Appendix B

Celestia Sustainability Certification System (CS^2)

Empowering Responsible Innovation in the New Space Economy

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2. Certification Framework

The Celestia Sustainability Certification System (CS^2) establishes a transparent and measurable framework to evaluate the environmental, technical, and ethical impact of space-related organizations.
The system applies to aerospace companies, research institutes, launch service providers, space insurers, and data-driven agricultural firms operating within or connected to Low Earth Orbit (LEO).

The certification provides a publicly verifiable sustainability score that enhances trust, transparency, and investment attractiveness — creating a "sustainability currency" for the orbital economy.

2.1 Core Dimensions of Evaluation

Each organization is assessed according to four main dimensions, weighted according to sustainability relevance and long-term orbital impact:

Dimension	Description	Weight
Orbital Sustainability	Evaluates the environmental footprint of satellites, compliance with orbital debris mitigation standards, and end-of-life disposal strategies.	40%
Material Responsibility	Examines the composition and degradation of satellite materials during re-entry, based on fragmentation behavior and toxic residue.	25%
Operational Ethics & Transparency	Considers data-sharing practices, open-access contribution, and alignment with UN principles for peaceful space use.	20%
Social & Economic Return	Measures the reinvestment of orbital activities into education, innovation, and socio-economic development, especially in developing countries.	15%

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3. Scoring Methodology

Each entity receives a CS^2 Index Score (0–100). The score is computed by aggregating weighted indicators across the four core dimensions.

Formula:

$$CS^2\ S \qquad\qquad core = \sum(W_i \times S_i)$$

Where:

- W_i= **weight of each dimension**
- S_i= **normalized sub-score (0–100) per dimension**

3.1 Orbital Sustainability Metrics (40%)

Parameter	Reference Standard	Metric Description	Scoring Guide (0–100)
Post-mission disposal compliance	*ISO 24113:2023 – Space debris mitigation requirements*	% of missions that comply with 25-year rule for LEO re-entry or move to graveyard orbit.	0–30
Collision risk probability	ESA Space Debris Office (SDO) Guidelines	Probability < 1 in 10,000 of catastrophic collision per mission.	0–25
Deorbit assurance	NASA-STD 8719.14B	% of satellites with propulsion or drag sail ensuring controlled re-entry.	0–25
Tracking transparency	IADC (Inter-Agency Debris Coordination Committee)	Real-time tracking data shared with public or international networks.	0–20

3.2 Material Responsibility (25%)

Parameter	Reference	Metric Description	Scoring
Material Composition Index (MCI)	ASTM E1559–09	Weighted by re-entry burn-up efficiency and non-toxic residue.	0–40
Fragmentation Profile	NASA ORDEM 3.0	Average particle size post-burnup (ideal <1 mm).	0–30
Thermal Disintegration Compliance	ESA Clean Space Initiative	Evidence of structural breakup before altitude 80 km.	0–30

3.3 Operational Ethics & Transparency (20%)

Parameter	Reference	Metric Description	Scoring
Data transparency	UN-COPUOS Guidelines 2021	Level of mission data accessibility to international community.	0–40
Fair access policy	Artemis Accords §3	Inclusion of developing nations or shared missions.	0–30
Ethical use compliance	ISO 26000	Internal code ensuring non-militarization and peaceful intent.	0–30

3.4 Social & Economic Return (15%)

Parameter	Reference	Metric Description	Scoring
Development reinvestment	OECD Framework for Green Growth	% of profit reinvested in education, R&D, or sustainability funds.	0–40
Inclusive partnerships	UN SDG 17	Partnerships involving developing countries or emerging markets.	0–30

Parameter	Reference	Metric Description	Scoring
Public engagement	ESA Education Office Metrics	Frequency of community and educational outreach programs.	0–30

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4. Certification Levels

Level	Score Range	Description
🟩 Platinum Orbit	90–100	Leader in sustainable orbital practices. Represents full compliance and proactive innovation.
🟨 Gold Orbit	75–89	Strong compliance and demonstrable social return; continuous improvement visible.
🟧 Silver Orbit	60–74	Meets essential sustainability and transparency requirements.
🟥 Bronze Orbit	45–59	Basic compliance achieved; sustainability risk mitigation required.
⚫ Uncertified	<45	Fails to meet minimum orbital sustainability or ethical standards.

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5. Benefits of Certification

1. Market Recognition: Certified companies gain public trust and credibility, increasing investor confidence.
2. Regulatory Advantage: Anticipates upcoming international sustainability standards for LEO usage.
3. Insurance Benefits: Lower premiums for launches and operations due to reduced collision and debris risk.
4. Access to the Celestia Index: Certified members appear in the *Celestia Global Index of Sustainable Space Entities (CGISSE)*.
5. Eligibility for Funding: Preference in Celestia-linked sustainability funds and government cooperation programs.