LSU Journal of Energy Law and Resources

Volume 11
Issue 2 *Spring 2023*

6-30-2023

Viasat v. SpaceX: FCC's Inherent Regulatory Authority Over Space Solar Power Systems, Wireless Power Transmissions, and Developer Considerations

Kayvon Paul

Viasat v. SpaceX: FCC's Inherent Regulatory Authority Over Space Solar Power Systems, Wireless Power Transmissions, and Developer Considerations*

Kayvon Paul[**]

TABLE OF CONTENTS

* This Note was supervised by former NJ BPU Commissioner Christine Bator, Esq.

** Kayvon J. Paul has a J.D. from Rutgers Law School where he served as a managing editor on the Rutgers Computer and Technology Journal. Prior to law school, Kayvon was a registered government affairs agent in the State of New Jersey. Kayvon will join a global law firm as a first year associate in their corporate and finance practice group (pending PA bar admission). The author would like to thank former NJ BPU Commissioner Christine Bator, Esq. for her insights and feedback on this article.

INTRODUCTION

The Russian invasion of Ukraine and retaliatory western sanctions plunged the world into an energy crisis in 2022.[1] Amidst the energy crisis, countries began considering heavily criticized energy sources—such as nuclear power—as well as contemplating revolutionary alternatives, such as carbon capture technologies and space solar power systems (SSPSs).[2] This article begins with an overview of the solar energy technology, current adoption challenges, and its future SSPS successor. Then, this article discusses the leading SSPS developments and national initiatives, and the existing regulatory landscape for SSPSs. Most importantly, this article focuses on the *Viasat v. FCC* decision and the Federal Communication Commission's inherent regulatory power over SSPS satellites and ground systems. Finally, this article describes how the recent *SpaceX* decision is instructive for future SSPSs, provides practical developer considerations to avoid unnecessary legal and regulatory hurdles in the future—as seen in *SpaceX*—and proposes public policy to assist with the transition to the SSPS era.

I. OVERVIEW OF SOLAR ENERGY

Solar energy is a renewable resource that harnesses the sun's radiation to create consumable energy.[3] Solar energy production is scalable, and projects fall into two main categories: utility-scale and end-use site production. A utility-scale solar project—also known as grid-scale—delivers electricity to a wholesale power grid or a local electricity utility; a retail end-use customer site is where the installation is located on the site or to a local community.[4] Utility scale projects involve developers, landowners, utilities, grid operators, government agencies, investors, and

1. *See generally* David Gaffen, *How the Russia-Ukraine War Accelerated a Global Energy Crisis,* REUTERS (Dec. 15, 2022, 4:14 AM), https://www.reuters.com/business/energy/year-russia-turbocharged-global-energy-crisis-2022-12-13/ [https://perma.cc/W3MF-T8R4].

2. *See generally* Børge Brende and Bob Sternfels, *Seizing the Momentum to Build Resilience for a Future of Sustainable Inclusive Growth*, MCKINSEY & CO. (Feb. 23, 2023), https://www.mckinsey.com/capabilities/risk-and-resilience/our-insights/seizing-the-momentum-to-build-resilience-for-a-future-of-sustainable-inclusive-growth [https://perma.cc/95YS-W8XB].

3. *See generally Solar Energy*, SOLAR ENERGY INDUS. ASS'N, https://www.seia.org/initiatives/about-solar-energy [https://perma.cc/H3FJ-9PHX] (last visited Mar. 22, 2023).

4. Stephen J. Humes, *Solar Energy Project Development Issues: Preliminary Considerations*, Practical Law Finance, Practice Note 7-522-8476, 3.

financing entities.[5] Such projects require extensive issue analysis including: land rights; projected electricity production; environmental regulations; required federal, state, and local permits; interconnection; and transmission considerations.[6]

Important solar project development considerations include site identification and determinations on the amount of sunlight (referred to as "insolation") that proposed sites receive on a daily, weekly, monthly, and yearly basis.[7] The amount of sunlight available determines the size of the potential project that can be built on a proposed site, the capacity, technology and infrastructure required, and the total project cost and potential return on investment.[8] Once a site is identified, the developer and legal counsel must: 1) perform an environmental due diligence review (state and/or federal) which identifies all of the potential risks and environmental concerns; 2) prepare an environmental impact statement; 3) conduct an interconnection analysis; and 4) begin the local, state, and/or federal permitting processes.[9] The interconnection analysis is the access point for which a solar project delivers energy to the grid, either by direct sales to the local electric utility or indirect sales in the form of net metered transactions with a host.[10]

Some of the biggest obstacles that utility-scale solar projects face revolve around transmission barriers and the lengthy land use permitting processes.[11] Regarding transmission barriers, utility-scale solar projects struggle to effectively transmit new electricity to customers.[10] According to a 2021 Green Tech Media report, "attempts to decarbonize the U.S. electricity system may be stymied by a lack of transmission to carry [] solar power from where it's most cheaply generated to where it's most needed."[12] Further, the National Council on Electricity Policy reported that "[c]ongestion on existing lines, increased energy demand that suggest a need for new electric transmission and the challenge of connecting

5. *Id.*
6. *Id.*
7. *Id.*
8. *Id.*
9. *Id.* at 5–10.
10. *Id.* at 10.
11. Amy Antoniolli, *Solar Energy Project Development Issues: Permitting and Environmental Concerns*, Practical Law Finance, Practice Note w-007-3713, 3–4. 10 Jeff St. John, *Report: Renewables Are Suffering From Broken US Transmission Policy*, GREEN TECH MEDIA (Jan. 12, 2021), https://www.greentechmedia.com/articles/read/report-renewables-are-suffering-from-broken-u.s-transmission-policy [https://perma.cc/82ST-WUAF].
12. Antoniolli, *supra* note 11.

renewable energy sources to load centers highlight some needs that could be underserved by the existing system in the near future."[13] This transmission problem worsens when contemplated new transmission lines would have to cross local and state lines as there becomes an issue of cost allocation.[14] Regarding land use permitting, solar energy projects are required in most cases to obtain a combination of site approvals and permitting licenses from municipalities and/or states which may require community stakeholder meetings, residential consent, and other regulatory hurdles in every local and/or state in which they seek to operate or site their facility.[15]

Additionally, a big obstacle hindering the widespread adoption and use of solar technology is the inadequate funding and financing mechanisms for large solar energy projects.[16] Generally, state and local governments respond to this obstacle by: 1) creating renewable markets by requiring utilities to interconnect with renewable generators and purchase power from these governments or requiring state and local governments to build renewable plants; 2) procuring or generating renewable energy under government-established renewable energy targets; 3) providing financial support to renewable energy developers in the form of tax credits, grants or loans; 4) requiring transmission lines that directly support renewable energy products; and 5) streamlining permitting processes.[17]

Many states have established set-asides for solar technology and energy projects that would otherwise be excluded from the market due to extremely high costs.[18] These set-asides mandate a certain quantity or percentage of solar energy to meet the goals of the state's renewable

---

13. *See generally* Julia Friedman & Miles Keogh, *Coordinating Interstate Electricity Transmission: An Introduction to the Debate*, NAT'L COUNCIL ON ELEC. POL'Y 1 (2008), https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Transmission_Siting_FINAL_41.pdf [https://perma.cc/FLY8-2SPT].

14. *Id.*

15. Antoniolli, *supra* note 11; *see generally Solar Energy: Solmart's Toolkit for Local Governments*, SOLSMART, https://solsmart.org/solar-energy-a-toolkit-for-local-governments/stakeholder-engagement/ [https://perma.cc/4PXD-P2DB] (last visited Dec. 14, 2022).

16. *See generally Part 1: Challenges in Solar Equipment Finance*, BAKER DONELSON (Sept. 2016), https://www.bakerdonelson.com/challenges-in-solar-equipment-finance [https://perma.cc/9CHA-BBFC].

17. JOEL B. EISEN ET AL., ENERGY, ECONOMICS, AND THE ENVIRONMENT: CASES AND MATERIALS 819 (5th ed. 2019).

18. Sadie Cox et al., *Solar Power: Policy Overview and Good Practices*, CLEAN ENERGY SOLS. Ctr. 36 (2015), http://www.nrel.gov/docs/fy15osti/64178.pdf [https://perma.cc/VG7G-T7PP].

portfolio standard.[19]Additionally, some states require consumers and/or utilities to pay a public benefits charge which may, in part, be used for state energy initiatives.[20]

At the local level, municipal governments are starting to offer special tax programs and community solar programs for their residents.[21] In terms of tax programming, some municipalities are offering property tax financing where residents are allowed to purchase renewable projects such as rooftop solar panels, and then repay it as a portion of their tax bill over a fixed period of time.[22]

Today, mainstream solar technologies include solar thermal plants, solar PV systems, and solar heating and cooling systems.[23] While SSPSs have been well researched, none have been successfully implemented. Solar thermal plants use heat collected from the sun to boil water and produce steam in order to spin a turbine.[24] Three types of solar thermal plants include parabolic troughs, concentrated solar power (power towers), and solar dish/engines.[25] Parabolic trough systems involve long, parallel trough structures with tubes placed in the middle that catch sunlight to heat water.[18] Concentrated solar power systems use a display of mirrors to concentrate sunlight on a receiver—usually a tower—which collects the heat to boil water.[26] Solar dish systems concentrate sunlight within the center of a satellite-type dish to heat water. [20]

Solar PV technology generates electricity directly from sunlight using semiconductors, such as silicon.[27] Solar PV is an attractive alternative to solar thermal technology, as it can be utilized at the utility, community, or

---

19. *Id.*

20. *See, e.g.*, *Societal Benefits Charge Credit Program*, N.J. CLEAN ENERGY PROGRAM, https://www.njcleanenergy.com/commercial-industrial/programs/societal-benefits-charge-credit-program [https://perma.cc/63L4-CPXQ] (last visited Jan. 29, 2023).

21. *Philadelphia Solar Rebate*, CITY OF PHILADELPHIA, https://www.phila.gov/programs/solar-rebate-program/ [https://perma.cc/8WNR-HV6Z], (last visited on Dec. 13, 2022).

22. EISEN, *supra* note 17, at 871–72.

23. *See generally Different Types of Solar Energy*, TRVST, https://www.trvst.world/renewable-energy/different-types-of-solar-energy/ [https://perma.cc/JK5D-TPL2] (last updated Jan. 9, 2023).

24. *Solar Explained: Solar Thermal Power Plants*, U.S. ENERGY INFO. ADMIN. (Apr. 15, 2022), https://www.eia.gov/energyexplained/solar/solar-thermal-power-plants.php [https://perma.cc/L3E6-MVUP].

25. *Id.*

26. *Id.*

27. *Id.* at 17.

distributed scale.[28] The fastest growing technology for residential and commercial solar power are grid connected PV systems, where solar panels attach to the property (buildings, rooftops, etc.) to generate electricity.[29] Solar heating and cooling systems are often used at commercial and residential properties;[30] these systems can be active or passive.[31] Active systems may use solar collectors to trap heat and transport it throughout a property using fans or other technology.[32] Other active systems may use solar hot water heaters, which harness the sun's energy to heat the water and store it in an insulated tank for later use.[26] Contrastingly, passive systems use building parts, like walls or windows, to trap or release heat.

A. Space Solar Power Systems

SSPSs require four main components: 1) the solar power satellite; 2) a space launch and transportation to orbit; 3) a ground antenna and associated laser beam/microwave technology; and 4) a power and satellite mission control.[33] Currently, there are two competing space solar satellite system proposals.[34]

One proposal includes laser beam SSPSs involving laser beam technology from non-geostationary orbit at approximately 400 km.[35] The laser solar satellites in this system, similar to SpaceX satellites, are smaller in size and operate as a group with other laser solar satellites, possibly in a constellation arrangement.[36] The laser SSPSs are an attractive option and, thus, may see a quicker path to implementation, as they carry low startup costs ($500 million to $1 billion), are smaller in size, and easier to

---

28. *Id.*
29. *Id.*
30. *See generally Active Solar Heating*, U.S. DEP'T OF ENERGY: ENERGY SAVER, https://www.energy.gov/energysaver/active-solar-heating [https://perma.cc/GH7Z-NNT4] (last visited Mar. 22, 2023).
31. *See generally id.*
32. *See generally id.*
33. *Space Based Solar Power: De-risking the Pathway to Net Zero*, FRAZER-NASH CONSULTANCY 10 (2021), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1020631/space-based-solar-power-derisking-pathway-to-net-zero.pdf [https://perma.cc/T5AJ-GRZ6].
34. *See generally Space Based Solar Power (Infographic)*, U.S. DEP'T OF ENERGY, https://www.energy.gov/maps/space-based-solar-power [https://perma.cc/4SH4-89G9] (last visited Dec. 14, 2022).
35. *See generally id.*
36. *Id.*

assemble.[37] However, such satellites would have difficulty beaming through natural elements, such as rain or clouds.[38] Also, due to the smaller size, energy output would be limited to around 1 megawatts (MW) to 10MW per satellite.[39]

The other proposal involves a microwave SSPS that utilizes microwave technology, in a geostationary orbit featuring large lightweight solar panels.[40] These solar panels would generate over three gigawatts of electricity on the satellite, which would convert into high frequency microwaves, or a similar technology, and beam with encryption to a rectifying antenna ("rectenna") on the earth.[41] The encrypted beam ensures the security and control of the transmitted energy.[42] Unlike a laser SSPS, the microwave SSPS can transmit steady and uninterrupted transmission of power.[43] However, because of the distance, it would be extremely difficult to repair and production would amount to billions of dollars, requiring up to 100 space launches and space assembly operations.[44] Both the rectenna for a microwave SSPS and the terrestrial receiver would be several kilometers in diameter.[45]

A rectenna is a device that converts electromagnetic waves in the air into direct electric currents, which can be used as a wireless power transfer system.[46] The electricity output of a solar power satellite is theoretically comparable to a nuclear power plant.[47] To summarize, generally, an SSPS involves a satellite with solar panels wirelessly transmitting solar energy directly to a ground system on earth.

The ground system would consist of a power and satellite mission control and a rectenna, which is a large open net structure containing small dipoles or aerials which capture the radio wave energy and convert it to

---

37. *Id.*

38. *See generally id.*

39. *Id.*; *see also Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33.

40. *Space Based Solar Power (Infographic)*, *supra* note 34; *see also Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33.

41. *See Space Based Solar Power (Infographic)*, *supra* note 34.

42. *See Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33.

43. *Id.*

44. *Id.*

45. *Id.*

46. Yana Taryana et al., *Rectifying Antenna Design for Wireless Power Transfer in The Frequency of 2.45 GHz*, IEEE 55–58 (2018), https://ieeexplore.ieee.org/document/8683919 [https://perma.cc/WK3R-EXY6].

47. *Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33.

DC electricity.[48] Recent developments contemplate placing these ground systems offshore with existing wind farms so that they may be connected into the existing grid connections.[49]

From a logistical standpoint, many parts for the solar power satellite require launching and assembly in space.[50] Once assembled, the solar power satellites collect, convert, and transmit solar energy directly from the sun to the ground station.[51] The ground station then receives, converts, and distributes the output energy into the grid.[52] The United States, Japan, China, South Korea, Europe, Canada, United Kingdom, and Australia are actively developing space solar power systems and technology development programs.[53]

The United States committed over $180 million to develop lightweight solar panel PV technology under the Space Solar Power Incremental Development and Research Project, which includes conducting power collection and conversion experiments in space.[54] The Air Force Research Laboratory (AFRL) reports working on "a series of integrated demonstrations and technology maturation efforts at the AFRL [] to develop space-based solar power collection and transmission capabilities."[55] The Space Rapid Capabilities Office ("Space RCO") or Space Force, within the U.S. Air Force, made it its mission to expedite the development and fielding of operationally focused capabilities, listing "overarching programmatic insight, early and prominent war fighter involvement, and . . . exploiting space technology or operational innovations to increase U.S. advantage" as key operating principles.[56] Interestingly, it also states that the Space RCO is ready to develop, test, train, and equip war fighter needs as they are identified at any time, so long as they are validated by U.S. Space Command. Additionally, that

48. *Id.* at 12.
49. *Id.*
50. *Id.*
51. *Id.* at 10.
52. *Id.*
53. *Id.* at 18.
54. *Id.* at 10.
55. *Space Power Beaming*, AIR FORCE RSCH. LAB'Y, https://afresearchlab.com/technology/space-power-beaming/ [https://perma.cc/J453-VZ9N] (last visited Jan. 31, 2023).
56. *Department of Defense Fiscal Year (FY) 2023 Budget Estimates: Research, Development, Test & Evaluation*, U.S. DEP'T OF DEF. 209 (2022), https://www.saffm.hq.af.mil/Portals/84/documents/FY23/RDTE_/FY23%20Space%20Force%20Research%20Development%20Test%20and%20Evaluation.pdf [https://perma.cc/7PFD-SWBN].

program's funds may be used to manage, execute, and deliver Space RCO weapon system capabilities.[57] Of relevance, the budget states that the program is supporting the AFRL developed Space Solar Power Project to collect solar energy and provide uninterrupted, reliable power.[58]

Most recently, the 2023 Space RCO appropriations included line-item appropriations for "Space Power/Thermal Research," in which the description stated "[d]evelop[ing] technologies for advanced space platform subsystems such as compact, high efficiency solar power cells and arrays, and innovative power generation concepts."[59]

Examples of the U.S. Department of Defense/Air Force's specific funded initiatives include:

- Developing space-based solar power collection and transmission technology via a series of integrated demonstrations and technology development/maturation efforts;
- Developing solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations;
- Continuing space flight demonstration of solar-to-RF panel payload (take delivery of solar-to-RF payload emulator, validate payload for delivery, continue pre-integration of payload-to-bus);[60]
- Delivering thermal integrated demonstration for on-orbit demonstration;
- Initiating structural operational prototype based on results from scaled array payload demonstrations and validated models;
- Updating operational prototype concept designs/analysis based on tile, rectenna, thermal, and structure demonstrations and updated models;
- Continuing functional demonstrations for critical technologies in energy generation, deployable structures,

57. *Id.*
58. *Id.*
59. *Id.* at 24.
60. *Space Power Beaming*, *supra* note 55. (According to the Air Force Research Laboratory, "a solar-to-RF panel is a system in which a tile collects solar energy in space via photovoltaic cells, converts the solar energy into Radio Frequency and beams it to a receiving antenna on the ground" which then rectifies the RF beam into useable power.).

thermal technology, RF transmission, and distributed control;

- Continuing development of high power arrays and storage capability for small satellites, including solar array structures for small missions, but scalable to all missions with specific generating power greater than 100 watts per kilogram;
- Completing transition of technologies developed for advanced space solar cells, solar array, and energy storage;
- Continuing research and development of high-pulsed power systems, including generation, storage, and heat rejection technologies for small satellites.[61]

On the opposite side of the Earth, Japan has researched space-based solar power since the 1980s, with a focus on wireless power transmission (successfully demonstrating kW scale wireless power transmission in 2015), including in-space experiments, and established a national goal in its space law framework.[62] The Japan Aerospace Exploration Agency has a roadmap for its space based solar power goals.[63]

The China Academy for Space Technology also developed a space based solar program with a roadmap in place.[64] As of 2023, China is constructing a facility for related power testing, with power beaming experiments underway.[65] In 2021, China established a new Committee of Space Solar Power.[66] In South Korea, both the Korea Electrotechnology Research Institute and the private sector are developing power beaming technologies.[67] The European Space Agency studied space solar technology over the last two decades and recently issued a solicitation for ideas to research related technology.[68]Additionally, ministers in both Canada and Australia both indicated an interest in developing government-sponsored space solar systems.[69]

---

61. *Department of Defense Fiscal Year (FY) 2023 Budget Estimates: Research, Development, Test & Evaluation*, *supra* note 56, at 24, 209.

62. *Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33, at 18.

63. *Id.*

64. *Id.*

65. *Id.*

66. *Id.*

67. *Id.*

68. *Id.*

69. *Id.*

The literature generally indicates that the development of a functioning SSPS is still years away.[70] Even though Space Solar Power Systems will be a massive undertaking, spillover benefits will include developments of: wireless power transmission which can be utilized for consumer electronics and electric vehicle charging; semiconductor technology; power beaming technology; and autonomous robot technology.[71]

III. REGULATORY CONSIDERATIONS FOR AMERICAN SSPSS

As of April 2023, there are no specific national or international regulations for SSPSs. Accordingly, the following regimes must be considered: international space, satellite, and telecommunications laws; the various local, state, and federal land use laws; and state and federal energy, satellite, and telecommunications laws. Even though no international regulatory framework for these advanced solar systems is in place, the International Astronautical Federation (IAF) Space Power Committee has coordinated technical discussion of this technology.[72]

In the United States, SSPSs will come into the purview of the U.S. Commercial Space Launch Act ("Space Launch Act").[73] The Space Launch Act "authorizes the Department of Transportation (DOT) and, through delegations, the Federal Aviation Administration's (FAA) Office of Commercial Space Transportation (AST), to oversee, authorize, and regulate both launches and reentries of launch and reentry vehicles, and

---

70. *See, e.g.*, *id.*; Andreas Treuer, *The Case for an Esa Preparatory Programme for Space-Based Solar Power for Terrestrial Energy Needs*, ESA 14–18 (2022), https://esamultimedia.esa.int/docs/technology/The_Case_for_an_ESA_preparatory_programme_for_Space-Based_Solar_Power_for_terrestrial_energy_needs.pdf [https://perma.cc/J5YB-QGQ5]; *Space Power Beaming*, *supra* note 55.

71. *Space Based Solar Power: De-risking the Pathway to Net Zero*, *supra* note 33, at 22–23.

72. *Id.* at 17; *see also* John C. Mankins, *Fifty Years of Space Solar*, INT'L ASTRONAUTICAL FED'N, https://www.iafastro.org/events/iac/iac-2018/technical-programme/keynotes/monday-1-october-2018/c31-fifty-years-of-space-solar.html [https://perma.cc/7KA6-LZG2] (last visited Feb. 1, 2023).

73. Paul B. Larsen, *Current Legal Issues Pertaining to Space Solar Power Systems*, SPACE L. COLL. 402 (1999), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3788397 [https://perma.cc/HQ6U-V2H8]; 51 U.S.C.A. § 50905 (a)(2) (West 2022) ("License applications and requirements"); *Commercial Space Transportation*, FED. AVIATION ADMIN., https://www.faa.gov/regulations_policies/faa_regulations/commercial_space [https://perma.cc/8ZVS-TQMA] (last updated May 18, 2021); 51 U.S.C.A. § 50917 (West 2022) ("Enforcement and penalty").

the operation of launch and reentry site[s]."[74] Under the Space Launch Act, the Secretary of Transportation has broad authority to

> establish procedures for safety approvals of launch vehicles, reentry vehicles, safety systems, processes, services, or personnel (including approval procedures for the purpose of protecting the health and safety of crew, government astronauts, and space flight participants, [] that may be used in conducting licensed commercial space launch or reentry activities.[75]

This includes "any additional requirement necessary to protect the public health and safety, safety of property, national security interests, and foreign policy interests of the United States."[76] Accordingly, space solar power systems will likely need to receive launch licenses and permits issued by the United States DOT and/or FAA.

Notably, the Space Launch Act enables the Secretary to "delegate duty or power under this chapter related to enforcement to an officer or employee of another executive agency with the consent of the head of the agency."[77] Taking this into consideration, it is possible that, based on the authority delegated by the Space Launch Act, the DOT can delegate SSPS licensing to another agency, such as the Department of Defense, Air Force, or Space Force in the future. This makes sense, as these entities actively budget, research, and develop space solar power systems and related systems for military capabilities.[78]

Additionally, any objects launched into space would require international registration in accordance with the United Nations (U.N.).[79] The U.N. has maintained a Register of Objects Launched into Outer Space since 1962.[80] The 1975 Convention on Registration of Objects launched into Outer Space entered into force in 1976.[81] The U.N. passed this resolution, highlighting the importance of respecting state sovereignty when participating in remote sensing activities. It is anticipated the U.N.

---

74. *Commercial Space Transportation, supra* note 73 ("Enabling Statute").
75. 51 U.S.C.A. § 50905 (a)(2) (West 2022).
76. *Id.* § 50905 (b)(2)(B) (West 2022).
77. *Id.* § 50917 (b)(2) (West 2022).
78. *See infra* Section IV ("The 2022 Space X Decision").
79. *United Nations Register of Objects Launched into Outer Space*, U.N. OFF. FOR OUTER SPACE AFFS., https://www.unoosa.org/oosa/en/spaceobjectregister/index.html [https://perma.cc/B65B-URCQ] (last visited Feb. 2, 2023).
80. *Id.*
81. *Id.*

will develop operating standards specifically for space solar power systems when the technology nears implementation.[82]

If SSPSs were constructed and launched from the moon, such activity would be governed by the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space.[83] The 1967 Treaty provides that states shall avoid harmful contamination of space and the Earth's environment.[84] Due to loose environmental protection standards set forth in the 1967 Treaty, it is likely that national governments will impose certain restrictions, as they have incentive to not destroy or pollute their home country's atmosphere, and international organizations may promulgate their own standards and regulations as SSPSs develop. For example, in the United States, the National Environmental Policy Act (NEPA) may mandate that solar satellite projects produce an environmental impact statement.[85]

In November of 2022, the Government Accountability Office released a report calling for the FCC to "reexamine its environmental review process for large constellation of satellites" since NEPA requires "federal agencies to consider the environmental effects of major federal actions prior to making decisions and to involve the public."[86] This may be related to the recent *Viasat v. FCC* decision (later referred to herein as the "*SpaceX* decision"), where opponents challenged the FCC's order allowing SpaceX to lower its satellite constellation's orbit as it, among other things, failed to comply with NEPA's environmental review requirements.[87]

As SSPS operators communicate using radio frequencies, such communications would likely be governed by the Federal Communications Commission (FCC) under the Federal Communications Act and the International Telecommunication Union (ITU).[88] Similar to

---

82. Larsen, *supra* note 73.

83. *Id.* at 402–03; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, art. XVI, Jan. 27, 1967, 18 U.S.T. 1810, 610 U.N.T.S. 205.

84. Larsen, *supra* note 73, at 404.

85. *Id.*; *see* National Environmental Policy Act, 43 U.S.C.A. § 1638 (West 2022).

86. *Satellite Licensing: FCC Should Reexamine Its Environmental Review Process for Large Constellations of Satellites*, U.S. GOV'T ACCOUNTABILITY OFF. (Nov. 2, 2022), https://www.gao.gov/products/gao-23-105005#:~:text=Constellations%20of%20Satellites-,Satellite%20Licensing%3A%20FCC%20Should%20Reexamine%20Its%20Environmental%20Review [https://perma.cc/WYB5-CLRJ].

87. *See infra* Section IV ("The 2022 Space X Decision").

88. Larsen, *supra* note 73.

other satellites, solar satellites would need active monitoring and intervention to remain in their fixed positions and freedom from the radio and physical interference of other satellites.[89] The ITU is a U.N. entity that coordinates the use of international radio frequencies and communications.[90] Generally, the ITU adopted Radio Regulations to: 1) "facilitate equitable access to and rational use of the natural resources of the radio-frequency spectrum and geostationary satellite orbits;" 2) "ensure the . . . resolution of cases of harmful interference between the radio services of different administrations;" and 3) "regulate new applications of radio communication technology."[91]

Given that many private actors and governments have satellites in space, either in geostationary orbit (GSO) or non-geostationary orbit (NGSO), solar satellites will be unlikely to avoid interference issues.[92] As space solar power satellite systems will be in geostationary orbit or non-geostationary orbit with other satellites, developers of space solar power systems will have to worry about colliding with other objects in geostationary orbit.[93] Radio frequency interference with other satellites in geostationary orbit or non-geostationary orbit (likely below their orbit)

---

89. *Id.* at 404.

90. *Id.*

91. *Radio Regulations 2020*, INT'L TELECOMM'S UNION, https://www.itu.int/hub/publication/r-reg-rr-2020/ [https://perma.cc/3ARJ-YJKV] (last visited Dec. 15, 2022).

92. *See Non-geostationary Satellite Sys.*, INT'L TELECOMM'S. UNION, https://www.itu.int/en/mediacentre/backgrounders/Pages/Non-geostationary-satellite-systems.aspx [https://perma.cc/RB3H-B7KU] (last updated June 2021).

> Geostationary (GSO) satellites are at 36 000 kilometres above the Earth, a place where they appear fixed in the sky when observed from the ground. Non-GSO satellites at medium Earth orbits (MEO) altitudes are between 8 000 and 20 000 kilometres above the Earth and low Earth orbits (LEO) altitudes are between 400 to 2000 kilometres above the Earth. Since non-GSO satellites move across the sky during their orbit around the Earth, nonGSO operators must deploy a fleet of satellites, generally called "constellations", to provide continuous service from these altitudes.

93. *See generally* Benjamin Silverstein, *How Governments Should Address the Increasing Risks of Satellite Collision*, CARNEGIE ENDOWMENT FOR INT'L PEACE (Apr. 11, 2022), https://carnegieendowment.org/2022/04/11/how-governments-should-address-increasing-risks-of-satellite-collision-pub-86868 [https://perma.cc/U46E-LE4W].

present the biggest issue for these new satellite systems.[94] Among other relevant issues, the orbit radio frequency interference issue was recently litigated between SpaceX and Viasat, with a recent court opinion coming out of the D.C. Circuit court on August 26, 2022.[95]

IV. THE 2022 SPACEX DECISION

In *Viasat v. Space Exploration Holdings*, DISH Network and Viasat appealed an FCC order favorable to its competitor, SpaceX, as it allowed the company to lower its satellites from geostationary orbit to non-geostationary orbit.[76] SpaceX intervened in the lawsuit to support the FCC.[96] 47 U.S.C section 316 authorizes the FCC to grant radio station licenses, including the operation of communication satellites,[97] and allows the FCC to modify a license if doing so serves the public interest.[98] This is particularly important in the *SpaceX* decision, since the FCC originally granted SpaceX a license to provide internet service via its satellites to service unserved areas in 2018.[99] After SpaceX launched half of its satellites, it petitioned the FCC to modify its license to allow its satellites to go into a lower non-geostationary orbit; by doing so, SpaceX's satellites could provide high speed internet service to unserved areas.[100] The FCC granted SpaceX's request.[101]

The D.C. Circuit Court explained that "[g]iven the complexity of satellite system design, the FCC seeks where possible to allow licensees 'to modify the technical design of their satellites as they are being built.'"[102] However, the court noted that, because technical changes could interfere with signals from other satellites, the FCC must find that proposed modifications do not present interference problems.[103] The court stated that regulations prioritize geostationary orbit systems over non-

94. S*ee generally Satellite Interference Monitoring and Resolution*, FED. COMMC'NS COMM'N, https://www.fcc.gov/general/satellite-interference-monitoring-and-resolution [https://perma.cc/AY56-ZD7C] (last visited Mar. 3, 2023).

95. *See generally* Viasat, Inc. v. Fed. Commc'ns Comm'n, 47 F.4th 769, 773, 774 (D.C. Cir. 2022).

96. *Id.* at 775.

97. 47 U.S.C. § 307(a).

98. *Id.* § 316(a)(1).

99. *Viasat, Inc.*, 47 F.4th at 774.

100. *Id.*

101. *Id.* at 775.

102. *Id.* (citing Teledesic LLC, Order and Authorization, 14 FCC Rcd. 2261, 2264) (Int'l Bureau 1999).

103. *Id.*

geostationary counterparts and laid out the relevant protocol.[104] Competitors DISH Network Corporation ("DISH") and Viasat, Inc. both objected. DISH objected to the modification, arguing that the proposed modification would interfere with its GSO satellite television service. Viasat, Inc. also objected, but argued that NEPA required the FCC to prepare an environmental assessment prior to granting SpaceX's modification.[105] The FCC rejected both arguments.[106]

On appeal, DISH argued that the FCC's interference determination violated the Administrative Procedure Act and the Communications Act while also hallenging the regulatory procedure for showing SpaceX's compliance with the ITU power limits.[86] DISH argued that the FCC unreasonably refused to consider expert reports on how the SpaceX proposed modification would interfere with DISH's satellites.[107] The court rejected this argument, highlighting that the reports at issue used a different method for assessing interference than what regulations required. DISH conceded the court's point, but argued that its experts had a better method for calculating interference.[88] The court affirmed that "an agency . . . should not entertain a challenge to a regulation, adopted pursuant to notice and comment, in an adjudication or licensing proceeding."[108]

Additionally, DISH argued that the FCC unreasonably waived the requirement of a favorable ITU finding, allowing SpaceX to proceed based on software validation alone. In response to this argument, the court stated that the FCC may waive its rules for good cause shown, and that good cause exists when particular facts would make strict compliance inconsistent with public interest.[109] The court found the FCC sufficiently explained that allowing SpaceX to lower the remainder of its constellation would facilitate deployment of broadband internet and improve service to remote and underserved areas.[110]

The court also rejected DISH's arguments that the FCC's interference determination violated sections 303 and 316 of the Federal Communications Act. Section 303 requires the FCC to promulgate regulations to prevent interference between stations, whereas section 316 permits license modifications to promote the public interest, which is

104. *Id.*
105. *Id.* at 775–76.
106. *Id.* at 776 (citing Second Modification Order, 36 FCC Rcd. 7995 ¶¶ 47, 92).
107. *Id.*
108. *Id.* (citing Trib. Co. v. FCC, 133 F.3d 61, 68 (D.C. Cir. 1998)).
109. *Id.* (citing AT&T Wireless Servs. v. FCC, 270 F.3d 959, 965 (D.C. Cir. 2001)); 47 C.F.R. § 1.3 (2022).
110. *Id.* at 777.

undermined by harmful interference.[111] The court rejected these arguments, as it found the FCC adequately addressed the interference issue.[112]

Responding to Viasat's environmental claim, the court found that Viasat lacked standing to bring the environmental claim as it failed to show that: 1) it suffered an actual, imminent, or certainly impending injury; and 2) its injured interests were of the sort protected by NEPA.[113] Viasat alleged three distinct injuries: 1) the possibility of SpaceX colliding with other space objects, which may result in debris colliding with its satellite; 2) SpaceX's constellation increases its own operating costs by making it more complex and expensive for Viasat to launch its own satellites; and 3) economic harm resulting from the FCC licensing one of its competitors.[114] Generally, the court found that the first injury was too speculative and involved too many assumptions and contingencies for the injury to manifest. Further, the court found that the remaining alleged injuries constituted economic harms, the interests of which NEPA did not protect.[115]

To summarize, the court found that the FCC adequately explained its conclusion that the modification of SpaceX's license would not interfere with DISH satellites, and Viasat lacked standing to pursue the NEPA claim.[116]

V. THE FCC'S INHERENT REGULATORY AUTHORITY OVER SSPSS

The *SpaceX* decision may be instructive for space solar development projects, as the FCC will certainly regulate solar satellites. The FCC may attempt to regulate the wireless transmission of power under the Federal Communications Act similar to its regulation and promotion of broadband networks and related wireless infrastructure.[117] Even if the FCC does not regulate the wireless transmission of power as "communication" under the Federal Communications Act, the FCC will certainly extend its regulatory

111. *Id.* at 778.

112. *Id.*

113. *Id.* at 778–79 (citing Fla. Audubon Soc'y v. Bentsen, 94 F.3d 658, 665 (D.C. Cir. 1996) (en banc)).

114. *Id.* at 779.

115. *Id.*

116. *Id.* at 778.

117. *See generally Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, Second Report and Order*, DA-19-277 (Mar. 22, 2018), https://www.fcc.gov/document/fcc-acts-speed-deployment-next-gen-wireless-infrastructure-0 [https://perma.cc/8N6B-6HRB].

authority on the basis of the physical components. According to the FCC's website, it regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia, and U.S. territories.[118] Specifically, the FCC's Bureau of Wireless Telecommunications division develops and executes policies and procedures for fast, fair licensing of all wireless services, including fixed microwave links, amateur radio, and mobile broadband services.[119] Nevertheless, the FCC's authority governs the construction of new towers and antennas which "requires compliance with the Commission's rules for environmental review."[120] This allows the FCC to meet its obligations under NEPA.[121]

Importantly, companies that place telecommunications satellites into orbit currently depend on the ITU system for allocating orbital slots, which is managed by ITU.[122] Studies show the current system to be inefficient,[123] calling for a new international agency to manage solar satellites entirely.[124] The issue of whether solar satellites will occupy GSO and/or NGSO has been discussed academically, and the speculated issue of interference, as seen in the *SpaceX* decision, has already been litigated.[125]

It is likely that American SSPSs, although a source of energy, will certainly be regulated by the FCC and the ITU for three reasons. First, the satellites are regulated by the FCC. Second, the ground system of the space solar power system would require wireless microwave transmissions and construction of a rectenna—both of which fall into the jurisdiction of the FCC. Third, SSPSs communicate via wireless transmissions to the controlling ground system.

---

118. *What We Do*, FED. COMMC'NS COMM'N, https://www.fcc.gov/about-fcc/what-we-do [https://perma.cc/E62W-A2NG] (last visited Jan. 30, 2023).

119. *Tower and Antenna Siting*, FED. COMMC'NS COMM'N, https://www.fcc.gov/wireless/bureau-divisions/competition-infrastructure-policy-division/tower-and-antenna-siting [https://perma.cc/VEV5-U2CR] (last visited Jan. 29, 2023).

120. *Id.*

121. *Antenna Structure Registration (ASR*), FED. COMMC'NS COMM'N, https://www.fcc.gov/wireless/support/knowledge-base/antenna-structure-registration-asr-resources/antenna-structure [https://perma.cc/4W6H-C374] (last visited Dec. 14, 2022).

122. Aleksey Shtivelman, *Solar Power Satellites: The Right to A Spot in the World's Highest Parking Lot*, 18 B.U. J.SCI. & TECH. L. 435, 437 (2012) (citing Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, art. I, Jan. 27, 1967, 18 U.S.T. 1810, 610 U.N.T.S. 205).

123. *Id.* at 441–45.

124. *Id.*

125. *Id.* at 441–47.

This does not mean, however, that the Federal Energy Regulatory Commission (FERC) will have no regulatory authority. FERC is "an independent agency that regulates the interstate transmission of electricity[,]" which includes: "[r]egulat[ing] the transmission and wholesale sale of electricity in interstate commerce" and "[r]eview[ing] the siting application for electric transmission projects."[126] Although the FCC will likely regulate space solar power satellites, antennas, and transmission of wireless power, FERC certainly regulates the transmission, distribution, and generation of the output energy entering the grid and crossing state lines.[127] When space solar power systems near functionability, it would be no surprise if FERC's Joint Federal-State Task Force on Electric Transmission ("Task Force") shifted its focus to the unique transmission issues that result from interconnecting the ground systems to existing grid infrastructure. The Task Force was formed to efficiently oversee the "development of new transmission infrastructure."[128]

VI. SPACEX CONSIDERATIONS FOR AMERICAN SSPS DEVELOPERS

Given the *SpaceX* decision and FCC's inherent regulatory authority over future SSPSs, there are several notable considerations for developers of this new technology to mitigate potential legal challenges and regulatory hurdles. This includes preparing an environmental assessment, strategically considering GSO versus NGSO licensing, setting aside wireless power transmission for unserved areas and government interests, and engaging satellite companies and government decision-makers from the start of the SSPS project until completion.

A. Environmental Assessment.

SSPSs will have to register their rectenna with the FCC.[129] Additionally, if the rectenna significantly impacts the environment, FCC rules require an environmental assessment to be submitted.[130] The FCC

126. *What FERC Does*, FED. ENERGY REGUL. COMM'N, https://www.ferc.gov/what-ferc-does [https://perma.cc/9HD6-AH6D] (last updated Aug. 16, 2022).

127. *See generally id.*

128. *Joint Federal-State Task Force on Electric Transmission*, FED. ENERGY REGUL. COMM'N, https://www.ferc.gov/TFSOET [https://perma.cc/E859-46D4] (last updated Feb. 2, 2023).

129. *See generally Antenna Structure Registration (ASR) - Overview*, *supra* note 121.

130. *Id.*

lists several scenarios for which an environmental assessment is required for antenna structures: 1) a structure located in a flood plain, wildlife preserve area, or wilderness area; 2) the construction will significantly change the surface area; 3) the structure will be more than 450 feet above ground level; or 4) if the structure will expose humans to high levels of radiofrequency radiation.[131] Most importantly, there is a catchall environmental assessment requirement if "the processing Bureau determines in response to a petition or on its own motion that the proposed facilities may have a significant environmental impact."[132] The U.S. Government Accountability Office recommended that the FCC review and document whether licensing large constellations of satellites will have significant effects on the environment, and the FCC agreed.[133] Considering that SSPS rectenna and ground systems will generally involve the use of novel technology and wireless transmission of power (microwaves and/or laser beam technology), the FCC may require the environmental assessment for all SSPSs. By doing so, the FCC would avoid legal challenges similar to those Viasat brought against the FCC in the *SpaceX* decision. Accordingly, all SSPS developers should invest time and resources up front and submit an environmental assessment to the FCC as part of their solar satellite registration to avoid years of litigation.

B. GSO vs. NGSO Considerations.

As stated in the *SpaceX* decision, regulations give preference to geostationary systems over non-geostationary systems.[134] However, given the complexity, expense, and risk associated with a GSO microwave SSPS, there may be incentive alignment between developers and investors to pursue NGSO laser beam SSPSs. As discussed above in the *SpaceX* decision, the primary legal issue centered around SpaceX's competitors—DISH and Viasat—contesting FCCs grant of SpaceX's license modification to lower its satellites from GSO to NGSO.[135] If the FCC did not grant SpaceX's modification request, this article would not exist and the interference issue never litigated; although, DISH and Viasat may have found another way to sue or hinder SpaceX. For example, DISH or Viasat

131. *Id.*

132. *Id.*

133. *Satellite Licensing: FCC Should Reexamine Its Environmental Review Process for Large Constellations of Satellites* GAO-1 (2022), https://www.gao.gov/assets/gao-23-105005.pdf [https://perma.cc/6RSA-RCNB].

134. Viasat, Inc. v. Fed. Commc'ns Comm'n, 47 F.4th 769, 775 (D.C. Cir. 2022) (citing 47 C.F.R. § 25.289 (2022)).

135. *See supra* pt. IV.

may have raised the issue of limited FCC environmental impact assessments on satellite constellations to the Government Accountability Office in an attempt to influence public policy and hinder SpaceX.

Because regulations prioritize GSOs and licenses are awarded first-in-time, developers of SSPSs should obtain a GSO license to avoid regulatory hurdles and fast-track their licensure. Hypothetically, an ideal solution creates a hybrid GSO-capable SSPS. As stated in the *SpaceX* decision, "given the complexity of satellite system design, the FCC seeks where possible to allow licensees to modify the technical design of their satellites as they are being built." From a non-technical, non-scientific perspective, potential hybrid systems may consist of: 1) a constellation of medium-sized microwave solar satellites, that are able to easily operate in NGSO; and 2) a SSPS system that contains several GSO laser satellites beaming solar energy to a constellation of smaller NGSO microwave beam satellites.

C. Wireless Power Transmission Set-Asides for Public Interest.

In order for a SSPS developer operating in GSO to successfully obtain FCC approval for a modification to lower itself into NGSO, the FCC will have to, among other things, find that the modification of the license will serve the public interest[136] and not cause significant interference to existing satellites.[137] Similar to SpaceX, by committing to provide wireless power transmission to unserved or underserved areas, developers of SSPS create a quasi-presumption of favorability, making it easier for the FCC to justify a future NGSO modification and defend against future litigation. Additionally, developers could take it a controversial step further and give the U.S. military the contractual right to commandeer the SSPS during a national emergency or energy crisis and allocate energy sources accordingly. It is no secret that if the government has an interest or relationship with a private corporation, it will participate in intergovernmental advocacy or put mechanisms in place to protect its interests.

D. Stakeholder Engagement

Because SSPSs involve the use of novel technology and provide wireless power transmission, they have no industry competitors. It would be impossible to repurpose existing satellites to provide wireless power transmission. Additionally, it would likely be cost-prohibitive and/or

136. 47 U.S.C. §316(a)(1).
137. *Viasat, Inc.*,47 F.4th at 775 (noting Teledesic, 14 FCC Rcd. 2261).

economically imprudent for existing satellite companies to branch into the SSPS industry if they already have a sound business providing other broadband internet, mapping, or telephone services. Since most of these companies are public, shareholders would likely vote against expending billions of dollars when the technology likely will not yield a return on investment until decades later.[138]

Even though there are no direct competitors to SSPSs, SSPSs will likely face challenges from companies with satellites in the same vicinity—as SpaceX encountered in its legal battle with Viasat. As discussed above, Viasat unsuccessfully attempted to use NEPA to challenge SpaceX's modification order, alleging that the lowering of SpaceX's satellites into NGSO caused a collision risk with its GSO satellites, and that it would cause increased expenses and complexity for Viasat to launch additional satellites.[139] Notwithstanding the court's finding that Viasat lacked standing to bring the claim, it is fair to speculate the assertion of similar challenges at the beginning of an SSPS's license proposal and at the time of any subsequent modification orders.

Accordingly, prior to submitting its FCC licensing application, a SSPS developer should reach out to American satellite companies and attempt to seek confirmation, mutual agreement, or an acknowledgement letter showing that the proposed SSPS project is not expected to cause any interference issues and that the satellite companies will not object to its SSPS before the FCC. Even if it is highly unlikely that any company will agree to such a writing, it may still be worth a shot.

Moreover, SSPS developers should host stakeholder engagement meetings and send formal invitations to all satellite companies and relevant government officials.[140] By doing so, the SSPS developer would proactively receive and address challenges and objections ahead of time. Most importantly, stakeholder engagement meetings would allow for SSPS to solicit feedback from regulatory agencies and policymakers while building relationships to increase their chance of licensure and governmental approval.

---

138. *See generally ESA to Apply for Funding for Space-Based Solar Energy Study*, SOLAR POWER CONF., https://solarpowerconference.com/esa-to-apply-for-funding-for-space-based-solar-energy-study/ [https://perma.cc/H8JW-QC5Z] (last visited Mar. 4, 2023).

139. *Viasat, Inc.*, 47 F.4th at 778–79 (citing Fla. Audubon Soc'y v. Bentsen, 94 F.3d 658, 665 (D.C. Cir. 1996) (en banc)).

140. Government officials may include representatives from Congress, FCC, FERC, FAA, DOT, DOD, ITU, and IAF.

CONCLUSION

In sum, this article discussed *Viasat v. FCC* and the FCC's inherent regulatory authority over SSPS satellites and ground systems, while briefly acknowledging FERC's role in regulating energy transmission from the SSPS ground systems. Based on the *SpaceX* decision, American SSPS developers may avoid unnecessary legal and regulatory hurdles and increase the likelihood of project success by: 1) preparing an environmental assessment; 2) strategically considering GSO versus NGSO licensing; 3) setting aside wireless power transmission for unserved areas and government interests; 4) engaging satellite companies and government decision-makers from the start of the SSPS project until completion; and 5) in light of the *SpaceX* decision, actively monitoring new case law developments on satellite interference issues and FCC and FAA regulations under the Space Launch Act.

While this article discussed wireless power transmission in the context of an SSPSs potential beaming and/or microwave technology to a rectenna, it does not consider the recent developments of wireless power transmission scientists and countries are studying and seeking to implement in the near future.[141] Taking this into consideration, future scientific and legal literature may speculate a wireless and futuristic United States and explore regulatory challenges that FERC and the FCC may face in situations where: 1) both SSPSs and wireless power transmission towers co-exist without specific rules, regulations, or laws governing them; 2) interference issues surface between broadband, radio, cell, and/or wireless power transmission towers; and 3) wireless power transmission towers and SSPSs present interconnection issues with existing energy infrastructure. These future studies will contribute to the growing intersectional scholarship on energy and telecommunications, helping to develop a framework for wireless power transmission systems and SSPSs, with the former being implemented possibly decades before the latter.

---

141. *See* Loz Brian, *NZ to Trial World-First Commercial Long-Range, Wireless Power Transmission*, NEW ATLAS (Aug. 3, 2020), https://newatlas.com/energy/long-range-wireless-power-transmission-new-zealand-emrod/ [https://perma.cc/4BHA-REZX]; *see also* David Nield, *Researchers Just Wirelessly Transmitted Power over 98 Feet of Thin Air*, SCI. ALERT (Sept. 2, 2022), https://www.sciencealert.com/researchers-just-wirelessly-transmitted-power-over-98-feet-of-thin-air [https://perma.cc/SM43-WDGX].