Reentry Ablation, Stratospheric Alumina & Launch Emissions: Physical Science vs. Unsettled Reporting

Pillar: Measurement & ESG Gap | **Basis:** Atmospheric Science vs. Reporting Gap | **Primary Source:** ESA / NASA / NOAA | **As Of:** As of Nov 2026 (ESA 2026: >3 Reentries/Day in 2025)

Design-for-demise prevents ground casualties (< 1:10,000) by vaporizing aluminum spacecraft in the upper atmosphere, but ESA's 2026 Report notes >3 intact objects/rocket bodies reentered daily in 2025—injecting alumina and soot where no standardized ESG accounting protocol exists.

Documented Instrument & Engineering Record

• The physical tradeoff: Design-for-demise protects people on the ground by burning up aluminum spacecraft buses in the mesosphere/stratosphere—converting solid metal into aerosolized aluminum oxide (alumina).

• Scale of traffic (ESA 2026 Report, data through end of 2025): Launch rates reached ~10 objects/day and >3 intact objects or rocket bodies reentered the atmosphere daily in 2025.

• Launch plume injections: Rocket launches inject black carbon, water vapor, and nitrogen oxides directly into the stratosphere and mesosphere, with different radiative forcing than ground-level combustion.

• Reporting boundary: While physical atmospheric research is active, neither GHG Protocol, ISSB IFRS S2, EU CSRD, nor FAA/FCC imposes a standardized space-specific radiative-forcing or ablation metric as of November 2026.

Atmospheric Vectors: Physical Reality vs. Compliance Status

Vector	Physical Mechanism	Compliance / ESG Status (Nov 2026)
Reentry Ground Impact	Surviving fragments > 15 J	Regulated: Ec < 1:10,000 (FCC / NASA)
Mesospheric Alumina	Vaporized Al bus from demisable sats	Unregulated; no ESG reporting standard
Stratospheric Launch Plume	Black carbon / NOx / H2O injection	Terrestrial Scope 1 fuel only; no RF multiplier

Mission Designer, Compliance Lead & Founder Takeaways

• Compliance leads should not invent custom stratospheric radiative-forcing multipliers inside statutory Scope 1/2/3 filings unless a recognized standard adopts one.

• Ground casualty safety (< 1:10,000) remains the legally binding priority over speculative atmospheric ablation offsets.

• Track NOAA, NASA, and ESA atmospheric research separately from statutory ESG disclosures.

Cross-Cluster Links & Primary Sources

• **No Space-Specific Scope 3 / ESG Standard Gap:** https://bcesg.org/wa-space-orbital-no-scope-3-esg-standard-gap/

• **Reentry Casualty Risk & Demisability:** https://bcesg.org/wa-space-orbital-casualty-risk-demisability/

• **ESA & NASA Debris Counts (2026):** https://bcesg.org/wa-space-orbital-esa-nasa-debris-counts-2026/

• **ESA Space Debris Office (2026 Report):** https://www.esa.int/about-us/directorates/operations/space-safety/space-debris

• **GHG Protocol Scope 3 Standard:** https://ghgprotocol.org/corporate-value-chain-scope-3-standard

Provenance Note: 2025 launch (~10/day) and reentry (>3 intact/day) rates cited from ESA 2026 Space Environment Report (data through end of 2025).