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Higher Altitudes and Higher Standards: Advocating the FCC Require Environmental Assessments for Mega- Constellations

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HIGHER ALTITUDES AND HIGHER STANDARDS: ADVOCATING THE FCC REQUIRE ENVIRONMENTAL ASSESSMENTS FOR MEGA-CONSTELLATIONS

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I. INTRODUCTION

With surprising consistency, internet speed and connectivity have progressed with a new generation, or "G," nearly every decade since the 1980s.[1] This pattern shows no sign of stopping, with countries such as Finland, Japan, China, and the United States already taking steps to prepare for 6G networks by or around the year 2030.[2] Even so, many areas of the world still do not have any networks at all, let alone the more recent 5G network.[3]

That leaves a big potential market for companies like SpaceX, Amazon, OneWeb, Viasat, and Telesat.[4] These companies are currently engaged in a satellite internet race to bring high-speed satellite internet to unserved and underserved communities around the world.[5] To achieve their goals, these companies require approval to launch hundreds or

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[1] Reinhardt Haverns, *From 1G to 5G: A Brief History of the Evolution of Mobile Standards*, BRAINBRIDGE WORKFORCE SOLS. (May 27, 2021), https://www.brainbridge.be/en/blog/1g-5g-brief-history-evolution-mobile-standards.

[2] Tim Fisher, *6G: What It Is & When to Expect It*, LIFEWIRE (last updated Aug. 18, 2022), https://www.lifewire.com/6g-wireless-4685524.

[3] *Id.*

[4] Mike Brown, *SpaceX Alternatives: Three SpaceX Rivals You Need to Know*, INVERSE (Sept. 28, 2021, 5:00 AM), https://www.inverse.com/innovation/starlink-alternatives.

[5] Clement Hearey, *When You Wish upon a "Starlink": Evaluating the FCC's Actions to Mitigate the Risk of Orbital Debris in the Age of Satellite "Mega-Constellations"*, 72 ADMIN. L. REV. 751, 752 (2020).

thousands of satellites into Earth's orbit, in what are known as "mega-constellations."[6]

In 1969, Congress enacted the National Environmental Policy Act (NEPA) "declar[ing] a national policy [to] encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere[. . . ;]" and "to enrich the understanding of the ecological systems and natural resources important to the Nation[.]"[7] As a result, every federal agency of the United States must "use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may," among other things, "assure for all Americans safe, healthful, productive, and [a]esthetically and culturally pleasing surroundings."[8] As a result, agencies including the Federal Communications Commission (FCC), National Aeronautics and Space Administration (NASA), and Environmental Protection Agency (EPA) must conduct their activities in a manner which complies with NEPA.[9]

In order to comply with NEPA, every agency must utilize a systematic, interdisciplinary approach to ensure the integrated use of the sciences and environmental design arts in planning and making decisions that may have an impact on the peoples' environment.[10] NEPA requires every agency to identify and develop methods and procedures in conjunction with the Council on Environmental Quality (CEQ) to ensure that unquantified environmental amenities and values receive appropriate

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[6] *Id. "*Mega-constellations are systems utilizing hundreds to tens of thousands of satellites in Low-Earth Orbit (LEO) to deliver low latency broadband data services anywhere on the planet." Francis Kinsella, *Mega-Constellations in Space: Revolutionising the Satellite Industry*, AIRBUS SECURE COMMC'NS, https://securecommunications.airbus.com/en/meet-the-experts/mega-constellations-in-space-revolutionising-satellite-industry. For example, SpaceX has applied for permission to launch up to 42,000 satellites in total; Amazon seeks to launch 3,236; OneWeb seeks to launch 648; and Telesat seeks to launch 298. Brown, *supra* note 4.

[7] National Environmental Policy Act of 1969 § 2, 42 U.S.C. § 4321 (2018).

[8] National Environmental Policy Act of 1969 § 101, 42 U.S.C. § 4331 (2018).

[9] *Id.*

[10] National Environmental Policy Act § 102.

consideration in decision-making, along with economic and technical considerations.[11]

To streamline the NEPA process, federal agencies may establish what are known as "categorical exclusions," which permit the Agency to determine if the action contemplated does not normally have a significant impact on the environment. Therefore, an agency is not required to further scrutinize the action.[12]

For example, the FCC regulates interstate and international communications by radio, television, wire, satellite, and cable in the United States and all of its territories, and it is the primary authority for communications law.[13] As a federal agency, the FCC must comply with NEPA.[14] However, the FCC has determined that satellites are per se categorically excluded from environmental assessment and, therefore, a satellite may be launched without concern for its individual or cumulative impact on the environment.[15] While there may be economic and bureaucratic benefits to this categorical exclusion, there are also environmental drawbacks, especially in light of a fast-growing industry in the telecommunications world: mega-constellations.[16]

This article will explore why the FCC's current regime on categorical exclusions is ill-prepared for the developing mega-constellation industry, why the regime should be revised to require that companies launching mega-constellations file an Environmental Assessment (EA) as defined in the National Environmental Policy Act, and how such a change might fiscally impact these companies. Part II of this article will explore the National Environmental Policy Act, discussing the purpose of the Act and the goals Congress sought to accomplish.[17] Part III will consider the FCC's policy on categorical exclusions and EAs, with a comparison of how some other federal agencies navigate their

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[11] *Id.*

[12] 40 C.F.R. § 1508.1(d).

[13] *What We Do*, FED. COMMC'N COMM'N, https://www.fcc.gov/about-fcc/what-we-do (last visited Sep. 10, 2022).

[14] National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332 (2018).

[15] Ramon J. Ryan, *The Fault in Our Stars: Challenging the FCC's Treatment of Commercial Satellites as Categorically Excluded from Review Under the National Environmental Policy Act*, 22 VAND. J. ENT. & TECH. L. 923, 930–31 (2020).

[16] *Id.*

[17] *See infra* Part II.

categorical exclusions and EA policies.[18] Part IV will discuss why, in certain circumstances, satellites should no longer be categorically excluded from environmental assessment and why the FCC should instead require the applicant company to submit an EA in those circumstances.[19] Finally, Part V will examine the economic and fiscal impact such a change may have on companies already expending vast amounts of money on mega-constellation projects, as well as the impact on those companies with portions of their mega-constellations already in orbit.[20]

II. THE NATIONAL ENVIRONMENTAL POLICY ACT'S PURPOSE AND PROCEDURE

President Nixon signed the National Environmental Policy Act into law on January 1, 1970, making the Act the first major environmental law in the United States.[21] The first section of NEPA is a declaration by Congress of the purpose, problem, and remedy which Congress intended the Act to address.[22] An in-depth look at the responsibility Congress imposed on federal agencies is necessary to understand why the FCC should require EAs before allowing a company to launch satellites as part of its mega-constellation.

A. *The Federal Government as "Trustee" of the Environment for Succeeding Generations*

Congress enacted NEPA in recognition of humankind's "profound impact" on the interrelations of all components of the natural environment, and *particularly* the profound impact of "new and expanding technological advances."[23] Congress also recognized that earlier national policies were designed to enhance the production of goods and increase the gross national product. Such policies—while good for the economy—largely led to negative impacts on the environment.[24] To combat these

[18] *See infra* Part III.

[19] *See infra* Part IV.

[20] *See infra* Part V.

[21] *National Environmental Policy Act*, NEPA.GOV, https://ceq.doe.gov (last visited Sep. 10, 2022).

[22] *Id*.

[23] National Environmental Policy Act of 1969 § 101, 42 U.S.C. § 4331 (2018).

[24] S. Rep. No. 91–296, at 5 (1969).

profound impacts, Congress imposed a continuing responsibility on the federal government to use all practicable means to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[25]

NEPA does not expressly create a statutory enforcement right.[26] Further, in light of the Supreme Court's 1980 ruling in *United States v. Mitchell*, courts are unlikely to hold that NEPA creates an implicit statutory enforcement right.[27] In *Mitchell*, individual allottees of land on a Native American reservation sued the federal government under the General Allotment Act to recover damages for mismanagement of timber resources found on the tribe's reservation.[28] The Supreme Court held that the General Allotment Act did not authorize awarding money damages against the United States for alleged mismanagement of the forest or lands (*i.e.*, trust property) allotted to the Native American tribe under the Act.[29]

Similar to the General Allotment Act at issue in *Mitchell*, NEPA does not expressly provide for the possibility of a damage award against the United States if a federal agency mismanages its duties under the Act.[30] In addition, a prohibitive injunction enjoining the launch of additional satellites is an unlikely remedy in light of the Supreme Court's ruling in *Winter v. Natural Resources Defense Council, Inc.*[31] In that case, the Court dissolved an injunction issued by the district court and stressed the clear national security interest in Naval training over the possibility of irreparable harm to the environment; an interest not so clearly present in the commercial mega-constellation industry.[32]

However, even if no person can sue the FCC to recover damages or to petition for a prohibitive injunction enjoining the launch of additional satellites, a plaintiff could still petition for a mandatory injunction.[33] While "[t]he usual [purpose] of an injunction is to restrain actual or threatened acts injurious to the complainants' rights, . . . [preventative] relief is not

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[25] National Environmental Policy Act of 1969 § 101, 42 U.S.C. § 4331.

[26] National Environmental Policy Act §§ 2–209.

[27] United States v. Mitchell, 445 U.S. 535 (1980).

[28] *Id.* at 537.

[29] *Id.* at 546.

[30] *See* National Environmental Policy Act §§ 2–209, 42 U.S.C. §§ 4321–70.

[31] Winter v. Nat. Res. Def. Council, Inc., 555 U.S. 7 (2008).

[32] *Id*. at 23–24, 31.

[33] W.R. Habeeb, Annotation, *Mandatory injunction prior to hearing of case*, 15 A.L.R. 2d 213.

always adapted or adequate [for] the situation."[34] In such cases, "some positive action involving a change of existing conditions is necessary—some affirmative act or acts essential to restore the status quo."[35] Thus, the ideal remedy in question would be a mandatory injunction ordering the redrafting of the FCC's policies, specifically revisiting the Agency's EA policy.

Applying statutory construction to the word "trustee" and given Congress's presumed knowledge of its meaning, Congress imposed fiduciary duties upon every federal agency for the benefit of the nation.[36] If a court determined that the FCC breached those duties regarding its NEPA policies as applied to mega-constellations, it could order the Agency to redraft those policies through a mandatory injunction.[37]

B. *The NEPA Process*

At the broadest level, Congress intended that the Act address inadequacies in the Nation's state of knowledge, established public policies, and government institutions when dealing with the "growing environmental problems and crises the Nation faces."[38] As evidence of these inadequacies, the Senate Report on NEPA pointed to "the loss of valuable open spaces"; "critical air and water pollution problems"; "radiation hazards"; and "an increasingly ugly landscape cluttered with billboards, powerlines, and junkyards."[39]

To alleviate these concerns, Congress directed all federal agencies to utilize a systematic approach to apply natural and social sciences in the planning and decision making of "major [f]ederal actions."[40] In short, a

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[34] *Id.*

[35] *Id.* (internal quotation marks and citation omitted).

[36] Restatement (Third) of Agency § 1.04 (Am. L. Inst. 2006); Restatement (Third) of Trusts, part 6, ch. 15, intro. Note (Am. L. Inst. 2007). Evans v. United States, 504 U.S. 255, 259 (1992) ("[A] statutory term is generally presumed to have its common-law meaning.").

[37] Getzel Berger, *Nationwide Injunctions Against The Federal Government: A Structural Approach*, 92 N.Y.U. L. REV. 1068 (2017). https://www.nyulawreview.org/wp-content/uploads/2018/08/NYULawReview-92-4-Berger.pdf

[38] S. REP. NO. 91-296, at 4 (1969).

[39] *Id.*

[40] National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332 (2018).

major federal action is "an activity or decision subject to [f]ederal control and responsibility," with some exceptions.[41] Notably, a major federal action may include "new and continuing activities, including projects and programs . . . regulated, or approved by [f]ederal agencies."[42] When an agency's activity constitutes a major federal action, NEPA requires that it assesses whether the activity will have a significant environmental impact.[43]

The environmental review process under NEPA involves three steps of analysis.[44] First, the agency will determine if the proposed action constitutes a categorical exclusion.[45] A federal action may be categorically excluded, and thereby not require a detailed environmental analysis, when the federal agency determines that a particular action "normally do[es] not have a significant effect on the human environment."[46]

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[41] 40 C.F.R. § 1508.1(q) (2021). The regulation excludes from the definition of major federal action those activities or actions that are outside the jurisdiction of the United States; non-discretionary activities or decisions; actions "that do not result in final agency action"; "[j]udicial or administrative civil or criminal enforcement actions"; funding assistance where the agency has no control over the subsequent use of the funds; non-federal projects with minimal federal funding or involvement "where the agency does not exercise sufficient control and responsibility over the outcome"; and loans or other financial assistance where the agency "does not exercise sufficient control and responsibility over the effects of such assistance." *Id.*

[42] *Id.*

[43] National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332 (2018); *see also National Environmental Policy Act Review Process*, U.S. ENV'T PROT. AGENCY (Oct. 25, 2021), https://www.epa.gov/nepa/national-environmental-policy-act-review-process [hereinafter *NEPA Review Process*].

[44] *See NEPA Review Process*, *supra* note 43.

[45] *Id.*

[46] 40 C.F.R. § 1508.1(d) (2021). The vast majority of NEPA reviews are completed using a categorical exclusion. Research has shown that approximately 92% of the projects processed by state transportation agencies and the Federal Highway Administration are categorically excluded. *NEPA Process & Transportation*, CENTER FOR ENVIRONMENTAL EXCELLENCE, https://environment.transportation.org/education/practical-applications/nepa-process/nepa-process-overview/. As for activities which receive funding through the American Recovery and Reinvestment Act, 95.9% of environmental reviews were completed using a categorical exclusion. COUNCIL ON ENV'T QUALITY, THE ELEVENTH AND FINAL REPORT ON THE NATIONAL ENVIRONMENTAL POLICY ACT STATUS AND PROGRESS FOR AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 ACTIVITIES AND PROJECTS 4 (2011).

If the action is not covered by a categorical exclusion, the agency will compile an EA.[47] An EA is a "concise public document prepared by a [f]ederal agency to . . . support its determination of whether to prepare an environmental impact statement or a finding of no significant impact" on a proposed federal action.[48]

If, based on the EA, the federal agency concludes that there may be a significant environmental impact from the proposed action, the agency must provide an Environmental Impact Statement (EIS).[49] The EIS is a "detailed statement" containing information on "the environmental impact of the proposed action," "effects [of the action] which cannot be avoided," and possible alternatives.[50] In considering whether the effects of the proposed action are significant, agencies must analyze the size of the potentially affected environment, the resources in that region, and the degree of the effects of the action.[51]

Once an agency completes a required EIS, the agency releases it to the public as a "draft EIS" "for public review and comment for a minimum of [forty-five] days."[52] The agency then considers the public reviews and comments and follows up the draft EIS with a "final EIS" and a mandatory "wait period" of at least thirty days.[53] The process ends when the agency issues a Record of Decision, which "explains the agency's decision, describes the alternatives the agency considered, and discusses the agency's plans for mitigation and monitoring, if necessary."[54]

C. *Council on Environmental Quality*

When Congress enacted the National Environmental Policy Act in 1969, it did more than simply make a commitment to take better care of the environment. One of the critical aspects of NEPA is the creation of the

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[47] 40 C.F.R. § 1501.4(b)(2) (2021).

[48] 40 C.F.R. § 1508.1(h) (2021).

[49] National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332 (2018).

[50] *Id.*

[51] Such analysis should include consideration of the size of the affected area (national, regional, or local) and the region's resources. 40 C.F.R. § 1501.3 (2021).

[52] *NEPA Review Process*, *supra* note 43.

[53] *Id.*

[54] *Id.*

Council on Environmental Quality (CEQ or the Council).[55] The Council is part of the Executive Office of the President and is supposed to coordinate "the federal government's efforts to improve, preserve, and protect America's public health and environment."[56] Importantly, the Council is responsible for actually implementing NEPA and ensuring that federal agencies comply with it.[57] It primarily implements NEPA "through issuing guidance and interpreting [federal agency] regulations that implement NEPA's procedural requirements."[58] The Act expressly imposes eight responsibilities on the Council, but one of its central duties and functions is "to review and appraise the various programs and activities of the Federal Government . . . for the purpose of determining the extent to which such programs and activities are contributing to the achievement of" NEPA's goals and purpose.[59]

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[55] National Environmental Policy Act of 1969 §§ 201–09, 42 U.S.C. §§ 4342–47 (2018).

[56] *Council on Environmental Quality*, THE WHITE HOUSE, https://www.whitehouse.gov/ceq/ (last visited Aug. 27, 2022).

[57] *See id.*

[58] *National Environmental Policy Act*, *supra* note 21.

[59] National Environmental Policy Act of 1969 § 204, 42 U.S.C. § 4344 (2018) (The Act states that it "shall be the duty and function of the Council (1) to assist and advise the President in the preparation of Environmental Quality Report[s]"; "(2) to gather timely and authoritative information" about current and prospective conditions and trends in the quality of the environment, to analyze and interpret the information to determine if those trends are interfering with the goals and purpose of NEPA, "and to compile and submit to the President studies relating to such conditions and trends; (3) to review and appraise the various programs and activities of the Federal Government in light of" NEPA "for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto; (4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic[,] health, and other requirements and goals of the Nation; (5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality; (6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes; (7) to report at least once a year to the President on the state and condition of the environment; and (8) to make and furnish studies, reports [] and recommendations on matters of policy and legislation as the President may request.")

Under NEPA, the Council was originally composed of three members appointed by the President and confirmed by the Senate.[60] Out of the three members, the President designated one to serve as Chair of the Council.[61] The Act required Council members to be to be people who were "exceptionally well qualified to analyze and interpret environmental trends" and information, "to appraise programs and activities of the Federal Government," "to be conscious of and responsive to" the various needs of the nation, "and to formulate and recommend national policies to promote the improvement of the quality of the environment."[62] After the enactment of NEPA, Congress subsequently reduced the Council to a single member, the Chair.[63]

To be sure, the responsibility of the Council to ensure that all federal agencies' NEPA policies are consistent with the Act's goals and purpose is a large task for three people, let alone one. Still, as the governmental body charged with implementing NEPA in a manner consistent with the Act's goals and purpose, the CEQ is not without fault in the FCC's deferential attitude towards the environmental impact of tens of thousands of satellites.[64]

III. THE FEDERAL COMMUNICATIONS COMMISSION'S POLICY ON CATEGORICAL EXCLUSIONS AND ENVIRONMENTAL ASSESSMENTS

A. *Categorical Exclusions*

A categorical exclusion is "a category of actions that the agency has determined, in its agency NEPA procedures . . ., normally do not have

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[60] National Environmental Policy Act of 1969 § 202, 42 U.S.C. § 4342 (2018).

[61] *Id.*

[62] *Id.*

[63] Due to expense concerns, the Council was reduced to one member in 2005. National Environmental Policy Act of 1969, Pub. L. No. 109–54, 119 Stat. 499, 543 (2005). The member—who also serves as Chair—exercises "all powers, functions, and duties of the Council" as originally created. *Id.* The Chair, thus, must still contain all the same qualifications originally required of Council members. *Id.*

[64] *See infra* Section III.A.

a significant effect on the human environment."[65] The FCC takes an interesting approach to this definition. Rather than create a list of actions that the agency has determined normally do not have a significant effect on the human environment, the agency has instead created a list of situations and circumstances that "may significantly affect the environment" and therefore necessitate the preparation of an EA.[66] The agency declares that "Commission actions not covered by [those enumerated situations and circumstances] are deemed individually *and* cumulatively to have no significant effect on the quality of the human environment and are categorically excluded from environmental processing."[67]

There are two exceptions to this broad categorical exclusion rule.[68] The first is that individuals may act as an "interested person" and allege that an action otherwise categorically excluded will have a significant environmental effect.[69] In such a case, the interested person must submit a written petition detailing the reasons justifying or circumstances necessitating further environmental consideration in the decision-making process.[70] The Commission reviews this written petition, and if it decides there may be a significant environmental impact, requires the petitioner to prepare an EA which serves as the basis for whether the Commission continues or discontinues a more detailed environmental analysis.[71]

Similarly, the second exception is when the Bureau responsible for processing a particular action, on its own motion, determines that the action may have a significant environmental impact.[72] While the FCC has established a broad, default rule that every action is categorically excluded unless it falls into what can fairly be dubbed an exception to the categorical exclusion rule, this is not the approach taken by other federal agencies.[73]

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[65] 40 C.F.R. § 1508.1(d) (2021); *see also Categorical Exclusions*, NEPA.GOV, https://ceq.doe.gov/nepa-practice/categorical-exclusions.html (last visited Aug. 28, 2022).

[66] 47 C.F.R. § 1.1307 (2021).

[67] 47 C.F.R. § 1.1306 (2021) (emphasis added); *see also id.* § 1.1307 (2021). Notably, it does not appear that the FCC has independently evaluated whether the act of launching hundreds or thousands of satellites into orbit constitutes an "extraordinary circumstance[]" for which any significant effects cannot be lessened and an environmental assessment must be prepared. 40 C.F.R. § 1501.4.

[68] *Id.*

[69] 47 C.F.R. § 1.1307 (2022).

[70] *Id.*

[71] *Id.*

[72] *Id.*

[73] 14 C.F.R. § 1216.304 (2022).

For instance, NASA's categorical exclusion rule requires that a proposed agency action be thoroughly vetted before the action can appropriately be deemed to be categorically excluded.[74] Initially, it is worth pointing out that that on its face, NASA is more transparent than the FCC with regards to the purpose of its categorical exclusions.[75] NASA specifically maintains that "[t]he use of a [categorical exclusion] is intended to reduce paperwork, improve Government efficiency, and eliminate delays[.]"[76] In contrast, the FCC's explanation of its NEPA procedures is limited to what is provided in the Scope of the Code of Federal Regulations; that "[t]he provisions of [subpart I of the Code of Federal Regulations] shall apply to all Commission actions that may or will have a significant impact on the quality of the human environment."[77]

NASA created explicit requirements that a proposed action must meet in order to be categorically excluded from further environmental assessment.[78] First, the action must fit within one of the categories of actions eligible for exclusion.[79] The exclusion of aircraft and airfield activities from environmental assessment are the most similar to the FCC's exclusion of satellites, whereas the FCC excludes all satellites—regardless of the size, type, or amount—from environmental analysis, NASA only provides that "[p]eriodic aircraft flight activities . . . which are routine and comply with [law]" will be excluded from environmental assessment.[80]

Second, even if an action proposed by NASA falls within one of the aforementioned exclusion categories, the action is only categorically excluded as long as it does not involve any extraordinary circumstances.[81] NASA provides a list of seven different extraordinary circumstances that will preclude the use of a categorical exclusion.[82] Notably, one of these

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[74] *Id.*
[75] *Id.*; *see also* 47 C.F.R. § 1.1306 (2022).
[76] 14 C.F.R. § 1216.304 (2022).
[77] 47 C.F.R. § 1.1303 (2022).
[78] 14 C.F.R. § 1216.304 (2022).
[79] *Id.*
[80] *Id.* (alteration in original).
[81] *Id.*
[82] See *id.*

> These circumstances include when the proposed action: (1) has a reasonable likelihood of having (individually or cumulatively) significant impacts on public health, safety, or the environment; (2) imposes uncertain or unique environmental risks; (3) is of significantly greater scope or size

extraordinary circumstances is when the proposed action "[i]s of significantly greater scope or size than is normal for [the] category of action."[83] The FCC should take note of this extraordinary circumstance exception in recognition that even if a single satellite, which may be no bigger than ten centimeters, is part of an action that is of significantly greater scope or size than is normal, an environmental assessment may be warranted.[84]

The Environmental Protection Agency (EPA) also requires certain conditions be met before a particular action will be categorically excluded from environmental assessment.[85] Similar to NASA's policies, to qualify for an exclusion under the EPA's procedure, the applicant must demonstrate that the proposed action (1) fits within a category of action that is eligible for exclusion, and (2) does not involve any extraordinary circumstances.[86] The EPA further breaks down its process for excluding certain actions by creating two subcategories of actions that are eligible for categorical exclusions.[87]

The first subcategory requires the EPA official overseeing the application to document the determination that an exclusion applies, [88]

> than is normal for this category of action; (4) has a reasonable likelihood of violating […] law or requirements imposed for the protection of the environment; (5) involves impacts on the quality of the environment that are likely to be environmentally controversial; (6) may adversely affect environmentally sensitive resources… [like] endangered species, their designated critical habitat, wilderness areas, floodplains, wetlands, aquifer recharge areas, coastal zones, wild and scenic rivers, and significant fish or wildlife habitat, unless the impact has been resolved through another environmental review process… [or] (7) may adversely affect known national natural landmarks, or cultural or historic resources […] unless the impact has been resolved through another environmental review processes.
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> *Id.*

[83] *Id.* (alteration in original).

[84] *Artificial Satellites*, SCIENCE LEARNING HUB (last updated Oct. 15, 2020), https://www.sciencelearn.org.nz/resources/269-artificial-satellites.

[85] 40 C.F.R. § 6.204 (2022).

[86] *Id.*

[87] *Id.*

[88] There are five types of actions which are eligible for a categorical exclusion but further require the necessary documentation. *Id.* These include: (1) "actions at EPA owned or operated facilities involving routine facility maintenance" or "grounds-keeping," replacing or installing equipment, or constructing "new minor ancillary facilities;" (2) "actions relating to existing

which further requires "[a] brief description of the proposed action; a statement identifying the categorical exclusion that applies to the action; and a statement explaining why no extraordinary circumstances apply to the proposed action."[89] There is a common thread throughout this category of actions.[90] These actions involve something which is only "routine" or "minor."[91]

The second sub-category of actions eligible for exclusion does not require further documentation and contains actions that the EPA can fairly label as administrative actions.[92] Such actions include those supporting the

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infrastructure (such as sewer systems; drinking water supply systems; and stormwater systems," which involve minor upgrading or minor expansion; (3) "actions in unsewered communities involving the replacement of existing systems," provided such action does not result in "substantial increases in the volume of discharge;" (4) "actions involving re-issuance of a NPDES [National Pollutant Discharge Elimination System] permit providing the original NEPA document are still valid […] and the permit conditions have not changed or are more environmentally protective;" and (5) "actions for award of grants authorized by Congress." *Id.*

[89] *Id.*

[90] *Id.*

[91] 40 C.F.R. § 6.204 (2022).

[92] There are ten types of actions which are eligible for exclusion and do not require further documentation. *Id.* These include: (1) procedural or administrative actions "necessary to support the normal conduct of EPA business;" (2) acquisition and contracting actions "necessary to support the normal conduct of EPA business;" (3) "actions involving information collection," planning, training programs, computer studies and activities, research, and other studies; (4) "actions relating to or conducted completely within a permanent, existing contained facility, such as a laboratory […] provided all waste is disposed of appropriately," but not including any construction; (5) "actions involving emergency preparedness planning and training;" (6) "actions involving the acquisition [or] disposition […] of existing permanent structures, land, equipment, materials or property provided the property is […] vacant or has only been used solely for office functions; has never been used for laboratory purposes […]; does not require site remediation; and will be used in essentially the same manner;" (7) "actions involving providing technical advice" to governments, agencies, or entities; (8) "actions involving approval of EPA participation in international 'umbrella' agreements for cooperation in environmental-related activities that would not commit the United States to any specific projects or actions;" (9) "actions involving containment or removal and disposal of asbestos-containing material or lead-based paint from EPA owned or operated facilities;" and (10) "actions involving new source NPDES [National Pollutant Discharge Elimination System] permit modifications that only make technical corrections

conduct of EPA business, EPA contracts, information collection and planning, actions related to existing facilities, and emergency preparedness.[93]

When comparing the FCC's categorical exclusion policy to that of NASA and the EPA, the FCC takes a far broader approach to categorically excluding agency actions than other federal agencies.[94] More specifically, looking at the language of the FCC's categorical exclusion policy reveals that the agency takes the position that an FCC action has, by default, no significant effect on the quality of the human environment and thus is categorically excluded from environmental review unless the action falls into a category of actions requiring further scrutiny. [95] This seems to run counter to the purpose of the categorical exclusion rule and NEPA.[96] In contrast, other agencies like NASA and the EPA take the default position that an agency action requires an EA, unless the action falls into a category warranting categorical exclusion.[97] The latter policy seems far more consistent with the goals and purpose of NEPA.

B. *Environmental Assessments*

An Environmental Assessment or EA is a document that applicants must prepare for FCC approval (or the Commission itself if the action is FCC-initiated) when the proposed action may have a significant environmental impact.[98] The document must explain the environmental consequences of the proposal and set forth sufficient analysis for the Commission to determine whether the proposed action will have a significant environmental effect.[99] Based on the EA, the Commission will either request additional information, make a finding of no significant impact, or require the applicant to prepare an Environmental Impact Statement (EIS).[100]

(such as correcting typographical errors) that do not result in a change in environmental impacts or conditions." *Id.*

[93] *Id.*

[94] *Compare* 47 C.F.R. § 1.1307 (2022) (the FCC's categorical exclusion policy), *with* 14 C.F.R. § 1216.304 (2022) (NASA's categorical exclusion policy), and 40 C.F.R. § 6.204 (2022) (the EPA's categorical exclusion policy).

[95] 47 C.F.R. § 1.1307 (2022).

[96] National Environmental Policy Act of 1969 § 2, 42 U.S.C.A § 4321 (2018).

[97] 14 C.F.R. § 1216.304 (2022); 40 C.F.R § 6.204 (2022).

[98] 47 C.F.R. § 1.1308 (2022).

[99] *Id.*

[100] *Id.* § § 1.1308, 1.1314.

While the FCC requires that an interested person prepares an EA in some situations, those situations generally only relate to telecommunication facilities or human exposure to radiofrequency.[101] Such circumstances include when a facility is located in a wilderness area or wildlife preserve, could threaten endangered species, or could affect historic or Native American sites.[102] Another circumstance mandating an EA is when an antenna tower or its supporting structures are equipped with high intensity white lights in residential neighborhoods.[103] Interestingly, it would seem that this last circumstance has less to do with the environment and more to do with aesthetic and nuisance.[104] Additionally, the FCC mandates an EA be prepared when an applicant seeks authorization for radiofrequency sources which would cause human exposure to radiation levels above what is permissible.[105]

NASA's approach is not significantly different from FCC's approach, with one notable exception.[106] NASA mandates the preparation of an EA when a proposed action cannot be categorically excluded, but is also not expected to result in a significant impact to the human environment's quality.[107] In that respect, NASA and the FCC's policies are similar. However, NASA provides a list of "actions normally requiring an EA," that includes "[s]pecific spacecraft development and space flight projects/programs."[108] Appendix A to the Subpart containing NASA's procedures for complying with NEPA defines "Space Flight Projects/Programs" as "[t]hose NASA actions that develop products intended for use in space and/or that support ground and space operations for products in space."[109] This is a notable and important distinction between the FCC's policy and NASA's policy because the former categorically excludes products intended for use in space—like

[101] 47 C.F.R. § 1.1307 (2022).
[102] *Id.*
[103] *Id.*
[104] *See id*.
[105] *Id.*
[106] 14 C.F.R. § 1216.305.
[107] *Id.*
[108] Other NASA actions which normally require an EA include: actions altering the ongoing operations at a NASA Center which could directly, indirectly, or cumulatively to substantial natural or physical environmental impacts; construction or modifications of facilities—similar to the FCC's mandate—which are not minor; proposed actions expected to result in significant changes to land use; or space flight projects/programs which would return extraterrestrial samples to Earth from solar system bodies. *Id.*
[109] Appendix A to Subpart 1216.3 of Part 1216.

satellites—from environmental review,[110] whereas NASA believes such technology normally requires an EA.[111]

IV. COMPANIES ESTABLISHING MEGA-CONSTELLATIONS SHOULD BE REQUIRED TO SUBMIT AN ENVIRONMENTAL ASSESSMENT

The FCC should revise its NEPA policies to require that commercial satellite operators establishing mega-constellations submit an EA prior to allowing the operator to launch. This change in policy would provide greater assurance that prior to approving mega-constellations for operation, the FCC would have appropriately considered the full impact of the mega-constellation on environmental realities, including the increase in orbital debris, the negative impact of fossil fuels on the atmosphere, and the detrimental effect of light pollution on astronomical research and the general aesthetic of the sky. As the agency's policy currently exists, the FCC only requires EAs for a few actions, such as erecting new facilities or communication antennas and imposing radio frequency limitations on communication technology.[112] Moving forward, the FCC should consider the impact that hundreds or thousands of satellites have on the environment collectively, rather than looking at the impact of a single satellite in isolation. The agency can accomplish this by looking at an applicant's EA and considering the physical size of the mega-constellation satellites, the composition of the satellites, the satellites' reflectivity, and the number of satellites that will become part of the constellation.

A. *The Fear of Orbital Debris' Damage to the Atmosphere*

The increase in space activity over the last few years comes down to a few things. First, former President Barack Obama opened up space to commercial development in 2011; prior to that, space was largely only accessible to the government.[113] Second, the size and price of satellites have dropped dramatically.[114] Today, a "nanosatellite" or "nanosat" weighs between twenty-five and fifty kilograms, is the size of two shoe boxes, and can be sent into orbit at a cost between $100,000 and $1,000,000.[115] In contrast, prior data collection or communications

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[110] 47 C.F.R. § 1.1307.

[111] 14 C.F.R. § 1216.305.

[112] *Supra* note 110.

[113] Mary-Ann Russon, *Satellite Boom Attracts Technology Giants*, BBC NEWS (Jan. 29, 2021), https://www.bbc.com/news/business-55807150.

[114] *Id.*

[115] *Id.*

satellites would weigh two to six tons, be as big as a school bus, and cost hundreds of millions of dollars to build and launch.[116] The current version of SpaceX's Starlink satellite weighs 573 pounds and is roughly the size of a table.[117] Third, the price of launch continues to get cheaper.[118]

Of primary concern is the increasing amount of traffic in low-Earth orbit (LEO). Low-Earth orbit encompasses satellites in Earth's orbit with an altitude of 2,000 km (1,200 mi) or less.[119] NASA's Commercial-Use Policy Defines LEO as the area of Earth's orbit close enough for transportation, communication, observation, and resupply.[120] The United States wants to maximize its commercial and governmental use of LEO to utilize space and maintain a permanent American foothold there.[121] Since the Russians launched Sputnik in 1957, the world has launched more than 9,000 objects into space; more than 2,000 of those are active satellites orbiting Earth.[122] That number pales in comparison to what is projected to be in orbit within several years, with some estimates projecting more than 50,000 satellites.[123]

If a collision of objects occurs, it would create orbital debris with potentially devastating impacts.[124] According to the FCC, "orbital debris consists of artificial objects orbiting the Earth that are not functional spacecraft."[125] Since humans began launching objects into space approximately sixty years ago, the amount of orbital debris has continued

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[116] *Id.*

[117] Adam Mann & Tereza Pultarova, *Starlink: SpaceX's satellite internet project*, SPACE.COM (Jan. 5, 2022), https://www.space.com/spacex-starlink-satellites.html.

[118] Russon, *supra* note 113.

[119] Darcy Elburn, *LEO Economy FAQs*, NAT'L AERONAUTICS & SPACE ADMIN. (last updated Nov. 19, 2021), https://www.nasa.gov/leo-economy/faqs.

[120] *Id.*

[121] *See NASA Interim Directive (NID) on Use of International Space Station (ISS) for Commercial and Marketing Activities*, NAT'L AERONAUTICS & SPACE ADMIN. 1, 3 (June 6, 2018), https://www.nasa.gov/sites/default/files/atoms/files/nid_8600_121_tagged.pdf.

[122] Hearey, *supra* note 5, at 753.

[123] *Id.* at 754.

[124] *See* Richard Hermer-Fried, *Kessler Syndrome: A United States' Statutory Solution for Satellite Debris Removal and the Mitigation of Orbital Collisions*, 18 J. INT'L BUS. & L. 259, 260 (2019).

[125] *In the Matter of Mitigation of Orbital Debris*, IB Docket No. 02-54, FCC 04-130 at 1.

to increase.[126] Not only does this pose a problem from an environmental perspective, but it also poses a problem from a scientific research perspective, addressed in more detail below.[127]

Satellites in LEO follow predictable paths around the Earth, but along the way those paths can cross with other objects in orbit—other satellites, old rocket stages, loose bits of metal—which can cause catastrophic collisions.[128] In 1978, Donald Kessler, a former head of NASA's Orbital Debris Program Office, published a hypothesis which predicted that debris created from collisions between objects in Earth's orbit would lead to a "cascade effect."[129] This hypothesis, nicknamed the "Kessler Syndrome," predicts a space collision may cause an increase in orbital debris that, because of the populous of satellites and other objects in space, leads to a chain reaction increasing the amount of debris and collisions.[130] Ultimately, this will leave entire orbital zones of space unusable and effectively end exploration, communication, and experimentation in those zones.[131]

Brian Weeden, the Secure World Foundation's director of program planning, suggests taking a hard look at the system for managing space traffic because it is ill-prepared for the future.[132] To avoid an impending collision, a satellite must expend some of its precious fuel, which is "like platinum," because once the fuel is gone the satellite cannot operate at full capacity and either the company loses money or the quality of service is diminished, thereby hurting consumers.[133] Thus, given the current system, experts believe a collision between objects in LEO is only a matter of time, and any action to avoid collisions will be reactionary, rather than proactive.[134]

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[126] Hermer-Fried, *supra* note 124, at 259.

[127] Mark Strauss, *Orbital Debris Creates a New Problem: Light Pollution*, AIR & SPACE MAG (June 2021), https://www.airspacemag.com/space/bright-lights-big-problem-180977824/.

[128] Geoff Brumfiel, *Space Traffic Is Surging, and Critics Worry There Could Be a Crash*, NPR (Jan. 29, 2020), https://www.npr.org/2020/01/29/800433686/space-traffic-is-surging-and-critics-worry-there-could-be-a-crash.

[129] Hermer-Fried, *supra* note 124.

[130] *Id.*

[131] *Id.*

[132] Brumfiel, *supra* note 128.

[133] *Id.*

[134] *Id.*

B. *Light Pollution*

Sensory pollution occurs when an activity that benefits some people harms others through the senses.[135] "Sensory pollution includes noise, light, and visual pollution."[136] The International Astronomical Union defines light pollution as "artificial light that shines where it is neither wanted, nor needed."[137] While light pollution is generally associated with the increased glow in the night sky by artificial light from Earth's surface,[138] a recent study estimating the overall impact that objects in orbit have on astronomers looking at the night sky concluded that, collectively, the sunlight reflected off of satellites "has the same effect as ground-based light pollution by making it 'difficult to see faint astronomical objects,'" according to researcher and astronomer John Barentine.[139]

Light pollution is apparent to scientists in hindering their research and curtailing their observations at observatories.[140] A recent study "considered the tens of thousands of objects in orbit as of 2020" and found that "there appears to be nowhere left on Earth where astronomers can view the stars without light pollution from space junk and satellites."[141] Regarding light pollution, astronomers worry principally about the bright trails of light from individual satellites, which disrupt naked eye observers and diminish the benefits of more sensitive astronomical tools.[142] This is because the streaks of light are often comparable to or at times even brighter than the objects astronomers are observing millions of light-years away.[143]

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[135] Andrea Johnson, *Blinded by the Light: Addressing the Growing Light Pollution Problem*, 2 TEX. A&M J. PROP. L. 461, 461 (2015).

[136] *Id.*

[137] Strauss, *supra* note 127.

[138] Johnson, *supra* note 135, at 462.

[139] Strauss, *supra* note 127.

[140] Johnson, *supra* note 135, at 467.

[141] Joshua Sokol, *Study Finds Nowhere on Earth is Safe from Satellite Light Pollution*, SCIENCE (Mar. 28, 2021), https://www.science.org/content/article/study-finds-nowhere-earth-safe-satellite-light-pollution.

[142] *Id.*

[143] Nicola Davis, *Light Pollution from Satellites 'Poses Threat' to Astronomy*, THE GUARDIAN (Mar. 30, 2021), https://www.theguardian.com/science/2021/mar/30/light-pollution-satellites-astronomy-mega-constellations; *Galaxies*, NASA HUBBLESITE, https://hubblesite.org/science/galaxies (last visited Aug. 23, 2022).

In addition to the direct light pollution created by the reflectivity of individual satellites and orbital debris, there is another fear: "[t]he collective cloud of satellites and debris" increasingly enshrouding the Earth "might scatter light back into the atmosphere."[144] In other words, astronomers fear that the projected density of satellites and orbital debris may trap escaping light, reflect it back to Earth, and wash out the faint light of distant objects.[145]

The FCC already recognizes a situation where artificial light can intrude upon the environment.[146] As previously discussed, one of the limited circumstances in which the FCC actually requires an EA is when "[a]ntenna towers and/or supporting structures . . . are to be equipped with high intensity white lights which are to be located in residential neighborhoods . . . ."[147] While the presence of high intensity white lights within a residential neighborhood is easily distinguishable from the light reflected off of satellites, it is still noteworthy that the FCC recognizes the detrimental effect light can have on the aesthetic of the night sky.[148]

C. *Carbon Emissions from Rocket Launches and the Impact on Climate Change*

"By a large majority, climate scientists agree that average global temperature today is warmer than preindustrial times and that human activity is the most significant factor."[149] The human impact on the environment can be expressed as a product of technology, consumption, and population.[150] Additionally, it is argued that no effort to reduce the human population's effect on the environment is likely to succeed unless all three of those factors are addressed.[151] By requiring mega-constellation companies to submit EAs prior to approving the companies' satellites for launch, the FCC can easily analyze the impact of two out of three of these

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[144] Sokol, *supra* note 141.

[145] *Id.*

[146] 47 C.F.R. § 1.1307(a)(8).

[147] *Id.*

[148] *See id*.

[149] David Herring & Michon Scott, *Isn't There a Lot of Disagreement Among Climate Scientists About Global Warming?*, CLIMATE.GOV (last updated Sept. 27, 2021), https://www.climate.gov/news-features/climate-qa/isnt-there-lot-disagreement-among-climate-scientists-about-global-warming.

[150] John C. Dernbach & Donald A. Brown, *The Ethical Responsibility to Reduce Energy Consumption*, 37 HOFSTRA L. REV. 985, 985 (2009).

[151] *Id.*

individual factors necessary to slow climate change: technology and consumption.[152]

The technology at issue is clear: companies are engaged in a satellite Internet race to bring Internet access to even the most remote parts of the world.[153] To do so, companies are establishing mega-constellations in low Earth orbit—a technology that requires the launch of hundreds or thousands of small satellites.[154] While it is clear there are benefits to this technology,[155] the same result can be achieved without the launch of tens of thousands of satellites.[156]

The sheer numbers of satellites aside, there is also the fear that some of these satellites may be using mercury as a propellant.[157] Mercury is a neurotoxin that can impair cognitive function and motor skills with even minimal exposure.[158] As a heavy element, if mercury were used to power satellites in low-Earth orbit, the mercury would eventually fall back to Earth's surface and threaten people, plants, animals and marine life.[159] Whether a company intends to launch 100 satellites or 42,000 satellites as part of its mega-constellation, this is a type of technology that may contribute to climate change.

Consumption is another climate change factor that can be analyzed at as it relates to mega-constellations. For purposes of this analysis, the focus is on SpaceX's Falcon 9 rocket, which is used to launch its Starlink satellites.[160] The Falcon 9 rocket runs on fossil fuels; more specifically, Rocket Propellant 1 (RP-1), a highly refined kerosene.[161]

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[152] *See id*.; 40 C.F.R. § 6.204 (2022).

[153] Hearey, *supra* note 5.

[154] Kinsella, *supra* note 6; Brown, *supra* note 4.

[155] For instance, companies that use what is known as geostationary orbit can use far fewer satellites to achieve the same goal as those in low-Earth orbit. The downside is that the Internet speed is slower. Brown, *supra* note 4.

[156] *Id.*

[157] Ryan, *supra* note 15, at 925–26.

[158] *Id.* at 926.

[159] *Id.* at 926.

[160] Mike Wall, *SpaceX launches 46 Starlink satellites, lands Falcon 9 rocket for 100th time*, SPACE.COM (Feb. 21, 2022), https://www.space.com/spacex-starlink-satellite-launch-4-8-rocket-landing.

[161] Lloyd Alter, *A SpaceX Launch Puts Out as Much as CO2 as Flying 341 People Across the Atlantic*, TREEHUGGER (last updated Nov. 14, 2019), https://www.treehugger.com/spacex-launch-puts-out-much-co-flying-people-across-atlantic-4857958.

Each launch burns 112,184 kilograms (kg) of RP-1 with each kg releasing three kg of carbon dioxide (CO2); thus, each launch releases 336,552 kg of CO2.[162] To put this into perspective, a standard commercial flight from London to New York City releases 986 kg of fuel.[163] Thus, one Falcon 9 launch is equivalent to approximately 341 flights across the Atlantic.[164]

SpaceX recently launched forty-six Starlink satellites on board one Falcon 9 rocket.[165] SpaceX has never launched more than sixty satellites at one time.[166] Although SpaceX is working on a launch vehicle—dubbed "Starship"—which could deliver 400 satellites to LEO per launch, this appears to be at least several years away.[167] Considering SpaceX hopes to eventually launch 42,000 satellites in its mega-constellation,[168] without Starship's capabilities the company will be forced to launch all of those on board a Falcon 9 rocket, sixty at a time.[169] After factoring in the almost 2,000 satellites that SpaceX already has in orbit,[170] that would require another 666 Falcon 9 launches—equivalent to 227,106 commercial flights from London to New York.[171] Even if SpaceX managed to complete Starship before it launches a single new satellite, the company would launch Starship 100 times; this is equivalent to 34,100 flights across the Atlantic.[172] Yet, the FCC continues to posit that mega-constellations are deemed not to have an individual and cumulative effect on the quality of the human environment.[173]

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[162] *Id.*

[163] *Id.*

[164] *Id*.

[165] Wall, *supra* note 160.

[166] Tariq Malik, *SpaceX says a geomagnetic storm just doomed 40 Starlink internet satellites*, SPACE.COM (Feb. 8, 2022), https://www.space.com/spacex-starlink-satellites-lost-geomagnetic-storm; *see also* Darrell Etherington, *SpaceX launches 60 new Starlink satellites, while Starship moves closer to being able to launch up to 400 at a time*, TECHCRUNCH (Mar. 4, 2021, 4:31 AM), https://techcrunch.com/2021/03/04/spacex-launches-60-new-starlink-satellites-while-starship-moves-closer-to-being-able-to-launch-up-to-400-at-a-time/.

[167] Etherington, *supra* note 166.

[168] Brown, *supra* note 4.

[169] *Id.*; Etherington, *supra* note 166.

[170] Mann & Pultarova, *supra* note 117.

[171] Alter, *supra* note 161.

[172] Mike Wall, *SpaceX could launch 100 missions in 2023, Elon Musk says*, SPACE.COM (Aug. 31, 2022), https://www.space.com/spacex-launch-100-missions-2023-elon-musk; Alter, *supra* note 161.

[173] 47 C.F.R. § § 1.1306, 1.1307.

Taken together, there are sufficient concerns to warrant an EA from these mega-constellation applicants to the FCC consisting of an environmental analysis of the impact of the mega-constellation. Such analyses should include consideration of the physical size of the mega-constellation's satellites, the composition of the satellites, the satellites' reflectivity, and the quantity of satellites that will become part of the constellation. Society can no longer afford to allow satellites to be launched into orbit with little to no concern for the environmental impact that tens of thousands of these satellites are expected to have.

V. THE POTENTIAL IMPACT OF AN FCC POLICY CHANGE ON MEGA-CONSTELLATIONS COMPANIES

As previously discussed, there are many companies engaged in the satellite internet race.[174] However, the companies looking to send the most satellites into low-Earth orbit are SpaceX and Amazon.[175] These projects have cost each of the respective companies' significant investments of both time and money, and an abrupt change in the FCC's NEPA policies would likely not be without some degree of financial difficulty for these companies. For purposes of this section, this discussion is largely focused on SpaceX since it seeks to launch the most satellites of any company and is the most financially invested.

Elon Musk, founder and CEO of SpaceX, first announced the idea of a satellite internet service in 2015, though at the time he had not decided what to call the service.[176] In June 2021, Musk estimated that his company already invested between $5–10 billion dollars into its Starlink satellite internet brand, with a projection that a total investment of $20–30 billion would be made by the time Starlink achieves positive cash flow.[177] In addition, SpaceX has invested a substantial amount of time into Starlink.[178] As noted, the project was first announced in 2015,[179] and as of January

[174] Brown, *supra* note 4.

[175] *Id*.

[176] Mann & Pultarova, *supra* note 117.

[177] Supantha Mukherjee & Clara-Laeila Laudette, *Musk says may need $30 bln to keep Starlink in orbit*, REUTERS (June 29, 2021, 2:07 PM), https://www.reuters.com/business/aerospace-defense/musk-sees-starlink-winning-500000-customers-next-12-months-2021-06-29/.

[178] Mann & Pultarova, *supra* note 117.

[179] *Id.*

2022 SpaceX has launched 1,900 Starlink satellites.[180] With permission to launch 12,000 satellites, a change in the FCC's categorical exclusion policy could interfere with the project's timeline.[181] Currently, SpaceX provides a beta for a standard service, released in October 2020, and a premium service, released in February 2022.[182] The company's standard service has more than 145,000 customers in twenty-five different countries, and requires a $99 refundable deposit, $499 hardware fee, and a service cost of $99 per month.[183] The newer, premium service is targeted at businesses and enterprises, and requires a $500 refundable deposit, $2,500 hardware fee, and $500 per month service cost.[184] Moreover, Musk estimated that his user base could grow to as much as 500,000 users by summer 2022.[185] If that estimate held true, Starlink would have brought in $250 million in hardware fees, with an additional $50 million per month, by summer 2022.[186] If Starlink's user base maxed out at 500,000, SpaceX would be approximately 195 years away from breaking even on its $10 billion investment.[187] Thus, any delays would push SpaceX further away from profitability.

Perhaps at least as costly as a delay while SpaceX prepared an EA is a more theoretical cost: the loss of business momentum.[188] Momentum is a business's "impression that everything they undertake succeeds effortlessly, as if they're being carried along by a tailwind that increases

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[180] *Id.*

[181] *Id.*; Jonathan O'Callahagn, *The FCC's Approval of SpaceX's Starlink Mega Constellation May Have Been Unlawful*, SCI. AM. (Jan. 16, 2020), https://www.scientificamerican.com/article/the-fccs-approval-of-spacexs-starlink-mega-constellation-may-have-been-unlawful/.

[182] Michael Sheetz, *SpaceX Rolls Out 'Premium' Starlink Satellite Internet Tier at $500 Per Month*, CNBC (Feb. 2, 2022, 8:11 AM), https://www.cnbc.com/2022/02/02/spacex-starlink-premium-satellite-internet-tier-at-500-per-month.html.

[183] *Id.*

[184] *Id.*

[185] Michael Sheetz, *Elon Musk Says SpaceX's Starlink Internet Service Possibly on Track for 500,000 Users in One Year*, CNBC (June 29, 2021, 11:42 AM), https://www.cnbc.com/2021/06/29/elon-musk-.html.

[186] *See* Sheetz, *supra* note 182. These numbers are based on the projected 500,000 total users paying for the standard service. *Id.*

[187] *Id*.

[188] *See* Knowledge at Wharton, *The Power of Momentum: Companies That Build Their Wave and Ride It*, UNIV. OF PA. (Aug. 20, 2008), https://knowledge.wharton.upenn.edu/article/the-power-of-momentum-companies-that-build-their-wave-and-ride-it/ [hereinafter *The Power of Momentum*].

their efficiency and propels them on to exceptional growth."[189] Some companies manage to hold onto the momentum, while in most cases the company is unable to carry it indefinitely.[190] Momentum can shift quickly—as quickly as one month—if the company does not "keep [its] finger on the pulse of [the] industry."[191] Starlink's business momentum is currently so strong that it has been rated as having the "[b]est potential" to be the top provider among current satellite internet providers.[192] Therefore, although Starlink is currently adding an estimated 59,000 users a month to its standard service,[193] should the FCC revise its EA policy, SpaceX could quickly lose momentum if current customers turn elsewhere due to SpaceX's lack of growth, quality, or connectivity, or if prospective customers find alternative ways to meet their internet needs.[194]

Similar to SpaceX, Amazon expects to invest more than $10 billion into Project Kuiper by the time it reaches full operation.[195] Kuiper will consist of 3,236 satellites, and the FCC has already given Amazon approval to launch all of them.[196] Those satellites will be launched to low-Earth orbit via ABL Space Systems, which offered to launch them for a relative bargain, at $12 million per launch.[197] However, Kuiper is still

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[189] *Id.*

[190] *Id.*

[191] Chris Porteous, *How to Build Business Momentum With Limited Resources*, BUSINESS.COM, https://www.business.com/articles/building-business-momentum-with-limited-resources/ (Aug. 23, 2022).

[192] *See* Trey Paul, *Best Satellite Internet Providers of 2022*, CNET (July 13, 2022, 5:00 AM), https://www.cnet.com/home/internet/best-satellite-internet/.

[193] The addition of 59,000 users a month is based on the arithmetic average of the difference between Elon Musk's estimate of 500,000 users by summer 2022 and the current number of 145,000 users, divided by six months. *See* Sheetz, *supra* note182; Sheetz, *supra* note 185.

[194] *See* Porteous, *supra* note 191.

[195] Monica Alleven, *Amazon Plans to Invest $10B in Project Kuiper*, FIERCE WIRELESS (July 31, 2020, 1:14 PM), https://www.fiercewireless.com/regulatory/amazon-plans-to-invest-10b-project-kuiper.

[196] *Id.*

[197] ABL Space Systems is a California-based startup, and although a $12 million per launch price tag might not sound like a good deal, compare that number to the $62 million price that a SpaceX Falcon 9 rocket launch could cost. Adam Clark Estes, *The Complicated Promise of Amazon's Space Internet*, VOX (Nov. 3, 2021, 11:20 AM), https://www.vox.com/recode/2021/11/3/22761345/project-kuiper-satellite-amazon-space-internet.

several years away from widespread use, so while it is too early to know exactly how much the service will cost, it will likely be comparable to Starlink.[198] Amazon currently plans to launch two prototype satellites in late 2022 to test the technology's connection capabilities.[199] As a comparison, SpaceX launched two prototype satellites in 2018, but did not begin to service customers until two years later.[200]

While any time delays in providing service to consumers could hurt these companies, the costs of producing EAs and EISs can be substantial—both in terms of time and money.[201]

A. *Environmental Assessments and Environmental Impact Statements Can Cost a Substantial Amount of Time*

As previously discussed, if a court were to decide that the FCC's current NEPA satellite policies are insufficient, it could issue an injunction and enjoin the launch of additional satellites in the mega-constellation until an EA is prepared.[202] In such a case, one detrimental effect to mega-constellation companies may be the loss of time and business.[203] While little information is available on the amount of time it takes to prepare an EA, it seems clear that it takes longer than the CEQ originally anticipated.[204] In the 1980s, the CEQ believed that for federal actions requiring an EA, the NEPA process would only take three months, and for many actions it would take significantly less time.[205] Similarly, Congress's NEPA Task Force conducted an assessment in 2003 and concluded that a "small" EA required federal agencies between two weeks and two months to complete, while a "large" EA required nine to eighteen months to

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[198] Mike Brown, *Amazon Project Kuiper: Launch Date, Specs, Beta, Plans for Starlink Alternative*, INVERSE (Nov. 19, 2021, 5:00 AM), https://www.inverse.com/innovation/amazon-kuiper-details.

[199] *Id.*

[200] *Id.*

[201] Mark C. Rutzick, *A Long and Winding Road: How the National Environmental Policy Act Has Become the Most Expensive and Least Effective Environmental Law in the History of the United States, and How to Fix It*, REGUL. TRANSPARENCY PROJECT OF THE FED. SOC'Y, 11 (Oct. 16, 2018), https://regproject.org/wp-content/uploads/RTP-Energy-Environment-Working-Group-Paper-National-Environmental-Policy-Act.pdf.

[202] *See* Habeeb, *supra* note 33.

[203] *See* Rutzick, *supra* note 201, at 11–12.

[204] *Id.*

[205] *Id.* at 12.

complete.[206] However, in practice the results seem to contradict that assertion.[207] While most federal agencies do not disclose much, if any, of their NEPA compliance, the Department of Energy (DOE) reported that between 2013 and 2016, the average time to prepare an EA ranged from thirteen to twenty-four months.[208]

If companies like SpaceX were enjoined from launching additional satellites to improve their mega-constellations, the companies may ultimately see a reduction in new users per month.[209] This could, in turn, slow the business momentum that SpaceX and others garnered over previous years and subsequently push profitability further down the road.[210]

In a worst case scenario for mega-constellation companies, the EA would result in a determination that there may be a significant environmental impact, thereby requiring the preparation of an EIS.[211] Similar to the discrepancy in the amount of time expected to prepare an EA versus the actual amount of time one appears to take, an EIS takes longer than originally predicted as well.[212] The CEQ estimated in 1981 that federal agencies should be able to prepare an EIS in twelve months or less.[213] In contrast, the 2003 Task Force estimated that an EIS ranged from one year to more than six years to complete.[214] Since the CEQ's original estimate in 1981, there has been a steady increase in the amount of time

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[206] The Task Force defines small EAs as "concise public documents that meet CEQ's existing minimum EA requirements. Specifically, they address the statement of need, alternatives (if required by NEPA, [*sic*] environmental impacts, and list of agencies and persons consulted." In contrast, a large EA is "associated with more controversial or high-profile projects, and are similar to an EIS in analysis, content, and format . . . Large EAs usually incorporate other internal agency planning and decision-making requirements that are not inconsistent with, but not required by, CEQ regulations." NEPA TASK FORCE, MODERNIZING NEPA IMPLEMENTATION 65 (2003), https://www.energy.gov/sites/deffault/files/2016/02/f29/finalreport.pdf [hereinafter REPORT TO THE CEQ].

[207] Rutzick, *supra* note 201, at 12–13.

[208] *Id.* at 13.

[209] *See* Sheetz, *supra* note 182.

[210] *See id.*; *see also The Power of Momentum*, *supra* note 188.

[211] 42 U.S.C. § 4332 (2018); 40 C.F.R. § 1508.1(h) (2022).

[212] *Rutzick*, *supra* note 201, at 12; REPORT TO THE CEQ, *supra* note 206, at 65–66.

[213] *See e.g.*, Rutzick, *supra* note 201, at 12.

[214] REPORT TO THE CEQ, *supra* note 206, at 66.

required for a federal agency to complete an EIS.[215] By 2006, the average time required was up to 3.4 years; followed by an average of 4.2 years in 2010; and then an average of 5.1 years in 2016.[216] These averages do not account for the time prior to preparing the EIS, so when factoring in the possibility that the initial EA could take up to twenty-four months, companies could potentially see their projects put on pause for over seven years.[217] This steady increase in the average length of time coincides with a government-wide increase in the average number of pages per EIS.[218] From 1999 to 2016, the average page count increased from 650 pages to 1,600 pages, respectively.[219]

B. *Environmental Assessments and Environmental Impact Statements Can Cost a Substantial Amount of Money*

If the FCC were to require mega-constellation companies to draft an EA prior to issuing approval to launch, there is the possibility that an EA could prove very costly since the organization, analysis, content, and length of an EA varies due to differences in the actions analyzed.[220] Additionally, a company may incur significant costs if the FCC decided, in reviewing the EA, that the mega-constellation would result in a significant environmental impact and thus requires the company to file an EIS.[221]

In 2003, Congress posited that a small EA typically ranged from ten to thirty pages in length and cost between $5,000 and $20,000.[222] Adjusted for inflation and the time value of money, that means a small EA could cost as much as $32,700 in 2023.[223] If the FCC required SpaceX to prepare a small, $32,700 EA, such a cost would amount to .000007% of SpaceX's current investment into Starlink.[224]

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[215] Rutzick, *supra* note 201.

[216] *Id.*

[217] *Id*.

[218] *Id.*

[219] *Id.*

[220] REPORT TO THE CEQ, *supra* note 206.

[221] *See id*. at 66 (explaining the typical cost a company undergoes for an EIS).

[222] *Id.* at 65.

[223] *Inflation Calculator*, COIN NEWS, https://www.usinflationcalculator.com (last visited April 9, 2023).

[224] Elon Musk estimated that SpaceX has currently invested $5–10 billion. A $32,700 EA would represent .000007% of a $5 billion investment, and .000003% of a $10 billion investment. Moreover, Musk anticipates that by the

In contrast to the small EA, Congress asserted that a large EA ranged from fifty to more than 200 pages in length and cost between $50,000 and $200,000.[225] Adjusted for inflation and the time value of money, a large EA could cost a mega-constellation company as much as $327,000.[226] That means that if SpaceX were required to prepare a large EA, it would cost the company .00007% of its total current minimum investment into Starlink.[227] However, these projections appear woefully underestimated.[228]

The DOE—the only federal agency to report the costs of its EAs—found that between 2013 and 2016, it spent over $18 million to prepare forty-two EAs; an average cost of approximately $430,000 per EA.[229] That number far exceeds the $32,700 inflation-adjusted estimate proposed by Congress's Task Force in 2003.[230] Even so, that only represents a tiny fraction of the $5 billion that SpaceX or the $10 billion that Amazon anticipates investing into their mega-constellation projects.[231]

The costs of an EIS can be substantially more than that of a large EA.[232] Congress's Task Force determined that an EIS could range from 200 to 2,000 pages in length and cost between $250,000 and $2,000,000.[233] However, just like with EAs, the CEQ and Task Force's cost estimates have not proven accurate.[234]

In 2013, the DOE reported that it spent $94 million on *three* EISs; one of which related to hazardous waste removal at a federal reservation and cost $85 million.[235] That appears to be an outlier, since over the following three years the DOE spent $41 million on ten EISs.[236] Thus,

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time SpaceX reaches profitability, the company's total investment will be $20–30 billion. Mukherjee & Laudette, *supra* note 177.

[225] REPORT TO THE CEQ, *supra* note 206 at 65.

[226] *Inflation Calculator*, *supra* note 223.

[227] Mukherjee & Laudette, *supra* note 177.

[228] Rutzick, *supra* note 201.

[229] *Id.* at 14.

[230] REPORT TO THE CEQ, *supra* note 206.

[231] Mukherjee & Laudette, *supra* note 177; Alleven, *supra* note 195.

[232] REPORT TO THE CEQ, *supra* note 206.

[233] *Id.*

[234] *See* Rutzick, *supra* note 201.

[235] *Id.* at 14.

[236] *Id.* The DOE spent $5 million on three EISs in 2014, $12 million on three EISs in 2015, and $24 million on four EISs in 2016.

between 2013 and 2016, the average cost of an EIS was over $10 million.[237]

After a review of the costs in terms of time and money that the preparation of an EA would have on mega-constellation companies, it is possible that the preparation of the EA would result delay companies up to two years and could potentially cost an average of $430,000 to complete.[238]

The delay in time would likely hurt SpaceX the most as they stand to lose business momentum and have already received approval to launch up to 7,500 satellites out of the desired 30,000 satellite constellation.[239] It is possible that to other companies like Amazon, who are potentially years away from providing meaningful service to consumers, the time delay could be a less significant factor. In fact, to those chasing SpaceX, the delay could even be welcome.[240]

Similarly, the financial cost of preparing an EA is not substantial in light of the total investment these companies are making into their mega-constellation companies.[241] As discussed, the most expensive EA is approximately $407,000; a mere .00009% of a $5 billion investment.[242] It would be difficult for these large companies to argue such a cost is unduly burdensome, especially since this number represents an expensive EA.[243]

The bigger costs to these companies would be if the FCC subsequently determined from a company's EA that it needed to prepare an EIS.[244] That could result in many years of delay and cost millions of dollars. In such a situation, the FCC is just acting as trustee of the environment for succeeding generations, just as Congress charged it to do in 1969.[245]

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[237] *Id.*

[238] *Id*.

[239] Michael Sheetz, *FCC Authorizes SpaceX To Begin Deploying Up To 7,500 Next-Generation Starlink Satellites*, CNBC (Dec. 1, 2022, 4:59 PM), https://www.cnbc.com/2022/12/01/fcc-authorizes-spacex-gen2-starlink-up-to-7500-satellites.html.

[240] *See* Jon Brodkin, *Judges Reject Viasat's Plea to Stop SpaceX Starlink Satellite Launches*, ARS TECHNICA (Jul. 22, 2021, 2:30 PM), https://arstechnica.com/tech-policy/2021/07/spacex-wins-court-ruling-that-lets-it-continue-launching-starlink-satellites/.

[241] Rutzick, *supra* note 201, at 14.

[242] *Id*.

[243] *Id*.

[244] *Id*.

[245] National Environmental Policy Act of 1969 § 101, 42 U.S.C. § 4331.

VI. CONCLUSION

The National Environmental Policy Act of 1969, imposed a heavy burden on every federal agency to "use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, function, programs, and resources" to the end that the Nation may "assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings."[246] NEPA also imposed a continuing responsibility on the federal government to use all practicable means to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[247]

In the years surrounding the enactment of NEPA, satellites were large and costly.[248] As a result, there were not many satellites or launches to result in a cumulative effect on the environment.[249] Thus, the FCC's determination that satellites were categorically excluded from environmental scrutiny was not unreasonable.[250] Times change, and such a rule is no longer reasonable.[251]

Scientists now legitimately fear that objects in orbit will collide with each other and create entire zones of unusable space.[252] They are additionally concerned about the impact these mega-constellations will have on scientific research and general aesthetics,[253] and acknowledge the contribution humans have on climate change.[254] Certainly a change in the FCC's policy could result in significant time delays and substantial costs to mega-constellation companies.[255] However, upon a balance of the equities between the profitability of these large companies on one side of the scale versus the usability of space, ability to conduct astronomical research, aesthetic of the night sky, and climate change on the other, the scale tips decidedly in favor of requiring these companies to submit Environmental Assessments.[256] Therefore, the FCC must amend its

[246] National Environmental Policy Act of 1969 § 101, 42 U.S.C. § 4331.
[247] S. Rep. No. 91–296, at 2 (1969).
[248] Russon, *supra* note 113.
[249] Hearey, *supra* note 5, at 753.
[250] Ryan, *supra* note 15.
[251] *Id*.
[252] Hermer-Fried, *supra* note 124, at 260.
[253] Johnson, *supra* note 135, at 462.
[254] Herring & Scott, *supra* note 149.
[255] Rutzick, *supra* note 201, at 14.
[256] *Id*.

Federal Regulations to include the operation of mega-constellations as an action that may have a significant environmental effect for which Environmental Assessments must be prepared.[257]

[257] 47 C.F.R. § 1.1307.