Response to the European Commission's Call for Evidence on the Draft EU Space Act

amazon

Introduction

Amazon's Project Kuiper (Kuiper) thanks the European Commission (hereafter, the Commission) for the opportunity to contribute to its call for evidence on the draft EU Space Act (EUSA). We consider publicly consulting stakeholders on draft legislation as essential to sound policymaking, and encourage the Commission to follow the same approach with the forthcoming Implementing Acts that will accompany the EUSA.

Background

Amazon has partnered and invested in the European Union (EU) for more than 25 years. Since 2010, **Amazon has invested over €225 billion in the EU and currently employs more than 150,000 people** – a testament to its long-term commitment to Europe. Amazon's operations in the EU range in scope and nature, from cloud computing through Amazon Web Services, to Amazon Stores' e-commerce and online Marketplace, digital content (including Prime Video and Twitch), and soon satellite broadband connectivity via the introduction of Kuiper.

With respect to satellite broadband services, Kuiper will bring high-speed, affordable broadband to unserved and underserved communities in the EU and around the world.[1] Kuiper's initial constellation of non-geostationary orbit (NGSO) fixed-satellite service (FSS) satellites will be comprised of more than 3,000 spacecraft in low Earth orbit (LEO). Kuiper began deploying its constellation in April 2025 with the launch of its first 27 satellites. As of the date of this submission, **Kuiper has deployed over 150 satellites through six missions**, and continues to expand its terrestrial infrastructure supporting the Kuiper network. Kuiper has unveiled innovative customer terminals that will offer high performance in small form factors and at affordable price points.

Kuiper will play an instrumental role in enhancing broadband coverage across the European continent, creating new opportunities for European consumers, businesses, and the public sector.[2] The technology will complement and expand existing connectivity solutions, enabling access throughout diverse geographic regions. Kuiper will also empower growth opportunities for local telecommunications operators by providing additional pathways to expand their networks, creating a more comprehensive connectivity solution that benefits both urban and rural communities. LEO-based satellite connectively provided by systems like Kuiper represents an effective approach for bridging the digital divide in Europe. For example, a report by Analysys Mason, commissioned by Amazon, estimates that **commercially-offered LEO broadband could help save up to 37% of the fibre subsidies needed to connect all households in seven EU countries by 2030**.[3]

Further, Kuiper is a key partner of the EU space industry through our satellite-launch partnerships with EU-based companies Arianespace and Beyond Gravity. A report by Oxford Economics, commissioned by Amazon, estimates that **26% of Amazon's publicly announced investments in Kuiper will be directed toward the EU space industry through these partnerships**.[4] Kuiper's launch and dispenser contracts are the largest in the history of Arianespace and Beyond Gravity—through 2029, these contracts **will support**

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[1] "Everything you need to know about Project Kuiper, Amazon's satellite broadband network" AboutAmazon.eu, March 2023
[2] "Here's your first look at Project Kuiper's low-cost customer terminals" – AboutAmazon.com, March 2023
[3] "Closing the Digital Divide in the EU: The Promise of LEO Satellite Broadband" - AboutAmazon.eu, February 2025.
[4] "How Project Kuiper is contributing to the European space industry" – AboutAmazon.eu, June 2025

€2.8bn in GDP contribution to the EU, more than 3,000 jobs annually on average, and more than €790m to government treasuries in the EU.[5]

Kuiper's Focus on Space Safety and Sustainability

Space safety and sustainability have been core tenets for Kuiper from day one, influencing the overall architecture of the Kuiper system, the design of the satellites, and the way Kuiper coordinates operations within its system and with other space operators. Kuiper is also **a signatory of the European Space Agency's (ESA) 'Zero Debris Charter'**, and is a strong supporter of the Charter's overall goal towards a safe and sustainable space environment. More generally, Amazon is committed to building a sustainable business for our employees, customers, and communities. This extends to Kuiper, which factors into Amazon's work on The Climate Pledge, a commitment to achieve net-zero carbon emissions across the business by 2040.[6]

Kuiper believes that **a safe and sustainable space environment is best achieved through a combination of advanced system design and operational choices**. In the case of Kuiper, these include:

- ***Constellation design parameters:*** Kuiper designed its constellation with a 20 km altitude separation between shells. Kuiper satellites maintain their orbital position within tight control boxes to ensure adequate spacing between satellites, allowing for efficient use of space and minimising the impact on other operations. Additionally, Kuiper selected orbital altitudes between 590-630 km allowing for faster deorbiting.
- ***Operational design:*** each Kuiper satellite is designed to minimise space debris creation and the impact on other space operators. This is accomplished through altitude control via steering through reaction wheels; the inclusion of propulsion for risk mitigation manoeuvre; incorporating shielding to prevent anomalies from penetrating micrometeorite impacts; the use of non-reactive Krypton to reduce risk of accidental explosions; and protection of satellite batteries via isolation of individual cells from neighbouring cells.
- ***Safety standards:*** to remediate collision risks, Kuiper produces and shares up-to-date operational data, such as ephemeris, covariance, and manoeuvre forecasting, and proactively engages in space safety coordination. At the end of the mission, Kuiper satellites are designed to actively deorbit in less than 1.5 years and fully demise in the atmosphere. Kuiper intends to maintain collision avoidance during active deorbit until demise is imminent.
- ***Reflectivity:*** Kuiper satellites are equipped with a dielectric mirror film that redirects sunlight away from Earth to decrease satellite brightness to observers on the ground. Kuiper is also deploying ground-based observatories to measure and continuously improve the brightness of our satellites.

[5] Idem.
[6] Amazon was recently named the top corporate purchaser of renewable energy in Europe, having invested in more than 230 projects in the region.

Kuiper's Comments on the Draft EUSA

Kuiper supports the Commission's commitment to fostering a safe, sustainable, and resilient space environment, and provides its comments below with these goals in mind.

(1) Kuiper supports an emphasis on safe space operations and space traffic coordination to achieve the goals of the EUSA

Kuiper supports rules that reinforce pragmatic system design and operational best practices to facilitate space safety for enabling the long-term sustainability of outer space operations, including on manoeuvrability, transparency through information and data sharing, trackability and collision avoidance. These measures should form the foundation of the EUSA's priorities, as they align with the EU Council's emphasis on advancing European space safety and sustainability initiatives.[7]

Kuiper supports the EUSA's performance-based rules on **manoeuvrability** for all satellites operating above 400km (Article 66). Small satellites below this altitude would deorbit quickly, but above this altitude, longer deorbit periods without manoeuvrability and the greater number of spacecraft increase the long-term potential for collisions. To account for changing technology and other potential future solutions, operators should not be restricted to a specific type of maneuverability, like propulsion. Instead, Kuiper recommends a performance-based manoeuvrability standard reflecting that satellites operating above 400km will be dynamically and operationally capable of avoiding collisions.

In addition, operational transparency through information and data sharing is important to enable predictability in space as it ensures better information on the location and trajectory of objects, enabling more accurate manoeuvre planning and long-term space sustainability of outer space operations. While Kuiper supports EUSA requirements for spacecraft to be trackable (Article 63) and registration with a collision avoidance service (Article 64), technical specifications should be aligned with best practices regarding space situational awareness and traffic coordination (see section 5 below).

Given the global nature of space operations, harmonised regulatory frameworks are essential. It follows that disparate requirements in regulatory frameworks with common goals increase operational complexity without enhancing safety. Along these lines, **Kuiper supports the Commission's initiative to establish the basis for equivalency determinations of third country regulatory frameworks (Article 105).** This equivalence mechanism will help strengthen international standards while reducing operational overhead for space operators. Specifically, Kuiper advocates for an expedited decision regarding the compatibility between the EUSA and existing U.S. regulations, which would enhance transatlantic cooperation and bolster Europe's space sector competitiveness.

Key Recommendations

- Kuiper recommends performance-based manoeuvrability standards above 400 km.
- Kuiper supports requirements for all spacecraft to be trackable and registered, with technical rules aligned to international best practice.
- Kuiper advocates for harmonised regulations and expedited recognition of compatible frameworks, such as those in the U.S.

[7] For example, "Space traffic management: Council adopts conclusions on the current state of play" (December 2023, available here) and "The Council calls for a European approach on space traffic management" (May 2023, available here).

(2) **Distinct safety rules for operators based on constellation size risk unintended consequences and will undermine space safety and sustainability.**

Safe space operations are important to the long-term sustainability of outer space operations and are a responsibility equally shared by all space operators. **Safety and sustainability standards therefore must be based on objective safety criteria that apply uniformly and universally to all spacecraft operators**. Kuiper urges the co-legislators to reconsider establishing disparate safety obligations based on an operator's number of spacecraft (as stipulated in Article 73).

In effect, the draft EUSA creates five separate categories of satellite operators:

(i) research or education institutions (exempted from certain Title IV provisions relating to safety and sustainability under Article 62);

(ii) operators with less than 10 satellites;

(iii) "constellations" (10-99 satellites);

(iv) "mega-constellations" (100-999 satellites); and

(v) "giga-constellations" (>999 satellites) (as stipulated in Article 73).

For example, in Articles 73 and Annex VI—and likely to be further expounded in Implementing Acts—the EUSA imposes more stringent space safety requirements on operators of "mega-" and "giga-constellations", than on smaller operators.

Such a stepwise increase of safety standards based on mission or constellation size is not supported by evidence. To the contrary, because operators of large constellations—with substantial assets and infrastructure—need to preserve their long-term infrastructure investment, they possess inherently stronger incentives to maintain orbital safety than smaller operators. In addition, a report by The Aerospace Corporation notes that smaller satellites compound the tracking problem, have shorter operational life, lack manoeuvrability, and rely on natural decay for end-of-life disposal, which adds to the overall risk of collision. Satellites in the 1-to-10 kg range are the most likely to fail early, and also the least likely to have manoeuvring capability or trackable emitters.[8] According to ESA's research, constellations in LEO have a ~95% compliance rate at clearing within 5 years (~99% within 25 years), whereas non-constellation objects only ~75% and ~85%, respectively.[9]

Researchers at LeoLabs have likewise noted that constellation operators have operated responsibly and, instead, the main risk to space safety and sustainability comes from "*an aggregation of hundreds of individual payloads not in constellations that have less sophisticated collision avoidance.*" In their own words: "*constellations are not the problem; they may well be the victim of future debris-generating events.*"[10]

The finding that large commercial constellations behave responsibly is further reinforced by research indicating that **legacy government missions have accounted for approximately 94% of all fragmentation**

[8] Vedda, J.A. and Hays, P.L. (2018), "Major Policy Issues in Evolving Global Space Operations", The Aerospace Corporation, available here.

[9] ESA (2025), Space Environment Report, available here. Out of all constellation spacecraft, there have been almost no instance where spacecraft have taken longer than 25 years to clear orbits and only in 25-50 instances they have taken longer than 5 years. Compared to 150 and 300 instances, respectively, for non-constellations.

[10] McKnight, D. and Dale, E. (2023), "Modelling Empirical Orbital Capacity", 2nd Orbital Debris Conference Papers, available here.

debris in low Earth orbit, while commercial missions are responsible for only about 6% - despite both having launched a comparable number of payloads.[11] Even in orbits most dense with commercial activity, such as the region between 450 and 610km, almost every object in LEO experiences more risk from non-commercial satellites and debris than from commercial objects.[12]

Of course, the impact of debris-generating space collisions affects vast orbital regions and numerous operators, regardless of whether the debris was generated by a single-satellite operator or a satellite that is part of a large constellation. As noted by the International Risk Governance Center (IRGC) at the Swiss Federal Technology Institute of Lausanne (EPFL) on space safety, "***spacecraft fragmentations are not localized events solely affecting spacecraft in the vicinity of the event****. They can adversely affect space operations across all orbital regimes.*"[13] For this reason, it is important to have technically informed rules that are based on international standards and best practices, and that apply universally to all spacecraft operators regardless of their fleet size. Creating safety rules based on fleet size departs from well-established vehicle safety best practices.

An analogy to terrestrial transportation networks is helpful in illustrating the point. In that context, **safety rules apply equally to all cars regardless of their fleet size.** There are not different rules of the road in the EU for households with one vehicle versus households with multiple vehicles. Similarly, in the EU drivers are not expected to undertake a different periodical safety check for their cars depending on whether they have one car or two cars, nor is a small limousine operator allowed to drive half as safe as a taxi company with a larger fleet. That's because such an approach would not ensure a safe road. The same principle should apply in space, where the consequences of accidents are the same regardless of how many other satellites are in an operator's fleet.

Ultimately, uniform standards that apply to all operators, regardless of the size of their operations will best achieve the EUSA's space safety goals. Kuiper encourages the co-legislators to take this approach, rather than create artificial distinctions between different space operators that will not advance space safety.

Key Recommendation

- Technical requirements should apply equally to all operators regardless of fleet size to ensure safe space operations.

(3) Reflectivity requirements must be science-based, apply equally to all operators, and align with international best practices.

Kuiper considers reflectivity a key consideration in its design and development process, and has collaborated closely with the astronomy and broader scientific community to take proactive measures addressing related concerns. Rather than fostering continued innovation and progress towards minimising the impact of satellites on astronomical observation, the EUSA's specific requirement that satellite operators meet a 7 visual magnitude brightness threshold across all operational conditions

[11] Dale, E.; She, H. and McKnight, D. (2025), "Quantifying Space Debris Contributions from Government and Commercial Actors", Proceedings 9th European Conference on Space Debris, ESA Space Debris Office, available here.
[12] She, Chandramouli, Dale (2025), "Space Debris Risks from Derelict Spacecraft, to appear in proceedings of IAC 2025.
[13] EPFL (2021), Collision risk from space debris – Current status, challenges and response strategies, available here.

(Article 72.2) imposes an unrealistic and currently unattainable requirement. **Kuiper encourages the co-legislators to reconsider the imposition of mandatory reflectivity requirements, and recommends adopting a more flexible approach in the final text.** Doing so would be consistent with technological reality.

Since its inception, **Kuiper has prioritised design and operational choices to help mitigate reflectivity** and reduce impact on astronomical observations. Such steps include:

- **deploying its constellation at altitudes between 590 km and 630 km,** consistent with recommendations included in the SATCON1 report, which note that lower altitudes reduce the number of satellites visible at any given time;
- **implementing steering and maneuvering capabilities** to orient solar arrays and spacecraft toward the sun, minimising reflective surfaces while in orbit and reducing satellite brightness from the ground;
- **equipping satellites with a dielectric mirror film** to redirect sunlight away from Earth, making the satellite less visible to observers on the ground;
- **building optical telescopes** to measure satellite reflectivity and brightness and continuously improve our brightness reduction measures; and
- **committing to share accurate ephemeris data** throughout operations to help observatories plan and coordinate research.

Kuiper has also worked closely with the scientific community to better understand their concerns and identify additional measures to mitigate the impact of its satellites on astronomical observation. For example, in June 2025, Kuiper established a satellite coordination agreement with the U.S. National Science Foundation (NSF). Among other things, that agreement involves coordinating as part of an effort to achieve recommendations in the International Astronomical Union's (IAU) Dark and Quiet Skies best practice guidance, including reducing the optical brightness of satellites through physical design changes, attitude manoeuvring and other methods, maintaining orbital elevations at 700 km or lower, and providing high-precision orbital information to astronomers.

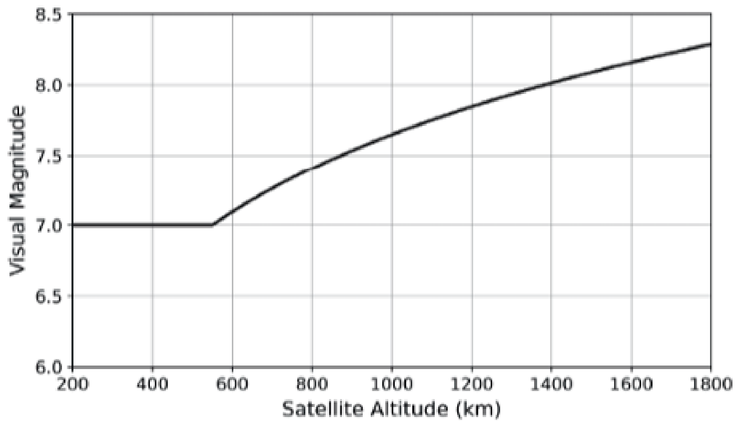
Despite these significant efforts, neither Kuiper, nor the satellite industry more broadly, have so far been able to develop technology that consistently mitigates brightness for satellites operating at low altitudes to the magnitude 7 threshold specified in the EUSA. Indeed, in its 2024 report on the Protection of the Dark and Quiet Sky, **the IAU notes** that ***"[i]ndustry leaders have pledged to make, and have made, substantial investments [20] to reduce the optical and radio visibility of their satellites. . . . Despite this work, at the time of writing there is no mitigation approach that has successfully reduced the brightness of a LEO satellite to the quantitative target level recommended by the astronomy community***.*"*[14]

Given the state of current technology, **the IAU recommends—*"on the basis of best efforts until technology is mature"*—** the adoption of a graduated visual magnitude limits, beginning at magnitude 7

[14] IAU CPS (2024), "Call to Protect the Dark and Quiet Sky from Harmful Interference by Satellite Constellations", available here. **Experts have confirmed the technological improvements satellite operators have voluntarily undertaken in recent years.** They note, for example, that *"the mean 1000-km brightness of Starlink Mini satellites orbiting at 550 km from Generation 2 are fainter than all models of Starlink Gen 1 spacecraft. This illustrates the successful brightness mitigation implemented by SpaceX." See* Mallama, A. and Cole, R.E. (2025), "Satellite Constellations Exceed the Limits of Acceptable Brightness Established by the IAU", available here.

for satellites operating below 550 km, and logarithmically increasing towards magnitude 8.5 as satellite altitude increases beyond 550 km (see Figure 1 below).[15] **Put differently, the IAU acknowledges that, at this time, magnitude 7 should be a goal rather than a strict requirement.**

Figure 1. Acceptable brightness limit of LEO satellites as formulated by the IAU CPS



Source: IAU CPS (2024), "Call to Protect the Dark and Quiet Sky from Harmful Interference by Satellite Constellations", available here.

Establishing an unachievable mandatory visual magnitude threshold risks undermining the EUSA's core objectives. The current environment of open collaboration among satellite operators—where brightness mitigation solutions are freely shared—stems from viewing reflectivity mitigation as a collective industry-astronomy effort. In the extreme, creating a new magnitude 7 requirement could prevent certain operators from obtaining EU access, even though their satellites would still orbit Earth and reflect sunlight producing the very effects the EUSA seeks to mitigate—thereby undermining its intended purpose. Likewise, imposing a magnitude 7 limit regardless of altitude could incentivise operators to deploy their satellites at higher altitudes in order to meet the EUSA's reflectivity requirements risking longer deorbit timelines.

Considering the state of current technology, and the voluntary efforts already underway by industry in collaboration with the scientific community to improve and mitigate the effects of satellite reflectivity, **the co-legislators should—consistent with the recommendation of the international scientific community—not impose mandatory, and unachievable, limits on reflectivity.** Instead, a more flexible, altitude-dependent, standard is appropriate.

[15] IAU CPS (2024), "Call to Protect the Dark and Quiet Sky from Harmful Interference by Satellite Constellations," at 14, 17. A recent research paper supports both the IAU's "best efforts" recommendation, as well as its gradual increase of the reflectivity requirement with altitude. *See* Mallama, A. and Cole, R.E. (2025), "Satellite Constellations Exceed the Limits of Acceptable Brightness Established by the IAU", available here. The paper finds that other than the OneWeb constellation, which operates at 1200 km, no current satellite constellation is able to meet the magnitude 7 limit at its operational altitude. As the paper notes, "*approximately half of OneWeb magnitudes also exceed the [altitude-dependent IAU CPS limits]*". Moreover, measurements in Mallama and Cole suggest that OneWeb's ability to mitigate brightness beyond the visual magnitude 7 is mainly driven by the higher altitude of their constellation at ~1200km. Instead, when evaluated at 1000 km, Mallama and Cole find that the OneWeb constellation would maintain a mean visual magnitude of 7.05, whereas at that altitude, two separate generations of the Starlink constellation would have greater brightness mitigation, with a mean visual magnitude of 7.15. These findings confirm that, as noted below, a strict magnitude 7 requirement could unnecessarily incentivise satellite operators to raise their operational altitudes in order to meet the regulatory requirement, without attended changes to technology.

Key Recommendations

- Adopt flexible, altitude-dependent brightness limitation goals, consistent with IAU guidance and current technological capabilities.
- Acknowledge ongoing industry efforts and collaboration, as the key to improve brightness mitigation.

(4) Technical safety requirements should follow general principles, align with well-established global standards and best practices, and be incorporated directly into the EUSA, not left for future Implementing Acts

To advance the shared goal of ensuring safe, secure, and sustainable access to space, Kuiper encourages the co-legislators to focus the EUSA on outcome-based objectives grounded in consensus-driven standards, and to avoid prescriptive methodologies that lack alignment with demonstrable safety outcomes, established technical expertise and best practices, and international standards.[16] **Established international standards reflect a thoughtfully calibrated balance** between requirements that have demonstrated their effectiveness in enhancing space safety and sustainability, technical viability, and economic impact on industry stakeholders. **Deviating from these standards, particularly without evidence supporting the alternative approach as safer or more efficient, introduces uncertainty into well-established practices, and risks imposing disproportionate burdens on operators without demonstrable gains in safety or sustainability**.

In several important respects, however, the draft EUSA proposes exactly that: rules deviating from globally recognised international standards and/or accepted best practices, or new, untested standards that lack scientific foundation. If implemented, these EU-specific provisions risk fragmenting the inherently global space domain, undermining space operations, stifling innovation, compromising international interoperability and cooperation, and imposing significant compliance costs on satellite operators.

As the co-legislators refine the EUSA and set outcome-based objectives, Kuiper also encourages **incorporation of such established international standards directly as requirements in the EUSA, rather**

[16] The EU Council has highlighted how "the EU already promotes a multilateral approach to ensure the preservation of the long-term safety and sustainability of activities in outer space, with the objective of reducing threats and risks for all space systems." Many international standards on space safety and sustainability have been developed by multilateral fora such as the **International Standards Organization (ISO), the Inter-Agency Space Debris Coordination Committee (IADC) and the European Space Agency (ESA), in no small part due to EU leadership**. The IADC is an international forum of space agencies dedicated to exchanging information and coordinating research on space debris. It develops technical guidelines to limit the creation of debris and promotes best practices for safe and sustainable space operations. The IADC's guidelines have become the basis for many national and international standards on debris mitigation. Its members include the world's major space agencies, such as NASA (U.S.), ESA (Europe), JAXA (Japan), Roscosmos (Russia), CNSA (China), ISRO (India), DLR (Germany), CNES (France), and several others. ISO has developed numerous standards, notably ISO's 24113 standard on debris mitigation (developed in 2023): Space systems – Space debris mitigation requirements (hereafter, ISO 24113:2023). ESA has recently developed its ESA Space Debris Mitigation Requirements (hereafter, ESDMR) in 2023. In addition, there are industry-led efforts facilitated by ESA on a Zero Debris Technical Booklet demonstrating the broad commitment to space safety.

than deferred to future Implementing Acts. This will provide upfront transparency and certainty about what the EUSA requires. When technical specifications are left for Implementing Acts, there is much less certainty and transparency, which is more likely to lead to obligations that depart from well-established global standards and best practices. Kuiper considers that Implementing Acts should be used solely for:

(i) future updates to safety and sustainability standards after adoption of the EUSA; and

(ii) developing the technical specifications for methodologies used for estimating probability calculations and thresholds.

Kuiper specifically highlights concerns with provisions related to (1) collision and debris mitigation, (2) disposal of spacecraft, and (3) orbital positioning, congestion, and selection.

A. Collision and Debris Mitigation

Passivation obligation (Annex V 1.2.1(e)-(f)). The requirement to passivate[17] spacecraft does not reflect modern constellation practices. Passivation requirements stem from legacy practices for high-orbit satellites that remain in space for a long time; for actively deorbiting constellations, such measures no longer enhance safety. For example, Kuiper satellites use Krypton propellant—an inert noble gas that cannot chemically explode—and tanks are designed to leak rather than burst, greatly reducing explosion risks. During post-mission disposal, Kuiper satellites lower their perigee at or below 350 km and reserve Krypton for conjunction avoidance maneuvers until atmospheric demise is imminent. Additional passivation measures to reduce risk of explosion are unnecessary. For these reasons, it is safer to retain manoeuvring capability until re-entry, limiting collision and debris risks through design (inert Krypton propellant and tank design) and orbital altitude reduction. **Kuiper recommends that passivation requirements as outlined in Annex V 1.2.1(e)(i)-(iii), (v)-(viii) and (f) are not made mandatory in cases where post-mission disposal approaches, like those implemented by Kuiper, demonstrate *superior effectiveness* in maintaining space safety and sustainability.**

Redundancy passivation function (Annex V 1.2.1(e)(iv)). The Commission's proposal for mandatory redundant passivation systems exemplifies a broader pattern of prescribing specific engineering requirements rather than focusing on outcome-based goals, such as successful post-mission disposal. There is no international standard mandating redundant passivation systems and, as demonstrated by Kuiper's state-of-the-art satellite design, such systems are not necessary to ensure high probabilities of successful disposal.

Kuiper's satellite design already incorporates robust safety measures. For example, our propellant tanks and battery systems are equipped with Whipple shields, which testing confirms prevent rupture from most penetrating impacts. Likewise, the battery design features sophisticated safety mechanisms - individual cells are electrically isolated through fuses, and the entire pack has demonstrated passive propagation resistance, ensuring that a single cell's thermal runaway cannot affect adjacent cells.

Implementing mandatory redundancy systems can be counterproductive and add risk. Redundant systems need to be carefully assessed, as they can increase system complexity and create new

[17] Passivation refers to the process of making a spacecraft or rocket stage inert at the end of its mission to reduce the risk of explosions or debris generation once it's no longer operational.

dependencies that could interfere with safe mission operations.[18] For this reason, **Kuiper recommends removing requirements for redundancy passivation**.

Design to limit fragmentation in case of collision (Annex V 1.3(b)). The Commission intends to introduce prescriptive engineering requirements through future Implementing Acts, mandating specific spacecraft design and manufacturing methods to minimise fragmentation risks from debris impacts. This approach **deviates from established ISO international standards**, which emphasise evaluating the probability of break-up events caused by debris or meteoroid collisions.[19] It **also differs from ESA's debris mitigation requirements**, which prioritise debris impact probability assessment and ensuring high probability of disposal success.[20] The highly complex and specialised nature of spacecraft design and manufacturing decisions explains why international regulatory bodies and space agencies have historically avoided prescribing specific technical solutions. **Kuiper recommends maintaining alignment with ISO standards and advises against introducing additional prescriptive requirements in this domain in future Implementing Acts**.

Intra-/inter-constellation collision risk (Article 73 and Annex VI.1). The draft EUSA proposes distinguishing between intra/inter-constellation collision risk, and anticipates further developing these categories in future Implementing Acts. International standards set by IADC, NASA, ESA, or ISO treat collision risks as a single quantitative metric, without differentiating based on ownership of spacecraft. Introducing separate intra/inter categories would duplicate established, science-based metrics with subjective classifications. For example, the FCC considers that the risk of collision between satellites that have collision avoidance manoeuvrability can be assumed to be zero or near zero.[21] As such, intra/inter-constellation collision risk appears without merit. **Kuiper recommends removing provisions relating to intra-constellation risk**.

B. Disposal of Spacecraft

Probability of successful disposal (Annex V 3.1.1-3.1.3). The Commission intends to establish thresholds for disposal success probability and corresponding calculation methods in future Implementing Acts. **Kuiper recommends incorporating thresholds directly into Annex V of the Act, rather than deferring them to future Implementing Acts.** The latter should instead focus on defining specific methodologies for probability calculations.

Finally, the draft EUSA proposes to **develop probabilities of successful disposal that are dependent on number of satellites (Article 73.2c)** in future Implementing Acts. International standards dictate successful disposal probabilities using performance-based, satellite-by-satellite metrics, not fleet-size multipliers. **Linking the disposal probabilities to the classes of constellation sizes introduces arbitrariness, distorts incentives, and penalises larger constellations even when they adhere to the same high engineering standards**. Disposal success depends on design, operations, and fuel availability, not on how many spacecraft share an orbital plane.

Removal of spacecraft (Annex V 3.3). The draft EUSA proposes a hierarchical set of methods for removing spacecraft from LEO. This represents another instance where the text emphasises prescriptive

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[18] Chandramouli, Y. and Shockley, L. (2025), A Sensitivity Analysis of DAS Lifetime Collision Probability Estimates, forthcoming in Procedures of AMOS 2025.
[19] ISO 24113:2003, §7.2.3.4.
[20] EDMR, §5.3.3.1 and §5.4.1.1, respectively.
[21] FCC FAQ:Orbital debris, available here.

methodologies (specifically, dictating particular disposal techniques) instead of focusing on outcome-driven objectives (such as ensuring any chosen disposal method achieves specified casualty risk mitigation thresholds). Kuiper satellites employ a design-for-demise approach, utilising controlled deorbit, followed by re-entry, ablation, and rapid demise - corresponding to either the second or third option in the EUSA ranking in Annex V 3.3. Notably, **international standards do not specify preferred re-entry methods, and ESA actually favors Kuiper's design-for-demise approach over the draft EUSA's top-ranked controlled re-entry method**.[22] The draft EUSA's preferred controlled re-entry with a defined impact footprint on the surface of Earth presents significant challenges, including propulsion design changes and higher likelihood of fragment survival during re-entry. **Kuiper recommends maintaining flexibility in re-entry method selection and removing any ranked preference from the draft text**.

C. Orbital Positioning, Congestion, and Selection

<u>**Orbital Positioning (Article 69 of the EUSA and Annex VI 1.2(b)):**</u> Orbital positioning of constellations involves technical trades, factoring in the existing debris environment, collision risks, mitigation measures, and disposal. **While the scientific community is studying these topics, there is no consensus on analysis methods, outcomes, and effectiveness**. Kuiper does not support the creation of novel rules lacking scientific foundation.

Additionally, orbital positioning is already addressed through an international regulatory framework governed by the International Telecommunication Union (ITU). The ITU coordinates frequency assignments and orbital parameters under long-standing global procedures, ensuring equitable access while avoiding harmful interference. **Overlaying additional regional rules on "orbital positioning" would duplicate or conflict with this framework, creating regulatory uncertainty without improving safety**.

<u>**Orbital Congestion (Article 69 of the EUSA and Annex VI 1.2(b)):**</u> The concept of "congestion" in orbit is not meaningfully defined in the technical literature or in guidance from leading authorities such as the IADC. The IADC Space Debris Mitigation Guidelines (2007, Rev. 2021) focus instead on measurable and enforceable parameters: limiting collision probability, preventing fragmentation, ensuring post-mission disposal, and controlling re-entry risk. These science-based metrics have been endorsed by the UN Committee on the Peaceful Uses of Outer Space (COPUOS)[23] and incorporated into ISO standards (e.g., ISO 24113:2019). In contrast, **vague notions of "orbital congestion" are inherently subjective and do not provide a reliable basis for compliance or enforcement**.

<u>**Orbital Selection (Article 69 of the EUSA and Annex VI 1.2(b)):**</u> The idea of "orbital selection" raises particular concerns. Orbital regimes evolve dynamically, shaped by mission requirements, spacecraft design, and international coordination mechanisms. NASA and ESA requirements consistently emphasise that sustainable operations depend on adherence to quantitative safety thresholds—such as life-time collision probability below 1 in 1000 and limiting orbital lifetimes. **Prescriptive "selection" rules could stifle innovation, discriminate against new entrants, and reduce Europe's competitiveness without demonstrable safety benefits**.

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[22] EDMR, §5.5.

Kuiper recommends removing references to novel concepts such as orbit positioning, orbital congestion and orbital selection from the EUSA.

Key Recommendations

- Focus on performance-based objectives aligned with demonstrable safety outcomes, best practices, and international standards.
- Incorporate established global standards directly in the Act, reserving Implementing Acts only for updates and probability-calculation methodologies.
- Avoid prescriptive engineering requirements (*e.g.,* redundant passivation, ranked disposal methods) that diverge from ISO, ESA, or IADC standards and add risk and complexity.
- Maintain flexibility in spacecraft disposal and orbital design, removing arbitrary or undefined concepts like "orbital congestion" and "orbital selection."
- Promote international consistency, ensuring EU rules reinforce—rather than fragment—the global framework governing safe and sustainable space operations.

(5) Collision avoidance, trackability and manoeuvrability should apply uniformly and align with established best practices.

Kuiper strongly supports government and private sector **efforts to advance the use of space situational awareness, tracking capabilities, manoeuvrability above certain altitudes, as well as setting requirements for all operators to be active participants in space traffic coordination.** Technology around data sharing, data processing, and coordinating activities are areas where innovation can have an outsized positive impact on space safety. More action by all actors is needed to make ephemerides, manoeuvre plans, and associated covariances available to other operators. While this is a long recognised best practice and an international standard, it is not yet sufficiently common practice.

With the projected increases in orbiting satellites in the coming years, predictability of other operators' movements will become more necessary for collision avoidance. Operators should **focus on transparency, providing operational contact information for space traffic coordination.** In addition, operators should make any high-fidelity tracking data available, such as data derived from their own operations and navigation receivers on board the satellite.

Kuiper strongly supports the measures for European operators to participate in the EU Space Surveillance and Tracking (EU-SST) collision avoidance (CA) services. However, concerns arise regarding the Commission's requirements for CA service providers for third-country operators. **Several of the general requirements in Annex IV that a CA service provider for a third-country operator is expected to meet are misaligned with current third-party services and established best practices, necessitating supplemental in-house tools**. In particular, there are concerns with the following provisions in Annex IV, as existing U.S. service providers—such as Space-Track—do not currently provide users with the following capabilities:

- 1.1.(b) – manoeuvre decisions, as these remain subject to the operator's own assessment;

- 1.1.(c) – services during all phases of the mission, as Space-Track only offers services starting several days after launch;
- 1.3.(a) – data quality checks to assess data from space operators;
- 1.4.(c) – an assessment of the risk of conjunctions based on miss distance geometry (point (ii)), conjunction avoidance options (point (iv)), and an assessment of whether mitigation actions decrease risk (point (v));
- 1.5.(a) – an assessment of the risk of conjunction on an hourly basis in LEO – only every 8 hours.

Many of these tasks are currently offloaded to operators. However, **it remains unclear whether the EUSA, under Annex IV point 1.1(a), permits third-country operators to complement the services of CA service providers with their own in-house systems to bridge gaps and meet the requirements set out in Annex IV**. TRACSS, the potential successor to Space-Track, similarly lacks some of these capabilities today, suggesting that U.S. operators will not have a public system meeting these standards for the foreseeable future, if ever.

Given this, **Kuiper recommends that third country operators be allowed to complement third party systems with in-house capabilities and be able to register and rely on the EU-SST as a CA service provider**, just as non-U.S. operators can rely on the U.S. Space-Track. EU authorities could also certify CA service providers meeting the EUSA requirements, facilitating and encouraging commercial services aligned with the EUSA goals.

In addition, several requirements listed in Annex III are counter to best practices and standards. In particular, providing a daily orbital forecast for up to 7 days at minute intervals (point 2.1(a) in Annex III) could undermine space safety. Predicting future flight paths entails significant uncertainty, and errors can be greater than a kilometre when projecting a day or more ahead. Moreover, manoeuvrable satellites are constantly planning and executing manoeuvres, rendering forecasts 7 days out unreliable.[24] **The inaccuracy of 7-day forecasts can lead to inappropriate collision-avoidance manoeuvres that may *increase* rather than reduce collision risk**. Instead, Kuiper supports projections of up to 3.5 days.[25]

Similarly, Annex III requires that the ground segment provides rank 7 covariance formation (position, velocity, drag) for 7-day trajectory forecasts. In practice, drag coefficient estimates are technically complex, capturing a combination of model-specific parameters that vary by operator.[26] These estimates add additional complexity for limited benefit when operators like Kuiper already provide their predicted ephemerides and maneuver plans directly to other operators. In general, Kuiper firmly believes that the best practice for space sustainability is sharing predicted ephemerides with other operators. Kuiper does not recommend requiring operators to provide rank 7 covariance estimates over rank 6, as that is a technical choice best left to the discretion of individual operators. **Instead, Kuiper recommends that**

[24] Hejduk, M.D., Snow, D.E. and Newman, L.K (2019), Satellite Conjunction Assessment Risk Analysis for "Dilution Region" Events: Issues and Operational Approaches, available at NASA (here).

[25] This is consistent with NASA's Spacecraft Conjunction Assessment and Collision Avoidance Best Practices Handbook (available here), that notes: "*Many aspects of the USSPACECOM orbit determination process are tuned to **optimize performance at 3 days' propagation**; this is not a terrible propagation state to choose for O/O covariance realism optimization for CA applications, although one could also choose something a bit shorter if that were to align more closely with manoeuvre commitment timelines.*"

[26] Mesalles-Ripoll et al (2025), Beyond Density Alone: Accuracy Assessment of Atmospheric Models for Orbit Prediction from a Satellite Operator's Perspective, AMOS, forthcoming. According to the authors, the choice of atmospheric model can affect predictions of drag coefficient by as much as 50-75%.

operators be encouraged to share their predicted ephemerides with other operators, either directly or through a secondary CA service provider.

Key Recommendations
• Support stronger use of space situational awareness, manoeuvrability, and data sharing to enhance transparency and collision avoidance.
• Encourage all operators to share accurate ephemerides, manoeuvre plans, and contact information to improve space traffic coordination.
• Allow third-country operators to complement third-party collision avoidance services with in-house systems or register with EU-SST.
• Avoid prescriptive forecasting requirements—such as 7-day orbital predictions—which are unreliable and may increase collision risks.
• Remove the rank-7 covariance requirement, as it adds complexity for little-to-no benefit in cases where operators are already sharing their ephemerides, covariances, and manoeuvre plans.

(6) There should be a consistent approach for registration of EU and non-EU satellite operators.

The draft EUSA stipulates that EU operators shall register through the competent authority of an individual EU Member State, subject to harmonised but nationally administered requirements. The draft mandates that the administrative process lasts no longer than 12 months (see Articles 6, 7 and 9).

Conversely, non-EU operators are required to go through a significantly more cumbersome process involving, as a first step, a "Compliance Board" within the EU Agency for the Space Program (EUSPA) with delegates from EU Member States (Article 45). The EUSPA would aim for a consensus decision, with the ability to make a decision by qualified majority voting, with a deadline of five months. Only after this process **will the registration go to the Commission, without a defined timeline for decision (Article 17).** The entire process will lead to considerable uncertainty and complexity, as well as potential delays in the Commission decision, which lacks any statutory deadline.

Kuiper supports a registration procedure for non-EU operators that follows the governance framework as for EU operators (*i.e.*, through a Member State authority), within the same time limit as EU operators (12 months). This will be facilitated by the new obligation to have a legal representative in a Member State of the Union (Article 23) and will ensure an equal treatment for EU and non-EU operators.

In addition, EUSPA's fees for registration are proposed to be proportionate to the turnover of the operators (Article 41.2). **Kuiper supports instead administrative fees that are cost-recovery oriented and aligned with the requirements of the registration process**, which are uncorrelated with the turnover of the satellite operator.

Key Recommendations

- Apply the same registration framework and 12-month timeline to EU and non-EU operators, allowing non-EU operators to register via an EU Member State authority through their legal representative.
- Base registration fees on cost recovery and administrative effort, not on operator turnover.

(7) Methodologies to estimate the environmental footprint should be technology neutral.

Kuiper integrates sustainability into every aspect of its operations, conducting detailed measurement and reporting of carbon emissions in accordance with the internationally recognized Greenhouse Gas Protocol (GHGP). We measure emissions from all three scope categories (Scope 1, 2, and 3) and utilise a diverse set of scientific measurements across our operations (for more details, see [Amazon Carbon Methodology]). This robust framework enables Kuiper to accurately measure and report greenhouse gas emissions, aligned with global standards for corporate carbon accounting and reporting.

Kuiper understands the need to continuously refine and incorporate evolving measurement techniques and improved data collection methods, ensuring consistent and comparable reporting over time. As such Kuiper shares the goal of building a robust methodology to estimate the carbon footprint of space operations. In terms of the Commission's future methodology, **Kuiper would support an approach that is technology neutral and accounts for the characteristics of different satellite systems (both in terms of orbits – LEO, MEO, GEO – as well as downstream service provided – communications, positioning, observation).** Further details, including ones related to the specific methodology the Commission develops for estimating the carbon footprint of space operators, are necessary to determine how onerous it will be to comply with this requirement.

Key Recommendation

- Develop a technology-neutral methodology for estimating the carbon footprint of space operations, reflecting differences across orbits and services and ensuring consistent, comparable reporting.

(8) There should be a longer implementation timeline, with satellites being developed, manufactured or launched excluded from the EUSA rules.

The **proposed 1 January 2030 implementation date for the EUSA presents significant operational concerns from a practical perspective.** If the final regulatory framework—including both the EUSA and its Implementing Acts—is not completed until 2028 or 2029, satellite operators will have only a narrow window to achieve compliance, even with the two-year transition period ending in 2032. This will undoubtedly cause delays in manufacturing and launch timelines for satellite constellation operators, including EU operators. Further, this timing could intersect with constellation deployment phases for future generations of satellite operators.

Kuiper recommends that **new requirements should not apply to satellites that are already being developed, manufactured, or launched.** Any generation (Gen-x) that is actively being developed, manufactured, or launched when the complete legislative package is adopted should be exempted from the obligations in the Act. In this sense, Kuiper also recommends to **extend the transitional period (Article 118) for non-geostationary-satellite orbit networks from 2 years to at least 7 years, following the critical design review**. This would align with the ITU's bring-into-use rules, under which operators must begin using their frequency assignment within seven years of the ITU filing.

Key Recommendations

- The proposed 1 January 2030 start date leaves insufficient time for compliance, risking major delays in manufacturing and launches.
- Satellites already in development or launch phases should be exempted and the transition period should be extended from 2 to at least 7 years, aligning with ITU bring-into-use rules.

(9) Powers of investigation outside of the EU can conflict with national legal obligations for third country operators.

In relation to the powers of investigation and inspection outside of the EU, the draft EUSA empowers the Commission to seek permission from third country operators and administrations to investigate and inspect facilities outside of the EU (see recital 120, Articles 48.4 and 52). Special consideration should be given here to any extra-territorial inspections that may conflict with obligations established domestically by home countries of third country operators. **In lieu of this approach, Kuiper recommends that the Commission collaborate with third country administrations, such as the U.S. government, to ensure alignment and reciprocity in requirements**. Inspections of non-EU facilities should be conducted by local personnel, in coordination with EU authorities if necessary. In any event, Kuiper would expect that with the requirement for companies to have a legal representative in the EU, inspections outside the EU are unlikely to be necessary.

Key Recommendations

- Extra-territorial inspections risk conflicting with domestic laws of third-country operators and should be approached cautiously.
- Kuiper recommends cooperation with third-country administrations (e.g. the U.S.) to ensure inspections are conducted locally.

(10) Existing cybersecurity regulations are sufficient to address the goals of the EUSA

The cybersecurity provisions set out in the EUSA risk disincentivising investment and reducing competition in the European space sector by creating a complex, duplicative and burdensome compliance environment for space operators. **The existing regulatory framework, particularly the NIS2 Directive (NIS2) and the Critical Entities Resilience Directive (CER), already set out robust and comprehensive**

cybersecurity and operational resilience obligations across critical infrastructure sectors, including space-related activities. For example, NIS2 mandates that essential and important entities implement appropriate and proportionate technical, operational, and organisational measures, calibrated to the entity's size, risk exposure, and the societal or economic impact of potential incidents. These measures are also required to reflect the state of the art and relevant European and international standards, and are subject to harmonised incident notification and risk management obligations. The CER Directive further reinforces the resilience of critical entities, including those supporting space services, by providing additional requirements where relevant and deferring to NIS2 where entities are subject to both. Together, NIS2 and CER provide a pre-existing, risk-based and largely outcomes-focused approach that should be effective, proportionate and operationally feasible for satellite operators.

By contrast, **the EUSA introduces a sector-specific cybersecurity regime that goes beyond and takes precedence over the requirements of NIS2 and CER**, setting out prescriptive and broad obligations that would be difficult to practically implement. For example, the EUSA mandates an "all-hazards" lifecycle risk management framework covering every phase of a space mission and all segments (ground, space, and link), with strict requirements from conception through to operation. **The incident reporting timelines are more stringent than those under NIS2 and the supply chain security requirements are more onerous**, including, for example, a mandatory inventory of critical assets of non-EU origin. These obligations are not only duplicative of the risk management and incident reporting requirements already established under NIS2 and CER, but also **risk creating confusion, administrative burden and potential conflicts in compliance**, particularly for operators that must straddle compliance with NIS2, CER and the EUSA (regardless of whether the EUSA takes precedence for its specific sector).

Taking the enhanced reporting obligations as an example, it is **not clear that the marginal acceleration in reporting timelines proposed by the EUSA would deliver a material improvement in risk mitigation** or operational resilience, especially given the highly technical and complex nature of space incidents, which often require careful assessment before meaningful reporting can occur. Nor is it substantiated that space activities are more critical or important, justifying a higher standard than *e.g.* for Earth-based power or critical digital infrastructure. In addition, **overreporting, which is an increased risk with enhanced timelines, could lead to the creation of an unmanageable and largely unhelpful dataset for regulators**. For those entities who must report under NIS2 and the EUSA, the financial impact of compliance with parallel regimes is likely to be significant, resulting in a de facto barrier to entry for SMEs, start-ups and new entrants.

On this basis, **Kuiper's view is that the cybersecurity and resilience objectives of the space sector can be fully achieved through the proper implementation and enforcement of NIS2 and CER**, supported by sector-specific guidelines where necessary. The introduction of a parallel, more prescriptive regime under the EUSA risks undermining the clarity, consistency, and proportionality that is essential for effective cybersecurity governance. It is for this reason that **Kuiper recommends a streamlined, harmonised approach that leverages the existing NIS2 and CER frameworks** (for all, not just ground-based, space infrastructure), avoids unnecessary overlap, and provides satellite operators with clear, practical, and workable obligations. This will ensure that the sector remains secure and resilient, while also supporting innovation and efficient operation in Europe.

Key Recommendations

- The EUSA's cybersecurity regime duplicates and exceeds NIS2 and CER requirements, creating unnecessary complexity and compliance burdens for operators.
- NIS2 and CER already provide robust, risk-based, and outcomes-focused frameworks that ensure cybersecurity and operational resilience for space activities.
- Prescriptive EUSA measures—such as all-hazards lifecycle management, accelerated reporting, and strict supply chain inventories—add cost without clear security benefits.
- Kuiper recommends a harmonised approach leveraging NIS2 and CER, ensuring clarity, proportionality, and effective cybersecurity without deterring innovation or competition.

(11) Insufficient detail in the Commission's Impact Assessment risks overstating benefits and downplaying costs.

Kuiper is concerned that the Commission's Impact Assessment may **underestimate the costs** and **overestimate the benefits** of its proposal. The Commission estimates **total annual costs of €323 million**, comprising €136 million in compliance costs (assumed as 1% of the space industry's annual turnover) and €180 million in manufacturing costs (based on input from industry representatives and ESA that are not detailed further). A **critical evaluation of the Impact Assessment is therefore difficult given the few details on the underlying methodology**. Moreover, as many of the technical specifications—which will be essential to assess the implications for operators' manufacturing, design, testing, and launch costs—have been deferred to future Implementing Acts, it **is unclear how the Commission has been able to reliably estimate the costs of its proposal**.

Many of the existing proposals already reflected in the draft EUSA (*e.g.*, on passivation and spacecraft removal methods) and those expected in future Implementing Acts (*e.g.*, on designs to limit fragmentation from collisions and probabilities of successful disposal) could impose **significant costs on industry unless they are aligned with international standards and best practices**. This also does not account for the ***opportunity costs*** of these provisions, or other provisions such as those on reflectivity (Article 72) or orbital congestion and selection (Article 69), which could **effectively restrict access to the EU single market for satellite operators unable to comply with them, and to EU citizens of the services they offer**.

More importantly, Kuiper is concerned about a potential **overestimation of the projected benefits**. The **Commission assumes that the proposed rules will lead to a 50% reduction in space debris over the next decade**, driven by higher standards for satellite shielding, requirements for passivation and end-of-life de-orbitation, and the registration of operators with EU-SST.[27] According to the Commission, this would generate annual benefits of €677 million for satellite operators. However, it **remains unclear how the EUSA would reduce existing debris in orbit, given that the Commission's own estimates do not account for in-orbit servicing**, which it acknowledges is not yet technologically mature.[28] In terms of future debris generation, modern satellite operators already comply with international standards and best practices that limit debris creation. As noted in section 2, 94% of debris in LEO originates from historical government missions, with only 6% attributable to commercial missions. It is also noteworthy that the Commission

[27] Page 49, Part I, Impact Assessment.
[28] Page 50, Part I, Impact Assessment.

estimates **the benefits of harmonised EU-level requirements**—as opposed to fragmented national rules, which the EUSA is intended to address—**at only €6 million per year**.

While Kuiper supports the Commission's objective of enhancing the safety and sustainability of space activities, the assumptions underpinning the Impact Assessment appear insufficiently substantiated. The absence of methodological transparency and the deferral of key technical parameters to future Implementing Acts make the cost and benefit estimates highly uncertain. In particular, the projected annual benefits lack clear empirical grounding. A **more evidence-based assessment—incorporating the technical specifications still to be defined in the Implementing Acts—will be essential to ensure a proportionate, effective, and industry-supported regulatory framework**.

Key Recommendations

- The Impact Assessment does not have sufficient details to allow an appraisal, and key technical parameters will only be defined in future Implementing Acts, making its €323 million cost estimate highly uncertain.
- Several EUSA provisions could impose significant, unquantified costs and restrict market access unless aligned with international standards and best practices.
- The projected €677 million in annual benefits could be an overstatement, as current operators already mitigate debris and most existing debris stems from legacy government missions.

Conclusion

Project Kuiper expresses its gratitude to the Commission for the opportunity to provide comments in response to the Consultation, and welcomes further dialogue and engagement with the Commission and co-legislators on these important issues.