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A Legal Regime for the Mining of Helium-3 on the Moon: U.S. Policy Options

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Abstract

Absent an agreed international legal framework, attempts by the United States or any other nation or private entity to acquire and bring to Earth significant quantities of He-3 could give rise to controversy and conflict. Consequently, it seems timely to revisit the issue of the legal regime potentially applicable to exploiting He-3 and other lunar resources. Part I of this Article will briefly discuss the technical and economic prospects for the develop of He-3-based fusion energy. Part II lays out the present legal situation concerning the exploitation of lunar resources such as He-3. Part III analyzes whether it is prudent for the United States to seek an international lunar resource regime. Concluding that it would be, Part IV provides possible policy options for the United States concerning the establishment of an international legal regime capable of facilitating the development of He-3-based fusion energy.

ARTICLES

A LEGAL REGIME FOR THE MINING OF HELIUM-3 ON THE MOON: U.S. POLICY OPTIONS

*Richard B. Bilder**

During the past several years, the United States and three of the world's other leading space powers, Russia, China, and India, have each announced their intent to establish a base on the Moon, in part with the purpose—or, in the case of the United States, at least the exploratory goal—of seeking to mine and bring to Earth helium-3 ("He-3"), an isotope[1] of helium rarely found naturally on Earth but believed to be present in large amounts as a component of the lunar soil.[2] The potential value of

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This Article draws upon and develops material in an earlier study by Richard B. Bilder, Eugene N. Cameron, Gerald L. Kulcinski, and Harrison H. Schmitt, LEGAL REGIMES FOR THE MINING OF HELIUM-3 FROM THE MOON (1989), *available at* http://fti.neep.wisc.edu/pdf/wcsar8901-1.pdf, prepared under the auspices of the Wisconsin Center for Space Automation and Robotics ("WCSAR") for the National Aeronautics and Space Administration ("NASA"). I also draw considerably for my discussion of technical aspects of lunar helium-3 ("He-3") mining and the potential for He-3 fusion energy from HARRISON H. SCHMITT, RETURN TO THE MOON: EXPLORATION, ENTERPRISE, AND ENERGY IN THE HUMAN SETTLEMENT OF SPACE (2006).

I wish to express my appreciation for helpful comments to Professor Gerald L. Kulcinski, Grainger Professor of Nuclear Engineering and Director of the Fusion Technology Institute at the University of Wisconsin-Madison; Professor John F. Santarius, Associate Director of the Fusion Technology Institute at the University of Wisconsin-Madison; former Senator Dr. Harrison H. Schmitt, who conducted geological studies on the Moon as a member of the crew of the 1972 Apollo 17 lunar landing mission; and Professor Bernard Oxman of the University of Miami Law School. However, their generous assistance should not be regarded as necessarily indicating their agreement with my legal analysis or policy suggestions.

1. An isotope is a chemical element form that holds a different number of neutrons in its nucleus than the other isotopes of the element and therefore carries a different atomic mass but retains its atomic number. *See, e.g.*, The Artemis Project, Lunar Helium-3 as an Energy Source, in a Nutshell, http://www.asi.org/adb/02/09/he3-intro.html (last visited Feb. 10, 2010).

2. The commitment of former President George W. Bush's administration to a U.S. return to the Moon by 2020 is described below. However, as this Article goes to print, the U.S. plan to return to the Moon has been cast into doubt by President Barack

Obama. On February 1, 2010, he submitted the administration's proposed 2011 budget for the NASA, which would put an end to NASA's Moon-bound Constellation program and effectively eliminate funds for any future U.S. manned lunar missions. *See* Joel Achenbach, *Sun Sets on NASA Moon Mission as 2011 Budget Scales Back Goals*, WASH. POST, Feb. 1, 2010, at A8; Kenneth Chang, *Billions for NASA, With a Push to Find New Ways Into Space*, N.Y. TIMES, Feb. 2, 2010, at A16. President Obama's proposed cancellation of NASA's Moon program has given rise to criticism. *See, e.g.*, Christopher Caldwell, *One Step Back for Mankind*, FINANCIAL TIMES (London), Feb. 6, 2010, at 7; Kenneth Chang, *Under Fire Administrator Defends NASA's New Direction*, N.Y. TIMES, Feb. 26, 2010, at A17; Amy Klamper, *Angst Greets Obama Space Plan*, SPACE NEWS, Jan. 29, 2010, http://www.spacenews.com/policy/100129-angst-greets-obama-space-plan.html; Harrison H. Schmitt, *Obama Space Policy Cedes Moon to China, Space Station to Russia and Liberty to the Ages*, FREE REPUBLIC, Feb. 6, 2010, http://www.freerepublic.com/focus/f-news/2445788/posts. As of this writing, it is uncertain whether Congress will agree to President Obama's change in direction. *See* Achenbach, *supra*.

On January 14, 2004, President George W. Bush committed the United States to a long-term human and robotic program to explore the solar system, starting with a return to the Moon by 2020. *See* Press Release, Office of the Press Sec'y, President Bush Announces New Vision for Space Exploration Program: Fact Sheet (Jan. 14, 2004), *available at* http://georgewbush-whitehouse.archives.gov/news/releases/2004/01/20040114-1.html; John King & Miles O'Brien, *Bush Unveils Vision for Moon and Beyond*, CNN, Jan. 15, 2004, http://www.cnn.com/2004/TECH/space/01/14/bush.space/; David E. Sanger & Richard W. Stevenson, *Bush Backs Goal of Flight to Moon to Establish Base*, N.Y. TIMES, Jan. 15, 2004, at A27.

In December 2006, NASA announced more detailed plans for a United States return to the Moon by 2020 and the establishment of a permanent lunar base by as early as 2024. *See, e.g.*, Marc Kaufman, *NASA Plans Lunar Outpost; Permanent Base at Moon's South Pole Envisioned by 2024*, WASH. POST., Dec. 5, 2006, at A1; Warren E. Leary, *NASA Plans Permanent Base for Exploration on the Moon*, N.Y. TIMES, Dec. 5, 2006, at A20. In May, 2007, NASA released THE GLOBAL EXPLORATION STRATEGY: THE FRAMEWORK FOR COORDINATION (2007), *available at* http://www.nasa.gov/pdf/178109main_ges_framework.pdf [hereinafter NASA, GLOBAL EXPLORATION STRATEGY], a document developed by fourteen national space agencies, including NASA, presenting a vision and plan for international collaboration in space exploration, including exploration of the Moon. *The Global Exploration Strategy* notes that: "Finally, the Moon's known abundance of Helium-3 could prove valuable if fusion reactors ever become feasible in the future," *id.* at 11, and NASA includes the study of lunar helium-3 for "fusion reactors on Earth" to "reduce Earth's reliance on fossil fuels" among its list of goals for future lunar missions. *See* NATIONAL AERONAUTICS AND SPACE ADMINISTRATION [NASA], LUNAR EXPLORATION OBJECTIVES 4 (2006), *available at* www.nasa.gov/pdf/163560main_LunarExplorationObjectives.pdf. According to Mark Williams, "While the U.S. Space Agency has neither announced nor denied any desire to mine helium-3, it has nevertheless placed advocates of mining helium-3 in influential positions." Mark Williams, *Mining the Moon: Lab Experiments Suggest that Future Fusion Reactors Could Use Helium-3 Gathered from the Moon*, MIT TECH. REV., Aug. 23, 2007, at 1.

On June 18, 2009, NASA launched its Lunar Reconnaissance Orbiter to conduct investigations for supporting future human exploration to the Moon. *See* Press Release, NASA, NASA Returning to the Moon with First Lunar Launch in a Decade (Dec. 18, 2009), *available at* http://www.nasa.gov/home/hqnews/2009/jun/HQ_09-142_LRO_Launch_Success.html; Jeffrey Kluger, *U.S. Shoots for the Moon, This Time to Stay*, TIME, June 18, 2009, http://www.time.com/time/health/article/0,8599,1905344,00.html. *See*

generally NASA, Lunar Reconnaissance Orbiter Website: Mission Overview, http://lunar.gsfc.nasa.gov/mission.html (last visited Feb. 10, 2010) (describing the technical aspects of the orbiter and the mission).

For the possible impact of budgetary limitations on NASA's proposed lunar programs, possibly presaging President Obama's subsequent change in policy, see the recent October 22, 2009 report by the blue-ribbon Review of U.S. Human Spaceflight Committee, appointed by President Obama, and chaired by Norman Augustine, REVIEW OF U.S. HUMAN SPACEFLIGHT COMMITTEE, SEEKING A HUMAN SPACEFLIGHT PROGRAM WORTH OF A GREAT NATION (2009) (suggesting that NASA should bypass the Moon for now). For comment on the report see, for example, Kenneth Chang, *Behind Moon Travel Goal, Big Talk and Little Money*, N.Y. TIMES, Aug. 25, 2009, at D2; Dennis Overbye, *NASA Panel Grapples with Cost of Space Plans*, N.Y. TIMES, Aug. 13, 2009, at A20; Robert S. Boyd, *Money Woes Likely to Hobble NASA's Planned Moon Mission*, MCCLATCHYDC.COM, Sept. 3, 2009, http://www.mcclatchydc.com/washington/story/74870.html.

On Russia, see *Russia to Launch Industrial Mining of Helium-3 on Moon in 2020*, PRAVDA, Mar. 17, 2006, at 1, *available at* http://english.pravda.ru/science/tech/77404-moon-0. In fact, a statement by Nikolai Sevastianov, head of the S.P. Korolev Rocket and Space Corporation "Energia," in January 2006, disclosed that mining helium-3 on the Moon is a main goal of the Russian space exploration program: "We are planning to set up a permanent station on the Moon by 2015. The industrial mining of helium-3, a rare isotope, is expected to begin on the Moon in 2020." *Id.*; *see also* AGENCE FRANCE-PRESSE, *Russia Plans Mine on the Moon by 2020*, SPACE DAILY, Jan. 25, 2006, http://www.spacedaily.com/reports/Russia_Plans_Mine_On_The_Moon_By_2020.html.

On China, see, for example, Jia Hepeng, *He Asked for the Moon—and Got It*, CHINA DAILY, Nov. 2, 2009, at 1 (quoting cosmochemist and geochemist Ouyang Ziyuan of the Chinese Academy of Sciences, now in charge of the Chinese Lunar Exploration program, as noting on many occasions that one of the many goals of the program would be the mining of helium-3 from which "each year three space shuttle missions could bring enough fuel for all human beings across the world"); *see also Aiming High: China Is Moving Heaven and Earth to Put a Man on the Moon*, ECONOMIST, Oct. 24, 2009, at 13; Melinda Liu & Mary Carmichael, *To Reach for the Moon: China's Lunar Program is About More than National Pride; Try This: A Limitless Supply of Clean, Safe Energy*, NEWSWEEK, Feb. 12, 2007, at 38; Casey Kazan, *China's New Moon Mission Blasts Off—Is Mining Helium 3 the Ultimate Goal?*, DAILYGALAXY.COM, Oct. 25, 2007, http://www.dailygalaxy.com/my-weblog/2007/10/chinas-new-moon.html; *China Tools up for Asian Space Race*, SPACEDAILY.COM, July 12, 2009, http://www.spacedaily.com/reports/China_tools_up_for_Asian_space_race_999.html.

On India, see Somini Segupta, *India Launches Unmanned Orbiter to Moon*, N.Y. TIMES, Oct. 22, 2008, at A8; Atul Sethi, *Helium-3 Sparks Interest in Moon*, TIMES OF INDIA, Oct. 23, 2008, http://timesofindia.indiatimes.com/HealthSci/Helium-3_sparks_interest_in_moon/articleshow/3631756.cms; Posting of Naxal Watch to INTELLIBRIEFS, http://intellibriefs.blogspot.com (Oct. 22, 2008, 2:32 AM EST).

Japan is also planning a manned mission to the Moon by 2020 and an operational lunar base by 2030. *See*, Michio Kaku, *The New Race for the Moon*, WALL ST. J., June 23, 2009, at A13. For a broader discussion on recent activities of member states of the United Nations ("U.N.") Committee on the Peaceful Uses of Outer Space ("COPUOS") relating to the Moon, see U.N. Comm. on Peaceful Uses of Outer Space [COPUOS], Legal Sub-Comm., *Note by the Secretariat: Activities Being Carried Out or to Be Carried Out on the Moon and Other Celestial Bodies, International and National Rules Governing those Activities and Information Received from States Parties to the Agreement Governing the Activities of States*

He-3 is that it is theoretically an ideal fuel for thermonuclear fusion power reactors, which could serve as a virtually limitless source of safe and non-polluting energy.[3] For example, it is estimated that forty tons of liquefied He-3 brought from the Moon to the Earth—about the amount that would comfortably fit in the cargo bays of two current U.S. space shuttles—would provide sufficient fuel for He-3 fusion reactors to meet the full electrical needs of the United States, or one quarter of the entire world's electrical needs, for an entire year.[4]

While the technological and economic feasibility of fusion-based nuclear energy, particularly fusion reactors utilizing He-3

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on the Moon and Other Celestial Bodies about the Benefits of Adherence to that Agreement, ¶¶ 4–18, U.N. Doc. A/AC.105/C.2/L.271/Add.1 (Oct. 22, 2008).

For further reading, see generally Adrian Blomfield, *Russians Suspect a Plot as NASA Backs Out of Joint Moon Exploration*, DAILY TELEGRAPH, May 1, 2007, at 18 (reporting that many countries, including China, Germany, India, Russia, and the United States, are taking the possibility of mining lunar He-3 "very seriously"); Jeffrey Kluger, *40 Years Later, It's Moon Race 2.0*, TIME, Nov. 24, 2008; John Lasker, *Race to the Moon for Nuclear Fuel*, WIRED, Dec. 15, 2006, http://www.wired.com/science/space/news/2006/12/72276; Williams, *supra*.

3. *See* L.J. Wittenberg et al., *Lunar Source of He-3 for Commercial Fusion Power*, 10 FUSION TECH. 167 (1986) [hereinafter Wittenberg et al., *Lunar Source of He-3*]; *see also* BILDER ET AL., LEGAL REGIMES FOR THE MINING OF HELIUM-3 FROM THE MOON (1989) ; HARRISON H. SCHMITT, RETURN TO THE MOON: EXPLORATION, ENTERPRISE, AND ENERGY IN THE HUMAN SETTLEMENT OF SPACE 13-33, 71-75 (2006) [hereinafter SCHMITT, RETURN TO THE MOON]; *see also* Harrison H. Schmitt, *Mining the Moon*, POPULAR MECHANICS, Oct. 2004, at 56; Timothy Ferris, Op-Ed, *A New Pathway to the Stars*, N.Y. TIMES, Dec. 21, 2003, at 49; Lawrence E. Joseph, Op-Ed, *Who Will Mine the Moon?*, N.Y. TIMES, Jan. 19, 1995, at A19 (in which he asks, "Will the Moon become the Persian Gulf of the 21st Century?"); Gary Cramer, *There's Helium-3 in Them There Moon Hills!*, Dec. 14, 2004, http://www.direct.ca/trinity/helium3.htm; *Moon Gas May Solve Earth's Energy Crisis*, Nov. 26, 2004, ABC NEWS, http://www.abc.net.au/news/newsitems/200411/s1252715.htm; Julie Wakefield, *Researcher's and Space Enthusiasts See Helium-3 as the Perfect Fuel Source*, SPACE.COM, June 30, 2000, http://www.space.com/scienceastronomy/helium3_000630.html; Williams, *supra* note 2.

In MOON (Sony Pictures 2009), a recently released science fiction movie, the protagonist is an astronaut sent to the Moon on contract with a private Japanese company to mine helium-3 to be used in terrestrial fusion energy reactors, which, at that time, supply seventy percent of the world's energy. *See id.*

4. Estimate given to author by Professor Gerald Kulcinski, Director of the Fusion Technology Institute, University of Wisconsin-Madison; *cf.* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 5 ("One metric tonne (2200 lbs.) of helium-3 fused with deuterium . . . has enough energy to supply a city of ten million, or one-sixth of the population of the United Kingdom, with a year's worth of electricity, or over ten gigawatts of power for that year."). For earlier estimates, see G.L. KULCINSKI & H.H. SCHMITT, THE MOON: AN ABUNDANT SOURCE OF CLEAN AND SAFE FUSION FUEL FOR THE 21ST CENTURY 29 (1987); BILDER ET AL., *supra* note 3, at 32; The Artemis Project, *supra* note 1.

as fuel, is still uncertain and contested, and its commercial realization at best decades away,[5] the implications of such a development could be far-reaching and profound. Fusion energy could significantly reduce the world's heavy dependence on fossil fuels, which are associated with environmental pollution, greenhouse gas emissions, and global warming—not to mention their rising price and role in recurrent geopolitical and economic tensions. Fusion energy could also provide a safer alternative to many countries' growing reliance on energy generated from nuclear fission reactors, which hold the potential dangers of nuclear accidents, terrorism, weapons proliferation, and radioactive waste disposal. Moreover, in contrast to the prospect of depletion of terrestrial fossil fuels, it is estimated that there is sufficient He-3 present on the Moon to meet humanity's rapidly growing energy needs for many centuries to come.[6] Thus, despite the problematic future of He-3-based fusion energy, it is not surprising that the United States and other major powers are beginning to position themselves to ensure their future access to lunar He-3 resources.

However, the growing interest in lunar He-3 poses its own problems. As yet, there is no international consensus on whether, or how, any nation or private entity can exploit or acquire title to lunar resources. The U.N.-developed 1967 Outer Space Treaty[7] does not specifically address this question. The related U.N.-sponsored 1979 Moon Agreement[8] purports to lay the groundwork for the eventual establishment of a regime for the exploitation of lunar resources, but that agreement has thus far been ratified by only a very few countries—not including the United States and none of which are currently leading space

5. *See, e.g.*, MSNBC Cosmic Log, http://cosmiclog.msnbc.msn.com (Apr. 2, 2008, 7:25 EST); *see also* Marvin L. Adams, *Sustainable Energy from Nuclear Fission Power*, BRIDGE, Winter 2002, at 20–27 (2002).

6. *See* Adams, *supra* note 5, at 24.

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

8. Agreement on the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement]. While the agreement is referred to by the U.N., and will be referred to in this Article, as "the "Moon Agreement," it is more commonly referred to in relevant literature as the "Moon Treaty." *See, e.g.*, references cited *infra* note 10.

powers.[9] Absent an agreed international legal framework, attempts by the United States or any other nation or private entity to acquire and bring to Earth significant quantities of He-3 could give rise to controversy and conflict. Indeed, without the security of an established legal regime, nations or private entities might well be reluctant to commit the very substantial money, effort, and resources necessary to mine, process, and transport back to Earth the amounts of lunar He-3 sufficient to support the broad-scale terrestrial use of He-3-based fusion energy.

Consequently, it seems timely to revisit the issue of the legal regime potentially applicable to exploiting He-3 and other lunar resources.[10] Part I of this Article will briefly discuss the technical

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9. *See, e.g.*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, U.N. TREATIES AND PRINCIPLES ON OUTER SPACE AND RELATED GENERAL ASSEMBLY RESOLUTIONS: STATUS OF INTERNATIONAL AGREEMENTS RELATING TO ACTIVITIES IN OUTER SPACE AS OF 1 JANUARY 2009, U.N. Doc. ST/SPACE/11/Rev.2/Add.2, U.N Sales No. E08.I.10 (2009) [hereinafter STATUS OF OUTER SPACE AGREEMENTS].

10. The Moon Agreement, and the question of the legal regime applicable to the exploitation of lunar resources, has spawned a surprisingly extensive literature, particularly in the early 1980's following the Moon Agreement's completion by COPUOS and its submission for consideration by the United States and other nations. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 275–98; BILDER ET AL., *supra* note 3, at 36–70, 76–109; *see also The Moon Treaty: Hearings before the Subcomm. on Science, Technology, and Space of the S. Comm. on Commerce and Transportation*, 96th Cong. (1980) [hereinafter *1980 Senate Hearings*]; STAFF OF SUBCOMM. ON SCIENCE, TECHNOLOGY, AND SPACE OF S. COMM. ON COMMERCE AND TRANSPORTATION, 96TH CONG., REPORT OF EILENE GALLOWAY (Comm. Print 1980) (providing an analytical study of the background, history, and issues raised by the Moon Agreement); STAFF OF SUBCOMM. ON SCIENCE, TECHNOLOGY, AND SPACE OF S. COMM. ON COMMERCE AND TRANSPORTATION, 96TH CONG., REPORT OF OFFICE OF TECHNOLOGY ASSESSMENT (Comm. Print 1980) (presenting a study of technologies and possibilities for the exploitation of extraterrestrial resources and an analysis of issues, constraints, and possible congressional actions regarding the Moon Agreement); STAFF OF SUBCOMM. ON SCIENCE, TECHNOLOGY, AND SPACE OF S. COMM. ON COMMERCE AND TRANSPORTATION, 96TH CONG., REPORT OF CONGRESSIONAL RESEARCH SERVICE (Comm. Print 1980) (reviewing the technological, foreign policy, and legal issues which may arise in connection with examination of the Moon Agreement) [collectively hereinafter 1980 SENATE COMMITTEE STUDIES]. *See generally* KERNAL BASLAR, THE CONCEPT OF THE COMMON HERITAGE OF MANKIND IN INTERNATIONAL LAW 159–204 (1998); CARL Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 246–341 (1982) [hereinafter CHRISTOL, MODERN LAW OF OUTER SPACE]; M.J. PETERSON, INTERNATIONAL REGIMES FOR THE FINAL FRONTIER 153–72 (2005); VIRGILIU POP, WHO OWNS THE MOON: EXTRATERRESTRIAL ASPECTS OF LAND AND MINERAL RESOURCES OWNERSHIP (2008); GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 102–66 (1989) (collecting articles, with comments).

Among the many relevant articles, see, for example, A. Blaser, *The Common Heritage in Its Infinite Variety: Space Law and the Moon in the 1990s*, 5 J. L. & TECH. 79 (1990); Bin Cheng, *The Moon Treaty: Agreement Governing the Activities of States on the Moon and Other*

and economic prospects for the development of He-3-based fusion energy. Part II lays out the present legal situation concerning the exploitation of lunar resources such as He-3. Part III analyzes whether it is prudent for the United States to seek an international lunar resource regime. Concluding that it would

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Celestial Bodies Within the Solar System Other than the Earth, December 18, 1979, 33 CURRENT LEGAL PROBS. 213 (1980); Carl Q. Christol, *The Common Heritage of Mankind Provision in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 14 INT'L LAW. 429 (1980) [hereinafter Christol, *Common Heritage*]; Gennady M. Danilenko, *The Concept of the "Common Heritage of Mankind" in International Law*, 13 ANNALS AIR & SPACE L. 247 (1988); Michael E. Davis & Ricky J. Lee, *Twenty Years After: The Moon Agreement and Its Legal Controversies*, 1999 AUSTL. INT'L L.J. 9 (1999); Stephen E. Doyle, *Legal and Policy Implications of Treating Natural Resources as the Common Heritage of Mankind*, *in* PROCEEDINGS OF THE 29TH COLLOQUIUM ON THE LAW OF OUTER SPACE 31 (Amer. Inst. Aeronautics & Astronautics ed. 1986); Arthur M. Dula, *Free Enterprise and the Proposed Moon Treaty*, 2 HOUS. J. INT'L L. 3 (1979); E. Galloway, *Issues in Implementing the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, *in* REYNOLDS & MERGES, *supra*, at 116–18; D. Goedhuis, *Conflicts in the Interpretation of the Leading Principles of the Moon Treaty of 5 December 1979*, 28 NETH. INT'L L. REV. 14, 14–29 (1981); D. Goedhuis, *Some Recent Trends in the Interpretation and the Implementation of the Rules of International Space Law*, 19 COLUM. J. TRANSNAT'L L. 213, 213–33 (1981); D. Goedhuis, *The Conflicts in the Interpretation of the Leading Principles of the Moon Treaty of 1979*, 60 INT'L L. ASS'N CONF. REP. 479 (1982) [hereinafter Goedhuis, *Conflicts*]; Nathan C. Goldman, *The Moon Treaty: Reflections on the Proposed Moon Treaty, Space Law, and the Future*, *in* PEOPLE IN SPACE: POLICY PERSPECTIVES FOR A "STAR WARS" CENTURY 140 (James Everett Katz ed., 1985); Brian Hoffstadt, *Moving the Heavens: Lunar Mining and the "Common Heritage of Mankind" in the Moon Treaty*, 42 UCLA L. REV. 575 (1994); N. Jasentuliyana, *The U.N. Space Treaties and the Common Heritage Principle*, 2 SPACE POLICY 296 (1986); Christopher C. Joyner, *Legal Implications of the Concept of the Common Heritage of Mankind*, 35 INT'L & COMP. L.Q. 190 (1986); Fracis Lyall, *On the Moon*, 26 J. SPACE L. 129 (1998); David Everett Marko, *A Kinder, Gentler Moon Treaty: A Critical Review of the Current Moon Treaty and Proposed Alternative*, 8 J. NAT. RESOURCES & ENVT'L L. 293 (1993); K. Narayana Rao, *Common Heritage of Mankind and the Moon Treaty*, 21 INDIAN J. INT'L L. 275 (1981); Nina Tannenwald, *Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space*, 29 YALE J. INT'L L. 363 (2004); Kevin B. Walsh, *Controversial Issues Under Article XI of the Moon Treaty*, 5 ANNALS AIR & SPACE L. 489 (1981); Sylvia Maureen Williams, *International Law Before and After the Moon Agreement*, 7 INT'LREL. 1168 (1981); Sylvia Maureen Williams, *The Law of Outer Space and Natural Resources*, 36 INT'L & COMP. L.Q. 142 (1987) [hereinafter Williams, *Law of Outer Space*]; Douglas Alan Barritt, Note, *A Reasonable Approach to Resource Development in Outer Space*, 12 LOY. L.A. INT'L & COMP. L. REV. 615 (1990); Barbara Ellen Heim, Note, *Exploring the Last Frontiers for Mineral Resources: Comparison of International Law Regimes for the Seabed, Outer Space and Antarctica*, 23 VAND. J. TRANSNAT'L L. 819 (1990); Harminderpal S. Rana, Note, *The "Common Heritage of Mankind" & the Final Frontier: A Revaluation of Values Constituting the International Legal Regime for Outer Space Activities*, 26 RUTGERS L.J. 225 (1994); A.D. Webber, Note, *Extraterrestrial Law on the Final Frontier: A Regime to Govern the Development of Celestial Body Resources*, 71 GEO. L.J. 1427 (1983); Kelly M. Zullo, Note, *The Need to Clarify the Status of Property Rights in International Space Law*, 90 GEO. L.J. 2413 (2002).

be, Part IV provides possible policy options for the United States concerning the establishment of an international legal regime capable of facilitating the development of He-3-based fusion energy.

I. *THE PROSPECTS FOR HE-3-BASED FUSION ENERGY*[11]

He-3 is a component of the "solar wind" comprised of gas and charged particles continuously emitted by the sun into the solar system in the course of its thermonuclear fusion processes.[12] During more than four billion years in which the solar wind has impacted the Moon, significant amounts of He-3, in addition to particles of other ionized components of the solar wind, have become embedded in the Moon's regolith—the loose and dusty upper layer of rocks and soil comprising much of the Moon's surface.[13] While He-3 constitutes only a minute proportion of the lunar regolith,[14] it is estimated that, altogether, there may be as much as one million metric tons of He-3 potentially recoverable

11. *See* L.J. Wittenberg et al., *A Review of Helium-3 Resources and Acquisition for Use as a Fusion Fuel*, 21 FUSION TECH. 2230, 2230–53 (1992) [hereinafter Wittenberg et al., *Review of Helium-3*]; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3; *see, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 63–143; BILDER ET AL., *supra* note 3, at 13–35; G.L. Kulcinski & H.H. Schmitt, *Fusion Power From Lunar Resources*, 21 FUSION TECH. 2221 (1992) ; J. Wakefield, *Researchers and Space Enthusiasts See Helium-3 as the Perfect Fuel Source*, SPACE.COM, June 30, 2000, http://www.space.com/scienceastronomy/helium3_000630.html; The Artemis Project, *supra* note 1.

For a description of the University of Wisconsin Fusion Technology Institute's WCSAR research on the development of He-3 energy and a sampling of media coverage regarding He-3, see FTI Research Projects: 3He Lunar Mining, http://fti.neep.wisc.edu/proj?rm=he3. *See generally*, John Lasker, *Future in Fusion? UW Team Involved in Controversial 'Race' to Harness Moon's Energy*, CAPITAL TIMES (Madison, Wis.), Dec. 23–24, 2006, at A1.

12. *See* G.L. KULCINSKI ET AL., MINING HELIUM-3 FROM THE MOON—A SOLUTION TO EARTH'S ENERGY NEEDS IN THE 21ST CENTURY 8 (1990), *available at* http://fti.neep.wisc.edu/pdf/fdm817.pdf. Normal helium, familiar as the gas used for balloons and blimps, consists of two protons and two neutrons. He-3 is a light, stable isotope of helium that contains two protons but only one neutron. The sun produces helium by fusing together hydrogen atoms, releasing enormous amounts of energy, but about one in every ten thousand helium atoms comes out in the form of He-3, missing one neutron. For a brief popular description, see The Artemis Project, *supra* note 1.

13. *See, e.g.*, KULCINSKI ET AL., *supra* note 12, at 8; The Artemis Project, *supra* note 1.

14. *See, e.g.*, E. N. Slyuta, A. M. Abdrakhimov & E. M. Galimov, *The Estimation of Helium-3 Probable Reserves in Lunar Regolith*, 38 LUNAR & PLANETARY SCI. 2175, 2176 (2007).

from the Moon's surface.[15] This amount of He-3 is theoretically equivalent to ten times the energy content of all of the coal, oil, and natural gas economically recoverable on Earth.[16] Since the Earth, unlike the Moon, possesses a magnetic field and atmosphere that deflect the solar wind, He-3 is rarely found naturally on Earth.[17] The small amounts of He-3 available for research and experiment on Earth are derived principally from the decay of tritium used in thermonuclear weapons.[18]

While interest in lunar He-3 relates to its potential use as a fuel for thermonuclear power reactors,[19] the technological and economic feasibility of fusion power itself has yet to be demonstrated.[20] Unlike the engineering and material requirements for power production in the uranium and plutonium-fueled nuclear fission reactors now operating in the United States and a number of other countries, the generation of power by thermonuclear fusion requires the containment of ionized plasmas at extremely high temperatures, a feat not easily or economically achievable at present with existing materials and technology.[21] Nevertheless, the enormous potential of fusion

15. *See* BILDER ET AL., *supra* note 3, at 26; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3, at 8.

16. *See* BILDER ET AL., *supra* note 3, at 32; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3, at 1.

17. *See* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 79–80; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3, at 7–9.

18. *See* BILDER ET AL., *supra* note 3, at 24–25; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3, at 2–7.

19. *See* BILDER ET AL., *supra* note 3, at 13–14; Wittenberg et al., *Lunar Source of He-3*, *supra* note 3, at 1. For a more popular introduction to nuclear fusion, see Craig Freudenrich, *How Nuclear Fusion Reactors Work*, HOWSTUFFWORKS, Aug. 11, 2005, http://science.howstuffworks.com/fusion-reactor.htm. The most likely use of He-3 as a fuel would be together with deuterium ("D"), an isotope of hydrogen, in a thermonuclear power reactor. *See* The Artemis Project, *supra* note 1.

20. *See, e.g.*, T. KENNETH FOWLER, THE FUSION QUEST 200 (1997); W.J. Nuttall, *Fusion as an Energy Source: Challenge and Opportunities* (Sept. 2008), *available at* http://www.iop.org/activity/policy/publications/file_31695.pdf. For expressions of skepticism concerning the practicality of nuclear fusion as a controlled source of energy, see, for example, *Nuclear Fusion: It's Impossible. And What's More, It's Improbable*, ECONOMIST, July 20, 2002, at 69, and Editorial, *Nuclear Fusion Must Be Worth the Gamble*, NEW SCIENTIST, June 7, 2006, at 3.

21. *See* World Nuclear Ass'n, *Nuclear Fusion Power* (Sept. 2009), http://www.world-nuclear.org/info/inf66.html; Ursula Schneider, *Fusion: Energy of the Future*, INT'L ATOMIC ENERGY AGENCY, Aug. 1, 2001, http://www.iaea.org/NewsCenter/News/2001/08012001_news02.shtml; *see also* Conditions for Fusion, Princeton Plasma Physics Lab., http://www.pppl.gov/fusionconditions.cfm (last visited Feb. 10, 2010). For a brief

energy continues to spur persistent and intensive efforts to overcome these obstacles. One of the most significant efforts is the recent establishment, by a consortium of the European Union (through the European Atomic Energy Community), Japan, the People's Republic of China, the Republic of India, the Republic of Korea, the Russian Federation, and the United States, of the International Thermonuclear Experimental Reactor ("ITER"),[22] a large-scale, international experimental research project designed to explore the scientific and engineering feasibility of magnetic containment fusion power production.[23] The program will be located in Cadarache, France, and is expected to cost over US$12 billion and continue for thirty years.[24]

For a number of reasons, including the limited terrestrial availability of He-3 and the very high temperatures required to achieve He-3-based fusion, most current research, and any first generation fusion power reactors, will likely be based on a fuel cycle involving the fusion of deuterium ("D") and tritium ("T"),

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discussion on the current state of technology of controlled thermonuclear fusion, see J.F. SANTARIUS ET AL., A STRATEGY FOR D-^{3}HE FUSION DEVELOPMENT 1 (2006), *available at* http://fti.neep.wisc.edu/pdf/fdm1291.pdf.

22. ITER also translates from Latin as "the way." *See* ITER History, http://www.iter.org/proj/pages/iterhistory.aspx (last visited Feb. 10, 2010).

23. *See generally* Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project, Nov. 21, 2006, 2006 O.J. L 358/62 [hereinafter ITER Agreement]. The International Thermonuclear Experimental Reactor ("ITER") agreement was signed on November 21, 2006. *See* John Tagliabue, *France: Countries Agree to Pursue Fusion Energy*, N.Y. TIMES, Nov. 22, 2006, at A5; Press Release, U.S. Dep't of Energy, U.S. Signs International Fusion Energy Agreement (Nov. 21, 2006). A signed copy of the original agreement is electronically available at http://www.iaea.org/Publications/Documents/Infcircs/2007/infcirc702.pdf. The United States is authorized by Congress to participate in ITER under the Energy Policy Act of 2005, Pub. L. No. 109-58, § 972(c), 119 Stat. 594, 900-01 (2005) (codified at 42 U.S.C. § 16312 (2006)). For a description of the history and mission of the ITER project, see the ITER website at http://www.iter.org/default.aspx (last visited Feb. 10, 2010).

24. *See* ITER Agreement, *supra* note 23, art. 24(1) (specifying the duration of the project); Tagliabue, *supra* note 23 (designating Cadarache, France, as the site location). Another different major experimental approach, attempting to utilize lasers to achieve nuclear fusion and produce energy, is the National Ignition Facility ("NIF"), located at Livermore, California. *See, e.g.*, William J. Broad, *In Hot Pursuit of Fusion (or Folly)*, N.Y. TIMES, May 26, 2009, at D1; Daniel L. Lyons, *Could this Lump Power the Planet?*, Newsweek, Nov. 23, 2009, at 42; *The National Ignition Facility: On Target, Finally*, ECONOMIST, May 30, 2009, at 81. For an expression of doubts regarding the likelihood of success of the NIF, see, for example, Editorial, *The Hoped-For Laser Miracles*, N.Y. TIMES, May 29, 2007, at A24.

two isotopes of hydrogen available on Earth and capable of fusing at considerably lower temperatures.[25] However, an He-3-D fuel cycle, if and when technically achievable, theoretically offers significant advantages as compared with the D-T fuel cycle. Unlike a D-T fusion reaction, which results in considerable neutron radiation, an He-3-D fusion reaction would produce little radioactivity and a substantially higher proportion of directly usable energy.[26] More specifically, the comparative

25. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 40–42, 64–65; BILDER ET AL., *supra* note 3, at 13–14; SANTARIUS ET AL., *supra* note 21, at 1. *See generally* sources cited *supra* note 12 (discussing the basics of nuclear fusion). Deuterium and tritium ("T") are both isotopes of hydrogen, an element whose most common isotope contains no neutrons and only one proton in its nucleus. *See* Fusion Reactions, Princeton Plasma Physics Lab., http://www.pppl.gov/fusionreactions.cfm (last visited Feb. 10, 2010). In a D-T fuel cycle, the nucleus of deuterium, a stable isotope of hydrogen containing one proton and one neutron, and the nucleus of tritium, a radioactive isotope of hydrogen containing one proton and two neutrons, come together in a fusion reaction that creates a helium ("He-4") nucleus consisting of two protons and two neutrons and releases one high-energy neutron. The technical description of the reaction is D + T → *n* (14.07 MeV) + He-4 (3.52 MeV), with the total energy released being 17.6 mega-electron volts ("MeV"). *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 64–65; *see also* World Nuclear Ass'n, *supra* note 21.

26. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 43–47, 65–67; G.L. KULCINSKI, USING LUNAR HELIUM-3 TO GENERATE NUCLEAR POWER WITHOUT THE PRODUCTION OF NUCLEAR WASTE (2001), *available at* http://fti.neep.wisc.edu/presentations/glk_isdc.pdf; J.F. Santarius, D-^{3}He Fusion: Physics, Engineering, and Applications (2003), http://fti.neep.wisc.edu/presentations/jfs_hallway.pdf [hereinafter Santarius, Overview Poster of D-^{3}He Fusion]; The Artemis Project, *supra* note 1.

In an He-3-D fuel cycle, the nucleus of helium-3, consisting of two protons and one neutron, captures the extra neutron of deuterium in a fusion reaction that creates a normal helium nucleus and emits a proton. Since the product weighs less than the initial components, the missing mass is converted to energy. The technical description of the reaction is D + He-3 → *p* (14.68 MeV) + He-4 (3.67 MeV), with the total energy released being 18.35 MeV. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 65–66; *see also* The Artemis Project, *supra* note 1. One kilogram of He-3 burned in a fusion reactor with 0.67 kilograms of deuterium will theoretically produce about 19 megawatt-years of energy output. *See* The Artemis Project, *supra* note 1.

In an He-3-He-3 fuel cycle, two helium-3 nuclei, each consisting of two protons and one neutron, fuse together to produce one helium-4 nucleus, consisting of two protons and two neutrons, and release two high-energy protons. The technical description of the reaction is He-3 + He-3 → 2p + He-4 (12.86 MeV), with the total energy released being 12.86 MeV. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 66; KULCINSKI, *supra*, at 5; J.F. SANTARIUS, LUNAR HE-3, FUSION PROPULSION, AND SPACE DEVELOPMENT 3 (1988), *available at* http://fti.neep.wisc.edu/pdf/fdm764.pdf. While this type of "third generation" fuel cycle would theoretically produce no neutrons and thus no radioactivity whatsoever, it would require such high temperatures as to be presently impractical. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 45; G.L. KULCINSKI & H.H. SCHMITT, NUCLEAR POWER WITHOUT RADIOACTIVE WASTE—THE

advantages of an He-3-D fuel cycle over a D-T fuel cycle would include: (1) increased electrical conversion efficiency; (2) reduced radiation damage to containment vessels, obviating the need for frequent expensive replacement; (3) reduced radioactive waste, with consequent reduced costs of protection and disposal; (4) increased levels of safety in the event of accident; and (5) potentially lower costs of electricity production.[27] In particular, an He-3-D fuel cycle would significantly reduce the risk of nuclear proliferation because an He-3-D reaction, unlike a D-T reaction, would produce few neutrons and could not be readily employed to produce plutonium or other weapons-grade fissile materials.[28] Consequently, interest in developing He-3-fueled thermonuclear energy is likely to continue.

How would lunar He-3 be extracted and transported to Earth?[29] Because the solar wind components are weakly bound to the lunar regolith,[30] it should be relatively easy to extract them utilizing reasonable extensions of existing technology. In one proposed scenario, once a lunar base is established, robotic lunar mining vehicles fitted with solar heat collectors would: (1) traverse appropriate areas of the Moon's surface—probably, in particular, the lunar maria, or "seas"—scooping up the loose upper layer of the lunar regolith and sizing it into small particles; (2) utilize solar energy to process and heat the collected regolith to the temperatures necessary to release, separate, and collect in a gaseous state the He-3, along with certain other solar-wind elements embedded in the regolith particles; (3) discharge the spent regolith back to the lunar surface; and (4) return with the collected He-3 and other gaseous byproducts to the lunar base.[31]

PROMISE OF LUNAR HELIUM-3 2–4 (2000), *available at* http://fti.neep.wisc.edu/pdf/fdm1131.pdf.

27. KULCINSKI ET AL., *supra* note 12, at 4–7; *see also* BILDER ET AL., *supra* note 3, at 17–22; SCHMITT, RETURN TO THE MOON, *supra* note 3, at 43–47; Santarius, Overview Poster of D-^{3}He Fusion, *supra* note 26.

28. *See* J.F. Santarius et al., *A Passively Proliferation-Proof Fusion Power Plant*, 44 FUSION SCI. & TECH. 289 (2003).

29. For a discussion of possible extraction methods, see SCHMITT, RETURN TO THE MOON, *supra* note 3, at 111–24, and BILDER ET AL., *supra* note 3, at 26–30.

30. *See* KULCINSKI ET AL., *supra* note 12, at 8.

31. *See id.* at 8–10. For an alternative technique using an in-situ method to evolve volatiles from the lunar regolith, see L.J. WITTENBERG, IN-SITU EXTRACTION OF LUNAR SOIL VOLATILES (1993), *available at* http://fti.neep.wisc.edu/pdf/wcsar9311-3.pdf.

The collected He-3 gas could then be liquified in the lunar cold and transported to Earth, perhaps in remotely-operated shuttles.[32] Importantly, this type of mining operation could result in the collection not only of He-3 but also significant amounts of hydrogen, oxygen, nitrogen, carbon dioxide, and water, all potentially very useful—indeed, perhaps indispensable—for the maintenance of a lunar base or further outer space activities such as expeditions to Mars or other planets.[33] Since He-3 is believed to comprise only a small proportion of the lunar regolith, it will probably be necessary to process large amounts of lunar regolith in order to obtain the quantities of He-3 necessary to sustain a large-scale terrestrial He-3-based power program. However, the extraction of He-3 and other solar wind components from the lunar soil seems in itself unlikely to have a significant detrimental impact on the lunar environment because the regolith will be discharged back to the Moon's surface immediately after processing.[34]

Whether the production of lunar He-3-based fusion power will prove commercially viable remains a complex and disputed question. The commercial success of such a development will clearly depend, among other things, on the parallel and integrated achievement of both economically efficient He-3-fueled fusion power reactors and a sustainable lunar mining enterprise capable of economically extracting and returning to Earth an assured supply of He-3 to fuel such reactors; neither is worth pursuing without the other. However, the development of He-3-based fusion need not start from scratch, but instead will likely build on the substantial research and investment already committed to the development of fusion power more generally in ITER and other already ongoing projects. Moreover, the development of lunar He-3 mining can similarly build on—and indeed form an additional rationale for—the already existing

32. *See* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 128.

33. *See* R.J. Bula et al., *Potential of Derived Lunar Volatiles for Life Support*, *in* 2 THE SECOND CONFERENCE ON LUNAR BASES AND SPACE ACTIVITIES OF THE 21ST CENTURY 547–50 (W.W. Mendell ed., 1988); *see also,* BILDER ET AL., *supra* note 3, at 30–31; SCHMITT, RETURN TO THE MOON, *supra* note 3, at 5, 109–43.

34. *See generally* E.N. Cameron et al., Net Environmental Aspects of Helium-3 Mining, Phase I: Effect on the Moon (Dec. 1990), *available at* http://fti.neep.wisc.edu/pdf/wcsar9012-1.pdf; G.L. Kulcinski, Environmental Aspects of Lunar Helium-3 Mining (Jan. 1992), *available at* http://fti.neep.wisc.edu/pdf/wcsar9201-5.pdf.

commitment of various space powers to establish lunar bases. As indicated earlier, lunar mining activities may be worth developing not only to extract He-3 from the regolith, but also to obtain a variety of other byproducts highly useful for the support of lunar bases.[35]

Finally, the economic viability of He-3-based fusion power will, of course, depend on its eventual production cost relative to alternative sources of energy such as fossil fuel or other conventional sources of energy, energy produced by nuclear fission reactors, or other forms of fusion energy—all figures difficult to accurately predict at this time. Proponents of He-3-based fusion energy argue that, notwithstanding the substantial costs involved in developing He-3 fusion reactors, establishing a lunar mining operation, and transporting He-3 back to Earth, He-3-based fusion power will eventually be more than competitive with the cost of other types of energy resources and provide more than sufficient incentive for the participation of both government and private enterprise.[36] But other

35. *See* sources cited *supra* note 33.

36. See, in particular, the detailed discussion of He-3 fusion economics in SCHMITT, RETURN TO THE MOON, *supra* note 3 and G.L. KULCINSKI ET AL., COMMERCIAL POTENTIAL OF D-HE3 FUSION REACTORS (1987), *available at* http://fti.neep.wisc.edu/pdf/fdm745.pdf. Schmitt predicts that He-3 gas could be returned to Earth for under US$1 billion per metric ton. SCHMITT, RETURN TO THE MOON, *supra* note 3, at 109–36. Kulcinski adds that, if He-3 was sold for US$4 billion per metric ton, He-3 energy would still be comparable to the value of oil at US$28 per barrel. *See* Margie Wylie, *Moon Has No Fast Answer to Energy Needs*, GRAND RAPIDS PRESS, Feb. 1, 2004, at A20 (quoting Kulcinski). Between May 2008 and May 2009, the price of crude oil ranged from about US$147 to US$30 per barrel. *See* Petroleum Navigator: Spot Prices, U.S. Dep't of Energy, http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=rwtc&f=d. As of early October 2009 it was approximately US$70 per barrel. *See id.* For a series of reports on the problematic future of oil as a world energy source, see generally FOR. POL'Y, Sept.–Oct. 2009.

Apart from its potential use as a fuel for fusion reactors, He-3 has important uses for, inter alia, scientific and medical research (for example, magnetic resonance imaging), neutron detection (for example, in connection with U.S. Department of Homeland Security responsibilities) and cryogenics. For recent indications of the impact of He-3 shortages on such programs, see, for example, *Helium-3 Shortage Could Put Freeze on Low-Termperature Research*, 326 SCI. 778 (2009); Matthew W. Wald, *Ingredient Shortage Slows a Program to Detect Smuggled Nuclear Bombs*, N.Y. TIMES, Nov. 23, 2009, at A14. According to the University of Wisconsin Fusion Technology Institute, the limited amount of He-3 now available is priced at more than US$5000 per gram, which is equivalent to US$5 million per kilogram or US$5 billion per metric tonne. *See* HARRISON H. SCHMITT, BUSINESS APPROACH TO LUNAR BASE ACTIVATION 3–4 (2002); Graeme Greene, *A Wrong Step for Mankind?*, METRO (London), May 27, 2009, at 14. Of course, this price could be expected to decrease if supplies of lunar He-3 became available.

commentators are more skeptical, doubting both the technical feasibility of such a complex and challenging development and the likelihood of He-3-based fusion power ever competing successfully with more traditional Earth-based energy systems.[37] Suffice it to say, major space powers currently consider the potential of He-3-based fusion energy sufficiently promising as to warrant their serious interest and to furnish at least an additional rationale for their commitment to programs to establish national stations on the Moon.

II. *THE CURRENT LEGAL SITUATION*

The most salient place to look for international rules governing the mining of He-3 or other lunar resources is the growing body of "space law," in particular, the 1967 Outer Space Treaty and 1979 Moon Agreement. However, while each of these sets out general principles relevant to the exploitation of lunar mining, neither provides a detailed legal regime for the conduct of such activities.

The 1967 Outer Space Treaty,[38] which is legally binding on 100 nations, including all of the principal space powers,[39] establishes a broad framework for the exploration and use of outer space and is widely regarded as the "charter" of international space law.[40] As relevant to possible lunar mining

37. *See, e.g., Lunar Science and Resources: Future Options: Hearing Before the Subcomm. on Space and Aeronautics of the H. Science and Technology Comm.*, 108th Cong. 78–79 (2004) (testimony of Dr. Timothy D. Swindle, Professor of Geosciences and Planetary Sciences, University of Arizona); Frank Close, *Fear over Factoids*, PHYSICS WORLD, Aug. 2007, at 16–17; Charles Seife, *Moon's "Abundant Resources" Largely an Unknown Quantity*, 303 SCI. 1603, 1603 (2004); *see also* John; J. Lasker, *Race to the Moon for Nuclear Fuel*, WIRED, Dec. 15, 2006, http://www.wired.com/science/space/news/2006/12/72276?currentPage=all (reporting that Jim Benson, founder of the space contractor Space Development, said that mining the moon for helium-3 doesn't pass the "net energy test" because it would require more energy to retrieve helium-3 and bring it back to Earth than it would yield). *But see* Wittenberg et al., *Review of Helium-3*, *supra* note 11, at 37 (arguing otherwise on the net energy test question).

38. Outer Space Treaty, *supra* note 7.

39. *See* U.N. Office for Outer Space Affairs, Treaty Signatures, http://www.oosa.unvienna.org/oosatdb/showTreatySignatures.do . The Outer Space Treaty had also been signed by twenty-six additional states. *Id.*

40. *See, e.g.*, Robert C. Bird, *Procedural Challenges to Environmental Regulation of Space Debris*, 40 AM. BUS. L.J. 635, 653–54 (2003) (stating that the Outer Space Treaty "has received universal acceptance among both commentators and spacefaring nations"); Amanda Lee Moore, *Legal Responses for Lunar Bases and Space Activities in the 21st Century*, *in* LUNAR BASES AND SPACE ACTIVITIES OF THE 21ST CENTURY (W.W. Mendel ed., 1985)

activities, the treaty provides that the state parties may "use" the Moon for peaceful purposes, presumably including not only scientific but other activities as well, but that they have a general obligation to share the benefits of their uses with all countries.[41] The treaty expressly prohibits any national appropriation by claim of sovereignty, use or occupation, or by any other means over specific territory on the Moon,[42] and forbids depriving "free access" to any area of the Moon or discriminatively excluding any state from the opportunity to explore or use the Moon.[43] However, it recognizes that state parties may establish stations and other installations on the Moon,[44] and that states have the right to exercise jurisdiction over its installations and personnel.[45] In addition, these activities may be carried out by nongovernmental entities,[46] international organizations, or joint enterprises.[47] Notably, while the Outer Space Treaty ostensibly bars the assertion of exclusive territorial claim to particular lunar mining sites, the treaty appears permissive in allowing a party to make "use" of lunar resources,[48] subject to certain general environmental, notification, inspection, and other constraints.[49] Moreover, nothing in the treaty precludes the possibility of lunar mining activities by state parties, intergovernmental organizations, or private enterprises, or ownership over resources removed from the Moon by such entities.[50] The treaty does provide, however, that any "use" of lunar resources should, in some unspecified sense and to some unclear extent, inure to the benefit and in the interests of all countries.[51] More broadly, the treaty also requires that all lunar activities shall be carried out under the principle of cooperation and with due regard to the interests of all other states parties.[52]

(describing the Outer Space Treaty as the "Magna Carta" for the exploration and use of space and the Moon); *see also* STATUS OF OUTER SPACE AGREEMENTS, *supra* note 9, at vi.

41. Outer Space Treaty, *supra* note 7, art. I.
42. *Id.* art. II.
43. *Id.* art. I.
44. *Id.* art. XII.
45. *Id.* art. VIII.
46. *Id.* art. VI.
47. *Id.* art. XIII.
48. *Id.* art. I.
49. *See, e.g.*, SCHMITT, RETURN TO THE MOON, *supra* note 3, at 282–86.
50. *See id.*
51. Outer Space Treaty, *supra* note 7, art. I.
52. *Id.* art. IX.

As its name indicates, the 1979 Moon Agreement,[53] which was developed within the U.N. Committee on the Peaceful Uses of Outer Space ("COPUOS")[54] and entered into force in 1984, was intended to supplement the Outer Space Treaty by dealing more specifically with potential human activities on the Moon and other celestial bodies within the solar system, other than Earth.[55] Currently, it has been ratified by only thirteen countries—Australia, Austria, Belgium, Chile, Kazakhstan, Lebanon, Mexico, Morocco, The Netherlands, Pakistan, Peru, Philippines, and Uruguay—none of which are presently engaged in significant space activities.[56] However, while the Moon Agreement presently has few parties and is, in any case, not legally binding on either the United States or any other current or likely major "space power," it is nevertheless likely to form at least the background for any possible future discussions concerning the development of a lunar mining regime. Consequently, it is worth describing in some detail.

Many provisions of the Moon Agreement in substance echo already binding provisions of the Outer Space Treaty.[57] However, the most relevant and controversial provision of the agreement, as it relates to the question of lunar mining, is article 11, which purports to establish a framework for eventually establishing an international regime to govern the exploitation of the Moon's natural resources. Article 11 provides:

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53. Moon Agreement, *supra* note 8.

54. COPUOS originally consisted of eighteen nation members, but has now grown to sixty-nine nation members. *See* United Nations Committee on the Peaceful Uses of Outer Space, http://www.oosa.unvienna.org/oosa/en/COPUOS/copuos.html (last visited Feb. 10, 2009). For an extensive discussion of the negotiation of the Moon Agreement within COPUOS, see *1980 Senate Hearings*, *supra* note 10, at 9–27, 46–47 (statement of Roberts B. Owen, Legal Adviser, U.S. Dep't of State, and testimony of S. Neil Hosenball, Chairman, U.S. Delegation to COPUOS and General Counsel of NASA). *See also* 1980 SENATE COMMITTEE STUDIES, *supra* note 10; PETERSON, *supra* note 10; Judge Helmut Tuerk, Vice-President of the Int'l Trib. for the Law of the Sea, Address at the Space Law Symposium 2009, The Negotiation of the "Moon Agreement," (March 23, 2009), *available at* http://www.oosa.unvienna.org/pdf/pres/lsc2009/symp00.pdf.

55. *See* STATUS OF OUTER SPACE AGREEMENTS, *supra* note 9, at vi.

56. As of January 2009, in addition to the thirteen state parties to the Moon Agreement, five other states have signed but not yet ratified the agreement: France, Guatemala, India, Romania, and Singapore. *See* STATUS OF OUTER SPACE AGREEMENTS, *supra* note 9.

57. *Compare* Outer Space Treaty, *supra* note 7, arts. I, III–V, *with* Moon Agreement, *supra* note 8, arts. 2–4, 10.

1. The Moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article.

2. The Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.

3. Neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place, shall become property of any State, national organization or nongovernmental 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. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article.

4. States Parties have the right to exploration and use of the Moon without discrimination of any kind, on a basis of equality and in accordance with international law and the terms of this Agreement.

5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.

6. In order to facilitate the establishment of the international regime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the Moon.

7. The main purposes of the international regime to be established shall include:

(a) The orderly and safe development of the natural resources of the Moon;

(b) The rational management of those resources;

> (c)The expansion of opportunities in the use of those resources;
>
> (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.
>
> 8. All the activities with respect to the natural resources of the Moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article 6, paragraph 2, of this Agreement.[58]

Article 6(2) of the agreement, which is referenced in article 11(8), provides:

> In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the Moon samples of its minerals and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the Moon in quantities appropriate for the support of their missions.[59]

Other provisions of the agreement provide, inter alia, that, in the exploration and use of the Moon, state parties shall pay due regard to the interests of present and future generations, and to the need to promote higher standards of living and conditions of economic and social progress and development;[60] shall take measures to prevent the disruption of the existing balance of the Moon's environment;[61] may pursue their activities on the Moon anywhere on or below its surface;[62] may establish

58. Moon Agreement, *supra* note 8, art. 11.
59. *Id.* art. 6(2).
60. *Id.* art. 4.
61. *Id.* art. 7.
62. *Id.* art. 8.

manned or unmanned stations on the Moon;[63] and shall retain jurisdiction and control over their personnel, vehicles, equipment, facilities, stations and installations on the Moon.[64] Article 16 provides that an international organization whose membership is comprised of a majority of state parties may conduct activities under the agreement if it formally accepts the agreement's obligations.[65] Article 17 permits any state party to propose amendments to the agreement, which enter into force for any state party accepting the amendments upon their acceptance by a majority of states parties and thereafter for each other party upon its individual acceptance.[66] Article 18 provides that the U.N. Secretary General shall, at the request of one-third of the states parties to the agreement and with the concurrence of the majority of the states parties, convene a conference of the states parties to review the agreement, which conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.[67]

It is relevant that the negotiation of the Moon Agreement in COPUOS, and the debate over its acceptance in the United States, took place in the context of concurrent negotiations in New York at the Third U.N. Law of the Sea Conference ("UNCLOS-3"). The UNCLOS-3 negotiations developed what was ultimately reported out by the conference as the 1982 U.N. Law of the Sea Convention ("LOSC").[68] During these negotiations, the conference approved, as part XI of the LOSC, inter alia, a highly controversial seabed mining regime—supported by a large bloc of developing countries but strongly opposed by the United States and certain other developed countries—that permitted mining of seabed mineral resources

63. *Id.* art. 9.

64. *Id.* art. 12(1).

65. *Id.* art. 16.

66. *Id.* art. 17.

67. *See id.* art. 18.

68. U.N. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter LOSC]. As of January, 2010, 160 countries were parties to the 1982 U.N. Law of the Sea Convention ("LOSC"). *See* U.N. Division of Ocean Affairs and Law of the Sea, Chronological Lists of Ratifications of, Accessions and Successions to the Convention as of November 2009, http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications. (last updated Nov. 5, 2009)

only under the aegis of an international authority effectively dominated by developing countries, and imposed significant limitations on the role of private enterprise.[69] As is well known, in 1982 the Reagan administration refused to either sign or ratify the LOSC, primarily on the grounds that the proposed international seabed regime would both hamper the development of seabed mineral resources and be antithetical to free enterprise principles strongly held by the United States.[70] Indeed, the United States has still not ratified the LOSC[71] despite the U.N. General Assembly's subsequent adoption of an implementation agreement in 1994 effectively nullifying the provisions of part XI that the United States and some other countries found objectionable.[72]

In view of this history, it is not surprising that the Moon Agreement, since its conclusion in 1979, has also encountered substantial opposition in the United States and some other countries. The phrases "common heritage of mankind" and

69. *See* LOSC, *supra* note 68, arts. 133–91, annexes III, IV (setting forth the deep seabed regime in part XI of the convention); *see also* RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 523 (1986) (summarizing the seabed regime of the LOSC and the U.S. objections in reporter's notes 2, 3, and 4). *See generally* LAW OF THE SEA: U.S. POLICY DILEMMA (Bernard H. Oxman, David D. Caron & Charles L.O. Buderi eds., 1983); Bernard H. Oxman, *The High Seas and the International Seabed Area*, 10 MICH. J. INT'L L. 526, 526–42 (1989).

70. *See, e.g.*, President Ronald Reagan, Statement on the Convention of the Law of the Sea, 18 WEEKLY COMP. PRES. DOC. 887, 887–88 (Jul. 9, 1982); *see also* Ambassador James L. Malone, Special Representative of the President for the Third U.N. Conference on Law of the Sea, Statement Before the House Foreign Affairs Committee on the Convention of the Law of the Sea (Aug. 12, 1982), DEP'T ST. BULL., Oct. 1982, 48–50; The Law of the Sea Convention, White House Office of Policy Information, Issue Update No. 10 (April 15, 1983), *reprinted in* LOUIS B. SOHN & JOHN E. NOYES, CASES AND MATERIALS ON THE LAW OF THE SEA 606 (2004).

71. President Clinton transmitted the convention and implementation agreement to the Senate for its advice and consent to ratification in 1994. *See* S. TREATY DOC. No. 103–39 (1994). However, the Senate has not yet acted with regard to the convention. *But see* sources cited *infra* note 130 (speculating as to current prospects for ratification).

72. *See* Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, G.A. Res. 48/263, ¶¶ 1–13, U.N. Doc. A/48/263 (Aug. 17, 1994) (endorsed as an annex to a resolution of the U.N. General Assembly and adopted with 121 states in favor, none opposed, and seven abstentions); *see also* Oceans and Law of the Sea, Oceans and the Law of the Sea in the General Assembly of the United Nations, http://www.un.org/Depts/los/general_assembly/general_assembly_resolutions.htm. (last visited Feb. 10, 2010) For a contemporary discussion, see, for example, Louis B. Sohn, *International Law Implications of the 1994 Agreement*, 88 AM. J. INT'L L. 696, 696–705 (1994), and particularly Bernard H. Oxman, *The 1994 Agreement and the Convention*, 88 AM. J. INT'L L. 687, 687–96 (1994).

"international regime" in article 11 of the agreement inevitably evoked similar phrases figuring prominently in the UNCLOS-3 negotiations and the LOSC, and raised the specter that the type of lunar mining regime contemplated by article 11 would simply mirror the restrictive seabed regime ultimately embodied in part XI of the LOSC.[73] Thus, a succession of industry and other representatives strongly opposed U.S. participation in the Moon Agreement during the treaty's 1980 congressional hearings, arguing that: (1) it would create a moratorium on commercial exploitation of lunar resources pending the conclusion of a more comprehensive agreement for regulating resource activities; (2) article 11 in any case purported to establish guiding principles for the eventual negotiation of a successor agreement that would very likely be contrary to free market principles and the commercial development of outer space by private enterprise; and (3) the agreement would give other countries, particularly developing nations, political control over the permissibility, timing, and direction of expanding commercial uses of outer space.[74] Responding to these concerns, and consistent with its position on the LOSC, the Reagan administration withdrew the Moon Agreement from consideration by the Senate and, while never explicitly rejecting it, refused to either sign or ratify the agreement.[75] Subsequent U.S. administrations have also shown little interest in the agreement[76] and, as previously noted, most other countries, including all of the other space powers, have likewise refrained from accepting the agreement to date.[77]

Debate as to whether the United States should join the Moon Agreement and as to the agreement's potential implications for the development of lunar resources has centered

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73. *See* Marko, *supra* note 10, at 319.

74. Statements were made in opposition to ratification of the agreement by the L-5 Society, *1980 Senate Hearings*, *supra* note 10, at 105–32, the American Astronautical Society, *id.* at 85–93, the Aerospace Industries Association, *id.* at 93–103, and United Technologies Inc., *id.* at 219–20. See, in particular, the testimony and statement of Leigh S. Ratiner, Counsel for the L-5 Society, *id.* at 105–32, and the testimony and statement of Marne A. Dubs, Chairman of the American Mining Congress Committee on Undersea Mineral Resources and Vice President of Kenecott Development Corporation, *id.* at 132–45. The politics of the agreement's rejection are well described in Goldman, *supra* note 10, at 141–47, and BASLAR, *supra* note 10, at 162–63.

75. *See, e.g.*, BASLAR, *supra* note 10, at 162.

76. *See id.*

77. *See supra* note 56 and accompanying text.

on several issues.[78] One question concerns the effect of the provision in article 11(1) that "the Moon and its natural resources are the common heritage of mankind."[79] As indicated, opponents of U.S. participation in the agreement suggest that, as a result of the UNCLOS-3 negotiations and part XI of the LOSC, the phrase "common heritage of mankind" has taken on a fixed meaning in international law to refer to resources that are not subject to direct national or private exploitation but can rather only be legally appropriated under the aegis of an international organization controlled by a majority of nations—in effect, by the bloc of developing nations, which are the most numerous.[80] In their view, the phrase reflects a particular economic and political philosophy that would likely limit the role of the United States and bar, or at least constrain, any significant role for the United States or private enterprise in the exploitation of lunar resources.[81]

Proponents of the agreement, on the other hand, deny that the "common heritage" concept has taken on any fixed meaning in international law.[82] They maintain, instead, that the "common heritage" concept, at least as accepted by the United States and most developed states, reflects simply a broad international consensus that certain very general equitable principles should be considered as applying to such common areas or resources.

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78. For detailed discussions of the various issues and arguments for and against ratification of the Moon Agreement, see *1980 Senate Hearings*, *supra* note 10, at 2–5 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State). *See also* BASLAR, *supra* note 10, at 159–85; PETERSON, *supra* note 10, 153–64; REYNOLDS & MERGES, *supra* note 10, at 94–177.

For detailed expressions of U.S. support of the agreement in 1979 and 1980, see *1980 Senate Hearings*, *supra* note 10, at 9–17, 46–67 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State, and S. Neil Hosenball, Chairman of the U.S. delegation to COPUOS and NASA General Counsel), and Marian L. Nash, *Contemporary Practice of the United States*, 74 AM. J. INT'L L. 418, 421–24 (1980) (excerpting in part the November 28, 1979, response of Secretary of State Cyrus Vance to a joint letter from Senator's Church and Javits of the Senate Foreign Relations Committee, and the January 2, 1980, reply of Assistant Secretary of State J. Brian Atwood to an inquiry by Senator Stone).

79. *See generally* BASLAR, *supra* note 10; POP, *supra* note 10, 121–33; Christol, *Common Heritage*, *supra* note 10; Danilenko, *supra* note 10; Hoffstadt, *supra* note 10; Jasentuliyana, *supra* note 10; Joyner, *supra* note 10; Rana, *supra* note 10; Rao, *supra* note 10.

80. *See* text accompanying *supra* note 73.

81. *See* BASLAR, *supra* note 10, at 162–63, 166–75; PETERSON, *supra* note 10, 159–60; Marko, *supra* note 10, at 311–13.

82. *See, e.g.*, PETERSON, *supra* note 10, 167.

More specifically, areas regarded as part of the "common heritage" should not be subject to exclusive national or private appropriation, there should be some sharing among all nations of the benefits of such "common heritage" resources, and there should be particular concern for the protection of the environment in areas regarded as the "common heritage."[83] In support of their position, it is arguable that the U.N. General Assembly, by approving the 1994 implementation agreement, effectively amending part XI of the LOSC so as to remove many of the strict constraints imposed on national or private exploitation of seabed minerals, has now clearly rejected any ideological or restrictive interpretation of the "common heritage" concept.[84] The proponents maintain, further, that the Moon Agreement does not expressly define the term "common heritage" and that the negotiating history of the Moon Agreement demonstrates that the countries participating in COPUOS intended the "common heritage" principle to have its own meaning in the Moon Agreement, separate and distinct from whatever meaning it may have in the LOSC.[85] They contend that this interpretation, insisted upon by the Soviet Union in particular, is reflected both in the final clause of article 11(1), which emphasizes that the "common heritage" concept "finds its expression in the provisions of this Agreement"[86] (rather than in any other agreement), and in article 11(5), which expressly contemplates a separate negotiation to establish a resource regime of a very general and unspecified character.[87] Consequently, in this view, the parties are free, if and when they eventually negotiate a resource regime under articles 11(5) and 18, to devise a lunar mining regime of whatever nature they wish—which can be completely different from the LOSC seabed regime as originally contemplated in part XI of the LOSC—

83. *See 1980 Senate Hearings, supra* note 10, at 13 (statement of Roberts B. Owen, Legal Adviser, U.S. Dep't of State); *see also* Marko, *supra* note 10, at 319–23.

84. *See supra* note 72 and accompanying text.

85. *See 1980 Senate Hearings, supra* note 10, at 4, 14 (testimony of Roberts B. Owen, Legal Adviser to the U.S. Dep't of State).

86. Moon Agreement, *supra* note 8, art. 11(1).

87. *See 1980 Senate Hearings, supra* note 10, at 6, 8 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State); Nash, *supra* note 78, at 423–24 (quoting Ambassador Richard W. Petree); *see also* Heim, *supra* note 10, at 834–35.

subject only to the very broad criteria set forth in article 11(7).[88] Moreover, they point out that any state party that disagrees with the type of regime negotiated under articles 11(5) and 18 can refuse to agree to it and avoid becoming legally bound.[89]

A second, related question is whether the Moon Agreement establishes a moratorium on the conduct of resource activities by states or private enterprises, or precludes states or private enterprises from acquiring property rights in extracted lunar resources pending the establishment of an international regime negotiated under article 11(5). As indicated above, opponents of U.S. acceptance of the Moon Agreement contend that the "common heritage" principle found in article 11(1) of the agreement has taken on a fixed meaning associated with part XI of the LOSC, and effectively mandates a moratorium and precludes states or private entities from acquiring such rights.[90] But supporters of U.S. participation in the agreement maintain that there is nothing in article 11 or other provisions of the Moon Agreement that suggests any such limitation on states or private enterprises, except as they might in the future expressly agree to such a moratorium in the context of negotiating the international regime contemplated by article 11(5) or otherwise.[91] Moreover, they argue that article 11(3) expressly provides that it is only natural resources "in place" that are not

88. *See 1980 Senate Hearings*, *supra* note 10, at 5 (testimony of Roberts Owen, Legal Adviser, U.S. Dep't of State); Nash, *supra* note 78, at 424 (quoting Ambassador Richard W. Petree).

89. *See, e.g.*, *1980 Senate Hearings*, *supra* note 10, at 4 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State).

90. *See, e.g.*, CHRISTOL, MODERN LAW OF OUTER SPACE, *supra* note 10, at 165–66; Marko, *supra* note 10, at 313–14.

91. For instance, U.S. State Department Legal Adviser Roberts Owens stated at the 1980 Senate Hearings:

> Again, Mr. Chairman, during the negotiation of this treaty, the United States took the position virtually from the outset that there should be no moratorium on the exploitation of these resources pending the establishment of the regime.
>
> That statement was repeatedly made by the representatives of the United States. Others acquiesced in that proposition. I think that virtually all the lawyers who have looked at the treaty and its negotiating history agree that during the interim, before the conference takes place in order to attempt to establish the regime, there will be no moratorium on the exploitation of these resources.

1980 Senate Hearings, *supra* note 10, at 7 (testimony of Roberts B. Owens, Legal Adviser to the U.S. Dep't of State).

subject to potential property or ownership rights, and that it is clear from the negotiating history that the phrase "in place" was specifically proposed by the United States, and accepted by the other nations present, as a recognition that the agreement did not imply any moratorium on the removal and ownership of lunar resources.[92] Finally, this group contends that the right contained in article 6(2) to collect and remove mineral and other samples for scientific investigation cannot be reasonably interpreted as having the negative implication that lunar resources cannot be removed for other purposes.[93]

A third question is whether the agreement in any other respect precludes private enterprise from a role in the eventual exploitation of lunar resources. Opponents of U.S. ratification insist that the agreement's provisions—in particular, its perceived threat of the possible imposition of an international regime similar to part XI of the LOSC—will discourage and, in practice, prevent meaningful private investment or participation in the development of lunar or other outer space resources.[94] To the contrary, proponents of U.S. acceptance argue that the negotiating history supports the view that the United States successfully preserved private enterprise rights.[95] As regards to specific provisions, they observe that articles 11(3) and 14 in particular expressly contemplate such a role for nongovernmental entities and that nothing in article 11 requires that any international regime eventually negotiated be of a nature that precludes a role for private enterprise.[96] They note further that, while article 11(7)(d) establishes as one criteria of such a regime an "equitable sharing by all States Parties in the

92. *See* BASLAR, *supra* note 10, at 168; Nash, *supra* note 78, at 422–23 (quoting then Secretary of State Cyrus Vance); *see also 1980 Senate Hearings*, *supra* note 10, at 6–7 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State).

93. *See 1980 Senate Hearings*, *supra* note 10, at 11–12 (statement of Roberts B. Owen, Legal Adviser, U.S. Dep't of State).

94. *See id.* at 109–10, 120–21 (testimony of Leigh Ratiner, Counsel, L-5 Society); Dula, *supra* note 10, at 16 (arguing that the agreement would impose an "implicit" or de facto moratorium on private enterprise development); *see also* Marko, *supra* note 10, at 314–16.

95. *See 1980 Senate Hearings*, *supra* note 10, at 16 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State); *see also* Goldman, *supra* note 10, at 144, 148 (contending that the Moon Agreement is neither a threat to the free enterprise system nor rules out exploitation of lunar resources by private companies).

96. *See 1980 Senate Hearings*, *supra* note 10, at 16 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State).

benefits derived from those resources,"[97] the term equitable sharing is not defined and cannot in this context be construed to mean "equal"; indeed, article 11(7)(d) expressly states that "the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon shall be given special consideration."[98] Thus, while there appears to be an obligation to share the benefits derived from the exploitation of lunar resources, such as He-3, with the international community, there is no definition of what the "benefits" to be shared are, and no indication as to how much must be shared, with whom, or in what form.

What, then, is the effect of the Moon Agreement on the law applicable to the exploitation of lunar resources and, in particular, the mining and exploitation of He-3? As indicated, the agreement is not in itself legally binding on the United States, nor indeed on other major space powers, or most other states, since they are not parties.[99] Arguably, the agreement should be given little weight as evidence of developing customary law, since, in contrast to other "space law" agreements that have achieved widespread ratification, the Moon Agreement has, over a considerable period, gained few adherents, none of which are significant space powers.

But this conclusion may be too cavalier. First, as indicated, the Moon Agreement arguably constitutes a reinforcement, spelling-out, or agreed interpretation by the space powers and many other concerned states participating in the COPUOS negotiations of a number of principles and obligations already contained or implicit in the Outer Space Treaty—which is already legally binding on parties to that treaty.[100] Second, the agreement reflects a long and careful process of negotiation and accommodation in COPUOS between the states primarily concerned with outer space and lunar activities as to the most sensible and viable rules for the conduct of activities on the Moon. In particular, the agreement's uncontroversial provisions, such as those regarding the establishment of stations,[101] conduct

97. Moon Agreement, *supra* note 8, art. 11(7)(d).

98. *Id.*; *see also* Carl Q. Christol, *The Moon Treaty Enters Into Force*, 79 AM. J. INT'L L. 163, 165 (1985); Goldman, *supra* note 10, at 144.

99. *See supra* text accompanying note 56.

100. *See supra* note 57 and accompanying text.

101. *See supra* note 63 and accompanying text.

of scientific research,[102] concern for environmental protection,[103] obligations of noninterference,[104] notice and consultation,[105] and so forth can be argued to evidence, at least as to these matters, an emerging body of customary lunar law. Thus, the Moon Agreement will almost certainly play some role and have to be taken into account in any further discussions concerning the development of a lunar mining regime.

The effect of article 11 on lunar resource exploitation or mining is, of course, more problematic. The agreement's prohibition on exclusive national or private claims to portions of the surface or subsurface of the Moon—and perhaps to resources in place—[106]simply reaffirms similar prohibitions already binding on the United States and other states under the Outer Space Treaty.[107] However, apart from any contested interpretation of the "common heritage" provision in article 11(1) as itself implying a moratorium on lunar mining until some kind of LOSC part XI international regime is established, there would appear to be nothing in article 11 or any other part of the agreement that prohibits states or private enterprises from mining and acquiring ownership of He-3 or other lunar resources pending the possible establishment of any international regime. Indeed, there is substantial support in the language of the agreement and its negotiating history for the legitimacy of such activities.[108] During the 1980 Congressional

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102. *See supra* note 59 and accompanying text.

103. *See supra* note 61 and accompanying text.

104. *See* Moon Agreement, *supra* note 8, art. 4.

105. *See* Moon Agreement, *supra* note 8, art. 5.

106. *See supra* notes 58, 92 and accompanying text.

107. *See supra* note 43 and accompanying text.

108. *See generally* discussion *supra* note 78, and accompanying text. In his written statement to the Senate Foreign Relations Committee in the 1980 Senate Hearings, S. Neil Hosenball, Chairman of the U.S. delegation to COPUOS and NASA General Counsel, summarized the U.S. position regarding interpretation of the agreement:

> The uncontradicted statements made by the United States (on the public United Nations record of negotiations), the defeat of specific proposals by other delegations, the reference to agreed understandings in the Committee Report and the General Assembly Resolution adopting the Treaty in my view conclusively establish as a matter of treaty interpretation that
>
> (1) A state may remove and exploit natural resources from the Moon and other celestial bodies. This conclusion is in part based on the uncontradicted statement of the U.S. Representative, April 19, 1973. The phrase 'in place' appears in Article 11, paragraph 3, and was as indicated proposed by the United States.

hearings in the U.S. Senate on the agreement, then Legal Adviser of the U.S. State Department, Roberts Owen, concluded on this point, "pending a Moon Conference in 15 or 30 years—and whether or not the United States becomes a party to the Moon Treaty—American companies will have a continuing legal right to exploit the Moon's resources."[109] This conclusion has generally

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> One or two particular points should be made concerning these matters as they are reflected in Working Paper 15 which the United States delegation introduced on April 17. As is apparent from the text, this working paper excludes the concept of a pre-regime moratorium. References to the words 'in place' in the first sentence of that paragraph and to paragraph 7 of Article X make this clear. More particularly, the words 'in place' in the first sentence of paragraph 2 are intended to indicate that the prohibition against assertion of property rights would not apply to natural resources once reduced to possession through exploitation either in the pre-regime period or, subject to the rules and procedures that a regime would constitute, following the establishment of the regime. Also with regard to the last sentence of paragraph 2 of Article X, the 'without prejudice' clause would apply to exploitation whether by a State, government entity, non-governmental enterprise or international organization.
>
> (2) There is no moratorium in the Treaty on exploitation of natural resources either pre-regime or if a state chooses not to become a party to the Treaty establishing such a regime. Proposals for such a moratorium were submitted for the record by India, Italy and other delegations. No such provisions appear anywhere in the Treaty and the United States through numerous statements in the record said it would not accept a moratorium.
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> . . .
>
> (4) The United States can carry out exploitation of the natural resources of the Moon or other celestial bodies through the use of public of private entities.

1980 Senate Hearings, supra note 10, at 59.

109. *1980 Senate Hearings, supra* note 10, at 6 (testimony of Roberts B. Owen, Legal Adviser, U.S. Dep't of State). More broadly, Owen went on to provide in his written statement that:

> In discussion [sic] the development of U.S. policy on the exploitation matter, I wish to stress that the United States constantly maintained several themes, which I would like to set forth and illustrate through references to the negotiating history of the Treaty.
>
> First, the United States was willing to accept the concept that the natural resources of celestrial [sic] bodies were the common heritage of mankind. Indeed, it was the United States which first proposed the phrase in the course of active negotiations. However, the U.S. view was—and is—that this concept embodies no substantive rules or a pre-determined form of legal regime, and the United States has consistently resisted efforts to give the phrase content which would be adverse to U.S. interests. In our view the phrase can acquire substantive meaning only by reference to the specific context in which it is employed.
>
> Secondly, the United States has consistently rejected any suggestion that the Moon Treaty should impose a moratorium on unilaterial [sic] exploitation

been supported by leading experts,[110] in the deliberations and report of the Space Law Committee of the International Law Association at its 1982 Montreal meeting,[111] and, notably, by the current parties to the Moon Agreement in a Joint Statement submitted to the most recent 2009 meeting of the legal subcommittee of COPUOS.[112]

In sum, while the Outer Space Treaty, perhaps as supplemented by the Moon Agreement, establishes a useful framework for many prospective activities on the Moon and clearly prohibits staking exclusive national or private claims to particular areas of the lunar surface, neither the treaty nor the agreement appears to preclude the mining and acquisition of property rights in lunar He-3 by national, international, or private enterprises, subject to certain broad "common heritage" obligations, such as the obligation to share to some unclear

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> of nonterrestrial natural resources pending the establishment of an international regime; indeed, we have insisted that even after such a regime is established, the right of unilaterial [sic] exploitation will continue to be available to those States which do not choose to participate in such a regime.
>
> Third, the United States has been aware of the vital role that American free enterprise can play in outer space, and the U.S. positions were designed to promote this role, both by ensuring that nothing in the Treaty would circumscribe this potential and by inserting into the Treaty certain rights which would be important to commercial exploitation by private or public entities.

Id. at 12.

110. *See, e.g.*, POP, *supra* note 10, at 146–47 (concluding, after surveying the literature, that most commentators consider that article 11 of the Moon Agreement does not establish any temporary prohibition on the appropriation or exploitation of lunar resources pending the establishment of some lunar resource regime); *see also* sources cited *supra* note 10.

111. *See* Goedhuis, *Conflicts*, *supra* note 10, at 479–531(including commentary on various questions put to the International Law Association Space Law Committee). The Sixtieth Conference expressly noted in its Resolution Number 10 that it "[i]s of the opinion that under the terms of the Agreement of the Moon Treaty there is no moratorium on the exploitation of the natural resources of the moon, prior to the establishment of the international regime as provided for in Article XII(5) of this Agreement." *The Montreal Conference Resolutions*, 60 INT'L L. ASS'N CONF. REP. 1, 12 (1982). For a discussion by a member of the International Law Association Space Committee, see Williams, *Law of Outer Space*, *supra* note 10.

112. *See* COPUOS, Legal Subcomm., *Joint Statement on the Benefits of Adherence to the Agreement Governing the Activities of State on the Moon or Other Celestial Bodies by States Parties to the Agreement*, ¶ 7(e), U.N. Doc. A/AC.105/C.2/L.272 (Apr. 3, 2008) (declaring that the Moon Agreement "does not propose a closed and complete mechanism" and "does not preclude any modality of exploitation, by public or private entities, or prohibit the commercialization of such resources, provided that such exploitation is compatible with the principle of the common heritage of mankind").

extent the benefits or proceeds of such activities. However, whatever the merits of this conclusion, it will clearly remain open to at least vigorous political as well as legal challenges—particularly by developing or other states currently unable to participate in lunar mining or other activities. Moreover, the Outer Space Treaty and Moon Agreement, and international law more generally, leave many other significant questions concerning the potential exploitation of He-3 or other lunar resources unresolved. Consequently, if the United States or other space powers that intend to establish stations on the Moon plan to proceed with mining lunar He-3 in connection with their potential development of an He-3-based fusion power program, they will be doing so under conditions of substantial legal and political—not to mention technological and economic—uncertainty. The question, then, is whether the United States should do something to remedy this situation and, if so, what?

III. *SHOULD THE UNITED STATES SEEK INTERNATIONAL AGREEMENT ON A LUNAR RESOURCE REGIME?*

As indicated, there does not at present appear to be any legal barrier to the United States engaging in lunar mining, save for the very general limitations imposed by the Outer Space Treaty and broader international law.[113] Moreover, as a practical matter, no other nation is likely in the near future to be in a position to prevent the United States from establishing a lunar base and conducting activities on the Moon as it wishes.[114] Consequently, the United States could presumably proceed with an He-3-based fusion energy program on the assumption that it could mine and bring to Earth lunar He-3 without any need for seeking further international approval. Under this approach, the United States could develop an appropriate legal regime of its own, consistent with its own needs and principles, rather than having to reach compromises with other countries. There is precedent for unilateral U.S. action of this kind—the 1980

113. *See* discussion *supra* Part II.

114. *See, e.g.*, James Clay Moltz, *Toward Cooperation or Conflict on the Moon?: Considering Lunar Governance in Historical Perspective*, STRATEGIC STUD. Q., 82, 89–99 (2009).

United States Deep Seabed Hard Mineral Resources Act,[115] which, following U.S. rejection of the 1982 LOSC, continues to govern the commercial recovery of deep seabed minerals by U.S. companies.[116] Subsequent to its enactment, the United States concluded international agreements with several other states in 1982 and 1984 (Belgium, France, Germany, Italy, Japan, the Netherlands, and the United Kingdom) to resolve overlapping claims with respect to mining areas for polymetallic nodules of the deep seabed.[117]

However, even if the United States could "go it alone" in this way, there are reasons why it may not wish to do so. First, neither the U.S. government nor U.S. private enterprise is likely to be willing to risk the very substantial investment and long-term effort necessarily involved in seeking to develop He-3-based fusion energy without some assurance that—assuming the very difficult technical and engineering obstacles to developing efficient fusion reactors and establishing permanent moon bases can be overcome—the requisite supply of lunar He-3 can continue to be obtained without encountering significant legal or political difficulties. Whatever may be the most legally persuasive interpretation of existing international law, other nations or people on Earth may challenge the unilateral appropriation of lunar resources by the United States, especially of a potentially uniquely valuable resource such as He-3. This, certainly, was the international experience in the 1960's when developing nations vigorously protested the prospect that a few technologically-advanced countries and their private enterprises might alone appropriate what was at the time assumed to be the mineral riches of the deep seabed. That perception ultimately led to the enunciation of the "common heritage" doctrine, the convening of UNCLOS-3, and the adoption of part XI of the 1982 LOSC.[118] Only a broadly accepted international agreement is likely to offer

115. *See* Deep Seabed Hard Mineral Resources Act, Pub. L. No. 96-283, 94 Stat. 553 (1980) (codified at 30 U.S.C. §§ 1401–73 (2006)).

116. *See* RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 523 rep. n. 5 (1987).

117. *See* Provisional Understanding Regarding Deep Seabed Matters, Aug. 3, 1984, T.I.A.S. No. 11,066, 1409 U.N.T.S. 463; Agreement Concerning Interim Arrangements Relating to Polymetallic Nodules of the Deep Sea Bed, Sept. 2, 1982, 34 U.S.T. 3451, 1871 U.N.T.S. 275; *see also* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 294–95; RESTATEMENT (THIRD) OF FOREIGN RELATIONS § 523, *supra* note 116, n.5.

118. *See supra* notes 68–69 and accompanying text.

the continued legal and political predictability that is essential if a long-term He-3-based fusion energy program is to be undertaken and sustained.[119]

Second, current commitments already obligate the United States to a certain level of international cooperation in space activities. While the Outer Space Treaty and present international law do not expressly bar the unilateral appropriation of lunar resources, they nevertheless impose an obligation on nations to cooperate in outer space activities and to avoid conduct that might give rise to disputes.[120] The United States is also committed to international cooperation in outer space activities under the Outer Space Treaty, the multinational framework for coordination in space exploration entitled "The Global Exploration Strategy,"[121] and other agreements, such as the International Space Station Agreement,[122] and has similarly

119. *See, e.g.*, Press Release, Int'l Inst. of Space Law, Statement of the Board of Directors of the International Institute of Space Law (Mar. 22, 2009), *available at* http://www.iislweb.org/docs/statement_bod.pdf ("At present, international space legislation does not include detailed provisions with regard to the exploitation of natural resources of outer space, the Moon and other celestial bodies, although it does set down a general framework for the conduct of all space activities, including those of private persons and companies, with respect to such natural resources. The [International Institute of Space Law] is of the opinion that a specific legal regime for the exploitation of [lunar] resources should be elaborated through the [U.N.], on the basis of present international space law, for the purposes of clarity and legal certainty in the near future.").

120. *See supra* note 52, and accompanying text; *see also* International Cooperation in the Peaceful Uses of Outer Space, G.A. Res. 63/90, U.N. Doc. A/RES/63/90 (Dec. 18, 2008). It is noteworthy that the Russian Federation and India have signed a ten-year cooperation agreement, which commenced December 2007, for the development of a shared space vehicle for Moon exploration. *See* COPUOUS, *Note by the U.N. Secretariat*, *supra* note 2, ¶ 15.

121. *See* NASA, GLOBAL EXPLORATION STRATEGY, *supra* note 2, at 12 ("The shared challenges of space exploration and the common motivation to answer fundamental scientific questions encourage nations of all sizes to work together in a spirit of friendship and cooperation.").

122. Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station, Jan. 29, 1998, T.I.A.S. No. 12,927; *see* Agreement Among the Government of the United States of America, Governments of Member States of the European Space Agency, the Government of Japan, and the Government of Canada on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned Civil Space Station, Sept. 29, 1988, Temp. State Dep't No. 92-65, 1992 WL 466295; Arrangement Concerning Application of the Space Station Intergovernmental Agreement Pending Its Entry into Force, Sept. 29, 1988, Temp State Dep't No. 88-336, 1988 WL 409764; *see also* Katherine

committed itself to international cooperation in developing fusion energy through its participation in the recently concluded ITER agreement.[123] U.S. insistence on a right to unilaterally appropriate lunar He-3, without further international agreement, could be controversial and regarded as inconsistent with these precedents.

Finally, if countries other than the United States also engage in activities on the Moon, as now appears highly likely, it will be in the interest of each of them to have at least some understandings to provide for cooperation on common problems and keep them from interfering with each other's activities. As the Moon Agreement anticipates,[124] if some kind of lunar agreement is in their common interests, it will be difficult for such an agreement to not address the salient and thus far unresolved issue of lunar resources exploitation.

Consequently, if the United States determines that it is serious about seeking to develop an He-3-based fusion energy program, it would seem sensible for it to also seek international agreement on a lunar resource regime designed to provide the long-term legal and political stability that such a program will most likely require.

M. Gorove, *The U.S./International Space Station Agreement of September 29, 1988: Some Legal Highlights*, 16 J. SPACE L. 182, 182–84 (1988); David C. Stewart, Note, *Resolution of Legal Issues Confronting the International Space Station Project: A Step Forward in the Development of Space Law*, 29 VA. J. INT'L L. 745, 745–61 (1989); *cf.* Press Release, Office of Sci. & Tech. Pol'y, Exec., Office of the President, Statement of U.S. National Space Policy (Oct. 6, 2006), *available at* http://www.globalsecurity.org/space/library/policy/national/us-space-policy_060831.pdf ("The United States will seek to cooperate with other nations in the peaceful use of outer space to extend the benefits of space, enhance space exploration, and to protect and promote freedom around the world.").

123. *See supra* note 23.

124. *See* Moon Agreement, *supra* note 8, art. 11; *see also supra* text accompanying note 60.

IV. *POLICY OPTIONS FOR A FUTURE LUNAR RESOURCE REGIME*

A. *Should the United States Try to Establish an Acceptable International Regime Even Before Lunar Mining and He-3-Based Fusion Power Are Feasible?*

There are clearly arguments that, given the current uncertainty as to the feasibility of both establishing a permanent U.S. lunar base capable of carrying on He-3 mining activities and developing fusion reactors that economically warrant investment in the creation of a major He-3-based fusion power program, it would be premature at this time for the United States to negotiate a lunar mining regime with other countries.[125] Other countries are unlikely to see a need for such negotiations at this time and, in any event, it is certainly arguable that the countries concerned simply do not now know enough to do a sensible job in this respect. Indeed, it was for this reason that COPUOS, in drafting article 11 of the Moon Agreement, expressly deferred the negotiation of such a regime to such time "as such exploitation is about to become feasible."[126]

There are, however, several reasons suggesting that the U.S. should seek to reach international agreement on such a regime quite soon and even before the possibility and practicality of a permanent moon base and an He-3-based fusion power program are clearly established. First, as discussed, states and enterprises are unlikely to be willing to undertake the substantial effort and investment involved in developing lunar He-3 mining and He-3-based fusion power without the assurance of political and legal stability that only a broadly accepted international agreement can provide.[127] Given the long lead time which will be required if the United States wishes to achieve a viable He-3-based fusion power program in the relatively near future—perhaps within the next half-century or so—it seems sensible for it to begin to take steps to put the necessary legal infrastructure in place fairly soon.

Second, the international climate is arguably now relatively favorable to achieving international agreement on the kind of

125. *See* sources cited *supra* note 5.

126. *See* Moon Agreement, *supra* note 8, art. 11(5); *see also* supra text accompanying note 58.

127. *See* discussion *supra* notes 118–19.

international lunar resource regime the United States hopes to achieve. Other major players, such as China, the European Union, India, Japan, and Russia, which currently appear to have the capability to participate in the potential exploitation of lunar resources, may well now share an interest with the United States in a more open-access regime and market-based mechanisms.[128] The U.N. General Assembly's adoption of the 1994 implementation agreement nullifying the provisions of part XI of the LOSC to which the United States objected clearly reflects a broader international acceptance of a U.S.-favored approach to the exploitation of deep seabed "common heritage" resources more favorable to the participation of free enterprise, which serves as persuasive precedent for the similar treatment of lunar resources.[129] Indeed, there is now growing support in the United States for U.S. ratification of the LOSC and accession currently seems increasingly likely.[130] In addition, international

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128. *See, e.g.*, Michio Kaku, *The New Race for the Moon: A Lot of Nations are Looking to Repeat Apollo's Feat*, WALL ST. J., Jun. 24, 2009, at A13 (describing global ambitions to mine the Moon).

129. *See supra* note 70 and accompanying text (relating to U.S. objections to part XI of the LOSC).

130. For a summary by the State Department of continuing U.S. administrations support of the LOSC, see U.S. Dep't of State: Law of the Sea Convention, http://www.state.gov/g/oes/ocns/opa/convention/ (last visited Feb. 10, 2010).

The George W. Bush administration explicitly supported U.S. accession. *See* Press Release, Office of the Press Sec'y, President's Statement on Advancing U.S. Interests in the World's Oceans (May 15, 2007), *available at* http://georgewbush-whitehouse.archives.gov/news/releases/2007/05/20070515-2.html; *see also* Kevin D. Futch, *Introductory Note on the President's Statement on Advancing U.S. Interests in the World's Oceans*, 46 I.L.M. 886, 886 (2007). For a review on the Bush administration's arguments supporting accession by the Legal Adviser to the State Department, see John B. Bellinger III, Legal Adviser, U.S. Dep't of State, The United States and the Law of the Sea Convention (Nov. 3, 2008), *available at* http://www.law.berkeley.edu/files/5-bellinger.pdf. *See also* John R. Crook, *President Urges Senate Approval of Law of the Sea Convention*, 101 AM. J. INT'L L. 650, 650–51 (2007); John R. Crook, *Law of the Sea Treaty Reported Out of Committee; Timing and Prospects for Full Senate Action Unknown*, 102 AM. J. INT'L L. 168, 168 (2008); John R. Crook, *Senate Approves Numerous Treaties, Not Including the Law of the Sea Convention*, 103 AM. J. INT'L L. 135, 135–36 (2009).

On April 6, 2009, at a joint session of the Antarctic Treaty Consultative Meeting and the Arctic Council, Secretary of State Hillary Rodham Clinton said that the United States was "committed" to ratifying the Law of the Sea Convention. Hilary Rodham Clinton, U.S Sec'y of State, Remarks at the Joint Session of the Antarctic Treaty Consultative Meeting and the Arctic Council, 50th Anniversary of the Antarctic Treaty (Apr. 6, 2009), *available at* http://www.state.gov/secretary/rm/2009a/04/121314.htm. On May 11, 2009, the Department of State listed the LOSC as one of the seventeen treaties on its

cooperation among the major technologically-advanced countries in both space and fusion power development is already ongoing under the International Space Station and ITER agreements[131] and the Obama administration appears to look favorably on cooperative multilateral rather than unilateral approaches to dealing with broad international issues.[132] Moreover, the recent spike in oil prices[133] and heightened international concern about global warming[134] reinforce the pressing need of the global economy to find ways to meet the world's growing appetite for energy while still decreasing greenhouse gas emissions, and thus to renewed international interest in the development of alternative energy sources such as nuclear fission and fusion.

Third, for a variety of reasons, the current influence and "bargaining power" of the United States both as a leader in space and nuclear technology, and more generally as an actor on the world stage, is arguably declining relative to that of China, the European Union, India, Russia, and other countries.[135] If this is so, the ability of the United States to negotiate the kind of lunar resource regime it wants may well be greater now than later.

"Treaty Priority List" from which the Administration seeks Senate advice and consent "at this time." Letter from Richard R. Verma, Assistant Sec'y, Legislative Affairs, U.S. Dep't of State, to Senator John Kerry, Chairman of the Senate Comm. on Foreign Relations (May 11, 2009), *available at* http://www.oceanlaw.org/downloads/2009TreatyPriorityList.pdf.

131. *See supra* notes 23, 121.

132. *See, e.g.*, Steven Erlanger & Sheryl Gay Stolberg, *Surprise Nobel for Obama Stirs Praise and Doubts*, N.Y. TIMES, Oct. 10, 2009, at A1.

133. *See, e.g.*, Daniel Yergin, *It's Still the One*, FOREIGN POL'Y, Sept.–Oct. 2009, *available at* http://www.foreignpolicy.com/articles/2009/08/17/its_still_the_one.

134. *See, e.g.*, Elisabeth Rosenthal, *Biggest Obstacle to Global Climate Deal May Be How to Pay for It*, N.Y. TIMES, Oct. 15, 2009, at A6.

135. *See, e.g.*, FAREED ZAKARIA, THE POST-AMERICAN WORLD (2008) (arguing that the rise of new global powers inevitably means the relative decline of U.S. influence); *see also* NAT'L INTELLIGENCE COUNCIL, OFFICE OF DIRECTOR OF NAT'L INTELLIGENCE, GLOBAL TRENDS 2025: A TRANSFORMED WORLD vi (2008), http://www.dni.gov/nic/PDF_2025/2025_Global_Trends_Final_Report.pdf ("Although the United States is likely to remain the single most powerful actor, the United States' relative strength—even in the military realm—will decline and U.S. leverage will become more constrained."); Scott Shane, *Global Forecast by American Intelligence Expects Al Qaeda's Appeal to Falter*, N.Y. TIMES, Nov. 21, 2008, at A14; Pamela Hess, *Intelligence Report: Say Farewell to American Supremacy*, HUFFINGTON POST, Nov. 20, 2008, http://www.huffingtonpost.com/2008/11/20/intelligence-report-say-f_n_145376.html.

Finally, it may be easier to establish the type of lunar resource regime that the United States would prefer while the feasibility of He-3 exploitation and fusion power—and, indeed, the possibility that we may eventually find valuable resources elsewhere in the solar system—is still uncertain and before potentially concerned states have developed important stakes in particular outcomes.

B. *What Kind of Lunar Resource Regime Should the United States Try to Obtain?*

Consistent with its past positions regarding the mineral resource provisions of both the Moon Agreement[136] and the LOSC,[137] the United States will presumably wish to seek a lunar resource regime having at least the following characteristics:

Provisions permitting and facilitating the exploration and development of lunar resources by the United States or its private companies. To begin, the regime should permit the United States or its private companies to conduct, without burdensome regulation or interference, any and all of the activities reasonably necessary to prospect for, explore, mine, process, and either use or transport to Earth lunar resources, in particular He-3. The regime must clearly provide for acquiring property rights in minerals or other substances removed from the Moon's surface or subsoil, the effective operation of and control over necessary stations or facilities, jurisdiction over necessary personnel, some measure of exclusivity over areas subject to resource activities, and some measure of privacy over proprietary information. The regime should also provide or permit a national or international management structure for He-3 production, marketing, and sales that permits timely decisions, within general guidelines, on all aspects of operational management. In particular, the regime should ensure the retention by the United States or its private companies of reasonable proceeds or profits commensurate with the effort involved and sufficient to encourage and warrant the level of investment involved.

A role for private enterprise. The regime should expressly allow and encourage private enterprise to play a significant role in the

136. *See generally 1980 Senate Hearings, supra* note 10.

137. *See supra* notes 70, 129 and accompanying text.

exploration and use of lunar resources, subject to appropriate and reasonable regulation. This means that private enterprise must have assurance of security of tenure during the life of mining operations and the right to earn and retain reasonable profits. Environmental regulations should be designed and used solely to minimize the impact of mining operations on the environment, to a degree consistent with economic viability of the operations. Any permitting process should be simple, direct, and prompt.

Consistency with international law. The regime should be consistent with existing U.S. obligations under the Outer Space Treaty, U.N. Charter, other international instruments, and customary international law. This recognition would include the obligations not to claim title to territory on the Moon,[138] to respect the right of other states to conduct activities there,[139] and to conduct any activities with due respect for environmental concerns.[140]

Recognition of broader international community concerns. The regime should recognize that the international community as a whole has legitimate interests in the exploration and use of the Moon and its resources. All states should have the right to conduct activities on the Moon without discrimination.[141] The regime should recognize that the international community is entitled to share the benefits of lunar exploitation.[142] However, any form of benefit sharing must be consistent with the right of the states and private enterprises primarily involved and in mineral or other resource activities to a principal role in decisions relating to the conduct of such activities and to a fair profit and return for their investment and effort. The regime should also require that all states conducting activities on the Moon must meet their obligations to the broader international community and to future generations by ensuring that their activities do not cause significant environmental or other damage.[143]

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138. *See supra* note 42 and accompanying text.
139. *See supra* note 43 and accompanying text.
140. *See supra* note 52 and accompanying text.
141. *See supra* note 58 and accompanying text.
142. *See supra* note 58 and accompanying text.
143. *See supra* note 61 and accompanying text.

Encouragement of international cooperation. The regime should encourage cooperation rather than competition among states conducting activities on the Moon, such as open access and reasonable exchanges of information, mutual assistance in situations of need, and joint activities where appropriate.

Dispute-avoidance and settlement procedures. The regime should contain provisions for the avoidance and peaceful resolution of disputes, including obligations requiring prior notification of actions likely to affect other states and consultation if problems, difficulties, or controversies arise.

Flexibility. The regime should include provisions permitting and facilitating its prompt revision and development as lunar activities proceed and the need for additional or different regulatory measures or arrangements becomes apparent. Again, the regime should recognize the right of states and enterprises primarily involved, and actually planning or engaged in resource activities to a prominent role in decisions relating to changes in or development of the regime.

C. *How Should the United States Seek to Achieve an Acceptable International Lunar Resource Regime?*

What steps might the United States take to try to achieve an acceptable lunar resource regime? Should it ratify and accede to the Moon Agreement, possibly with reservations, and then move within the article 11 and 18 framework of that agreement to negotiate such a regime? Should it negotiate an acceptable regime beforehand as a condition precedent to its acceptance of the Moon Agreement—perhaps in the form of a proposed agreed amendment or protocol pursuant to article 18 of the agreement—only then joining the agreement with the assurance that the proposed agreed-upon regime will be incorporated within the Moon Agreement's framework? Should it instead seek a new amendment or protocol to the Outer Space Treaty, making clear the right of its parties to acquire and utilize lunar or other extraterrestrial resources? Or should it seek to negotiate, either on a broad or a narrow multilateral basis, an entirely new agreement, embodying the type of regime it considers acceptable, outside the framework of the present Moon Agreement or Outer Space Treaty? Finally, regardless of the way that the United States seeks to establish a lunar mining regime

ensuring it access to lunar He-3, should it also seek to establish, together with other concerned countries and perhaps interested private enterprises, an international or quasi-international entity for the cooperative mining of lunar He-3, and possibly even for the terrestrial development of a global He-3-based fusion energy program?

1. Should the United States Accede to the Moon Agreement?

Ratifying the Moon Agreement, under conditions which assure that a lunar resource regime acceptable to the United States will eventually be established under articles 11 and 18 of the agreement may be the simplest way of achieving the U.S. objective of providing a stable legal and political environment in support of a long-term commitment to an He-3-based fusion energy program. The arguments in favor of reconsidering the past refusal of the United States to ratify the Moon Agreement are as follows.

First, the Moon Agreement is currently the principal "game in town"—the only international instrument specifically designed to deal with issues relating to the exploration of the Moon and the use of its resources. It represents the best efforts and embodies the carefully considered compromises and pragmatic accommodations of some seven years of negotiation by the United States and the principal space powers and other states most concerned. As indicated, the United States fully participated and achieved most of its objectives in this long, drawn-out negotiation.[144] With the arguable exception of article 11, the agreement provides a broadly sensible and non-controversial set of rules for the conduct of lunar activities already in place.[145] Indeed, the legal subcommittee of COPUOS, at both its most recent 2008 and 2009 meetings, devoted considerable time to a discussion of the reasons for low participation in the Moon Agreement, the benefits of adherence to the agreement, and the possibility of revision of the agreement

144. *See 1980 Senate Hearings, supra* note 10, at 9–17, 56–67 (statement of Roberts B. Owen, Legal Adviser, U.S. Dep't of State, and S. Neil Hosenball, Chairman, U.S. Delegation to COPUOS and General Counsel of NASA).

145. *See supra* notes 58, 73–98, 106–12 and accompanying text (discussing article 11 of the Moon Agreement).

so as to encourage broader participation.[146] Given this history, the United States could have difficulty persuading other states of the need to embark on a completely new negotiation.

Second, whatever their merits at the time, the arguments presented in 1980 in opposition to U.S. ratification of the agreement appear now even less persuasive. As discussed, suggestions that the Moon Agreement—and more particularly its "common heritage" language—establishes a moratorium on lunar mining, precludes a role for private enterprise, or prescribes any particular type of international regime applicable to lunar resource exploitation, particularly some kind of regime dominated by developing nations, find little support in either the language of the agreement or its negotiating history.[147] In particular, it seems clear that, while article 11 appears to require good faith efforts to negotiate an international regime at such time as resource exploitation becomes likely, it neither mandates that the regime take any particular form—particularly one mirroring the original (pre-1994 implementation agreement) LOSC seabed regime—nor requires state parties to accept any regime with which they are not satisfied. Moreover, the criteria set out in article 11(7) for any such regime appear generally consistent with U.S. objectives.[148] Finally, as indicated, the U.N. General Assembly's adoption of the 1994 implementation agreement modifying the provisions of part XI of the LOSC to which the United States strongly objected, suggests that the international community, particularly the technically advanced countries most concerned and likely to be involved in lunar exploration and development, can now be expected to be

146. *See* COPUOS, Legal Subcomm., *Report of the Legal Subcommittee on its Forty-Eighth Session*, ¶¶ 32–33, U.N. Doc. A/AC.105/935 (Apr. 20, 2009); COPUOS, Legal Subcomm., *Report of the Legal Subcommittee on its Forty-Seventh Session*, ¶ 42, U.N. Doc. A/AC.105/917 (Apr. 18, 2008); *Report of the Chairman of the Working Group on the Status and Application of the five United Nations Treaties on Outer Space*, ¶¶ 14–25, COPUOS, Legal Subcomm., *Report of the Legal Subcommittee on its Forty-Seventh Session*, annex I, U.N. Doc. A/AC.105/917 (Apr. 18, 2008); *see also* COPUOS, *supra* note 112 (contending that even though the Moon Agreement contains provisions that develop principles set out in the Outer Space Treaty, other provisions are unique to the agreement and clarify or complement principles, procedures, and notions contained in other outer space treaties).

147. *See supra* notes 58, 78, 82–93, 95–98, and accompanying text.

148. *See supra* notes 74, 95–98, and accompanying text.

receptive to the kind of lunar resource regime the United States would find acceptable.[149]

Third, while U.S. ratification of the Moon Agreement would not in itself provide a detailed lunar resource regime acceptable to the United States[150] the United States could, and should, condition or structure such ratification and accession in a way designed to ensure that, either before or after U.S. ratification and accession, an acceptable resource regime will in fact be adopted by the parties to the agreement. Some possibilities for seeking to ensure this result are discussed below.

Fourth, to the extent that concerns as to the meaning or ideological implications of the agreement continue to pose a political obstacle to U.S. ratification, such concerns could also be met through appropriate U.S. reservations, declarations, or understandings to its ratification of the agreement. For example, in 1982 the American Bar Association's House of Delegates approved a joint report of the American Bar Association sections on International Law and on Natural Resources Law recommending U.S. ratification accompanied by declarations consistent with the following principles:

> (a) It is the position of the United States that no provision in this Agreement constrains the existing right of governmental or authorized non-governmental entities to explore and use the resources of the Moon or other celestial body, including the right to develop and use these resources for commercial or other purposes, and no such constraint is accepted by this ratification;
>
> (b) It is the position of the United States that nothing in this Agreement in any way diminishes or alters the existing right of the United States to determine unilaterally how it shares the benefits derived from development and use by or under the authority of the United States of natural resources of the Moon or other celestial bodies;
>
> (c) Natural resources extracted or used by or under the authority of a State Party to this Agreement are subject to the exclusive control of, and shall be the property of the State

149. *See supra* note 72 and accompanying text.

150. *See supra* notes 67, 87–88, and accompanying text (explaining that only state parties acting collectively can participate in establishing such a regime under articles 11 and 18 of the agreement).

Party or other authorized entity responsible for their extraction or use. In this context, it is the position of the United States that Articles XII and XV of this Agreement preserve the existing right of States Parties to retain exclusive jurisdiction and control over their facilities, stations and installations on the Moon and other celestial bodies, and that other State Parties are obligated to avoid interference with normal operations of such facilities;

(d) Recognition by the United States that the Moon and its natural resources are the common heritage of all mankind is limited to recognition (i) that all States have equal rights to explore and use the Moon and its natural resources, and (ii) that no State or other entity has an exclusive right of ownership over the Moon, over any area of the surface or subsurface of the moon, or over its natural resources which have not been, or are not actually in the process of being, extracted or used by actual development activities on the Moon;

(e) It is the position of the United States that no moratorium on the commercial or other exploration, development and use of the natural resources of the Moon or other celestial body is intended or required by this Agreement. The United States recognizes that, in the development and use of natural resources on the Moon, States Parties to this Agreement are obligated to act in a manner compatible with the provisions of Article VI(2) and the purposes specified in Article XI(7), and the purposes specified in Article XI(7). However, the United States reserves to itself the right and authority to determine the standards for such compatibility unless and until the United States becomes a party to a future resources regime;

(f) Acceptance by the United States of the obligation to join in good faith negotiation for creation of a future resources regime in no way constitutes acceptance of any particular provisions or proposed provisions which may be included in an agreement creating and controlling such a regime; nor does it constitute any obligation or commitment to become a Party to such a regime regardless of the contents of any such agreement.[151]

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151. *See* ABA Section of International Law & Section of Natural Resources Law, Recommendation to the ABA House of Delegates, 465 (Jan. 25–26, 1982), *reprinted in* Carl Q. Christol, *The American Bar Association and the 1979 Moon Treaty: The Search for a*

It is true, of course, that U.S. accession to the Moon Agreement would involve risks, such as those raised in the 1980 Senate hearings, based on a pessimistic prediction of the likely outcome of any eventual article 11 and 18 negotiations.[152] Thus, U.S. accession might well encourage wider participation in the agreement by many non-space powers and developing states—countries that might have a different ideology and approach to the exploitation of lunar resources from that of the United States. Conceivably, if these nations constituted a majority of parties to the agreement, they might succeed in imposing a resource regime unacceptable to the United States in any future article 11 and 18 negotiations. In this event, U.S. accession to the Moon Agreement could result in embedding and legitimating a lunar resource regime embodying principles contrary to U.S. interests. Moreover, U.S. accession might, in this case, effectively preclude its pursuit of alternative, more hopeful strategies. While it is true that under the agreement the U.S. is not legally obliged to agree to any eventual international regime that it does not like, it might by that time be impractical for the United States to either "go it alone" or seek some other agreement.

However, there are various approaches the United States could employ to alleviate these concerns. For example:

- The United States could indicate to the current parties to the Moon Agreement that it was prepared to ratify and accede to the agreement, conditional on their first acting under article 11 and 18 to adopt a lunar resource regime reflecting principles acceptable to the United States. Conceivably, the present parties might value U.S. adherence sufficiently to adopt such a regime. However, since none of the current parties are now, or likely in the future to be, involved in lunar resource activities, they might not be best suited to fashioning the kind of resource regime the United States would hope to have established.

Position, 9 J. SPACE L. 77, 90 (1981). On the position of the American Bar Association, see *1980 Senate Hearings*, *supra* note 10, at 67–85 (testimony and statement of Ronald F. Stowe, Chairman, Aerospace Law Committee of the American Bar Association Section on International Law). *See also* Christol, *supra*, at 77–90.

152. *See supra* text accompanying notes 90, 94.

- The United States could negotiate an agreement with like-minded countries having a present or potential spacefaring capability and concern with the effective development of lunar resources, such as China, the European Union, India, Japan, and Russia, for the proposed simultaneous accession by each of them to the Moon Agreement, coupled with a joint declaration indicating their intent, upon their accession, to move under article 18 to establish an acceptable resource regime meeting U.S. requirements. The combined influence of these major powers would presumably be sufficient to ensure the adoption by all of the parties to the agreement of such a regime.
- Perhaps preferably, the United States could, more broadly, negotiate with both the current parties to the agreement, the other principal space powers, and other interested states for specific terms of an acceptable proposed lunar resource regime, with the understanding or express agreement that, if the United States and other non-party states then joined the agreement, both the old and new parties would then promptly agree to call an article 18 conference to formally adopt this previously agreed upon lunar resource regime.
- Alternatively, while the United States could not propose amendment of the Moon Agreement since it is not a current party, it could, as a member of COPUOS, propose the negotiation in COPUOS, and perhaps adoption by the U.N. General Assembly, of a protocol or additional instrument supplementing the Moon Agreement providing for a lunar resource regime acceptable to the United States, with the understanding that it would ratify the agreement and protocol or additional instrument only if the protocol or additional instrument received sufficient acceptance, including acceptance by the other principal space powers, so as to enter into force as binding upon all parties. This approach would, of course, be similar to that followed by the U.N. General Assembly in its adoption of an implementation agreement in 1994 effectively nullifying the provisions of part XI of the LOSC

to which the United States and some other states objected.[153]

As already mentioned, the current parties to the agreement might be willing to agree to one of these possible arrangements in order to encourage and facilitate participation by the United States and other space powers in the agreement.[154] Discussions in recent meetings of the Legal Committee of COPUOS suggest that the parties to the Moon Agreement, as well as other states, are actively exploring the possibility of revisions, arrangements, or other accommodations that might persuade the United States and other countries to ratify and accede to the agreement.[155] Once again, international experience with the analogous situation involving seabed minerals is suggestive, where a majority of states in the U.N. General Assembly were prepared to negotiate and adopt the 1994 implementation agreement modifying the mineral resource regime set out in part XI of the LOSC in the hope of encouraging the United States and other important states to join the LOSC.[156]

2. Should the United States Attempt to Establish an International Lunar Resource Regime Outside of the Framework of the Present Moon Agreement?

While this Article suggests that there are now good arguments for the United States to ratify and accede to the Moon Agreement, preferably—and collectively—with other space powers, under arrangements that would ensure that the legal regime established pursuant to article 11 fully satisfies U.S. requirements,[157] the fact remains that U.S. ratification may not currently be politically attainable. As was the case when the agreement was first presented to the Senate in 1980, influential and respected individuals and groups within the United States continue to strongly oppose U.S. ratification. They remained convinced that the agreement's fundamental cast, especially its provisions characterizing lunar resources as the "common heritage of mankind" and mandating the establishment of an

153. *See supra* note 72 and accompanying text.
154. *See supra* note 149 and accompanying text.
155. *See supra* note 146 and accompanying text.
156. *See supra* note 72 and accompanying text.
157. *See* discussion *supra* Part III.A.

"international regime," will in practice inhibit the private and public development and exploitation of He-3 and other lunar resources, and, in particular, create such uncertainty for private enterprise as to effectively discourage, if not prevent, private investment and industry from playing any meaningful role in the exploitation of such resources—a role they believe essential to the successful commercial development of such resources.[158] It

158. For a cogent statement of the arguments against U.S. ratification of the Moon Agreement, see SCHMITT, RETURN TO THE MOON, *supra* note 3, at 286–95. Noting the various issues raised in the 1980 Senate Hearings concerning article 11 and other provisions of the agreement, Schmitt states:

> [A] one nation, one vote, [U.N.] style organization . . . seems very unlikely to be workable even though such an organization is envisioned by the 1979 Moon Agreement. . . . The inevitable politicization of decision-making in such organizations, and the stagnation which invariably results, argues against . . . [its being suitable] for complex technical endeavors.

Id. at 151.

> [T]he opportunities and benefits of private enterprise in developing lunar resources would disappear if the United States should ratify the Moon Agreement. If international political interference with a Return to the Moon is to be avoided, the United States and other spacefaring nations should unequivocally reject this Agreement . . . .

Id. at 292. Schmitt concludes that:

> The Moon Agreement, if ratified by major spacefaring nations, would create a high degree of uncertainty that is antithetical to private commercial activities on the Moon. The Agreement would, in effect, create a *de facto* moratorium on such activities. A mandated international management regime would both complicate national and private commercial efforts and give other countries political control over the permissibility, timing and management of all commercial and national resource activities on the Moon.

Id. at 295. Instead, Schmitt proposes:

> In removing the Moon Agreement from the playing field, the United States and other nations could state that their policy will be to license competent entities to bring lunar resources to Earth under the general authority and constraints of the Outer Space Treaty of 1967. More proactively, these nations could state in policy and law that, under specific conditions, they will recognize a private entity, or other entity's property and mineral rights within a requested area on the Moon. [Schmitt goes on to suggest such conditions].

Id. at 293–94; *see also Lunar Exploration: Hearing on Lunar Exploration Before the Subcomm. on Science, Technology and Space of the S. Comm. on Commerce, Science and Transportation*, 108th Cong. (2003) (testimony of Hon. Harrison H. Schmitt, Chairman, Interlune-Intermars Initiative, Inc.), *available at* http://commerce.senate.gov/pdf/schmitt110603.doc [hereinafter *2003 Lunar Exploration Hearings*]. Doctor Schmitt currently is Chairman of Interlune-Intermars Initiative, Inc., an organization with the goal of advancing private sector acquisition and use of lunar resources. *See* BASLAR, *supra* note 10, at 161–90 (broadly discussing what he considers problems with the Moon Agreement); G.H. Reynolds, *Return of the Moon Treaty: The Monster L-5 Slew Lives Again*, AD ASTRA, May–June 1994, at 27, 28 (stating that the creation of an international

may be argued that, given the risks and uncertainty necessarily involved in the development of lunar He-3-based fusion energy, the enormous investment certainly required, and the likely very long time horizon before any financial return, the prospect of private enterprises choosing to play a leading role in He-3 or other lunar resource development—at least without substantial government assistance—is open to question.[159] However, the 1980 Senate hearings and subsequent lack of administration interest in the agreement suggest that, if such opposition persists, the prospect for Senate advice and consent to ratification any time soon remains uncertain.[160]

Consequently, if ratification of the Moon Agreement proves either undesirable or politically unachievable, the United States could seek to establish a lunar resource regime wholly apart from the Moon Agreement. As discussed, some precedent for this approach exists in the U.S. rejection of the 1982 Law of the Sea Convention,[161] and subsequent conclusion of bilateral agreements between the United States and several other countries resolving overlapping claims regarding seabed-mining areas.[162] The possibilities open to the United States in this respect include the following:

- The United States, as a party to the Outer Space Treaty, could propose an amendment or protocol to that treaty that would clearly protect and provide for the right of any state or private enterprise to mine, acquire property rights in, and exploit lunar or other outer space resources and to retain a reasonable share of the profits.

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authority "would discourage—if not outright prevent—the development of lunar resources any time soon.").

Interestingly, in the recent science-fiction movie *Moon*, the lunar He-3 is exploited by a private Japanese company that employs the protagonist engaged in the actual mining activities. *See* MOON, *supra* note 3.

159. *See, e.g.*, Kenneth Chang, *Grand Plans for Moon and Mars, Budget Permitting*, N.Y. TIMES, July 14, 2009, at D2 ("The nascent private space industry, which has yet to send anyone into orbit, does not seem likely to head to the Moon, either, with no obvious profit windfall to offset the billions of dollars in cost. 'The idea that a private investor can put together the funds to develop rockets capable of a lunar mission is extremely speculative, verging on fantasy,' said John Logsdon, chairman of space history at the National Air and Space Museum.").

160. *See* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 286–87.

161. *See supra* note 70 and accompanying text.

162. *See supra* note 117 and accompanying text.

- The United States could propose to other "space powers" and other interested countries the negotiation, on a global basis, of an entirely new Moon Agreement intended to replace the present agreement, and containing different and more detailed provisions reflecting U.S. preferences. The new agreement might incorporate and be generally consistent with the tenor and provisions of the Moon Agreement apart from its provisions regarding the establishment of an acceptable lunar resource regime. Such a negotiation could conceivably occur either within COPUOS or outside the U.N. framework.
- The United States could take the same approach it adopted under the 1980 Deep Seabed Hard Mineral Act with respect to the issue of deep seabed mining,[163] and negotiate a lunar resource agreement only with like-minded states actually engaged in space activities and showing a potential capacity to engage in lunar mining activities, such as China, the European Union India, Japan, and Russia. Such an agreement might not attempt to deal with lunar activities as a whole, which are already broadly covered in the Outer Space Treaty and in provisions of the Moon Agreement that may arguably be binding as customary law,[164] but could deal only with the provision of rules relating more directly to the exploitation of lunar resources.
- Finally, if objections are raised that it is premature to try to agree now on a detailed lunar resource regime, since the exploitation of such resources is unlikely for many years, the United States might propose that the space powers and other nations potentially involved in lunar exploration and development, and possibly other countries concerned, enter into at least a broad "lunar resource principles" framework agreement, expressing a firm commitment to the basic character of a regime which would be acceptable to the United States.

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163. *See* RESTATEMENT (THIRD) FOREIGN RELATIONS § 523, *supra* note 116, n.5; *supra* text accompanying notes 115–16.

164. *See* discussion *supra* notes 101–05.

However, each of these possibilities has drawbacks. Each bypasses and ignores the existing Moon Agreement and may, on that basis alone, fail to win broad international support. Moreover, the last three approaches may fail to provide the kind of broader legal and political assurance that long-term state and private investment in He-3-based fusion energy development is likely to require.

3. Should the United States Seek to Establish an International Organization or Enterprise for the Cooperative Development of Lunar He-3 Mining and Perhaps, More Broadly, of Terrestrial He-3-Based Fusion Energy?

The United States could take the initiative in seeking to establish a user-based international organization or enterprise designed to cooperatively develop and manage the mining and distribution of lunar He-3 along with other lunar resources and, perhaps more broadly, at least certain aspects of the development, production, and distribution of He-3-based fusion energy on Earth.[165] The organization could be comprised of, first, the principal space powers and other nations willing to actively participate in creating the necessary capabilities; second, other nations and entities who are users or beneficiaries of such capabilities; and, perhaps, third, private companies, consortia, or investors interested and capable of investing and participation in the enterprise as a whole.[166] The organization could be based on a recognition that the Moon and its resources constitute a common heritage of humankind, that the enormous potential of He-3-based fusion energy deserves to be shared by all of the Earth's nations and peoples, and that this promise might best be

165. For example, see the proposal by Harrison H. Schmitt and Christopher C. Joyner for the establishment of INTERLUNE, a user-based international organization whose primary purpose would be to manage the initial development of commercial helium-3 fusion power on Earth and the development and operation of helium-3 production facilities on the Moon. *See* Christopher C. Joyner & Harrison H. Schmitt, *Lunar Bases and Extraterrestrial Law: General Gegal Principles and a Particular Regime Proposal (INTERLUNE), in* LUNAR BASES AND SPACE ACTIVITIES OF THE 21ST CENTURY, *supra* note 40, at 741.

166. *Id.*; *see also* BILDER ET AL., *supra* note 3, at 88–89; Harrison H. Schmitt, INTERLUNE Concept for Helium-3 Lunar Development 1–4 (1992), *available at* http://icf4.neep.wisc.edu/pdf/wcsar9203-2.pdf. *See generally* SCHMITT, RETURN TO THE MOON, *supra* note 3, at 149–53 (presenting various financial and managerial approaches for mining the moon).

achieved by a cooperative, rather than individualistic or confrontational, approach to the development and management of such a complex, challenging, costly, and potentially history-changing source of energy. The world's leading technologically advanced nations have already taken significant steps in this direction in their cooperative approach to the development and operation of the International Space Station[167] and the formation of ITER.[168] The potential inclusion of private companies and consortia in such an organization would recognize the growing interest and the important and exciting possibilities of participation by private enterprise in the commercial development of spaceflight and space resources.[169]

Such a cooperative international organization could take a variety of forms. As several commentators have suggested,[170] it might, for example, be modeled on the International Telecommunications Satellite Organization ("INTELSAT"), the innovative user-based intergovernmental commercial consortium which, pursuant to a U.S. initiative, was established by a number of government and operating entities, initially on an interim basis in 1964 and then by permanent agreement in 1973, to own and manage a constellation of communications satellites providing international broadcast services to all areas of the

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167. *See supra* note 122 and accompanying text; *see also* Cheryl Mansfield, *A Station Celebration*, NASA, Dec. 4, 2008, http://www.nasa.gov/mission_pages/station/behindscenes/construction_begins.html (discussing the collaboration between various nations to create the International Space Station).

168. *See supra* notes 22–24.

169. *See, e.g.*, Commercial Space Launch Act, Pub. L. No. 98-575, § 3(1), 98 Stat. 3055, 3055 (codified at 49 U.S.C. § 70101(b)(1) (2006)) (stating as U.S. policy the desire "to promote economic growth and entrepreneurial activity through the use of the space environment for peaceful purposes"); *see also 2003 Lunar Exploration Hearings*, *supra* note 158 (testimony of Hon. Harrison H. Schmitt, Chairman, Interlune-Intermars Initiative, Inc.); *Flying High: America's Government Has No Money for Its Human-Spaceflight Plans. The Private Sector Has Plenty*, ECONOMIST, Sept. 12, 2009, at 87. *See generally* H.L. VAN TRAA-ENGELMAN, COMMERCIAL UTILIZATION OF OUTER SPACE: LAW AND PRACTICE 277–313 (1993) (discussing private enterprise and space law). Notably, President Obama's proposed 2011 budget for NASA calls for spending US$6 billion over five years to fund the development of private commercial spacecraft that could ferry astronauts into low-earth orbit. *See* Chang, *supra* note 2.

170. *See, e.g.*, *1980 Senate Hearings*, *supra* note 10, at 8, 15, 26, 173 (statements of Roberts B. Owen, Legal Adviser, Dep't of State, and statement of Eileen Galloway, Director, Int'l Institute of Space Law of the Int'l Astronautical Federation); BILDER ET AL., *supra*, note 3, at 89; PETERSON, *supra* note 10, at 164; SCHMITT, RETURN TO THE MOON, *supra* note 3, at 289; Doyle, *supra* note 10, at 31–37; Galloway, *Implementing the Moon Agreement*, *supra* note 10.

world.[171] Membership in INTELSAT was open to any state that was a member of the International Telecommunications Union ("ITU"), but access to the system was available to every nation.[172] Under the INTELSAT agreement, shares and votes in INTELSAT were reallocated periodically in proportion to each member's contribution to and use of the system.[173] That is, members that contributed more investment through substantial use, such as the United States, had more shares and voting weight in substantive decisions of the organization. The organization's primary source of revenue was from satellite usage fees, which, after deducting operating costs, were redistributed to INTELSAT members in proportion to their shares.[174] As indicated, satellite services were available to any nation, whether or not a member of INTELSAT and all users paid the same rates.[175] This nondiscriminatory pricing structure in effect subsidized lesser use by developing countries with heavier use by more developed nations, thus providing some sharing of the benefits of space communications technology. INTELSAT was tied to the U.N. through its recognition of the regulatory functions of the ITU.[176]

In 2001, INTELSAT, which by that time had over one-hundred members, was privatized and renamed Intelsat, Ltd.[177] It is now the world's largest provider of satellite services, operating

171. *See* Agreement Relating to the International Telecommunications Satellite Organization INTELSAT, Aug. 20, 1971, 23 U.S.T. 3813, 1220 U.N.T.S. 22 [hereinafter INTELSAT Treaty]; *see also* PETERSON, *supra* note 10, at 173–212; MILTON L. SMITH, INTERNATIONAL REGULATION OF SATELLITE COMMUNICATIONS 29–30 (1990); VAN TRAA-ENGELMAN, *supra* note 169, at 112–33; Steven A. Levy, *Intelsat: Technology, Politics and the Transformation of a Regime*, 29 INT'L ORG. 655, 658 (1975).

A similar organization, the International Maritime Satellite Organization ("INMARSAT") was established in 1979 to establish maritime satellite services, now extended to land and air mobile communications and maritime communications. *See* Convention on the International Maritime Satellite Organization (INMARSAT) art. 3, Sept. 3, 1976, 31 U.S.T. 1, 1143 U.N.T.S. 105. In 1999, INMARSAT was also converted into a private commercial company under United Kingdom law. *See* Daya Kishan Thussu, *Lost in Space*, 121 FOREIGN POL'Y 70, 71 (2001); *see also* VAN TRAA-ENGELMAN, *supra* note 169, at 137–58 (discussing INMARSAT in detail).

172. *See* INTELSAT Treaty, *supra* note 171, pmbl.

173. *See* Operating Agreement Relating to the International Telecommunications Satellite Organization INTELSAT art. 6, Aug. 20, 1971, 23 U.S.T. 4091, 1220 U.N.T.S. 149 [hereinafter INTELSAT Operating Agreement].

174. *See id.* art. 8(e).

175. *See* INTELSAT Treaty, *supra* note 171, pmbl.

176. *See* INTELSAT Operating Agreement, *supra* note 173, art. 13, annex A(4).

177. *See* INTELSAT: 2000 and Beyond, http://www.intelsat.com/about-us/history/intelsat-2000s.asp (last visited Feb. 10, 2010).

a fleet of over fifty communication satellites and providing service to over 600 Earth stations in more than 149 countries and territories.[178] INTELSAT offers not only a successful example of international cooperation with respect to the profitable commercial development of a common space resource but also suggests the possibility of transitioning an initially intergovernmental commercial consortium to participation or management by private enterprise.

Whatever form such a cooperative international institutional arrangement took, it would be designed and serve to provide access and influence to all nations, participants, investors, and customers in the development and use of He-3-based fusion power, alleviate conflict and discontent over which nation or nations should control lunar resources or resource-related operations on the Moon, and assure that the benefits of He-3-based fusion energy would be widely shared by all nations and peoples. Among the more important objectives of such an organization or enterprise would be: (1) raising the necessary capital to sustain the development of a technologically and economically viable He-3-based fusion energy system; (2) developing the necessary fusion and lunar He-3 recovery technology; (3) assuring effective and environmentally-sound operation of terrestrial and lunar fusion-energy related facilities and services; (4) assuring reliable supplies of He-3 and other resources to terrestrial customers; (5) maintaining reasonable and uniform rate structures to all users; (6) assuring access to proprietary technologies, and resources and profits related to a fair valuation of members' participation and contribution; and (7) resolving disputes among members concerning their participation in such an enterprise.

Such an organization or enterprise might conceivably be established independent of any separate international agreement regarding a lunar mining regime. Presumably, if this organization embraced a sufficiently broad and significant membership, including all of the leading space powers, it could in itself constitute such a regime, although it would, of course, have to conform to the broad principles set forth in the Outer

178. *See* INTELSAT: About Us, http://www.intelsat.com/about-us/ (last visited Feb. 10, 2010); *see also* INTELSAT: Mission and Spacecraft Library, http://msl/jpl.nasa.gov/Programs/intesat.html (last visited Feb. 10, 2010).

Space Treaty and those provisions of the Moon Agreement which can be considered to now reflect customary international law.[179] Alternatively, such an organization or enterprise could be designed to supplement and be compatible with the Moon Agreement or other international agreement which might be negotiated to deal with lunar resources. Indeed, article 16 of the Moon Agreement specifically provides that an international organization whose membership is comprised of a majority of state parties may conduct activities under the agreement if it accepts the agreement's obligations.[180] Finally, such an organization or enterprise could be established under the Moon Agreement by the parties to that agreement as, in itself, a part of the "international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon" that the parties undertake to establish under article 11(5) and 18 of that agreement.[181]

CONCLUSION

The need for affordable, safe, and non-polluting energy to serve the Earth's growing population is increasingly evident and urgent. The development of lunar He-3-based fusion energy, while still uncertain of achievement, offers humanity a credible prospect of meeting that need for centuries to come. Thus, it is not surprising that the United States and other nations proposing the eventual establishment of lunar bases have expressed interest in the possible mining and exploitation of lunar He-3.

However, neither nations nor private commercial enterprises are likely to be willing to commit resources to an He-3-based fusion energy program absent a stable and predictable legal regime governing lunar resources that provides reasonable assurance that any such effort and investment will be rewarded and can be carried on without controversy or disruption. Yet, at present, international space law fails to establish any detailed rules governing the mining, ownership, and exploitation of He-3 and other lunar resources or to provide such assurance.

179. *See* discussion *supra* notes 101–05.

180. *See supra* text accompanying note 65.

181. Moon Treaty, *supra* note 8, arts. 11(5), 18.

Consequently, if the United States seriously contemplates the possible development of He-3-based fusion energy, it is in its national interest to take steps to establish what it would consider as an acceptable and agreed-upon international lunar resource regime—and to do so relatively soon.

There are a variety of ways, discussed above, in which the United States could seek to establish such an acceptable international lunar resource regime. Perhaps the simplest and most promising would be approaches involving collective accession by the United States and other major "space powers" to the Moon Agreement under conditions or arrangements that assure the incorporation of an acceptable lunar resource regime within the Moon Agreement pursuant to articles 11(5) and 18 of that agreement. An additional initiative, well worth exploring, is the possibility of the formation by the United States, other "space powers," and other interested nations of a user-based international organization or entity—open to all nations and perhaps private enterprises—to undertake the collective development and conduct of lunar He-3 and other resource mining activities, as well as perhaps at least some aspects of the development and management of terrestrial He-3-based fusion energy itself. Such a collective enterprise might be established on its own or perhaps incorporated within the framework of the Moon Agreement under article 18 of that agreement.

However problematic and seemingly remote, the question of the exploitation of He-3 and other lunar resources warrants the U.S. government's—and international lawyers'—present attention. While President Obama's recent proposal to eliminate funding for NASA's Moon-bound Constellation program raises doubts as to whether NASA will, at least in the immediate future, implement the previous administration's program,[182] it seems likely that the United States, and at least some other nations, will eventually establish bases on the Moon—and perhaps on Mars or other planets or their moons. Beginning now to think about and craft collective solutions to the issues which may well arise from such programs may not only facilitate such national activities but avoid difficulties and disputes in the future. Moreover, international cooperation in developing—and making available

182. *See supra* note 2.

to all nations and people—a prospectively ideal and abundant source of affordable, safe, and nonpolluting energy could usher in a new and hopeful era for all humanity.