HOUSE COMMITTEE ON
NATURAL RESOURCES
CHAIRMAN BRUCE WESTERMAN

To:	House Committee on Natural Resources Republican Members
From:	Subcommittee on Oversight and Investigations Staff, Michelle Lane (Michelle.Lane@mail.house.gov) and Lucas Drill (Lucas.Drill@mail.house.gov) x52761
Date:	February 24, 2025
Subject:	Oversight Hearing titled "*Contrasting Momentum in the Space Mining Economy to the Terrestrial Mining Regulatory Morass*"

The Subcommittee on Oversight and Investigations will hold an oversight hearing titled "*Contrasting Momentum in the Space Mining Economy to the Terrestrial Mining Regulatory Morass*" on **Tuesday, February 25, 2025, at 10:15 a.m. in 1324 Longworth House Office Building**.

Member offices are requested to notify Cross Thompson (Cross.Thompson@mail.house.gov) by 4:30 p.m. on February 24 if their Member intends to participate in the hearing.

I. KEY MESSAGES

- Minerals, particularly critical minerals, are vital to life today, tomorrow, and into the future.
- Although the U.S. has countless mineral deposits within its borders, long permitting timelines and anti-mining policies advanced by progressive NGOs and previous administrations have stymied domestic mining activity.
- While timelines for developing domestic mining resources grow, foreign adversaries like China increase their foothold on the worldwide supply chain of production, processing, and refining of critical and hardrock minerals, making U.S. domestic supply chains increasingly vulnerable.
- American space mining companies are leading a technological revolution that may soon enable the financially viable mining of natural resources from celestial bodies.
- The time is now to embrace both permitting reform for domestic mining and new technologies that will ultimately benefit all forms of mining as the United States seeks to secure its domestic mineral supply chains.

II. WITNESSES

- **Mr. Misael Cabrera**, Director, Professor of Practice, School of Mining and Mineral Resources, The University of Arizona, Tucson, AZ
- **Mr. Steven Place**, Senior Policy Advisor, AstroForge, Washington, DC
- **Mr. Saurav Shroff**, CEO, Starpath, Hawthorne, CA
- **Mr. Richard Painter**, Professor of Corporate Law, University of Minnesota Law School, Minneapolis, MN (*Minority witness*)

III. BACKGROUND

Minerals are Vital to Modern Life

Minerals, particularly those listed as critical minerals by the Department of the Interior's U.S. Geological Survey (USGS), are integral to our modern way of life and will remain essential indefinitely. Critical and other hardrock minerals are used in countless applications, including consumer electronics, medical devices, satellites, and military technologies essential to national security. Minerals are also imperative to the development and use of alternative energy technologies, including batteries.

The global demand for minerals is expected to rise exponentially in the decades ahead. Notably, according to the World Bank, the growing demand for minerals will increase nearly 500% by 2050.[1] The growing demand for minerals strongly correlates to the growing demand for energy technologies such as EV batteries, solar photovoltaic (PV), wind, and geothermal energy, which are more mineral-intensive than fossil fuel technologies.[2] Climate goals further drive the demand for minerals. For instance, to achieve net-zero emissions globally by 2050, the world will require a sixfold increase in mining by 2040.[3] Moreover, as new technologies that are yet to be imagined materialize, the demand for mined minerals will only increase.

Yet, despite widespread acknowledgment of the importance of critical and other hardrock minerals to our future, as well as mapped mineral systems covering every state in the U.S.,[4] America's mineral supply chain is suffering. Due largely to permitting delays and legislative restrictions that discourage domestic investment and restrict long-term mineral supply, mineral extraction in the U.S. is nonsensically slow.[5] In fact, a 2024 study by S&P Global found that U.S. critical mineral projects take an average of 29 years from discovery to production—the second-longest in the world.[6] Only Zambia is less efficient in mining minerals within its own

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[1] Climate Smart Mining Facility, *Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition*, THE WORLD BANK (2020), https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf.
[2] *Id.*
[3] James Marshall, *Insufficient minerals threaten energy transition —report*, E&E NEWS (May 5, 2021), https://www.eenews.net/greenwire/stories/1063731805.
[4] Mineral Resources Program, *Mineral Systems Map of the United States*, U.S. GEOLOGICAL SURVEY (Aug. 1, 2023), https://www.usgs.gov/media/images/mineral-systems-map-united-states.
[5] Wilson Center, Duncan Wood, *et al., The Mosaic Approach: a Multidimensional Strategy for Strengthening America's Critical Minerals Supply Chain*, https://www.wilsoncenter.org/sites/default/files/media/uploads/documents/critical_minerals_supply_report.pdf.
[6] Bonakdarpour et al., *Mine development times: The US in perspective*, S&P Global (June 2024), https://cdn.ihsmarkit.com/www/pdf/0724/SPGlobal_NMA_DevelopmentTimesUSinPerspective_June_2024.pdf.

borders.[7] Worse yet, U.S.-based mining projects also lose over one-third of their value due to delays during the permitting process.[8] Because of these self-inflicted wounds, the United States is almost entirely reliant on foreign nations to feed its need for minerals.

Dependence on Foreign Nations for Minerals Presents Serious Economic, National Security, and Humanitarian Threats

The United States is alarmingly dependent on foreign nations to meet its mineral demand. Of the 50 minerals identified by the U.S. government as critical, America imports more than half of its supply for 29 of them and all of its supplies for 12 more.[9] Unfortunately, but unsurprisingly, China dominates the world market in both raw and refined products.[10]

Chinese mineral supply chains account for approximately 60% of worldwide production and 85% of processing and refining capacity.[11] The United States is import-reliant on China for 26 of the 50 minerals[12] designated as critical.[13] China also dominates mineral refining, accounting for 85-90% of global rare earth element mine-to-metal refining.[14] Notably, China refines 80% of the world's cobalt, 60% of the world's lithium,[15] and 65% of the world's nickel,[16] critical minerals that are integral for modern technology and electric vehicles.

Relying on foreign nations, particularly China, for minerals has clear economic, national security, and humanitarian implications. China has repeatedly used its mineral supply dominance to strategically flood markets, stifle foreign competition, and cripple industries through export bans. For example, in 2023, after new Chinese-backed production drove a steep decline in cobalt prices, Idaho Cobalt Operations (ICO), America's only cobalt mine, was forced to suspend construction mere weeks before it came online.[17] Additionally, Chinese export bans have pummeled U.S. mineral supply chains. In July 2023, China curbed gallium and germanium exports, followed by high-purity and high-quality graphite and rare earth elements mining, mineral processing, and smelting technology later in the year.[18] On August 14, 2024, China

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[7] *Id.*
[8] *Id.*
[9] *Mineral Commodity Summaries 2024*, USGS, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024.pdf.
[10] Ernest Scheyder, *China set to control rare earth supply for years due to processing dominance*, REUTERS (May 29, 2019), https://www.reuters.com/article/us-china-usa-rareearth-refining/china-set-to-control-rare-earth-supply-for-years-due-to-processing-dominance-idUSKCN1T004J.
[11] Bonnie S. Glaser & Abigail Wulf, *China's Role in Critical Mineral Supply Chains*, GERMAN MARSHALL FUND (Aug. 2, 2023), https://www.gmfus.org/news/chinas-role-critical-mineral-supply-chains.
[12] Zongyuan Zoe Liu, *How to Secure Critical Minerals for Clean Energy Without Alienating China*, COUNCIL ON FOREIGN RELATIONS (May 25, 2023), https://www.cfr.org/blog/how-secure-critical-minerals-clean-energy-without-alienating-china.
[13] U.S. Geological Survey, *2022 Final List of Critical Minerals*, 87 Fed. Reg. 10381, DEPT. OF THE INTERIOR (Feb. 24, 2022), https://www.federalregister.gov/documents/2022/02/24/2022-04027/2022-final-list-of-critical-minerals.
[14] Jared Cohen, *Resource realism: The geopolitics of critical mineral supply chains*, GOLDMAN SACHS (Sep. 13, 2023), https://www.goldmansachs.com/intelligence/pages/resource-realism-the-geopolitics-of-critical-mineral-supply-chains.html.
[15] Steven P. Bucci, *America's National Security Is Dependent on Critical Rare Earth Minerals—and Worse, on China*, THE HERITAGE FOUNDATION (Nov. 8, 2022), https://www.heritage.org/defense/commentary/americas-national-security-dependent-critical-rare-earth-minerals-and-worse.
[16] Jared Cohen, *Resource realism: The geopolitics of critical mineral supply chains*, GOLDMAN SACHS (Sep. 13, 2023), https://www.goldmansachs.com/intelligence/pages/resource-realism-the-geopolitics-of-critical-mineral-supply-chains.html.
[17] Ernest Scheyder and Pratima Desai, *Western miners push for higher metals prices to ward off Chinese rivals*, REUTERS (JULY 22, 2024), https://www.reuters.com/markets/commodities/western-miners-push-higher-metals-prices-ward-off-chinese-rivals-2024-07-22/.
[18] Gracelin Baskaran and Meredith Schwartz, *China Imposes Its Most Stringent Critical Minerals Export Restrictions Yet Amidst Escalating U.S.-China Tech War*, CENTER FOR STRATEGIC & INTERNATIONAL STUDIES (Dec. 4, 2024), https://www.csis.org/analysis/china-imposes-its-most-stringent-critical-minerals-export-restrictions-yet-amidst.

issued export restrictions on antimony, a mineral vital for the defense industry.[19] On December 3, 2024, China announced export bans on "dual-use" technologies explicitly targeted at the U.S. after the U.S. took steps to limit exports of semiconductor and artificial intelligence (AI) technologies to China.[20]

Furthermore, whereas U.S. labor and environmental protections are among the best in the world, China's and many other mineral-producing nations are among the worst. For example, China-backed operations in Congo have well-documented cases of forced and child labor in the mining sector, with labor practices often labeled "modern-day slavery."[21] Similarly, workers in China-financed industrial parks in Indonesia face abuses like unsafe conditions, deceptive requitement, unpaid wages, restricted movement, and even physical violence as a means of punishment.[22]

The United States cannot allow foreign governments to continue locking mineral supply chains in a stranglehold. Instead, the U.S. approach to mining ought to be two-fold: (1) streamline permitting and mining processes to expand domestic mineral extraction; and (2) embrace American companies investing in new technologies to expand American mineral production.

Space Mining

Definitionally, space mining refers to mining for resources on celestial bodies like moons, asteroids, and planets. Specifically, the term "space mining" refers to two categories of activities:

1. *Extractive Mining for Commercial Purposes*: The extraction of resources from asteroids, the Moon, Mars, or other celestial bodies and their return to the Earth for commercial purposes. Examples include mining asteroids for critical minerals and precious metals, such as lithium, platinum, and rhodium.

2. *In-Situ Resource Utilization (ISRU)*: Resources are extracted from a celestial body to be used for other in-space activities.[23] An example includes mining for water on the Moon to make fuel for lunar activity or a permanent Moon presence.[24]

Domestic Governance Frameworks for Space Mining

51 U.S.C. §51302 directs the federal government to facilitate and promote "commercial recovery of space resources" and to discourage government barriers to such activities. Per 51 U.S.C. §51303, U.S. commercial entities are entitled to any space resources they obtain, including the use or sale of those resources.

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[19] *China will limit exports of antimony, a mineral used in products from batteries to weapons*, AP (Aug. 15, 2024), https://apnews.com/article/china-antimony-export-controls-critical-material-2fcfe08912d20996e9aa87d1fb97dd6a.
[20] *Id.*
[21] Terry Gross, *How 'modern-day slavery' in the Congo powers the rechargeable battery economy*, NPR (Feb. 1, 2023), https://www.npr.org/sections/goatsandsoda/2023/02/01/1152893248/red-cobalt-congo-drc-mining-siddharth-kara.
[22] *List of Goods Produced by Child Labor or Forced Labor*, Dept. of Labor, https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-goods.
[23] *See Using Space-Based Resources for Deep Space Exploration*, NASA, https://www.nasa.gov/overview-in-situ-resource-utilization/.
[24] Nicholas James Bennett, et al., *Commercial viability of lunar In-Situ Resource Utilization (ISRU)*, 182 PLANETARY AND SPACE SCIENCE (Mar. 2020), https://www.sciencedirect.com/science/article/abs/pii/S0032063319301163; Gerald Sanders, *In Situ Resource Utilization (ISRU) – Surface Excavation & Construction*, NASA (Jan. 21, 2021), https://www.nasa.gov/wp-content/uploads/2015/03/jsanders_lunar_isru_tagged_0.pdf.

USGS plays a key role in achieving 51 U.S.C §51302's goals. Foundationally, USGS is tasked with "examination of the geological structure, mineral resources, and products of the national domain."[25] In 1962, Congress extended USGS' jurisdiction to include resources "outside the national domain" if DOI determined that those resources were important to national interests.[26] One year later, USGS founded its Astrology Science Center, which researches planetary geology and maps celestial bodies.[27] In 2015, USGS explicitly applied its jurisdiction to space.[28] Importantly, USGS actively analyzes natural resources on asteroids, the moon, and other celestial bodies to, among other things, help develop the domestic framework for space mining.[29]

Executive Order 13914, *Encouraging International Support for the Recovery and Use of Space Resources*, was issued in April 2020 and directed the Department of State, Department of Commerce, and National Aeronautics and Space Administration (NASA) to take appropriate actions to encourage international support for public and private recovery and use of space resources.[30]Other countries have also "enacted domestic legislation permitting and regulating space mining activities," such as Japan, Luxembourg, and the United Arab Emirates.[31]

International Governance Frameworks for Space Mining

There are three main international governance frameworks for space mining: the Outer Space Treaty, the Moon Agreement, and the Artemis Accords.[32]

1. *Outer Space Treaty*: The Outer Space Treaty, executed in 1967, is the foundational treaty governing space activities, with over 100 countries as signatories.[33] Articles I and II of the Outer Space Treaty pertain to space mining and ISRU. These Articles establish outer space as the "province of all mankind" and prevent claims of sovereignty in space.[34]

2. *Moon Agreement*: The Moon Agreement, signed in 1979 and executed in 1984, is a multilateral agreement with eleven signatories.[35] Article 11 of the Agreement states that the surface and subsurface of the Moon and its resources cannot become the property of any country, intergovernmental organization, or non-governmental entity.[36] The United States, Russia, and China have not signed the Moon Agreement.

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[25] 43 U.S.C. §31(a); Rachel Lindbergh, *Space Resource Extraction: Overview and Issues for Congress*, CONG. RESEARCH SERVICE (July 29, 2024), https://www.crs.gov/reports/pdf/R48144/R48144.pdf.
[26] P.L. 87-626; 43 U.S.C. §31(b); Rachel Lindbergh, *Space Resource Extraction: Overview and Issues for Congress*, CONG. RESEARCH SERVICE (July 29, 2024), https://www.crs.gov/reports/pdf/R48144/R48144.pdf.
[27] Rachel Lindbergh, *Space Resource Extraction: Overview and Issues for Congress*, CONG. RESEARCH SERVICE (July 29, 2024), https://www.crs.gov/reports/pdf/R48144/R48144.pdf.
[28] *Id.*
[29] *Id.*
[30] EXEC. ORDER NO. 13914, 85 Fed. Reg. 20381 (Apr. 6, 2020), https://www.federalregister.gov/documents/2020/04/10/2020-07800/encouraging-international-support-for-the-recovery-and-use-of-space-resources.
[31] Melissa de Zwart, et al., *Space resource activities and the evolution of international space law*, 211 ACTA ASTRONAUTICA, (Oct. 2023), https://www.sciencedirect.com/science/article/pii/S0094576523002977.
[32] *Id*.
[33] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, G.A. Res. 2222, (Jan. 27, 1967), https://treaties.un.org/doc/Publication/UNTS/Volume%20610/volume-610-I-8843-English.pdf.
[34] *Id*.
[35] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, G.A. Res. 34/68, A/RES/34/68 (Dec. 5, 1979), https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXIV-2&chapter=24&clang=_en.
[36] *Id*.

3. *Artemis Accords*: The Artemis Accords, initiated in 2020, are a U.S.-led, non-binding multilateral agreement among nations that establishes a set of principles and guidelines for space exploration.[37] Signing the Artemis Accords is a prerequisite for participation in NASA's Artemis program, a robotic and human lunar exploration program.[38] Section 10 of the Artemis Accords directs signatories to extract and utilize space resources in accordance with the Outer Space Treaty.[39]

Space Mining Has Almost Limitless Potential

Natural resources on the Moon, Mars, and asteroids may improve conditions on Earth and allow humanity to expand further into space.[40] Celestial bodies, such as moons and asteroids, contain potentially enormous amounts of metals and minerals. For example, the average geological concentration of certain metals is much higher in metallic asteroids than on Earth.[41] Researchers at the Colorado School of Mines and the International Monetary Fund found evidence that this is especially true for critical minerals such as cobalt, nickel, platinum, and other metals.[42] Notably, the study found that metallic asteroids contain more than a thousand times as much nickel as the Earth's crust in terms of grams per metric ton.[43]

The density and abundance of minerals on celestial bodies makes the economic potential for space mining almost incomprehensible. Asterank, an asteroid database project that studies asteroid composition and measures the potential value of over 6,000 asteroids that NASA currently tracks, has determined that mining just the top 10 most cost-effective asteroids, those that are both closest to Earth and greatest in value, would produce a profit of around $1.5 trillion.[44]

Space Mining Supplements Mining on Earth

An emerging technology, mining minerals in space is currently not possible without crucial support from the domestic mining industry. For example, American space mining companies typically "rideshare" on commercial spaceflight operations, many of whom utilize a large quantity of stainless steel in building their rockets.[45] The mining companies themselves often build their own robotics systems, which use both "off the shelf" and proprietary components,

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[37] *Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes*, NASA & THE U.S. DEPT. OF STATE (Oct. 13, 2020), https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf.
[38] Christian Davenport, *NASA unveils new principles for space exploration*, WASH. POST (May 15, 2020), https://www.washingtonpost.com/technology/2020/05/15/moon-rules-nasa-artemis/.
[39] *Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes*, NASA & THE U.S. DEPT. OF STATE (Oct. 13, 2020), https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf.
[40] *See* Philip T. Metzger et al., *Affordable, Rapid Bootstrapping of the Space Industry and Solar System Civilization*, 26 JOURNAL OF AEROSPACE ENGINEERING (Apr. 2, 2012), https://ascelibrary.org/doi/10.1061/%28ASCE%29AS.1943-5525.0000236.
[41] Kevin M. Cannon et al., *Precious and structural metals on asteroids*, 225 PLANETARY AND SPACE SCIENCE (Jan. 2023), https://www.sciencedirect.com/science/article/pii/S0032063322001945#bib41.
[42] Max Fleming et al., *Mining in space could spur sustainable growth*, 120 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, (Oct. 2023), https://www.pnas.org/doi/10.1073/pnas.2221345120.
[43] *Id*.
[44] *See* Shriya Yarlagadda, *Economics of the Stars: The Future of Asteroid Mining and the Global Economy*, HARVARD INTERNATIONAL REVIEW (Apr. 8, 2022), https://hir.harvard.edu/economics-of-the-stars/.
[45] *SpaceX Relies on Stainless-Steel for Starship Mars Rocket*, WORLD STEEL ASSOCIATION, https://worldsteel.org/media/steel-stories/innovation/spacex-relies-on-stainless-steel-for-starship-mars-rocket/.

some of which, like most modern communications systems, require critical and rare earth minerals.[46]

In due course, the resources extracted from celestial bodies may directly benefit domestic mining operations by increasing the availability of necessary minerals. While regulatory burdens continue to slow mining in the United States, foreign nations like China choke off exports, and existing domestic mineral supplies shrink, minerals mined in space could be used on Earth to build chips and machinery necessary to support terrestrial mining and other industries.

The technologies developed for mining in space can be used to advance domestic mining, improving operations. For example, advanced imaging systems used to identify celestial bodies ideal for mining can be used on Earth to more effectively identify the locations of natural resources beneath the Earth's surface.[47] Other technologies with potentially significant crossover include robotics for surface and subterranean exploration and material extraction, advanced navigation systems, life support systems and lasers to break up extracted materials.[48]

That advancements in space mining can and do benefit terrestrial mining operations can be seen by observing coordination between the domestic and space mining industries. Companies like Caterpillar and Rio Tinto have not only invested in applying their existing mining technologies to mining in space, but also in understanding how novel space mining technologies can be applied to projects on Earth in harsh conditions where modern machinery being used struggles to perform adequately.[49]

Space Mining is a Reality, not a Pipe Dream

In contrast to the federal regulatory morass that stymies domestic development of America's mineral resources, mineral extraction in space is moving rapidly. Though this may seem like a far-off concept, private industry in the U.S. has driven novel technological developments, increased manufacturing capacity for spacecraft, and implemented ride-share-like programs for rocket launches to reduce costs and timelines for space missions.[50] As a result of these developments, U.S. companies like AstroForge, Karman+, Black Moon Energy Corporation, and Starpath Robotics, are actively pursuing space mineral extraction and are creating supply chains in space, with several promising missions scheduled over the next few years.[51]

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[46] Douglas Gorman, *AstroForge Unveils New Spacecraft for Deep Space Mission*, PAYLOAD (July 31, 2024), https://payloadspace.com/astroforge-unveils-new-spacecraft-for-deep-space-mission/.
[47] *See* Esa Nummi, *Technology from Space May Help Mining on Earth*, THERMO FISHER SCIENTIFIC (Aug. 23, 2016), https://www.thermofisher.com/blog/mining/technology-from-space-may-help-mining-on-earth/.
[48] *Space Technology Goes Down to Earth to Support Mining*, THE EUROPEAN SPACE AGENCY (Dec. 30, 2003), https://www.esa.int/About_Us/Business_with_ESA/Business_Opportunities/Space_technology_goes_down_to_Earth_to_support_mining.
[49] Luigi Scatteia and Yann Perrot, *Lunar Market Assessment: Market Trends and Challenges in the Development of a Lunar Economy*, PWC (Sept. 2021), https://www.pwc.com.au/industry/space-industry/lunar-market-assessment-2021.pdf; Rachel Lindbergh, *Space Resource Extraction: Overview and Issues for Congress*, CONG. RESEARCH SERVICE (July 29, 2024), https://www.crs.gov/reports/pdf/R48144/R48144.pdf.
[50] Ibtisam Abbasi, *Mining Equipment in Space: The Future of Extraterrestrial Resource Extraction*, AZO MINING (Nov. 23, 2023), https://www.azomining.com/Article.aspx?ArticleID=1773.
[51] Even the U.S. government has been successful in exploring extraterrestrial bodies. In 1996, NASA launched a spacecraft, NEAR Shoemaker, that orbited and eventually landed on an asteroid in 2001. In 2016, NASA and the European Space Agency jointly launched a spacecraft, Rosetta Philae, that successfully landed on a comet. In 2023, NASA's OSIRIS-REx mission collected a physical sample from an asteroid and returned it back to Earth.

Not only can the minerals mined in space eventually be brought back to bolster supply chains in the United States, but the technologies developed for mining in harsh deep space conditions can be applied to modern mining projects on Earth to more easily access and process minerals.

In addition, mineral extraction in space also has the potential to provide minerals, fuels, and elements that are not readily accessible on earth, particularly Helium-3.[52] Helium-3 is a non-radioactive isotope that is identified as a an "ideal fuel for the operation of a fusion reactor."[53] The significant presence of Helium-3 on the Moon was initially confirmed by "lunar samples brought back to Earth from the Apollo 11, 12, 14-17 missions and the Luna 16 and 20 missions."[54] The Black Moon Energy Corporation (BMEC) has estimated that the Helium-3 gross resource on the Moon is approximately 1.7 million metric tons.[55] BMEC has developed a plan to "delineate and retrieve the Helium-3 resource from the lunar surface and bring it to Earth" for use in fusion reactors.[56]

These efforts collectively represent a first step for the space mining industry and a giant leap for mankind's ability to use natural resources found in our universe effectively. As technology progresses at a rapid pace, costs are further reduced, and collaboration in the industry continues, the U.S. could not only develop the ability to harness vast space resources but also apply these technologies to mining operations on Earth to secure U.S. mineral supply chains.

Like most sectors, the mining industry has historically been driven by new and innovative technology. Today, promising new technologies in mapping, data, refining efficiencies, and more promise to upend the industry just as updates in machinery, robotics, and basic safety equipment did in years past.[57] The time is now to embrace both permitting reform for domestic mining and new technologies that will ultimately benefit all forms of mining as the United States seeks to secure its domestic supply chain. This is crucial not only for developing emerging technologies but also for ensuring national security.

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[52] Dana A. Shea & Daniel Morgan, *The Helium-3 Shortage: Supply, Demand, and Options for Congress* (R41419), CONG. RESEARCH SERVICE (Dec. 22, 2010), https://sgp.fas.org/crs/misc/R41419.pdf.
[53] Florian Vidal, *Helium-3 from the lunar surface for nuclear fusion*?, POLYTECHNIQUE INSIGHTS (May 17, 2022), https://www.polytechnique-insights.com/en/braincamps/space/extraterrestrial-mining/helium-3-from-the-lunar-surface-for-nuclear-fusion/.
[54] Aaron D.S. Olson, *Lunar Helium-3: Mining Concepts, Extraction Research, and Potential ISRU Synergies*, NASA KENNEDY SPACE CENTER (2021), https://ntrs.nasa.gov/api/citations/20210022801/downloads/AIAA%20ASCEND%202021%20Paper_211018.pdf.
[55] Black Moon Energy Corporation, Congressional Deck (February 2025). On file with Committee.
[56] Black Moon Energy Corporation, Elevator Pitch (April 21, 2024). On file with Committee.
[57] Miranda Barker, *Innovation Can Disrupt the Mining Industry. These Sustainable Start-Ups are Leading the Way*, WORLD ECONOMIC FORUM (Nov. 29, 2024), https://www.weforum.org/stories/2024/11/13-innovations-making-the-mining-and-metals-industry-more-sustainable/.