

The Other Side of the Deterrence Moon

Elevating “Deterrence from Space” in Strategic Competition

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Current discussions about the intersection of deterrence and space focus exclusively on deterrence *in* space. These conversations fail, however, to consider how the United States can leverage its space assets to deter offensive actions in nonspace domains, a concept this article calls deterrence *from* space. This notion differs from deterrence *in* space in that it reframes space assets as both powerful deterrents themselves and as vulnerable liabilities needing deterrence protection. Given the rise of China’s capabilities and ambitions, the United States must not neglect the ways in which deterrence from space can enhance integrated deterrence. Such deterrence includes capabilities such as orbital-class rocket resupply and robust space-based solar power.

Much has been written about how best to deter US adversaries, most importantly the People’s Republic of China (PRC), from attacking US assets in the space domain.¹ Yet despite the ubiquity of statements on the “critical” nature of US military and intelligence satellites to “the modern American way of war,” or others detailing the specifics of how satellites support the warfighter in other domains, the ways in which space assets can directly affect military operations and American integrated deterrence writ large are rarely addressed.² Thus, what remains noticeably absent from such discussions as well as discussions on cross-domain deterrence—and from space deterrence literature as a whole—are detailed accounts of what deterrent effects space assets produce themselves.

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1. Krista Langeland and Derek Grossman, *Tailoring Deterrence for China in Space* (Santa Monica, CA: RAND Corporation, 2021), <https://www.rand.org/>; Stephen J. Flanagan et al., *A Framework of Deterrence in Space Operations* (Santa Monica, CA: RAND Corporation, 2023), <https://www.rand.org/>; Steve Lambakis, *A Guide for Thinking about Space Deterrence and China* (Fairfax, VA: National Institute Press, 2019), <https://www.nipp.org/>; and Scott Pace, “A U.S. Perspective on Deterrence and Geopolitics in Space,” *Space Policy* 66 (November 2023), <https://doi.org/>.

2. Michael P. Gleason and Peter L. Hays, “Getting the Most Deterrent Value from U.S. Space Forces,” in *Space Agenda 2021: Informing the Future of Space* (El Segundo, CA: Aerospace Corporation, October 2020), 55, <https://csps.aerospace.org/>; and Nathaniel A. Peace, “Space Denial: A Deterrence Strategy,” *Joint Force Quarterly* 111, no. 4 (October 30, 2023), <https://ndupress.ndu.edu/>.

This significant gap in the literature indicates the potential of military strategists to propagate perspectives in which space assets are viewed myopically as liabilities in need of the protection of deterrence rather than as assets with powerful deterrent properties of their own. In reality, space assets fall on both sides of this metaphorical deterrence moon—they are simultaneously both vulnerable liabilities and powerful deterrents themselves.

This article examines how the United States can bolster its efforts to deter its “pacing challenge,” the PRC, from offensive actions in nonspace domains, using American space capabilities.³ Borrowing from the US Space Force mission statement—which is to “secure our Nation’s interests in, from, and to space”—this article will subsequently refer to the act of using deterrence to protect American satellites and space assets specifically from attacks in the space domain as deterrence in space, and the act of using American space assets to deter offensive actions in nonspace domains as deterrence from space.⁴

Given the rapid rise of PRC military capabilities and ambitions, the United States must integrate use of a deterrence-from-space framework into its operational and strategic mode of thinking.⁵ This article focuses on two US space capabilities as examples of the unique deterrence capabilities elucidated by a deterrence-from-space framework: orbital-class rocket resupply and space-based solar power. The United States must continue to invest in, develop, evaluate, and eventually deploy these technologies to maximize its potential deterrent effect with respect to China.

Theoretical Foundations

Deterrence from space differs from deterrence in space by reframing the positionality of space assets from vulnerable liabilities to deterrent assets. Deterrence from space is also wider in scope and focuses on using space assets to deter aggression and attacks in all nonspace domains, whereas deterrence in space solely focuses on deterring attacks specifically within the space domain.⁶

Deterrence from space, grounded in traditional deterrence theory, prioritizes the following distinctions. First, it is important to distinguish between the two forms of strategic coercion—namely, deterrence and compellence.⁷ States certainly could compel from space by continuously and actively inflicting forceful punishment on an adversary using space

3. Lloyd J. Austin III, *National Defense Strategy of the United States of America* (Washington, DC: Department of Defense [DoD], 2022).

4. “United States Space Force Mission,” US Space Force, accessed December 11, 2023, <https://www.spaceforce.mil/>; Langeland and Grossman, *Tailoring Deterrence, Pace, U.S. Perspective*; and Gregory D. Miller, “Preventing War with a Warfighting Domain: Nuclear Deterrence Lessons for Space,” *Astropolitics* 19, no. 1–2 (May 4, 2021), <https://doi.org/>.

5. Dean Cheng, *Cyber Dragon: Inside China’s Information Warfare and Cyber Operations*, The Changing Face of War (Santa Barbara, CA: Praeger Security International, 2017); and Austin, *National Defense Strategy*.

6. Miller, “Preventing War.”

7. Michael J. Mazarr, *Understanding Deterrence* (Santa Monica, CA: RAND Corporation, April 19, 2019), 2, <https://doi.org/>.

assets until the adversary stops acting in a specified way. Given the sophisticated nature of US space capabilities, compellence from space is likely already theoretically possible. Yet due to other difficulties, such as the need for a carefully calibrated time frame and credibility roadblocks that plague all conceptions of compellence, this article focuses only on the concept of deterrence from space.⁸ Deterrence from space is conceptually bound to threats of force held in reserve, derived from space assets, to prevent some specified adversarial action in any nonspace domain.⁹

Acknowledging the further distinction between deterrence by denial and deterrence by punishment from space, this article will focus on deterrence by denial from space. This can be conceptualized as the use of space assets to deny an adversary the ability to achieve some offensive end in a nonspace domain by imposing sufficient costs such that the offensive action is not worth pursuing in the first place.¹⁰

Integrated Deterrence

Deterrence from space fits perfectly within the notion of integrated deterrence outlined in the 2022 *National Defense Strategy*, whereby the United States first aims to deny adversaries opportunities in which the costs do not outweigh the advantages of attacking.¹¹ Integrated deterrence “seeks to integrate all tools of national power across domains, geography, and spectrum of conflict, while working with allies and partners.”¹²

Deterrence by denial from space complements this framework by emphasizing the deterrent effects of capabilities the United States already employs. Some of these capabilities include GPS-provided position, navigation, and timing capabilities, which bolster precision-weapons targeting; satellite-based military communications, which enhance military responsiveness, readiness, and coordination; and space-based nuclear command and control systems, which underpin America’s nuclear capabilities.¹³

These current space capabilities when viewed with a deterrence-from-space framework become key contributors to the effectiveness of general US strategic efforts to deter by denial due to the ways in which they increase the cost of offensive adversarial actions in all domains. In addition to highlighting the deterrence-by-denial effects generated by current US space assets, the deterrence-from-space framework elucidates deterrence-by-denial properties of space assets, such as orbital-class rocket resupply and space-based solar power, that otherwise would not be considered deterrents.

8. Thomas Schelling, *Arms and Influence*, Veritas Paperback ed. (New Haven, CT: Yale University Press, 2020), 69–78.

9. Miller, “Preventing War”; and Schelling.

10. Austin, *National Defense Strategy*; and Lambakis, *Guide*.

11. Austin; and Langeland and Grossman, *Tailoring Deterrence*.

12. Stacie Pettyjohn and Becca Wasser, *No I in Team* (Washington, DC: Center for New American Security, December 14, 2022), executive summary, <https://www.cnas.org/>.

13. Langeland and Grossman, *Tailoring Deterrence*; and Lambakis, *Guide*.

Finally, it might be argued that devoting more attention to deterrence from space is not necessary because the use of American space assets as deterrents is implied by the United States' reliance on cross-domain punishment threats—that “deterrence is just deterrence.”¹⁴ Yet this is not the case. One of the pillars of effective deterrence in any domain is clear communication.¹⁵ Without effective communication that results in one's adversaries understanding and believing one's deterrent threats, adversaries will not be deterred.¹⁶

Given the current literature and official government documents' lack of discussion about deterrence from space, the United States may not be clearly communicating its ability and intention to use space-based capabilities as deterrents beyond their use in support of the warfighter. Importantly, proper communication regarding this additional frame of reference for space deterrence will increase both the likelihood that US policymakers and military officials view space assets as having their own inherent deterrent effects and the likelihood that the PRC understands and internalizes this deterrence potential.¹⁷

A View from China

To evaluate the credibility of US deterrence from space vis-à-vis China, a baseline understanding of China's conceptions of space deterrence is necessary. It is important to delineate the difference between Western theoretical conceptions of deterrence from the nearest Chinese concept, 威慑 or *weishe*.¹⁸ The basis of the Western concept of deterrence, as understood by the United States, is the idea of dissuasion—that is, that threats of force are used in order to prevent an adversary from certain action and will only be carried out if the adversary performs this action. The Chinese concept of *weishe*, on the other hand, can best be understood as strategic coercion as defined by Thomas Schelling. Western strategic ideas of both dissuasion and persuasion are included in this concept; therefore, *weishe* encompasses both Western ideas of deterrence and compellence.¹⁹

Another meaningful contrast between these Western and Chinese concepts is whether they are considered a means to larger ends or an end in and of themselves. In US military

14. Austin, *National Defense Strategy*; and Nicole Petrucci, “Building Space into Multi-Domain Deterrence Strategy,” *Angle of Attack: A Journal of Airpower Strategy* [blog], December 1, 2018, <https://www.airpowerstrategy/>.

15. Bryan Boyce, “Twenty-first Century Deterrence in the Space War-Fighting Domain: Not Your Father's Century, Deterrence, or Domain,” *Air & Space Power Journal* 33, no. 1 (2019), <https://www.airuniversity.af.edu/>.

16. Boyce.

17. Austin, *National Defense Strategy*.

18. Dean Cheng, “Chinese Views on Deterrence,” *Joint Force Quarterly* 60, no. 1 (2011), <https://ndupress.ndu.edu/>; Cheng, “An Overview of Chinese Thinking About Deterrence,” in *NL ARMS Netherlands Annual Review of Military Studies 2020: Deterrence in the 21st Century—Insights from Theory and Practice*, ed. Frans Osinga and Tim Sweijts (Hague: T. M. C. Asser Press, 2020), 177–200, <https://doi.org/>; and James Scouras, Edward Smyth, and Thomas Mahnken, *Cross-Domain Deterrence in US-China Strategy: Workshop Proceedings* (Laurel, MD: Johns Hopkins University Applied Physics Laboratory, 2017), <https://www.jhuapl.edu/>.

19. Cheng, “Chinese Views”; Cheng, “Overview”; Scouras, Smyth, and Mahnken; and Schelling, *Arms and Influence*, 4–5, 69–78.

strategy, preventing adversaries from acting is a goal worth pursuing for its own sake. In PRC military strategy, however, *weishe* is a means of achieving other broader strategic goals; mainly, it is a method of psychological warfare that has the power to constrain the actions of adversaries. In other words, *weishe* is not to be pursued—or, more representative of Chinese strategy, used—for its own sake, but only to force adversaries to submit to strategic objectives.²⁰

These unique characteristics of *weishe* directly affect how the PRC applies this concept to space to create the concept of 空间威慑 or *kongjian* [space] *weishe*.²¹ This concept entails using “space forces and capabilities to deter or coerce an opponent, preventing the outbreak of conflict, or limiting its extent should conflict occur.”²² Unlike the United States, whose concern about establishing deterrence in space stems from its own dependence on space assets, China is concerned with operationalizing *kongjian weishe*, which stems from its recognition that the United States is both dependent on and vulnerable in space.²³ Thus, if one had to choose, it would be most accurate to compare *kongjian weishe* with the concepts of deterrence—and compellence—from space as opposed to in space. This is because the PRC is not particularly focused on preventing adversaries from attacking its satellites or acting in space, but rather on employing space systems, which give it the ability to influence the perceptions, and thus behavior, of adversaries in all domains, but particularly nonspace domains.²⁴

Thus, China’s own theory of *kongjian weishe* is likely evidence of the credibility of a US deterrence-from-space posture with regard to China. Given that the PRC already values its space assets primarily for the strategic and holistic effects they produce in all nonspace domains and the fact deterrence from space aims to use space assets in largely the same way, it seems highly likely the PRC will find US deterrence from space credible.²⁵ This is because deterrence from space simply asks the PRC to believe its own words that *kongjian weishe* “has a great deterrent effect on the enemy.”²⁶ Ultimately, if the PRC believes that it can credibly achieve such a coercive effect using *kongjian weishe*, it is reasonable to conclude that the PRC will similarly find its closest Western conception, deterrence from space, to be equally credible and effective.²⁷

While the similarities between *kongjian weishe* and deterrence from space enhance the credibility of US deterrence from space efforts vis-à-vis China, they also provide for one area of potential escalatory misunderstanding. Given the tendency of states to project their

20. Cheng, “Chinese Views”; and “Overview.”

21. Cheng, “Overview”; and *Cyber Dragon*.

22. Cheng, “Overview.”

23. Cheng.

24. Cheng, “Overview”; and *Cyber Dragon*.

25. Cheng.

26. *In Their Own Words: Science of Military Strategy 2020* (Montgomery, AL: China Aerospace Studies Institute, January 2020), 130, <https://www.airuniversity.af.edu/>.

27. *Their Own Words*, 130.

own behaviors and beliefs onto their adversaries, US deterrence from space could be mistakenly viewed by China as a means of compellence.²⁸ China's use of a singular concept for both compellence and deterrence has the potential to blind the PRC to this nuance in US thinking. Evidence of such misperceptions already exists. Analysis of PRC perceptions of US actions in space find the PRC tends to interpret US deterrent efforts in space as being aggressive or coercive.²⁹

While this presents the possibility of unintended escalation due to misperception, the advantages associated with US employment of a deterrence-from-space framework outweigh these potential risks. Not only does deterrence from space enhance integrated deterrence by increasing the effectiveness of deterrence by denial, but also past US actions in space aimed at clarifying its intentions have generally been viewed as disingenuous by China.³⁰ Thus, refraining from implementing a deterrence-from-space framework would rob the United States of deterrence advantages without assuaging PRC misperceptions.

Deterring China from Space

To successfully determine how the United States might leverage its space assets to deter the PRC from space, one first must understand how China calculates the cost-benefit analysis of taking offensive actions as well as what specific interests the United States must credibly hold under threat for China to be deterred. While an exhaustive discussion of China's interests is outside the scope of this paper, one PRC vital interest seems particularly susceptible to US deterrence from space: military-balance/cost-benefit calculations.

China's main interest in achieving either an equilibrium balance of power with the United States or, from its perspective, preferably an imbalance in its favor, stems from long-standing designs on becoming the regional hegemonic power in the Asia-Pacific region and achieving "reunification" with Taiwan.³¹ As such, the PRC is extremely concerned with the balance of military power in the region.³² Importantly, China seems to rely on calculations of military balance as part of its determination for the use of force to invade Taiwan, refraining from invading so long as it believes the likelihood of defeat is higher than that of success.³³

Thus, the PRC's military-balance cost-benefit calculation is susceptible to targeting by US deterrence from space. The United States should do so by investing in, developing, and eventually deploying orbital-class rocket resupply and robust space-based solar power.

28. Alexis A. Blanc et al., *Chinese and Russian Perceptions of and Responses to U.S. Military Activities in the Space Domain* (Santa Monica, CA: RAND Corporation, October 11, 2022), <https://www.rand.org/>.

29. Blanc et al.

30. Blanc et al.

31. Lindsay Maizland, "China's Modernizing Military," Council on Foreign Relations, updated February 5, 2020, <https://www.cfr.org/>; and Jared M. McKinney and Peter Harris, "Broken Nest: Deterring China from Invading Taiwan," *Parameters* 51, no. 4 (November 17, 2021), <https://press.armywarcollege.edu/>.

32. McKinney and Harris; Maizland; and Cheng, *Cyber Dragon*.

33. McKinney and Harris.

Orbital-Class Rocket Resupply

The United States can enhance the effectiveness of its overall deterrence posture with regard to China by investing in and developing orbital-class rocket resupply as a deterrence-from-space capability. Orbital-class rocket resupply capability entails the use of rocket-powered spacecraft to rapidly transport large amounts of cargo, or possibly even people, from one point on the globe to any other, via flights that reach just above the atmosphere of Earth and into space—just over 100 kilometers in altitude.³⁴ Such flights require the use of orbital class rockets, such as SpaceX’s Starship or other similarly sized orbital platforms.³⁵

While the time such capabilities will spend in the space domain is minimal, their development is inextricably linked to the development of space domain technologies and research and development, and therefore can only be viewed as space capabilities.³⁶ While this technology is still years away from being operational, current estimates suggest such a capability would be able to transport the equivalent cargo payload of a US Air Force C-17 cargo plane—about 170,000 pounds—anywhere in the world in less than an hour’s time, with even larger payloads likely possible as the technology progresses.³⁷

While US Transportation Command has already invested in studies and demonstration contracts with private companies such as SpaceX and Blue Origin, the Department of Defense needs to remain steadfast in its pursuit and development of these technologies.³⁸ The Pentagon’s efforts regarding orbital-class rocket resupply technologies have been criticized mainly for being either too provisional or, most cogently, for being technologically too nascent to warrant investment.³⁹ Yet given this technology’s potential unmatched ability to alter China’s military balance calculations in contingencies in the Asia-Pacific region, the nascent stage of this technology offers a powerful argument for more substantial investment in its development.

Currently, US deterrent threats to respond with force against either a PRC invasion of Taiwan or its use of military force in other Asia-Pacific contingencies face an enormous credibility problem due to the extreme logistical difficulty of supporting and deploying

34. US Transportation Command (USTRANSCOM) Public Affairs, “Rocket Cargo Delivery Gets Big Boost,” press release, June 7, 2021, <https://www.ustranscom.mil/>; Theresa Hitchens, “Starship Troopers? TRANSCOM-SpaceX Accord Raises Policy Eyebrows,” *Breaking Defense*, October 8, 2020, <https://breakingdefense.com/>; and Sandra Erwin, “SpaceX Wins \$102 Million Air Force Contract to Demonstrate Technologies for Point-to-Point Space Transportation,” *SpaceNews*, January 19, 2022, <https://space.news.com/>.

35. Von P. H. Fernandes et al., “The World in 90 Minutes or Less: Rocket Logistics and Future Military Operations,” *Campaigning: The Journal of the Joint Forces Staff College* (October 13, 2022), <https://jfsc.ndu.edu/>.

36. Fernandes et al.

37. Hitchens, “Starship Troopers?”; and “C-17 Globemaster III,” *Military.com*, accessed December 12, 2023, <https://www.military.com/>.

38. “United States Transportation Command,” USTRANSCOM (website), accessed December 12, 2023, <https://www.ustranscom.mil/>; Hitchens; and Erwin, “SpaceX.”

39. Hitchens.

US troops so far away from the American homeland.⁴⁰ This so-called tyranny of distance includes the vast surface area of the Pacific Ocean, which poses fuel sufficiency issues for cargo flights, the immense lead times needed to move sufficient supplies and troops into the Asia-Pacific theater, and the extreme scale of such efforts.⁴¹ These logistical nightmares undermine even integrated deterrence's most sincere threats to respond with force to China's offensive actions, based solely on the fact that US follow-through might not be feasible within a reasonable time frame.⁴² The PRC weighs this US inability for rapid response into its calculations of the regional military balance and thus ultimately into whether to find American deterrent threats sufficiently plausible.⁴³

A fully functional orbital-class rocket resupply capability would resolve these logistical infeasibilities, affirming US deterrence concerning China's aims regarding Taiwan. The ability to move cargo planes'-worth of military supplies and possibly even troops from the American homeland or other military bases around the globe to the Asia-Pacific theater in under an hour would strengthen deterrence by denial by increasing the likelihood that the PRC would deem offensive actions inadvisable in the first place. Moreover, this capability would also strengthen US deterrence by punishment by increasing the rapidity with which the United States could carry out its deterrent threats if needed.⁴⁴

The capability of orbital-class rocket resupply is still likely decades away from being mature enough to reach production or integration into US military operations.⁴⁵ The lack of test flights, uncertainties about how cargo would need to be stored to successfully survive flights, and concerns about the feasibility of deploying intricate and temperamental technologies such as rockets at an effective scale all pose serious challenges to the realization and implementation of orbital-class rocket resupply as an effective deterrent from space.⁴⁶ Given the ability of such a technology to solve an otherwise overwhelming deterrence problem for the United States, however, the Department of Defense and senior political leaders should continue to invest in and develop orbital-class rocket resupply.

Notably, orbital-class rocket resupply demonstrates the importance of using multiple conceptual frames when discussing the relationship between deterrence and space. Given this capability's lack of deterrent effect specifically within the space domain, it is not and never would be mentioned in the context of deterrence in space. Yet with the conceptual framework of deterrence from space, its potential deterrent effect becomes obvious. Even if future US leaders find the use of orbital-class rocket resupply at scale to be infeasible or cost ineffective, integrated deterrence can only be strengthened by seriously evaluating

40. McKinney and Harris, "Broken Nest"; and Maximillian K. Bremer and Kelly A. Grieco, "The Four Tyrannies of Logistical Deterrence," Stimson Center, November 8, 2023, <https://www.stimson.org/>.

41. Bremer and Grieco.

42. McKinney and Harris, "Broken Nest"; and Bremer and Grieco.

43. McKinney and Harris.

44. McKinney and Harris; and Bremer and Grieco, "Four Tyrannies."

45. Fernandes et al., "World."

46. Fernandes et al.

this capability and all others whose deterrent effects only become apparent within a deterrence-from-space framework.

Space-Based Solar Power

Another deterrence-from-space solution that can increase the overall effectiveness of US integrated deterrence vis-à-vis China, is space-based solar power. Space-based solar power is created using satellites that transform solar energy into microwaves, which are then wirelessly beamed down to Earth to be used as power.⁴⁷ This space-based technology can bolster US efforts to deter PRC coercive military actions short of war in the Asia-Pacific region.

Implicit in the conception of *weishe* is China's reliance on coercive military measures short of war, sometimes referred to as irregular warfare.⁴⁸ The PRC's use of irregular warfare measures has recently come to the forefront of global news. For example, in 2023, the Chinese navy blocked Philippine access to one of the island nation's own shoals, and it conducted exercises that same year simulating a naval blockade of Taiwan.⁴⁹ China's tactic of using naval blockades, designed to either cut off access/trade to a given island to force an adversary to submit, is hard for US deterrent threats to prevent.⁵⁰ The difficulty of deterring such tactics and other irregular warfare measures lies in the fact that threatening to respond with force is much less credible when the initial provocation does not constitute an act of war.⁵¹

While the PRC has not attempted to blockade US Asia-Pacific Allies and partners, such as Japan and Taiwan, the ineffectiveness of traditional deterrent threats in preventing this type of coercion suggests China could attempt such blockades, despite the logistical challenges. Importantly, both Japan and Taiwan are particularly vulnerable to coercion via blockade since each relies on imports to provide over 90 percent of their energy needs.⁵² Employing an irregular warfare tactic vastly reduces the likelihood of American military retaliation while also providing the PRC with significant leverage with which to gain political concessions. This not only exemplifies *weishe* in its purest form, but also conforms to the Chinese strategic interest of maintaining a favorable military balance.⁵³

47. "Space-Based Solar Power Overview," European Space Agency, August 8, 2022, <https://www.esa.int/>.

48. Cheng, "Overview"; Cheng, *Cyber Dragon*; and Scouras, Smyth, and Mahnken, *Cross-Domain Deterrence*.

49. Ben Blanchard and Yimou Lee, "China Ends Taiwan Drills after Practising Blockades, Precision Strikes," Reuters, April 10, 2023, <https://www.reuters.com/>; and Karen Lema and Kay Johnson, "Explainer: Why China, the Philippines Keep Fighting over Tiny Shoal," Reuters, December 11, 2023, <https://www.reuters.com/>.

50. John J. Klein, *Fight for the Final Frontier: Irregular Warfare in Space* (Annapolis, MD: Naval Institute Press, 2023).

51. Klein.

52. "Japan: Overview," US Energy Information Administration, July 7, 2023, <https://www.eia.gov/>; and Joseph Webster, "Does Taiwan's Massive Reliance on Energy Imports Put Its Security at Risk?," *New Atlanticist* (blog), Atlantic Council, July 7, 2023, <https://www.atlanticcouncil.org/>.

53. Klein, *Fight*; McKinney and Harris, "Broken Nest"; and Cheng, "Overview."

Space-based solar, however, has the potential to deprive the PRC of the coercive leverage of blockades by decreasing the dependence of both Taiwan and Japan on energy imports in times of crises. While still in its infancy, space-based solar technology is much further along in development than orbital-class rocket resupply capabilities.⁵⁴ Fortunately, even modest projections of the potential power-generation capabilities of space-based solar suggest single satellites would be able to provide two gigawatts of power, enough to continuously power a city of two million people.

Even better, the energy-providing microwaves produced by solar power satellites can be directed anywhere in range that has the requisite power-receiving antennae. This means that whether the United States builds these satellites in collaboration with its Asia-Pacific Allies and partners or builds them for its own in-theater use, in times of crises, the United States could redirect power where needed.⁵⁵ In this way, space-based solar power can bolster US integrated deterrence with regard to China by decreasing the chance that PRC blockades would produce their desired coercive effect, thus disincentivizing their use.

While space-based solar power technology is indeed ahead of orbital-class rocket resupply in its development, various technological challenges and feasibility concerns remain. Fully functional systems will not be able to be deployed until the government or industry develops reliable space-debris protection techniques and the government acquires a more substantial understanding of potential environmental or health effects caused by the wireless transmission of power.⁵⁶ Perhaps the most critical roadblock to the development of this technology is the expected costs associated with launching the requisite satellite systems into orbit.⁵⁷ Despite criticism of its methodology, a recent NASA report determined the cost per kilowatt hour of electricity produced by space-based solar far exceeds that of traditional renewable energy sources.⁵⁸

While such price disparities might make space-based solar infeasible as a renewable energy source, the cost-benefit calculation necessarily changes when such capabilities are viewed as a possible deterrent within a deterrence-from-space framework. With the use of deterrence from space, the value of the potential power provided by this capability necessarily exceeds the value of traditional and standard power generation due to its potential deterrent effect against China's coercion.

Fielding capable and robust space-based solar satellites might not be enough to deter China from employing irregular warfare tactics, such as blockades, on its own. Yet, it most

54. Peggy Hollinger, "How to Make Space-Based Solar Power a Reality," *Financial Times*, October 17, 2023, <https://www.ft.com/>; and Robert Lea, "Scientists Beam Solar Power to Earth from Space for 1st Time Ever," *Space.com*, June 12, 2023, <https://www.space.com/>.

55. Hollinger.

56. Rajini Karduri et al., "Exploring the Viability of Space-Based Solar Power," *International Journal of Advanced Research in Innovative Discoveries in Engineering and Applications* 4, no. 2 (April 27, 2019), <http://dx.doi.org/>.

57. Jeff Foust, "NASA Report Offers Pessimistic Take on Space-Based Solar Power," *SpaceNews*, January 19, 2024, <https://spacenews.com/>.

58. Foust.

certainly would be an effective addition to US deterrence-by-denial efforts in the Asia-Pacific region as it would negatively alter the PRC's cost-benefit calculations regarding the use of such coercive behavior. Using the framework of deterrence from space, the United States should continue to invest in, research, and develop space-based solar power.

Conclusion

Careful review of the current literature and theoretical landscape regarding deterrence and space reveals a dangerous US national security gap: a lack of discussion and integration of a deterrence-from-space framework into overall US strategic and deterrence thinking. Deterrence from space, which seeks to leverage US space capabilities to deter offensive actions in all nonspace domains, is theoretically compatible with and complementary to integrated deterrence. Continuing to neglect the theoretical and practical importance of deterrence from space will only detract from the effectiveness of overall US deterrence by leaving potential space-based deterrent capabilities unexplored and unleveraged.

Importantly, the United States must pursue deterrence from space by continuing to invest in, develop, and deploy orbital-class rocket resupply and robust space-based solar power. Now, more than ever, the United States must not be content with leaving one-half of the deterrence moon in darkness. ✈️

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