space resources (even if not territory itself) is incompatible with the commitments to free access and common benefit that are central to the OST.”).

50. Elizabeth Howell, *Apollo 17: The Last Men on the Moon*, SPACE (Oct. 03, 2018), <https://www.space.com/17287-apollo-17-last-moon-landing.html>.

return to the moon in Space Policy Directive-1.⁵¹ Under this Directive, the NASA Administrator is to “[l]ead an innovative and sustainable program of exploration with commercial and international partners” to return humans “to the Moon for long-term exploration and utilization”⁵²

5. Executive Order 13914

Executive Order 13914 builds off the Space Act of 2015 and Space Policy Directive-1.⁵³ The President declared that “Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law.”⁵⁴ Further, President Trump asserted that the United States does not view outer space as a global commons and will encourage international support for the public and private recovery and use of resources in space.⁵⁵ The Order highlights the uncertainty created by the Moon Agreement and states that the Moon Agreement is not an effective or necessary instrument to guide nations in the recovery and use of resources in space.⁵⁶ Finally, the Order instructs the Secretary of State to negotiate joint statements and bilateral and multilateral arrangements with foreign states for safe and sustainable operations of public and private recovery of space resources.⁵⁷

6. The Artemis Accords

The United States has announced a new program to land the first woman and the next man on the moon by 2024.⁵⁸ This endeavor carries the name *Artemis*, the twin sister of Apollo (the name of the first lunar program) and the goddess of the moon in Greek mythology.⁵⁹ NASA released the full Artemis Accords, announcing partnerships with seven nations.⁶⁰ The

51. See Memorandum on Reinvigorating America’s Human Space Exploration Program, 2017 DAILY COMP. PRES. DOC. 901 (Dec. 11, 2017) (“[T]he United States will lead the return of humans to the Moon. . .”).

52. *Id.*

53. Exec. Order No. 13914, 85 Fed. Reg. 20381 (Apr. 6, 2020).

54. *Id.* sec. 1.

55. *Id.*

56. *Id.* secs. 1–2.

57. *Id.* sec. 3.

58. NAT’L AERONAUTICS & SPACE ADMIN., *supra* note 13, at 1.

59. See *Artemis Principles*, *supra* note 13 (describing the Artemis program as the “Twin Sister of Apollo”); Mark Cartwright, *Artemis*, ANCIENT HIST. ENCYC. (July 24, 2019), <https://www.ancient.eu/artemis/>.

60. Dennis O’Brien, *The Artemis Accords: Repeating the Mistakes of the Age of Exploration*, SPACE REV. (June 29, 2020), <https://www.thespacereview.com/article/3975/1>; NAT’L AERONAUTICS & SPACE ADMIN., *supra* note 13, 8–15 (containing agreement and signatures of partnering nations: United Kingdom, United Arab Emirates, Grand Duchy of Luxembourg, Japan, Italy, Canada, and Australia).

Accords highlight the ten principles of what NASA and their partners hope to guide “civil space activities conducted by the civil space agencies of each Signatory.”⁶¹ These principles are: (1) Peaceful Purposes; (2) Transparency; (3) Interoperability; (4) Emergency Assistance; (5) Registration of Space Objects; (6) Release of Scientific Data; (7) Protecting Heritage; (8) Space Resources; (9) Deconfliction of Activities; and (10) Orbital Debris and Spacecraft Disposal.⁶² This paper is most interested in the principles of Peaceful Purposes, Release of Scientific Data, Space Resources, and Deconfliction of Activities.

Under the principle of Peaceful Purposes, the Artemis Accords state all activities conducted will be peaceful, per the requirements of the OST.⁶³ Under the principle of Releasing of Scientific Data, all Artemis Accords partners will agree to release their scientific data publicly to ensure that the entire world can benefit from new exploration and discovery.⁶⁴

The Artemis Accords explicitly state that “extraction and utilization of space resources . . . should be executed in a manner that complies with the Outer Space Treaty.”⁶⁵ In particular, the Accords state that the extraction of space resources do not inherently constitute national appropriation under Article II of the OST.⁶⁶ The articles of the OST that the Accords implicitly reference cover the non-appropriation of the moon by national parties, the international responsibility for national activities in outer space, and the agreement to inform the UN and the world of the nature, conduct, location, and results of such activities.⁶⁷

Finally, under the principle of Deconfliction of Activities, the Accords state NASA and partner nations will provide public information regarding the location and general nature of operations through the development of “safety zones” to prevent harmful interference.⁶⁸ Mike Gold, the acting associate administrator for international and interagency relations for NASA, defined these zones as areas where there would be notification and coordination between partner nations to protect such zones.⁶⁹

61. NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 13, § 1, at 2.

62. *Id.* § 3–12, at 3–7.

63. *Id.* § 3, at 3.

64. *Id.* § 8, at 4.

65. *Id.* § 10, ¶ 2, at 4.

66. *Id.*

67. OST, *supra* note 32, art. II, VI, XI.

68. NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 13, § 11, at 5–6.

69. *Id.*; Mike N. Gold, *Artemis Accords – Enabling International Partnerships for Lunar Exploration*, U.S. DEP'T. STATE (May 15, 2020, 3:15 PM), <https://www.state.gov/briefings-foreign-press-centers/artemis-accords-enabling-international-partnerships-for-lunar-exploration/> (foreign press centers briefing).

C. Environmental Harms and Benefits

1. Ecological Jurisprudence

As space exploration becomes more commonplace, some scholars question whether humans have the right to exploit resources from celestial bodies.⁷⁰ The Space Act assumes that resources in space should be viewed as resources for humans.⁷¹ The Act applies our flawed institutions to an essentially blank slate, where we could expand our ethical framework to prevent humans from causing planetary damage throughout the universe.⁷²

2. Rocket Launches and the Atmosphere

Billions of particles are released into the air when a rocket launches from Earth.⁷³ These include carbon dioxide, water vapor, aluminum oxide, and more dangerously—soot.⁷⁴ The soot particles from rocket launches negatively impact the quality of air because they enter the stratosphere directly and remain there for many years.⁷⁵ The cumulative combustion emissions from launches can change the composition of the atmosphere and could deplete the ozone layer.⁷⁶ A single solid rocket engine releases billions of aluminum oxide particles into space that can linger for up to two weeks before dispersing and re-entering the atmosphere.⁷⁷ The aluminum oxide particles threaten the potential contamination of other spacecraft.⁷⁸

3. Benefits on the Earth

Scientific studies have estimated the greenhouse gas emissions from asteroid mining operations and compared them with the emissions from Earth-based mining.⁷⁹ The authors based their calculations on greenhouse

70. See, e.g., Loder, *supra* note 10, at 294 (expressing that space exploration for resource recovery should stop until scientists can create a way to equitably and sustainably mine asteroids, unlike what humans have done with the Earth).

71. *Id.* at 276.

72. See *id.* at 296, 312, 317 (cautioning against simply applying earth law to space when a blank slate exists).

73. Erin C. Bennett, *To Infinity and Beyond: The Future Legal Regime Governing Near-Earth Asteroid Mining*, 48 *Tex. Env't L.J.* 81, 93 (2018).

74. *Id.*

75. *Id.*

76. *Id.* at 94.

77. OFFICE OF TECH. ASSESSMENT, OTA-BP-ISC-72, ORBITING DEBRIS: A SPACE ENVIRONMENTAL PROBLEM – BACKGROUND PAPER 15 (1990).

78. *Id.*

79. ANDREAS M. HEIN ET AL., 69TH INT'L ASTRONAUTICAL CONG., IAC-18-D4.5.11, EXPLORING POTENTIAL ENVIRONMENTAL BENEFITS OF ASTEROID MINING 1, 4 (Oct. 5, 2018).

gases released into the atmosphere from rocket launches and reentries.⁸⁰ Mining one kilogram of platinum from an asteroid would release 150 kilograms of CO₂ in the atmosphere,⁸¹ but when mining one kilogram of platinum from the Earth, 40,000 kilograms of CO₂ are released into the atmosphere.⁸² As technology becomes more advanced, rocket fuel becomes greener, and as rockets can be used more times, the amount of CO₂ released from launches and reentries can be reduced by using “green propellants.”⁸³

III. ANALYSIS

Obtaining resources in space is no longer a question of *if* it will happen, but *when* it will happen. Under the Artemis Accords, the extraction and utilization of resources on the Moon, Mars, and asteroids is no longer hypothetical.⁸⁴ There is a huge incentive to be on the forefront of this blossoming industry. Governmental organizations and private companies are currently researching the feasibility of human and robotic missions to learn more about the composition of asteroids.⁸⁵ Humans could use the abundant resources in space to create tools, which would not need to be transported from Earth, to expand space exploration efforts farther than ever before.⁸⁶ The Space Act of 2015 is the United States’s attempt to “make a future where America and her people guide us in our journey to the stars”⁸⁷

A. The Outer Space Treaty

Over fifty years ago, the “most important and most fundamental source of international space law” was signed in Washington, D.C.; London; and Moscow.⁸⁸ The Treaty on Principles Governing the Activities of States in the

80. *Id.* at 2.

81. *Id.* at 4, tbl.2.

82. *Id.* at 1.

83. *See id.* at 5 (explaining that eco-design principles, like reusable rocket stages, can reduce the environmental impacts of rocket launchers in relation to CO₂ levels and energy consumption).

84. *See generally* NAT’L AERONAUTICS & SPACE ADMIN., *supra* note 13 (presenting principles for space exploration agreed upon by several spacefaring nations).

85. *Strategic Mineral Management*, MASS. INST. TECH., MISSION 2016, <http://web.mit.edu/12.000/www/m2016/finalwebsite/> (last visited Jan. 24, 2020).

86. Sarah Cruddas, *The Truth About Asteroid Mining: Could the Untold Riches in Asteroids and Other Planets Be the Key to Exploring the Wider Universe?*, BBC, FUTURE (Jan. 5, 2016) <https://www.bbc.com/future/article/20160103-the-truth-about-asteroid-mining>.

87. 161 CONG. REC. 7634 (2015) (Statement of Congressman Kevin McCarthy).

88. OST, *supra* note 32, art. XVII; Loren Grush, *How an International Treaty Signed 50 Years Ago Became the Backbone for Space Law*, VERGE (Jan. 27, 2017), <http://www.theverge.com/2017/1/27/14398492/outer-space-treaty-50-anniversary-exploration-guidelines>; *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, U.S. STATE DEP’T (Jan 20, 2017), <https://2009-2017.state.gov/t/isn/5181.htm>.

Exploration and Use of Outer Space is better known as the Outer Space Treaty.⁸⁹ The OST was the second non-armament treaty (following the Antarctic Treaty) and sought to prevent new colonial competition.⁹⁰ In 1957, the United States was the first to propose the development of an inspection system for testing space objects.⁹¹ However, the Soviet Union, testing their first intercontinental ballistic missile (ICBM), declined the invitation.⁹² Sputnik was sent into orbit, launching the space race.⁹³ In 1960, President Eisenhower addressed the United Nations General Assembly and advocated for the peaceful use of outer space and arms control.⁹⁴ In 1963, the General Assembly adopted a resolution which called on all states to refrain from placing weapons of mass destruction into outer space.⁹⁵ This came after the Soviet Union and the United States stated they had no desire to place nuclear weapons in orbit or on celestial bodies.⁹⁶ Attempting to strengthen the 1963 resolution, both the United States and Soviet Union submitted draft treaties.⁹⁷ The United States focused only on celestial bodies and the Soviet Union focused on the whole outer space environment.⁹⁸ Both countries came to an agreement, the General Assembly adopted the resolution, and opened the Treaty for signature on January 27, 1967.⁹⁹

The Outer Space Treaty contains seventeen short articles and was not intended to be comprehensive, as it was signed in the early stages of space travel.¹⁰⁰ OST has served as the foundation for every piece of space legislation drafted since and is open for interpretation as space technology advances.¹⁰¹

89. Johnson, *supra* note 32.

90. *Outer Space Treaty*, FED’N AM. SCIENTISTS, <http://fas.org/nuke/control/ost/intro.htm> (last visited Dec. 8, 2020) [hereinafter OST History].

91. *See id.* (stating the U.S. proposed an international verification system early in 1957).

92. *Id.*

93. *See generally id.* (inferring from chain of events that eventually led to what is currently known as “the space race”).

94. *See Text of Eisenhower’s Address to the 15th Session of U.N. General Assembly*, N.Y. TIMES (Sept. 23, 1960), <https://www.nytimes.com/1960/09/23/archives/text-of-eisenhowers-address-to-the-15th-session-of-un-general.html> (proposing international action regarding space in speech before UN).

95. OST History, *supra* note 90.

96. *See id.* (inferring based on the restrictions established in Article IV of the Outer Space Treaty).

97. OST History, *supra* note 90.

98. *Id.*

99. *See id.* (“Differences on the few remaining issues [between the U.S. and Soviet Union] . . . were satisfactorily resolved in private consultations during the General Assembly session by December.”); G.A. Res. 2222 (XXI), (Dec. 19, 1966) (adopting and commending the OST); OST, *supra* note 32, art. XVII (marking signing of the treaty).

100. *See generally* OST, *supra* note 32 (containing articles I–XVII).

101. Grush, *supra* note 88; *See* 51 U.S.C. §§ 51302–03 (2018) (referring to the United States’s international obligations under the Outer Space Treaty).

Article I states, “[o]uter space, including the moon and other celestial bodies, shall be free for exploration and use by all States” and States should explore “for the benefit and in the interest of all countries.”¹⁰²

As interests in mining of space resources increase, so do conflicting interpretations of Article II of the OST.¹⁰³ Under Article II, nations cannot appropriate outer space, the moon, or other celestial bodies by claim of sovereignty, use or occupation, or by any other means.¹⁰⁴ On one side, scholars from the International Institute of Space Law (IISL) interpreted Article II to prohibit both national and private appropriation.¹⁰⁵ The Moon Agreement supports this view—under Article 11 of the Agreement, celestial resources are the “common heritage of mankind.”¹⁰⁶ By the common heritage approach, there is an absolute bar on both private and state appropriation because celestial resources are for the benefit of all states.¹⁰⁷ On the other side, some posit that a categorical exclusion of property rights on celestial bodies contradicts Article 17 of the Universal Declaration of Human Rights, which guarantees the right to personal property.¹⁰⁸ Legislation introduced by the United States and Luxembourg also supports private companies owning the resources extracted from celestial bodies.¹⁰⁹

Article VI first declares that State Parties bear responsibility for national activities in outer space, whether or not government agencies carry out those activities.¹¹⁰ Second, activities of non-governmental entities shall require authorization and continuing supervision by the host State Party.¹¹¹

Article XV opens the treaty to amendment, stating:

102. OST, *supra* note 32.

103. Grush, *supra* note 88.

104. OST, *supra* note 32, art. II.

105. *Statement by the Board of Directors of the International Institute of Space Law on Claims to Property Rights Regarding the Moon and Other Celestial Bodies*, INT’L INST. SPACE L. (2004), https://www.iislweb.org/docs/IISL_Outter_Space_Treaty_Statement.pdf.

106. *See* Moon Agreement, *supra* note 38, art. XI.

107. Kurt Taylor, *Fictions of the Final Frontier: Why the United States Space Act of 2015 is Illegal*, 33 EMORY INT’L L. REV. 653, 653 (2019).

108. *See* Austin C. Murnane, Note, *The Prospector’s Guide to the Galaxy*, 37 FORDHAM INT’L L. J. 235, 262 (2013) (asserting contradiction with Article 17); G.A. Res. 217 (III) A, Universal Declaration of Human Rights (Dec. 10, 1948) (“Article 17: (1) Everyone has the right to own property as well as in association with others. (2) No one shall be arbitrarily deprived of his property.”).

109. *See* U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90, 129 Stat. 704, 721 (2015) (codified at 51 U.S.C. § 51303) (“A United States citizen engaged in commercial recovery of an asteroid resource or a space resource . . . shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource.”); *Loi du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace* [Law of July 20th 2017 on the Exploration and Use of Space Resources] arts. 1, 3–5, *Journal Officiel Du Grand-Duché De Luxembourg*, *Mémorial A*, N° 674 (2017) [hereinafter Luxembourg’s Law] *Journal Officiel du Grand Duché de Luxembourg* [Journal Officiel], *Loi du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace*, A674-1, A674-1 (N° 674, July 28, 2017) (securing the right of private operators working in the space sector to resources extracted in space).

110. OST, *supra* note 32, art. VI.

111. *Id.*

Any State Party to the Treaty may propose amendments to this Treaty. Amendments shall enter force for each State Party to the Treaty accepting the amendments upon their acceptance by a majority of the States Parties to the Treaty and thereafter for each remaining State Party to the Treaty on the date of acceptance by it.¹¹²

This suggests that the OST may be amended if 55 out of 109 State Parties consent to the change.¹¹³

B. The Space Act of 2015

The law in effect today, the Space Act of 2015, got its start as H.R. 2262, the “Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015.”¹¹⁴ Representative Kevin McCarthy introduced the Act on May 12, 2015 in the House of Representatives.¹¹⁵ The purpose of H.R. 2262 was “to facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions, and for other purposes.”¹¹⁶ On November 10, 2015, the Senate unanimously passed a reconciled version of the house bill with a new name: “The U.S. Commercial Space Launch Competitiveness Act.”¹¹⁷ While the Senate version incorporated the House version, the final bill included a revised version of the space-resource property-right language.¹¹⁸ The House version included language that created a cause of action arising from harmful interference.¹¹⁹ However, the Congressional Record contains no discussion of harmful interference or why the final draft of the Space Act of 2015 omitted the cause-of-action.¹²⁰

On November 16, 2015, the House approved the reconciled version from

112. *Id.* art. XV.

113. Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Eighth Session, U.N. Doc. A/AC.105/C.2/2019/CRP.3* (2019).

114. See U.S. Commercial Space Launch Competitiveness Act, Pub L. No. 114–90, 129 Stat. 704, 704–05 (2015) (finalizing the Space Act); 161 CONG. REC. 6477 (2015) (introducing bill in the House).

115. 161 CONG. REC. 6477; Press Release, Media Center for Congressman Kevin McCarthy, *House Passes Congressman McCarthy’s SPACE Act*, (Nov. 16, 2015), <https://kevinmccarthy.house.gov/media-center/press-releases/house-passes-congressman-mccarthys-space-act>.

116. U.S. Commercial Space Launch Competitiveness Act, 129 Stat. at 704 .

117. See 161 CONG. REC. 18067-72, 18089 (2015) (showing unanimous consent to pass the amended bill).

118. *Id.* at 18072; Jeff Foust, *U.S. Senate Passes Compromise Commercial Space Bill*, SPACE NEWS (Nov. 11, 2015), <https://spacenews.com/u-s-senate-passes-compromise-commercial-space-bill/>.

119. 161 CONG. REC. 7643, 7646.

120. See U.S. Commercial Space Launch Competitiveness Act, 129 Stat. at 721 (omitting subsection on “Civil Action for Relief from Harmful Interference” in final law) (codified at 51 U.S.C. § 51303); 161 CONG. REC. 18072 (omitting subsection on civil action from § 51303 in engrossed senate amendment without debate).

the Senate.¹²¹ This final version of the bill grants rights to resources extracted by commercial entities in the United States on asteroids and other celestial bodies.¹²² President Obama signed the legislation into law on November 25, 2015.¹²³

The Space Act defines an asteroid resource as “a space resource found on or within a single asteroid” and defines a space resource as “an abiotic resource in situ in outer space,” which includes water and minerals.¹²⁴

Under § 51302, Congress directed the President to:

(1) facilitate commercial exploration for and commercial recovery of space resources by United States citizens; (2) discourage government barriers to the development in the United States of economically viable, safe, and stable industries for commercial exploration for and commercial recovery of space resources in manners consistent with the international obligations of the United States; and (3) promote the right of United States citizens to engage in commercial exploration for and commercial recovery of space resources free from harmful interference, in accordance with the international obligations of the United States and subject to authorization and continuing supervision by the Federal Government.¹²⁵

This suggests Congress intends to lower as many barriers as possible to enable the private exploration and recovery of space resources.

Under § 51303, rights to asteroid or space resources obtained are granted to:

A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid

121. 161 CONG. REC. 18147 (concurring in Senate amendment by two-thirds of House); Jeff Foust, *House Passes Commercial Space Bill*, SPACE NEWS (Nov. 16, 2015), <https://spacenews.com/house-passes-commercial-space-bill/>.

122. See U.S. Commercial Space Launch Competitiveness Act, Public L. No. 114-90, § 51303, 129 Stat. 704, 721 (2015) (detailing entitlement to resource recovery).

123. *Id.* at sec.403, 129 Stat. at 722; Alyssa Navarro, *President Obama Signs Pro-Asteroid Mining Bill into Law*, TECH TIMES (Nov. 27, 2015), <https://www.techtimes.com/articles/110935/20151127/president-obama-signs-pro-asteroid-mining-bill-into-law.htm>.

124. U.S. Commercial Space Launch Competitiveness Act, § 51301, 129 Stat. at 721.

125. *Id.* § 51302.

resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.¹²⁶

Notably, this right is granted exclusively to U.S. citizens.

Additionally, the President was to submit a report to Congress specifying: “(1) the authorities necessary to meet the international obligations of the United States, including authorization and continuing supervision by the Federal Government; and (2) recommendations for the allocation of responsibilities among Federal agencies [to facilitate the authorization and continuing supervision].”¹²⁷ On April 4, 2016, John Holdren, the Director of the of White House Office of Science and Technology Policy, submitted a report to Congress proposing a “Mission Authorization” framework that meets the United States’ obligations under the OST.¹²⁸ The framework designates that missions will be authorized by the Secretary of Transportation, in coordination with the Secretary of Defense, the Secretary of State, the Secretary of Commerce, the NASA Administrator, the Director of National Intelligence, and any other agencies that the Secretary of Transportation deems appropriate.¹²⁹ Additionally, the Secretary of Transportation is to maintain a registry of Mission Authorizations, where Mission Authorization holders will periodically provide updated information whenever they experience a material change to operations.¹³⁰ At the time of Holdren’s report to Congress, it was the Administration’s view that it was premature to establish a comprehensive regulatory framework mirroring mature commercial space activities, such as launch services.¹³¹

C. The Flaws of the Space Act of 2015 & the Artemis Accords and Their Incompatibility with the OST

1. Lack of Safety Procedures

The Space Act does not contain any procedures to ensure the safe mining of asteroids.¹³² The only provision of the Act related to safety was the now-

126. *Id.* § 51303.

127. *Id.* § 51302.

128. JOHN P. HOLDREN, OFF. OF SCI. AND TECH. POL’Y, REPORT ON ON-ORBIT AUTHORITY, AS REQUIRED BY THE COMMERCIAL SPACE LAUNCH COMPETITIVENESS ACT 1, 1 (Apr. 4, 2016), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf [hereinafter HOLDREN LETTER].

129. *Id.* at 6.

130. *Id.* at 7.

131. *Id.* at 4.

132. See U.S. Commercial Space Launch Competitiveness Act, §§ 51301–3, 129 Stat. 704, 721 (2015) (demonstrating no safety measures in Act).

removed portion of § 51303(b): “Safety of Operations: A United States commercial space resource utilization entity shall avoid causing harmful interference in outer space.”¹³³ The proposed bill neglected to define “harmful interference” and seemingly removed the language all together.¹³⁴ The enacted version only referenced harmful interference in Congress’s direction to the President to “promote the right of United States citizens to engage in commercial exploration for and commercial recovery of space resources free from harmful interference”¹³⁵ The bill’s lack of safety specifications led to a debate on the House floor.¹³⁶

In opposition to H.R. 2262, Representative Donna Edwards of Maryland echoed this concern and worried that as the Space Act stood, the aerospace industry could work in a regulation-free environment without any specific safety requirements until 2025.¹³⁷ Without safety procedures, asteroid mining could adversely affect objects in orbit around Earth.¹³⁸ When the surface of an asteroid is disturbed, its gravity is too weak and some surface particles could escape and settle into regions traversed by satellites in geosynchronous orbit.¹³⁹ At first, this escaped debris would not likely present a problem, but as more asteroids are mined and more satellites are launched, it becomes more likely a satellite will be dangerously struck.¹⁴⁰ Without stronger guidance from the government, private entities are left to develop their own containment procedures for mining.¹⁴¹ Deep Space Industries, a private company aiming to mine asteroids, has stated they will plan their targets to minimize the risk of debris and might bag or shroud the asteroid to prevent dust and loose stones from escaping.¹⁴² However, private policies like that of Deep Space Industries are not enough to make up for the lack of guidance in the Space Act of 2015.

133. See 161 CONG. REC. 7646, 7656 (2015) (noting the House in the Committee of the Whole’s rejection of the amendment as a substitute by a vote of 173 ayes and 236 noes).

134. Compare *id.* at 7646 (instructing U.S. commercial space resource entities to avoid, and including a civil right of action for relief from, “harmful interference”), with 161 CONG. REC. 18140 (2015) (promoting the right of citizens to engage in commercial exploration and recovery without “harmful interference” as only a general goal).

135. U.S. Commercial Space Launch Competitiveness Act, § 51302, 129 Stat. at 721.

136. See 161 CONG. REC. 18141–42 (weighing the benefit of a lack of Federal Aviation Administration (FAA) safety regulations for the developing spaceflight industry against the prevention of potential accidents).

137. See 161 CONG. REC. 7634–35 (letter from Joanne Irene Gabrynowicz submitted for the record by Rep. Edwards.) (opposing the bill’s extension on postponing FAA authority to regulate safety).

138. See Sarah Scoles, *Dust from Asteroid Mining Spells Danger for Satellites*, NEW SCIENTIST, (May 27, 2015), <https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/>.

139. *Id.*

140. See *id.* (asserting risk of asteroid mining will increase as asteroid mining become more widespread).

141. See *id.* (discussing efforts by one company to contain mining debris).

142. *Id.*

The Artemis Accords make an attempt to create safety procedures through the use of Safety Zones.¹⁴³ Seemingly consistent with Articles XI and IX of the OST, NASA and partner nations will provide public information regarding the location and general nature of operations on the moon to prevent harmful interference.¹⁴⁴ This is discussed *infra* in part C.1.

2. Absence of any Licensing System

Nor did the Space Act establish “an interagency review to help identify appropriate roles and responsibilities and a proposed organizational structure for the . . . oversight and licensing of commercial space resource exploration and utilization.”¹⁴⁵ Instead, the Space Act provided that the President shall submit a report to Congress specifying which Federal Agencies are to be responsible for authorizing and continually supervising commercial entities in outer space.¹⁴⁶ Currently, there are three agencies that oversee U.S. commercial space activities: (1) the Federal Aviation Administration (FAA), which authorizes and regulates launch and reentry; (2) the Federal Communications Commissions (FCC), which licenses and regulates communications satellites; and (3) the National Oceanic and Atmospheric Administration (NOAA), which licenses commercial entities operating remote sensing systems in space.¹⁴⁷ In April of 2016, the Executive Branch complied with the reporting requirement of the Space Act and recommended the Department of Transportation, in coordination with the Departments of Defense, State, Commerce, NASA, and the Director of National Intelligence, to authorize and continually supervise space mining activities by United States companies.¹⁴⁸ However, Congress has yet to adopt these recommendations.¹⁴⁹

143. See NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 13, § 11, at 5–6 (stating “[t]he area wherein this notification and coordination will be implemented to avoid harmful interference is referred to as a ‘safety zone.’”); *Artemis Principles*, *supra* note 13 (stating that state partner nations will “inform the size and scope of safety zones” to avoid harmful interference).

144. See NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 13, at 5–6 (committing to provide partner nations with necessary information on the “location and nature of space-based activities”).

145. 161 CONG. REC. 7634 (statement of Rep. Edwards).

146. See U.S. Commercial Space Launch Competitiveness Act, Public L. No. 114–90, § 51302, 129 Stat. 704, 721 (2015) (discussing the President’s reporting requirements).

147. *The Commercial Space Landscape: Innovation, Market, and Policy Testimony Before the H. Comm. on Sci., Space, and Tech.*, Subcomm. on Space, 116th Cong. 1 (2019) [hereinafter *Montgomery Testimony*] (statement of Laura Montgomery).

148. HOLDREN LETTER, *supra* note 128, at 6.

149. See *id.* at 6–7 (listing recommended amendments to U.S.C. title 51, ch. 509); 51 U.S.C.A. §§ 50902, 50919(g) (West, Westlaw through Pub. L. 116–179) (showing no recommended mission authorization amendments); *Chapter 509: Commercial Space Launch Activities*, GOVTRACK, <https://www.govtrack.us/congress/bills/uscode/chapter/51/509> (showing no bills in the current Congress regarding the recommended mission authorization amendments) (last visited Dec. 11, 2020).

The OST demands that States Party to the Treaty authorize and continually supervise the activities of non-governmental entities in outer space.¹⁵⁰ Article VI states:

State Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.¹⁵¹

Legal scholars are split on whether the Space Act conforms with this requirement.¹⁵²

On one side, scholars argue that Article VI's requirement of authorization and continual supervision does not create an obligation on the private sector because the treaty is not self-executing.¹⁵³ Read narrowly, Article VI grants State Parties discretion to decide what activities require authorization and continuing supervision.¹⁵⁴ In their testimony before the Committee on Science, Space, and Technology, Laura Montgomery urged the United States might need not to regulate asteroid mining at all because it would not cause harm to any human, unlike mining operations on Earth.¹⁵⁵ However, this argument alone is shortsighted and only accounts for the risk in the nearby environment. As stated above, asteroid mining could create debris that could impact satellites in Earth's orbit.¹⁵⁶ Additionally, the cumulative impact from an increase in rocket launches can change the composition of the atmosphere and could deplete the ozone layer.¹⁵⁷

150. OST, *supra* note 32, art. VI.

151. *Id.*

152. See 161 CONG. REC. 7634–35 (2015) (letter from Joanne Irene Gabrynowicz submitted for the record by Rep. Edwards expressing that lack of spaceflight oversight in the Space Act does not comply with the OST); *Montgomery Testimony*, *supra* note 147, at 5–9 (arguing that OST, Art. VI does not apply to private actors and is not legal basis for FAA regulation).

153. *Montgomery Testimony*, *supra* note 147, at 5.

154. *Id.* at 6.

155. *Id.* (comparing mining on Earth, where safety and environmental concerns provide a need for independent oversight, to mining on asteroids, where regulation is not needed because only robots will be present).

156. Scoles, *supra* note 138.

157. Bennett, *supra* note 73 at 93.

On the other side, scholars suggest that licensing is necessary to meet the obligations under the OST.¹⁵⁸ It is customary that all commercial space activities require appropriate licensing by an authorized agency.¹⁵⁹ Additionally, both the State Department and the Obama Administration were concerned by the lack of a national regulatory framework regarding private companies' activities on celestial bodies.¹⁶⁰ Specifically, the Obama Administration stated:

While the administration strongly supports the bill's efforts to facilitate innovative new space activities by U.S. companies, such as the commercial exploration and utilization of space resources to meet national needs, the administration is concerned about the ability of U.S. companies to move forward with these initiatives absent additional authority to ensure continuing supervision of these initiatives by the U.S. Government as required by the Outer Space Treaty.¹⁶¹

The United States can ensure compliance with the OST by adopting a licensing regime similar to those employed in every other U.S. commercial space activity.¹⁶² On April 4, 2016, the Obama Administration informed Congress that the Secretary of Transportation, in coordination with other agencies, could authorize missions and maintain a registry of mission authorizations.¹⁶³ The Space Act of 2015 did not initially set up such a regime, and has not yet implemented the Executive's proposal.¹⁶⁴ Instead of a full licensing regime, the Accords reference the Registration Convention to register any relevant space object.¹⁶⁵ Under this provision, the United States is not explicitly able to authorize and continuously supervise private parties

158. See 161 CONG. REC. 7634–35 (2015) (letter from Joanne Irene Gabrynowicz submitted for the record by Rep. Edwards expressing concern that the Space Act does not meet the OST requirement of “continuing supervision” of spaceflight activities).

159. See *id.* (stating “[u]nlicensed U.S. commercial space activities are unprecedented in United States space law.”).

160. See *id.* at 7634–35 (stating “[th]e lack of a specific licensing regime also fails to meet the State Department’s concern . . . the lack of a national regulatory framework with respect to private sector activities on celestial bodies).

161. See *id.* at 7634.

162. See DANIEL MORGAN, COMMERCIAL SPACE: FEDERAL REGULATION, OVERSIGHT, AND UTILIZATION R45416 (Nov. 29, 2018) (referencing the preexistence of a licensing regime that underscores commercial space activity).

163. HOLDREN LETTER, *supra* note 128, at 6.

164. See 51 U.S.C.A. §§ 50902, 50919(g) (West, Westlaw through Pub. L. 116–179) (showing no recommended mission authorization amendments); Space Act, Pub. L. No. 114–90, 129 Stat. 704, 707 (2015) (requiring the Secretary of Transportation to submit a report recommending an approach for future licensing activities).

165. NAT’L AERONAUTICS AND SPACE ADMIN., *supra* note 13, at 3.

under the requirements of Article VI of the OST.¹⁶⁶ Thus, the Act and the Artemis Accords fail to meet the requirements of Article VI of the OST.

3. No Guidance for Dispute Resolution from Harmful Interference

The United States has opened the door and invited other spacefaring States to adopt similar legislation. In 2017, Luxembourg followed suit by enacting an initiative that allows private companies to claim mineral deposits without violating the OST.¹⁶⁷ This rise in competition could eventually lead to disputes over resources with no obvious resolution framework in place.

Under the OST, State Parties are not to engage in activities that would harmfully interfere with the peaceful use and exploration of space by other states without first undertaking international consultations.¹⁶⁸ Article IX states in pertinent part:

If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other State Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.¹⁶⁹

Scholars have interpreted this notion of “harmful interference” to have two implications: (1) to prevent State Parties from interfering with productive activities of other States engaging in private endeavors; and (2) to limit

166. See HOLDREN LETTER, *supra* note 128, at 3 (stating “[m]any space-faring States discharge the [OST, Art. VI] obligation through a more general licensing framework for non-governmental space activities.”).

167. See JP Casey, *Mining-Technology, The History of Space Mining: Five Key Events for Mineral Exploration in Space*, MINING-TECH. (Mar. 18, 2019) <https://www.mining-technology.com/digital-disruption/history-of-space-mining/> (comparing the Luxembourg and US laws in a historical perspective).

168. OST, *supra* note 32, art. IX.

169. *Id.*

activities that may harm the environment.¹⁷⁰ Proposed versions of the Space Act included a cause of action protecting the right to be free from harmful interference, but it was ultimately dropped from the text of the enacted legislation.¹⁷¹ In the prior versions, if the aggrieved party was: (1) first in time; (2) acted reasonably for exploration and utilization of asteroid resources; and (3) acted in accordance with the international obligations of the United States—there was a cause of action against another party.¹⁷²

The cause of action portion from the proposed bills was likely consistent with the requirements of the OST. The previous House and Senate versions did not conflict with the OST because the bills did not grant jurisdiction to the United States over any asteroid or asteroid resources, but granted the United States jurisdiction to companies that fall under United States jurisdiction.¹⁷³ Essentially, these bills gave the United States jurisdiction to resolve disputes between U.S. companies but not jurisdiction over physical asteroids. Had these proposed versions asserted jurisdiction over territory in space, it could be a claim of sovereignty by other means, which is prohibited under the OST.¹⁷⁴

Under Section 11 of the Accords, a procedure for avoiding disputes arising from harmful interference is laid out. As mentioned above, the Accords provide that harmful interference can be avoided by the designation of safety zones.¹⁷⁵ These safety zones are defined as “the area in which nominal operations of a relevant activity or an anomalous event could cause harmful interference” and their size should reflect the nature of the operations being conducted in the environment.¹⁷⁶ Safety zones are meant to be temporary and are “expected to change over time reflecting the status” of the operation.¹⁷⁷ Christopher Johnson, a respected space lawyer, has noted that the lack of permanence of these safety zones aligns the Accords with the

170. Elliot Reaven, *The United States Commercial Space Launch Competitiveness Act: The Creation of Private Space Property Rights and the Omission of the Right to Freedom from Harmful Interference*, 94 WASH. UNIV. L. REV. 233, 253 (2016).

171. Compare Stephen DiMaria, Note, *Starships and Enterprise: Private Spaceflight Companies' Property Rights and the U.S. Commercial Space Launch Competitiveness Act*, 90 ST. JOHN'S L. REV. 415, 417 (2016) (highlighting the stricken language from the OSA that barred harmful interference in outer space recovery), with 161 CONG. REC. 7653–54 (2015) (demonstrating the difference between the proposed and agreed upon language of the Space Act).

172. See 161 CONG. REC. 7653–54 (showing proposed amendment as a substitute adopted causes of action supporting first in time and reasonable use in accordance with international treaties).

173. See *id.* at 7643, 7646 (original house bill with cause of action for harmful interference); *id.* at 18072 (revised senate bill); Reaven, *supra* note 170, at 255–56 (arguing that “the right to freedom from harmful interference is most likely compliant” with the OST).

174. See OST, *supra* note 32, art. II (explaining that “[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation . . .”).

175. NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 13, § 11, at 5–6.

176. *Id.* at 11.

177. *Id.*

requirements of the OST.¹⁷⁸ If the establishment of a safety zone were permanent, it would be akin to national appropriation, which is prohibited under Article II of the OST.¹⁷⁹

4. Environmental Jurisprudence was Overlooked

As an initial issue, some argue that asteroids should not be exploited by humans simply because they are able to.¹⁸⁰ One expert in property law urges that asteroid use should be limited to water extraction necessary to maintain human life; asteroid use should be justified through equitable resource distribution among nations and people.¹⁸¹ However, the Space Act of 2015 already hinders the ability to apply a new legal approach to the nearly pristine environment of space.¹⁸²

Examining the text of the Senate's proposed bill, which was ultimately incorporated in the Space Act of 2015, sheds light on how efforts to protect the space environment from exploitation are hindered.¹⁸³ Although the proposed bill is not law, it shows the drafters' intent behind enacted legislation. Under the proposed bill, "any asteroid resources obtained in outer space are the property of the entity that obtained such resources, which shall be entitled to all property rights thereto."¹⁸⁴ Further, under the civil-action section of the proposed bill, a plaintiff who was "first in time" conducting resource utilization could prevail over another entity, provided other requirements were met.¹⁸⁵ The proposed bill stated:

"CIVIL ACTION FOR RELIEF FROM HARMFUL INTERFERENCE.—A United States commercial space resource utilization entity may bring a civil action for appropriate legal or equitable relief, or both, under this chapter for any action by another entity subject to United States jurisdiction causing harmful interference to its operations with respect to an asteroid resource utilization activity in outer space."¹⁸⁶

178. Christopher Johnson, *A First Look at the Artemis Accords*, LINKEDIN (Oct. 14, 2020), <https://www.linkedin.com/pulse/first-look-artemis-accords-christopher-johnson/>.

179. *Id.*

180. *See generally*, Loder, *supra* note 10, at 295 (lamenting that humans have an exploitative nature that often overlooks the necessity of ecological protections).

181. *Id.* at 297.

182. *Id.*

183. *See* 161 CONG. REC. 7646 (2015) (identifying the different legal approach in the proposed House bill that was rejected but made its way into the final language).

184. *Id.*

185. *Id.*

186. *See id.* ("the activity is reasonable for the exploration of and utilization of asteroid sources.").

The notion of “first in time” has its origin in the General Mining Law of 1872, through the westward expansion of the United States and the exploitation of water and mineral rights.¹⁸⁷

The Mining Law rewarded those who were the first to prospect and discover valuable minerals.¹⁸⁸ The Prior Appropriation Doctrine also grew out of this westward expansion—rewarding water rights to the first person to make use of the water.¹⁸⁹ By using “first in time,” the Senate implicitly suggested the doctrine that governed westward expansion should similarly govern the exploitation of resources in space. Although this provision does not appear in the Space Act of 2015, its presence in the legislative history, along with § 51302 (a)(2)¹⁹⁰ suggests the purpose of the Space Act is to allow the exploitation of resources in space by U.S. companies. The Trump Administration has further strengthened the association between American expansionism and space exploration. On July 6, 2020, the White House tweeted an image of the President and Vice President watching the first launch of American astronauts from American soil since 2011.¹⁹¹ This image had the word “DESTINY” laid across it with the caption: “Americans are the people who pursued our Manifest Destiny across the ocean, into the uncharted wilderness, over the tallest mountains, and then into the skies and even into the stars.”¹⁹² The language we use to describe space travel matters—using themes of American expansionism pairs the nation’s future in space with racist beliefs of the past that drove Indigenous people from their homes in the name of White entitlement.¹⁹³ This language is contrary to the notion of Environmental Jurisprudence and paints a picture that space is for the benefit of the United States, not all humankind.

187. See generally General Mining Law of 1872, 30 U.S.C. § 26 (2018) (“The locators . . . shall have exclusive right of possession and enjoyment of all the surface included within the lines of their locations. . . .”); Lauren E. Shaw, *Asteroids, the New Western Frontier: Applying Principles of the General Mining Law of 1872 to Incentivize Asteroid Mining*, 78 J. AIR L. & COM. 121, 143–44 (2013).

188. Shaw, *supra* note 187; see also General Mining Law of 1872, 30 U.S.C. § 26 (supporting the “first in time” notion, as well as rewards for discovering valuable minerals).

189. John G. Wrench, *Non-Appropriation, No Problem: The Outer Space Treaty is Ready for Asteroid Mining*, 51 CASE W. RESV. J. INT’L L. 437, 457 (2019).

190. See U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90, 129 Stat. 704, 704 (2015) (presenting the current language of the act); 161 CONG. REC. 7646 (2015) (showing past language of the act).

191. The White House 45 Archived (@WhiteHouse45), TWITTER (July 6, 2020, 10:02 PM), <https://twitter.com/WhiteHouse45/status/1280321140326633472>.

192. *Id.*

193. Marina Koren, *No One Should ‘Colonize’ Space*, ATLANTIC (Sept. 17, 2020), <https://www.theatlantic.com/science/archive/2020/09/manifest-destiny-trump-space-exploration/612439/>.

5. Economic Impacts Were Overlooked

Another issue that the Space Act of 2015 overlooked was the economic impact of asteroid mining. Ryugu, the asteroid host to the two small hopping robots mentioned above, is valued to be \$82.76 billion, with \$30.08 billion in profit.¹⁹⁴ This particular asteroid is rich in nickel, iron, cobalt, and water.¹⁹⁵ It is ranked as one of the most accessible asteroid in our solar system, meaning its orbital characteristics and its relatively consistent distance from the sun makes it fairly easy to get to.¹⁹⁶ While the technology to access more valuable asteroids does not exist yet, it is only a matter of time before private companies are landing on asteroids valued in the quadrillions.¹⁹⁷ As these ventures are still in their nascent stages, we must ask ourselves whether we want asteroid mining to make the rich richer or if we want it to benefit all of humanity.

Although the Space Act of 2015 entitled the right to possess, own, transport, use, and sell asteroid resources to all United States citizens,¹⁹⁸ only a select few companies have the ability to do so.¹⁹⁹ Namely, Planetary Resources and Deep Space Industries have plans to begin asteroid mining in the future.²⁰⁰ While the influx of minerals from space would not likely tank the economy, the wealth inequality would become more extreme, exacerbating rather than alleviating existing problems on Earth.²⁰¹

Article I of the OST provides: “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.”²⁰² The Space Act of 2015 failed to consider this crucial flaw in the plan to develop asteroids for the benefit of all humanity and, in doing so, could be in breach of the OST. Legal scholars suggest the question of ownership in space needs to be decided internationally to avoid exasperating

194. Wall, *supra* note 2; Webster, *supra* note 4.

195. Webster, *supra* note 4 (stating Ryugu is composed of nickel, iron, cobalt, water, nitrogen, hydrogen, and ammonia).

196. *Id.* (locating Ryugu relatively close to the top of the list of “most accessible” asteroids).

197. Matt Davis, *Will Asteroid Mining be an Outer-Space Gold Rush?*, BIG THINK (Sept. 28, 2018) <https://bigthink.com/technology-innovation/economic-impact-of-asteroid-mining>.

198. See U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90, 129 Stat. 704, 721 (2015) (codified at 51 U.S.C. § 51303) (outlining rights to United States citizens).

199. Davis, *supra* note 197.

200. Jeff Foust, *The Asteroid Mining Bubble Has Burst*, SPACE REV. (Jan. 7, 2019), <http://www.thespacereview.com/article/3633/1>.

201. Davis, *supra* note 197 (suggesting space resources would be treated similarly to the diamond market, where just enough diamonds are released to satisfy demand to ensure continued profits); Morgan Saletta & Kevin Orrman-Rossiter, *Can Space Mining Benefit All of Humanity?: The Resource Fund and Citizen’s Dividend Model of Alaska, the ‘Last Frontier’*, 43 SPACE POL’Y 1, 3 (2018).

202. OST, *supra* note 32, art. 1.

the already unequal distribution of wealth around the world.²⁰³ One way to facilitate this is through the establishment of an international organization with the right to lease asteroids and other celestial bodies.²⁰⁴ This concept is explored in the section IV.

The Artemis Accords seemingly take a different approach to benefit all humankind—through knowledge, not economics. Under the principle of Releasing Scientific Data, NASA and partners have agreed to release their scientific data publicly to ensure that the entire world can benefit from the Artemis journal of exploration and discovery.²⁰⁵ The exploration of outer space for the benefit and in the interest of all countries is the core tenant of the OST. The framework proposed by the Accords would include the world in the scientific benefits.²⁰⁶ Due to the nature of the bi-lateral and multi-lateral agreements set up under the Accords, many countries would be left behind economically.

IV. SOLUTIONS

A. Creation of an International Space Licensing Agency

A new international organization, developed from an amendment to the OST or through a new treaty, would lease asteroids and charge royalties on production.²⁰⁷ This would solve the U.S.'s dilemma of balancing the growth of private industry with the obligation under the OST to benefit all of humanity. One terrestrial model this new organization could look to is the Alaska Permanent Fund.²⁰⁸

The Alaska Permanent Fund is a universal cash-transfer program, established through revenues on oil and gas leases.²⁰⁹ It has been successful because of the vast oil reserves in Alaska, which are unlike anywhere else in the country except Texas and North Dakota.²¹⁰ The Alaska Permanent Fund is truly meant for the citizens—an independent trust corporation was set up in order to shield the fund from politicians.²¹¹ The dividend is calculated

203. Saletta, *supra* note 201, at 4.

204. *Id.*

205. NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 13, § 8, at 4.

206. *Id.*

207. Saletta, *supra* note 201, at 3.

208. *Id.*

209. Dylan Matthews, *The Amazing True Socialist Miracle of the Alaska Permanent Fund*, VOX (Feb. 13, 2018), <https://www.vox.com/policy-and-politics/2018/2/13/16997188/alaska-basic-income-permanent-fund-oil-revenue-study>.

210. *See id.* (expressing that Alaska has a relatively unique substantial number of oil reserves that lead to the program's success).

211. ALASKA PERMANENT FUND CORP., AN ALASKAN'S GUIDE TO THE PERMANENT FUND 31 (12th ed. 2009).

based on the number of eligible Alaskan applicants in a dividend year, and on half of the statutory net income averaged over the five most recent fiscal years.²¹²

Under Alaska Statute § 43.23.005, to be eligible to receive one permanent fund dividend, an individual:

- (1) applies to the department;
- (2) is a state resident on the date of application;
- (3) was a state resident during the entire qualifying year;
- (4) has been physically present in the state for at least 72 consecutive hours at some time during the prior two years before the current dividend year;
- (5) is
 - (A) a citizen of the United States;
 - (B) an alien lawfully admitted for permanent residence in the United States;
 - (C) an alien with refugee status under federal law; or
 - (D) an alien that has been granted asylum under federal law;
- (6) was, at all times during the qualifying year, physically present in the state or, if absent, was absent only as allowed [by law]; and
- (7) was in compliance during the qualifying year with military selective service registration requirements . . . if those requirements were applicable to the individual, or has come into compliance after being notified of the lack of compliance.²¹³

A similar structure could be implemented in the leasing of outer space resources and would likely be consistent with the needs of the OST and private companies.²¹⁴ Some scholars suggest by using the revenue from mineral leasing rights in outer space to pay dividends to all residents on Earth, the Treaty would provide legal clarity while ensuring the exploitation of the common province of all mankind.²¹⁵ For example, to be eligible for the hypothetical SPACE-FUND, an individual must:

- (1) apply to the United Nations Space Fund Department;
- (2) be a resident of a State Party to the Outer Space Treaty of 1967 on the date of application;
- (3) was a resident of a State Party to the Outer Space Treaty of 1967 during the entire qualifying year;

212. ALASKA STAT. § 43.23.025(a)(1)–(3) (2019).

213. ALASKA STAT. § 43.23.005 (2019).

214. Saletta, *supra* note 201, at 4.

215. *Id.*

- (4) has been physically present in the State Party to the Outer Space Treaty of 1967 for at least 72 consecutive hours at some time during the prior two years before the current dividend year;
- (5) is
- (A) a citizen of a State Party to the Outer Space Treaty of 1967;
 - (B) an alien lawfully admitted for permanent residence in a State Party to the Outer Space Treaty of 1967;
 - (C) an alien with refugee status under applicable State Party law; or
 - (D) an alien that has been granted asylum under applicable State Party law;
- (6) was, at all times during the qualifying year, physically present in the Member State, or if absent, was absent only because the individual:
- (A) was receiving secondary or postsecondary education;
 - (B) was receiving vocational, professional, or other specific education on a full-time basis;
 - (C) was receiving continuous medical treatment recommended by a licensed physician;
 - (D) was providing care for the individuals terminally ill family member;
- (7) or any additional requirements made by amendment to this section.

An international regime would be consistent with the OST, while still incentivizing private companies to pursue ventures in asteroid mining.

B. Modeling Luxembourg's Expansive View

Inspired by the United States' push into conferring property rights in outer space resources to private entities, Luxembourg was the second country to pass space resource legislation.²¹⁶ Like the Space Act, Luxembourg's law states that space resources are capable of being appropriated.²¹⁷ However, unlike the Space Act, Luxembourg's law lays out an extensive administrative process, including: (1) the establishment of an Authorization Ministry; (2) the factors to be considered in authorization; (3) the requirement for risk

216. Luxembourg's Law, *supra* note 109, art. 1; Lorenzo Gradoni, *What on Earth is Happening to Space Law?*, EJIL:TALK! (Sept. 5, 2020, 4:30pm), <https://www.ejiltalk.org/what-on-earth-is-happening-to-space-law-a-new-space-law-for-a-new-space-race/>.

217. Luxembourg's Law, *supra* note 109, art. 1.

assessment and regular audits; and (4) fee ranges.²¹⁸ As stated above, the Space Act only confers property rights to U.S. citizens, but the Luxembourg law confers property rights to companies with any registered office in the country.²¹⁹ Compared to the United States' view, Luxembourg's deliberate recognition of any company with a registered office in country to claim property rights for space resources is move in harmony with the OST.²²⁰

The core of the OST, embodied in Article I, is that "[o]uter space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind."²²¹ To take advantage of the many benefits of space resources, all a company would have to do is set up and register an office within Luxembourg. In fact, the government in Luxembourg offers "incentives for private sector companies seeking to develop space mining opportunities and start-ups investing capital to support their growth."²²² However, in the United States, only U.S. citizens are recognized to have property rights in space resources, which severely limits compliance with Article I.²²³

The United States should take note of Luxembourg's more expansive model and should amend the Space Act of 2015 to recognize property rights of any private company that has a registered office in the United States. This change would not only comply with the OST but would likely reduce conflict between companies' claims to the same asteroid resources, conferred on them by different legal regimes from separate countries.

V. CONCLUSION

The Space Act of 2015 does not provide enough of the right guidance for private companies and the international community to operate without problems arising down the line. The Artemis Accords mend some of the inconsistencies between the Space Act of 2015 and the OST but still leave out a licensing regime, and environmental and economic considerations. On its face, the Accords assert all activities will be in compliance with the

218. *Id.* arts. 2, 10, 13.

219. *Compare* Loder, *supra* note 10 (explaining how the terms of the OST prohibit granting or owning property rights in space), *with* Luxembourg's Law, *supra* note 109, arts. 1–2, 4 (authorizing private companies to explore or use space resources).

220. *Compare* Luxembourg's Law, *supra* note 109, arts. 1–2, 4 (authorizing private companies to explore or use space resources), *and* Space Act, *supra* note 9, § 51303 (allowing U.S. citizens to "possess, own, transport, use, and sell the asteroid or space resource . . .") *with* OST, *supra* note 32, art. I ("The exploration and use of outer space . . . shall be for exploration and use by all States . . .").

221. OST, *supra* note 32, art. I.

222. *Space Resources: Frequently Asked Questions*, LUX. SPACE AGENCY, <https://space-agency.public.lu/en/space-resources/faq.html> (last updated Sept. 29, 2019).

223. *See* U.S. Commercial Space Launch Competitiveness Act, Public L. No. 114–90, § 51303, 129 Stat. 704, 721 (2015) (identifying only a United States citizen's right to appropriate).

obligations under the OST. The moon and asteroids have plenty of resources that are worth the time to collect, but the United States must monitor exploitation within existing international frameworks. The Space Act of 2015, the Artemis Accords, and the Outer Space Treaty could all be amended to provide further guidance and to provide a dividend for all humankind.