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In-Space Economy in 2025 – Analysis and Deep Dives into In-Space Transportation and Reentry Vehicles

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Abstract

In-space economy is emerging, driven by expanding commercial activities beyond Earth. Nascent industries such as orbital transfer vehicles, commercial space stations, in-space manufacturing, satellite servicing, reentry vehicles and commercial landers are slowly laying the foundation. For example, in the last 2 years, more reentry vehicles have been announced and flown and more space tugs have flown. Firefly successfully landed on the Moon, Intuitive Machines survived but tipped over twice, ispace failed twice and Astrobotic had propulsion issues. Starship reached space, and Vast rescheduled its first space station to 2026.

This paper provides a data-driven analysis of the evolving in-space economy as of 2025, following studies from 2021 and 2023. Using data from Factories in Space, a public database of over 1000 commercial entities operating in the in-space economy, space resources, and in-space manufacturing sectors. In addition, separate focus will be on two critical sectors: in-space transportation and reentry vehicles. While startup activity continues to rise, in-orbit demonstrations remain limited, and revenue growth lags behind expectations, raising concerns about sustainability and potential investment bubbles. The first section of the paper provides a short description of key developments since the last report, structured to the 10-category classification and glossary. It highlights industry milestones, investment trends, and policy shifts.

The second section provides an updated statistical analysis of companies currently active, or aspiring to be, in the in-space economy. It examines development stages, geographic distribution, and funding trends. Emerging patterns include increased microgravity flight services, re-entry capsules, and space tugs, along with renewed interest in space-based solar power and new space data centres.

The third section is a deep dive into in-space transportation including on-orbit servicing, space debris removal and recycling, and propellant reloading. Dedicated figures on founding and funding are presented. Despite growing interest and upcoming demonstrations, market analyses indicate that commercial revenue challenges persist. The fourth section is a deep dive into cargo transportation such as re-entry vehicles and lunar landers. Similarly, dedicated figures are presented and the financial landscape is assessed, identifying investment trends, opportunities, and potential risks of oversaturation.

By analyzing market drivers, technology advancements, and financial trends, this publication provides policymakers, investors, and entrepreneurs with insights to navigate among emerging opportunities. Given the scarcity of detailed in-space economy overviews, this study aims to provide biannual assessments while capturing key developments, some of which are likely to evolve into very large space industries.

Keywords: in-space economy, space-based economy, cislunar economy, in-space manufacturing

1. INTRODUCTION

Factories in Space has tracked new in-space economy entities since 2018. This paper updates and improves the author's surveys from 2021 and 2023, providing a statistical overview of commercial organisations active in the in-space economy.[1,2] Figure 1 illustrates the in-space economy fields.

There are 1099 entries in this study and in the database as of August 2025, likely the largest public dataset of its kind. This is nearly 300 more compared to 825 entries in the 2023 study.[2] The number of unique companies is about 1000 because some organisations appear more than once when active in multiple fields under the taxonomy used here.

In-space economy is the new extraterrestrial space industries.[3] In-space economy means generating revenue in space using assets in orbit or beyond Earth. The term is sometimes used interchangeably with space-based economy and, in narrower scope, on-orbit economy, space-for-space economy, low-Earth-orbit economy, or beyond-Earth space economy. It includes cislunar activities as well

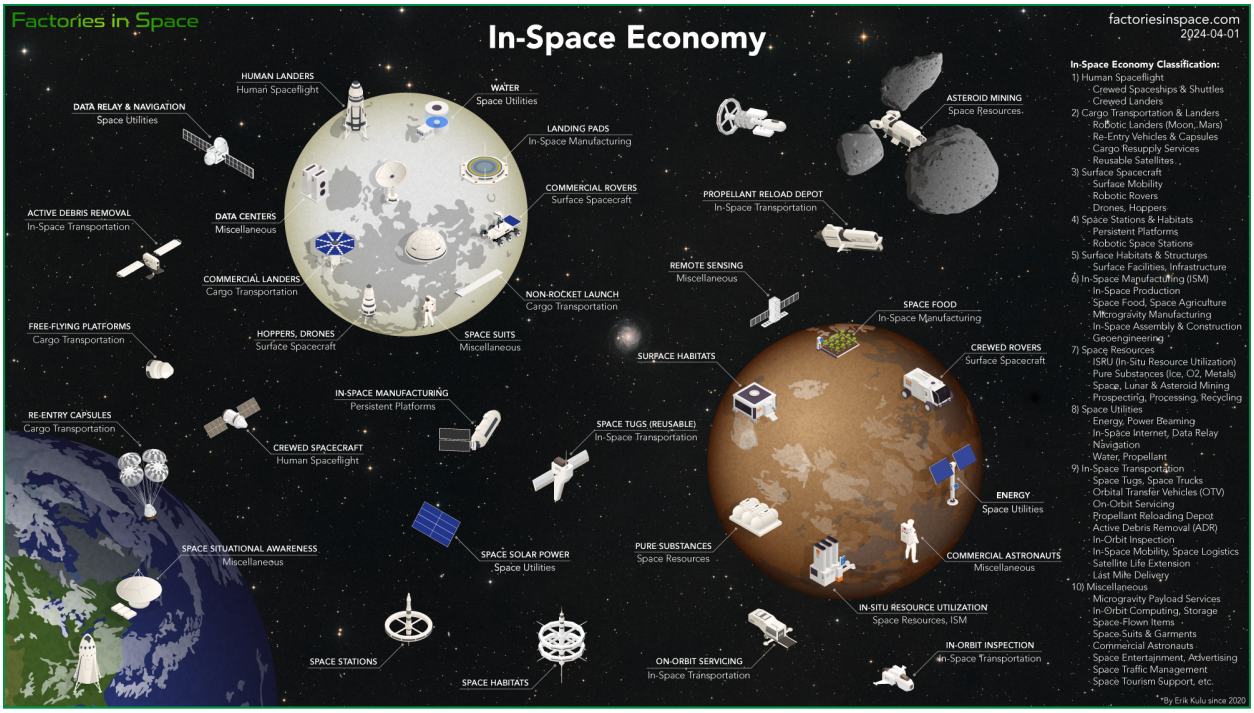

Figure 1: Future In-Space Economy Illustration

as the Moon and Mars. Prior work has also defined space-for-space as goods and services produced in space for use in space, such as mining the Moon or asteroids for materials to build habitats or supply refuelling depots.[4]

The new in-space economy spans space stations, commercial landers, in-space manufacturing, and other emerging fields. New space economy and in-space economy terms were formed to distinct the new areas and to be able to follow them without existing space industries inflating the numbers. For clarity, this survey excludes satellite constellations serving terrestrial markets and Earth-to-orbit launch vehicles.

Literature Review Literature on the broader in-space economy remains limited. The 2021 and 2023 surveys include an extended review of earlier publications and provide estimates for the size of the space economy.[1,2] To avoid duplication, readers seeking historical context can refer to these. At the same time, specialised studies on individual in-space segments are becoming more common.

For a deeper dive into in-space manufacturing, see the author's 2024 survey.[5]

The 2024 State of the Space Industrial Base report stresses that the US must accelerate commercial innovation and investment in emerging in space economy sectors such as logistics, manufacturing, and resource utilization to maintain leadership.[6]

Malshe et al. (2023) define factories in space as modular orbital nodes that do servicing, assembly, and manufacturing, and they outline a framework and research priorities in autonomy, materials and processes, logistics, standards, and digital twins to build a resilient space infrastructure.[7]

Researchers at Politecnico di Milano, including F. Abdulhamid and B. P. Sullivan, have published a series of papers on the Factory in Space concept that outlines architectures and business cases for orbital and lunar space factories.[8,9]

ESPIs 2023 OSAM survey maps current capabilities, near-term prospects, and legal and policy gaps for servicing, assembly, and manufacturing in orbit.[10] NASA's 2024 Technology Taxonomy organizes research across a three-level hierarchy to align technology areas with mission needs and industry.[11]

Recent policy studies emphasize benefits and hurdles for ISAM. GAO's 2025 assessment finds ISAM can extend spacecraft utility and enable new missions, but standards, costs, and adoption barriers remain unresolved.[12] A U.S. policy review outlines ISAM benefits, key challenges, and options such as standards, incentives, testbeds, and acquisition pathways.[13] Broader work examines financing architectures for settlement-class infrastructure[14] and

argues that resource abundance in space means economics must lead to unlock societal value.[15] The UK IOSM paper sets near-term national priorities, including autonomy and refueling.[16] A lunar field guide frames a ten-year blueprint for scalable lunar infrastructure and roles for industry.[17] European outlooks set goals and scenarios for exploration to 2040 and beyond.[18,19]

Motivation & Trends We continue to need new economic drivers for spaceflight. Something new and potentially larger than any existing space industry, such as telecommunications, remote sensing, launch and research. The following supporting macro trends for in-space economy are ongoing:

- Decreasing launch costs. Now about 2-3 times less according to P. Lionnet,[20] but potentially 10-100 times lower in the future, e.g. Starship.
- Commercialization of space and LEO.
- Commercial services and infrastructure.
- ISRU and space resources advancements.
- Pollution and climate change on Earth.
- Increasing momentum for space settlements.
- NewSpace iterative mindsets and affinity for bolder risks, also from long-term investors.

First, this paper gives a short review of key events since late 2023. Second, it presents a statistical overview of the 1099 surveyed in space economy entities. Third, it takes a deep dive into two markets: in-space transportation and reentry vehicles, a subsegment of cargo transportation & landers.

2. NOTABLE UPDATES SINCE 2023

This section provides a non-exhaustive selected chronology of the recent advances and companies in the in-space economy. For fuller historical context, refer to the author's 2021 and 2023 surveys.[1,2]

Space economy market outlooks diverge. Major banks project about a $1 trillion space economy by 2040, while Pullen argues it could reach $4 trillion and would require many more specialized workers.[21] Novaspace forecasts the space economy approaching $1 trillion in the early 2030s, led by satcom, launch, and emerging in-space services.[22] A 2025 analysis describes mixed signals in the space economy.[23] NASA's 2024 review catalogs 17 distinct commercial-development mechanisms and traces their use across four eras to show how the agency has catalyzed U.S. space markets.[24]

Overall, from late 2023 through 2025, the in-space economy saw a broadening base of startups and achievements, even as only a few services have had orbital demonstrations and less so recurring.

2.1 Commercial Space Stations

Since October 2023... The commercial space station sector has seen a consolidation of efforts and progress in development, as the community slowly prepares for retirement of the ISS.

Northrop Grumman announced it would no longer pursue its own CLD and would instead join Voyager Space's Starlab project.[25]

NASA has sought industry feedback on Commercial LEO Destinations (CLDs), and in September 2025, it outlined a revised strategy to spend up to $1.5 billion to support at least two companies in demonstrating crew-tended space stations.[26,27]

The demand for ISS access was highlighted by the ISS National Lab's Fiscal Year 2024 report, which noted a record year for peer-reviewed publications and that cumulative post-flight fundraising for startups surpassed $2.2 billion.[28]

Voyager's IPO provided new insights into Starlab, including an estimated development cost of $2.8–3.3 billion, a target launch date of 2029, a planned 30-year service life, and a habitable volume about 45% of the ISS U.S. segment.[29]

Vast completed the primary structure of Haven-1 module for a 2026 launch.[30] Sierra Space completed pressure tests of LIFE inflatable habitat.[31]

Commentary questioned whether NASA's revised CLD approach could limit U.S. ambitions in LEO relative to China's plans.[32] At the same time, European analysts discussed alternatives to participation in the NASA-led Gateway program.[33] Academic studies explored conceptual designs, such as a lunar space station for in-space manufacturing.[34]

2.2 Asteroid Mining (Space Resources)

Since October 2023... A surge of renewed private investment in the space resources sector, particularly for asteroid mining and lunar materials.

Karman+ raised $20M in early 2025 to build an asteroid-mining autonomous spacecraft.[35]

Interlune emerged from stealth, announcing its plan to harvest lunar helium-3.[36,37] In parallel, LH3M was granted five patents for its lunar helium-3 extraction methods.[38]

In late 2024, Starpath Robotics raised $12 million to develop lunar water ice mining.

AstroForge secured the first-ever commercial deep-space spectrum license from the U.S. FCC.

Their first satellite launched in early 2025 but failed to reach destination.[39]

U.S. DARPA's LunA-10 initiative selected first projects in 2023[40] and published results in the "The Commercial Lunar Economy Field Guide" in 2025.[17]

Ethos Space, a lunar infrastructure startup, emerged from stealth in 2024 with plans for surface power and excavation systems. They have published whitepapers, including on Helium-3.

A study on asteroid remnants suggested that it may be more profitable to mine asteroids that have impacted the Moon rather than those in orbit.[41] Rocket Lab asked NASA to open its Mars Sample Return mission to commercial competition.[42] China announced it would open its 2028 Mars sample return mission to international cooperation.[43]

The UK's Aqualunar Challenge selected a microwave concept to purify water ice on the Moon.[44]

2.3 Surface Habitats

Since October 2023... NASA awarded NextSTEP study contracts for logistics and mobility (e.g., carriers, offloading, staging, tracking, trash management) to support long-duration surface operations under Artemis. The selected proposals have a combined value of $24 million.[45]

Architecture firm Hassell Studio, in collaboration with the European Space Agency (ESA), released a Lunar Base Master Plan in early 2024 proposing designs for a sustainable Moon habitat.[46]

Thales Alenia Space signed a contract in 2025 with the Italian Space Agency (ASI) to develop the first human outpost on the lunar surface.[47]

ICON shared their Project Olympus and LunA-10 plans.[48] They use a robotic 3D printing called Laser Vitreous Multi-material Transformation, in which high-powered lasers melt regolith, that then solidify to form strong, ceramic-like structures.[49]

Many countries have joined the Artemis Accords and several joined the ILRS (International Lunar Research Station) project led by China and Russia.

2.4 Commercial Landers

Since October 2023... Firefly's Blue Ghost achieved the first fully successful commercial landing in March 2025 and was operated after sunset.[50]

Intuitive Machines achieved the first commercial soft lunar landing with Nova-C IM-1 in February 2024,[51] but the lander tipped over. IM-2 mission landed in March 2025, but also tipped over, and was operated for less than 24 hours.[52]

Astrobotic's Peregrine lander failed after launch in January 2024 due to a propulsion leak.[53]

ispace's Hakuto-R Mission 2 attempted landing in June 2025 but likely crashed again.[54]

Thales Alenia Space signed a contract with ESA for €862 million to develop Argonaut lunar lander with the first mission planned for 2031.[55,56]

Recent work describes free-flying lunar drones and their uses for Moon exploration.[57] Commercial operators report rising demand for lunar lander services beyond NASA contracts.[58] Firefly Aerospace secured a fourth lunar lander award in 2025.[59]

2.5 Commercial Rovers

Since October 2023... Lunar Outpost's MAPP rover was on the IM-2, but it was not possible to be deployed after the lander tipped over.[60] Dymon's Yaoki rover was also onboard IM-2.[61]

ispace's Mission 2 had an in-house rover onboard, but the lander likely crashed.[54]

NASA awarded Lunar Terrain Vehicle contracts in April 2024 to Intuitive Machines, Lunar Outpost, and Astrolab.[62]

NASA's VIPER rover was canceled in July 2024, but in September 2025, Blue Origin won the contract to deliver it to the Moon.[63]

Canada continued with Lunar Utility Rover (LUR) program in 2025. The 3 companies Canadensys Aerospace, MDA Space and Mission Control will split $14.6 million for the 18-month studies.[64]

Mexico's COLMENA project had 5 tiny rovers on the failed Astrobotic Peregrine mission.[65]

2.6 Commercial Cargo

Since October 2023... China plans to launch 2 new space station cargo spacecraft (Haolong cargo space shuttle and Qingzhou cargo spacecraft) on commercial rockets in 2025.[66]

In 2024, ESA signed two first-phase contracts for commercial space cargo return service with Thales Alenia Space and The Exploration Company.[67]

Sierra Space's Dream Chaser was delivered for testing in 2024, but its first mission has been delayed to 2026.[68,69] However, an ISS resupply mission may never happen.[70]

SpaceX has flown 33 commercial resupply missions as of September 2025.[71] Northrop Grumman has flown 23 Cygnus missions with the last NG-23 being an XL version.[72]

2.7 Commercial Human Spaceflight

Since October 2023... SpaceX has flown 18 crewed missions including 11 for NASA, 4 for Axiom, and 3 others (Inspiration 4, Polaris Dawn, Fram2).[73]

Polaris Dawn astronauts performed the first non-governmental spacewalk in 2024.[74] Fram2 was the first crewed flight over poles.[75]

Boeing's Starliner capsule had propulsion issues on the first crewed flight in 2024, and two astronauts returned on SpaceX's Crew Dragon.[76]

Blue Origin has flown 35 suborbital missions with 14 of them crewed.[75] Virgin Galactic launched 7th commercial flight and 12th overall in June 2024 before retirement.[77] New Delta class space plane could fly as soon as 2026.[78]

China's Deep Blue Aerospace announced plans in October 2024 to start flying suborbital tourists by 2027 using a reusable rocket system.[79]

Starship had 10th test flight in Aug 2025.[80]

NASA issued a solicitation for two additional private-astronaut missions in 2026–2027.[81]

A recent review presents trends and forecasts for space travel and tourism through 2034.[82] A. Rabsahl has further written about space tourism.[83,84]

2.8 Re-Entry Vehicles and Microgravity Flight Services

Since October 2023... Varda Space Industries has flown 4 times. The spacecraft of the latter was now developed in-house, instead of Rocket Lab.[85] Varda raised $187M in 2025[86] and shared plans.[87]

ATMOS Space Cargo launched its PHOENIX-1 prototype in April 2025 and declared it a success as the heat shield inflated.[88,89] However, it is unclear how far the capsule made it.

The Exploration Company's Mission Possible reentry test in June 2025 demonstrated key spacecraft systems but lost communications after reentry but before parachute deployment.[90]

Orbital Paradigm announced its first reentry demonstration for late 2025 with 3 customer payloads, and is developing larger reusable vehicles.[91]

Space Cargo Unlimited raised €27.5M in September 2025.[?]

SpaceX is rumored to plan for Starship-based in-orbit drug research called Starfall.[92]

SpaceWorks Enterprises will fly the RED 25 reentry capsule in 2026.[93] RED-Data mission prices start at $1.5 million without recovery.[?]

Intuitive Machines revealed Zephyr reentry vehicle and up to $10M grant.[94] It used to be called URV but was removed from the website for a while.

Radian plans a vehicle for hypersonic tests.[95]

The ISS National Lab's FY24 report notes more than 100 payloads delivered, roughly 80 percent from commercial entities and about 70 percent via commercial service providers, along with a record year for publications.[96] CBS research found that NASA-sponsored experiments aboard the ISS lead to significantly more cited papers and patents.[97]

2.9 In-Space Manufacturing

Since October 2023...

A recent Payload article highlights the challenge of grouping servicing, assembly, and manufacturing under the single ISAM acronym with COSMIC director Greg Richardson noting that "they are different types of missions with a different spectrum for when they might become available, or when they might be most useful".[98] The same report observes that although technical demonstrations have been successful, market demand has developed more slowly, even as optimism persists due to falling launch costs and the expected growth in hardware.

The 2024 ISAM State of Play characterizes the state of ISAM through 312 functional capability area activities, 56 facilities, and 114 developers.[?]

Semiconductor initiatives expanded, including Texas A&M consortium on chips in space for materials and process advances.[99] Astral Materials was founded and has received for example SBIR Ignite Phase I and Phase II grants.[100] SpaceWorks and Astral Materials were selected for a 2026 semiconductor crystal manufacturing and product return demonstration using the RED 25 reentry capsule.[101] Starflight Dynamics raised over $2 million for "high-throughput bulk crystal growth systems, targeting advanced semiconductor and quantum materials".[?] There is also a student microgravity crystal growth projects under REXUS.[102]

ESA and Airbus demonstrated the Metal3D printer in orbit and returned first parts.[103,104]

European projects reported systems results, including PERIOD outcomes on manufacturing, assembly and refuelling, and a mixed architecture trade study for large on orbit structures.[?,105] EURISE is a 24-month research and innovation project, funded by the European Commission, and focused on advancing in-space servicing, assembly, and manufacturing (ISAM).

Redwire announced SpaceMD to commercialize pharmaceutical development in space and a royalty agreement structure with a partner.[106] LambdaVision received an InSPA Phase 2 award to advance layer by layer artificial retina manufacturing.[107]

Biomanufacturing surveys identify early commercial opportunities and strategic advantages for health and materials.[108,109] Reviews of protein and crystal growth summarize microgravity benefits and experimental constraints.[110,111]

Programmatic analyses call for more attempts and faster iteration to reach commercial proofs.[112] Additional commentary and news coverage examine industrial prospects and investment signals for ISM and orbital infrastructure.[?,113] Research on sustainability frames ISM around resource efficiency and lifecycle assessment, including a conceptual sustainability framework and case work on upcycling metal debris into usable feedstock.[114,115]

DARPA announced interest in biologically grown large space structures.[116]

Space robotics companies are on the rise. Icarus Robotics raised a $6.1M for robot astronauts to do mundane work on the ISS.[117] Rendezvous Robotics raised $3M to build reconfigurable space infrastructure using self-assembling tiles.[118]

2.9.1 Luxury-Novelty: In-Space Manufacturing

Near-term luxury-novelty space demonstrations include a 2026 "off-Earth footprint" footwear design experiment and two beer brewing investigations launched to the ISS in 2025.[?,119]

Analysis examines sponsorship and brand activation in orbit as emerging revenue streams.[?] There have been debates over orbital advertising.[120]

Policy work considers leisure and hospitality norms for crews and visitors, including alcohol policy in orbital settings.[121]

2.10 In-Space Transportation (Space Tugs)

Since October 2023... D-Orbit continued ION missions, now at 20.[122] Exotrail conducted first OTV flight in Nov 2023.[123]

Impulse Space raised $300 million to scale Mira and Helios vehicles for GEO delivery.[124] Mira has flown twice since Nov 2023.[125] Sees strong demand for GEO rideshare program.[126]

NASA selected six companies to study orbital transfer vehicles (OTVs) for multi-orbit delivery.[127]

ESA advanced propellant storage and refilling technologies through new industrial contracts and In-Space Transportation Club sessions.[128,129]

The U.S. DIU began studies on Starship-enabled refueling applications.[130]

DARPA canceled DRACO nuclear propulsion in 2025 after reassessing launch economics.[131]

Northrop Grumman's Mission Robotic Vehicle (MRV) has been delayed to 2026.[132]

Consolidation has already been happening. Launcher was acquired by Vast in 2023[133] and the space tug was cancelled after 2 failed missions. Atomos was acquired by Katalyst in 2025.[134]

The U.S. Space Force removed funding for in-space mobility in its FY26 budget.[135] Despite that, Space Force also recently requested that the next-generation space domain awareness satellites will be equipped with a capability to be refueled on orbit.[136] C. Galbreath argued the Space Force should adopt ISAM to maintain space superiority over China.[137]

Euroconsult projects several billion USD in cumulative servicing revenues by the early 2030s.[138]

The U.S. Government Accountability Office's 2025 ISAM assessment highlighted that the sector still faces unresolved technical challenges and uncertain economic justification, highlighting that benefits and costs are not yet fully weighed.[139] It underscored the industry's continued reliance on single-use satellites despite the availability of servicing technologies, pointing to slow adoption of capabilities.[140]

Forecasts from Euroconsult project a few billion USD in cumulative on-orbit servicing revenues by the early 2030s, driven mainly by GEO life extension and last-mile services.[138]

Increased mobility has become a popular topic. Portal Space Systems raised $17.5M.[141]

Chinese orbital logistics startup InfinAstro raised angel round funding in 2025.[142]

2.10.1 Satellite Servicing

Since October 2023... Astroscale U.S. was selected to conduct two hydrazine refueling operations of a U.S. Space Force asset in GEO in 2026.[143] D-Orbit and Eutelsat announced a GEO in-orbit servicing mission partnership.[144] Quantum Space released life-extension services and secured a $40 million for maneuverable spacecraft.[145,146]

Starfish Space's second docking test launched in 2025.[147] China launched Shijian-25 to test on-orbit refueling and mission-extension technologies.[148]

Reviews and surveys documented servicing readiness, manipulators, and end-effectors.[?,149] Policy and operations statements emphasized the need to show clear military advantage before wider refueling adoption, and operators cited fuel constraints as a limiter on autonomy.[150,151]

Trade reporting pointed to slow market uptake despite technical progress.[140,152]

2.10.2 Space Debris Removal

Since October 2023... Astroscale went public in 2024 and continues to develop its next debris removal missions and a life-extension servicer for GEO satellites.[153] ADRAS-J approached within 15 meters of a rocket upper stage.[154]

ESA published its Zero Debris Technical Booklet to guide mission design and procurement toward debris-neutral operations.[155] The UK released the Stage 1 public report of its RPO Regulatory Sandbox to de-risk licensing of inspection, docking, and removal missions.[156] Circular-economy approaches for end-of-life and reuse continued to gain traction in community guidance and events.[157]

Astroscale and ClearSpace passed the halfway mark in early 2025 in de-risking key technologies for potentially de-orbiting two satellites in a single mission in 2028 for the UK.[158] Kall Morris Inc.'s ISS residency on debris operations where the REACCH payload will demonstrate its ability to capture and hold a range of objects in microgravity.[159]

European Defense Fund (EDF) selected the SPADER solar-concentration debris removal system.[160] Comparative policy analysis proposed a UN Sustainable Development Goal for orbital debris, drawing on marine-debris management.[161] Additional reviews assessed debris trends and mitigation frameworks.[162] JAXA's safety standard for on-orbit servicing remained a reference for mission design.[?]

2.11 Space Utilities

2.11.1 In-Space Internet

Since October 2023... Kepler launched first microsatellites in late 2023, announced successful test of optical inter-satellite links, and plans to launch 10 satellites in 2025.[163]

NASA has contracted at least 6 in-orbit relay demonstrations for 2025-2026.[164,165]

Chinese startup Cangyu outlined a mixed-orbit commercial relay system.[166]

Polaris Dawn mission tested SpaceX's Plug and Plaser lasercom terminal with Starlink satellites.[167]

A bill sets aside $700M for NASA to hire a company on a fixed-price contract to build an Mars Telecommunications Orbiter (MTO). It specifies that a contractor must deliver by the end of 2028.[168] Blue Origin unveiled their MTO concept using its Blue Ring platform.[169,170]

2.11.2 Space Data Centres

Space data centres has been one of the most popular and hyped new topics with dozens, if not hundreds, of articles, analyses and blog posts.[?,171–177] However, some of the repeated statements about free energy and vacuum cooling have been overstated. While technical challenges are theoretically solvable, economics is far from proven.

Starcloud, previously Lumen Orbit, raised a seed round of $21M.[178,179] Sophia Space announced a $3.5M pre-seed round in May 2025.[180,181] The acquisition of Relativity Space by former Google CEO Eric Schmidt was reportedly driven by ambitions to deploy computing infrastructure in orbit.[182,183] Ethos Space writes about building space ports and data centers on the Moon.[184] Lonestar has had two space data center payloads on Intuitive Machines Moon landers, but the level of demonstration is unclear after both tipped over.[61]

A stepping stone is edge computing on satellites.

2.11.3 Space Energy & Energy on the Moon

Since October 2023... Space Solar Power (SSP) or Space-Based Solar Power (SBSP) has seen relativly large fundraising. Aetherflux was founded in 2024 to pursue orbital solar power and has raised over $60 million.[185] Overview Energy raised a $11.7M seed round in September 2024.[186] Reflect Orbital has raised over $26M.[187] Star Catcher has raised over $12M.[188]

However, there are also mixed signals. ESA's SOLARIS program was effectively canceled with most planned projects not started. NASA's OTPS report judged SSP economics challenging.[189–191]

Kevin Barry has been publishing state of the industry reports.[192] A modeling study argued SSP could help Europe meet net-zero targets under certain cost trajectories.[193] Leading China scientist called for top-down plan to develop space solar power technology and warns that country is lagging behind competitors such as the US.[194]

On the Moon, surface power studies accelerated. Italy initiated development of a nuclear reactor for lunar settlements.[195] NASA highlighted plans to speed work on lunar nucelar reactor.[196,197] Recent analysis assessed space based solar power for improving operational robustness of lunar EVAs and exploration architectures.[198]

A Japanese wireless power transmission test was reported in 2025.[199] StarCatcher and Starcloud announced a 2025 partnership to apply power beaming to their systems.[200] DARPA's POWER program has broke records by beaming over 800 watts of laser power across 5 miles, tripling the power and quadrupling the distance of past demos.[?]

3. MARKET SURVEY

3.1 Survey Criteria

The survey criteria, which has resulted in the 1100 entries currently, is the following:

- Belongs to the in-space economy, as defined in the next section of high-level classifications and sub-categories.
- More precisely "new in-space economy". For example, excluding launch vehicles, unless they are also meant for interplanetary flight like Starship; excluding satellite manufacturing, unless they will be reusable; excluding satellite fleets and constellations around Earth; and more.
- Commercial entities or at minimum offering commercial services to the public markets.
- Discovering the new startups is a main challenge and many might be missed for some time.

3.2 In-Space Economy Classification

One goal of this paper is to continue iterating on the taxonomy for the commercial entities in the in-space economy to be able to group them.

Until such categories are defined and widely accepted, the activities will continue to be called with different names as per personal preferences, which makes it more challenging to determine competitors and estimate market sizes. The categories have been limited to 10 to make the figures more practical to read, but this may change in the future.

The following classification is preliminary and author expects it to improve greatly thanks to feedback, independent iterations, and especially over the upcoming years as the new space-based industries continue to grow and become established.

4. IN-SPACE ECONOMY TAXONOMY

Here follows the summary of terminology and definitions for the primary 10 high-level classifications. Please see the 2023 version for complete version. They have not been repeated to save space.

1. **Human Spaceflight & Landers** - Space vehicles designed for any kind of human flight. Also referred to as crewed spaceflight.[201] It is a separate category due to difficulty level, but could be merged in the future.
2. **Cargo Transportation & Landers** - Spacecraft transporting goods from and to Earth, Moon and Mars.
3. **Surface Spacecraft** - Spacecraft operating on the surface or near the surface of a planetary body. Includes rovers, drones, hoppers.
4. **Space Stations & Space Habitats -** Free-flying space stations and very large space habitats. Can be called space platform, orbital colony, space colony, and space settlement. May be located in orbit around the Earth, Moon, Mars, Venus and in Lagrange points. Could be rotating to achieve artificial gravity.[202]
5. **Surface Habitats & Surface Structures -** alternatively surface facilities. Facilities on the surface of Moon and Mars for habitation, storage and manufacturing. Structures can include physical infrastructure, antennas, various plants, factories and more.
6. **In-Space Manufacturing** (ISM) - alternatively Off-Earth Manufacturing[203] and Space-Based Manufacturing.[204] ISM divides into 2 large areas. First area is manufacturing products in microgravity for Earth, which will be brought back to be sold on terrestrial markets. Second area is manufacturing large-scale space structures that will remain in space. Author presented a dedicated paper on ISM in 2022 including many new subcategories.[205]
7. **Space Resources** - Deals with the prospecting, mining, beneficiation, processing, ISRU and recycling of natural or artificial resources in space, incl. Moon, Mars and asteroids.[3,206] Some processing and ISRU activities could also be considered to be in-space manufacturing.
8. **Space Utilities** - alternatively In-Space Utilities. There will exist distinctive supply chains and physical infrastructure for common goods like energy, internet, navigation and water.
9. **In-Space Transportation** - Broad category about multi-functional spacecraft providing services to other spacecraft in direct contact or short-distance away and capable of sizeable orbit changes. There are many similarities between the following sub-categories, because all those spacecraft must be capable of significant orbital velocity changes. Key difference with Cargo Transportation is that these vehicles will stay in space and do not reenter or land.
10. **Miscellaneous** - Supporting and connected services to the in-space economy, which largely would not exist without it. Some of them may not strictly generate revenue in space.

5. 2025 STATISTICAL OVERVIEW

This section presents the statistical overview of the 1099 entries included in this new in-space economy survey of primarily commercial space entities.

Emphasis is on changes, trends and new additions. Most previous content and examples have not been repeated. For more historical facts and context, please see the previous 2021 and 2023 papers.[1,2]

5.1 Classifications with Status

Figure 2 shows the classification of in-space economy about 1000 entities and 1099 entries as many companies have multiple submissions.

Overall, approximately 1/3 of entities are in dormant, concept or early stages. About 1/3 are in development. Approximately 10% of companies have launched some technologies to orbit.

Human Spaceflight has grown from 13 to 16 entries with the addition of PLD Space[207] and Chinese. SpaceX is active in the human orbital spaceflight category and cargo transportation. Blue Origin is active in the suborbital human spaceflight and Virgin Galactic started regular missions in 2023.[208]

Surface Habitats has increased from 22 to 27.

Surface Spacecraft are up from 43 to 48 but none are active or demonstrated yet due to lunar lander complete or partial failures.

Space Stations have increased from 37 to 41.

Cargo Transportation & Landers has increased significantly from 67 to 98, largely due to numerous re-entry vehicles like space capsules. Among landers, Firefly and Intuitive Machines have demonstrated.

Space Resources has grown from 78 to 116. OxEon Energy is demonstrated as per MOXIE heritage.

In-Space Transportation with 120 entries (up from 95 from 2 years ago) is popular due to a large increase in orbital transfer vehicle (space tug) startups. This category also includes satellite servicing, active debris removal and propellant reloading, because of the large overlap in spacecraft technologies. Northrop Grumman (SpaceLogistics), D-Orbit and Momentus are active in the in-space transportation category. Astroscale, Exotrail, Rocket Lab and Impulse Space are demonstrated. Early consolidation is happening. Atomos was acquired by Katalyst. Launcher was acquired by Vast but OTV cancelled.

Space Utilities classification has grown from 96 entries to 148. This includes space-based solar power, space data centres and space data relays.

In-Space Manufacturing with 209 entries, up from 167, is again the most popular single category. This includes numerous companies which have performed demonstrations, done research or made limited novelty products such as space beer. None are considered active, which would require regularly making the same product or material for Earth or space.

Miscellaneous includes non-hardware or space advocacy organizations that are active due to lower barriers of entry. ISS-based and other microgravity testing providers, which are actively offering services, are also under Miscellaneous.

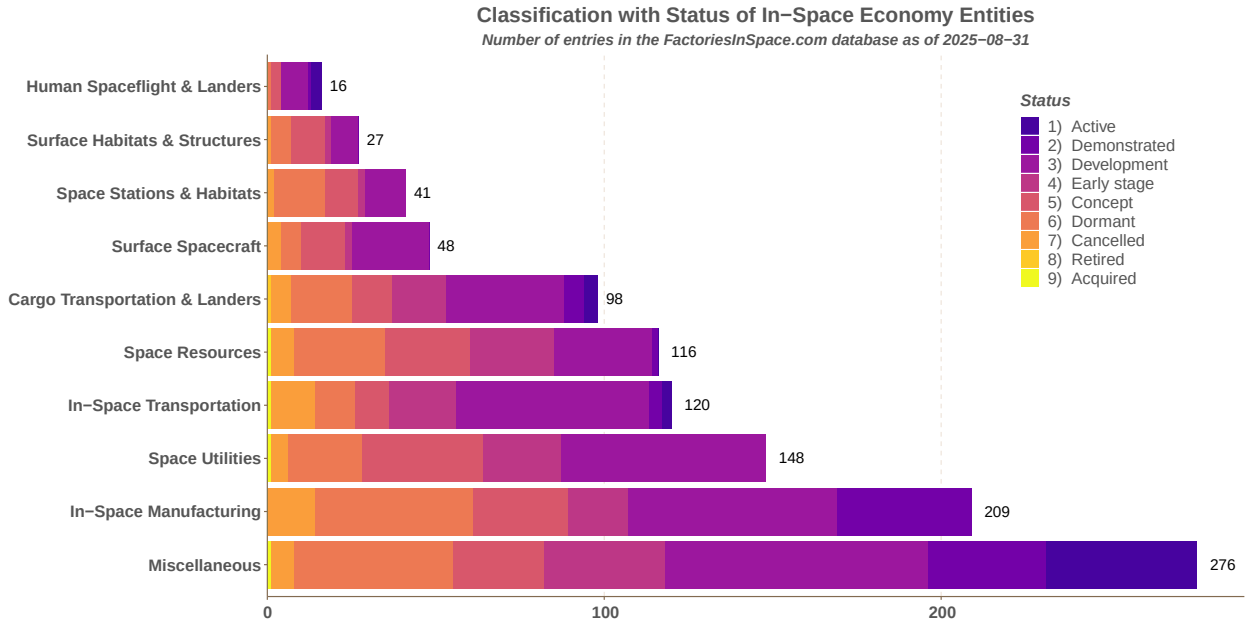

Figure 2: In-Space Economy Classification by Status

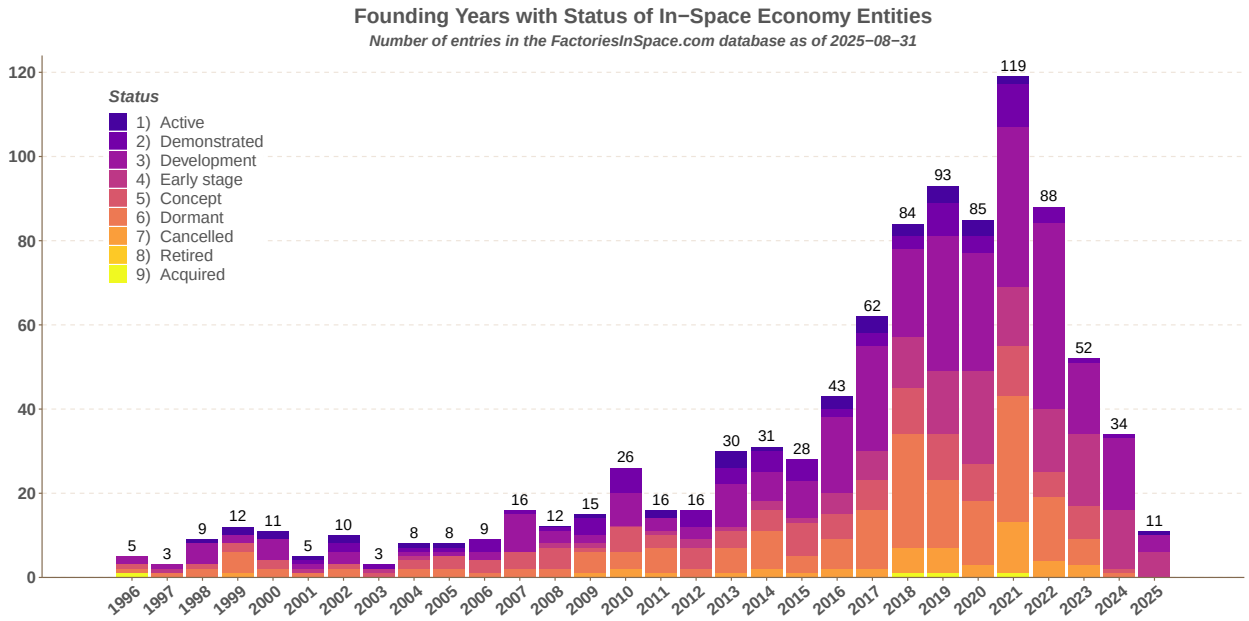

Figure 3: In-Space Economy Organisation Founding Years by Status

5.2 Founded with Status

Figure 3 lists the founding years of organisations together with the status categories.

Establishment of a company does not correlate to a successful long-term business or to demonstration missions, because most will become dormant before. As seen from the chart, many commercial organizations are in the early stages, where the visible progress could be limited to a website and a small partially committed team. Only approximately 10% of entries have performed orbital demonstrations or are active. There remains to be a long path for many in-space economy services to become commonplace.

The peak of 2021 is likely to remain as later years show decline in company formation. In 2021, there were key challenges started, which always results in major company or project founding.

The author has forecast that successful Starship missions and return to the Moon will kick off another startup founding wave in about 2-3 years. However, the timelines have been optimistic as 2-4 years has already passed. Nevertheless, in these fields new peaks are very likely in the future.

Founded in 2024 are for example Aetherflux (space solar power), Catalyx Space (re-entry capsule), Exobiosphere (drug discovery), Icarus Robotics (robot astronauts), Instict (lunar GPS), Lux Aeterna (reusable satellites), Starcloud (space data centres) and more.1

Founded in 2025 are for example Genesis SFL (re-entry capsule), KSAT's HYPER (space data relay), Rendezvous Robotics (in-space assembly), Sophia Space (space data centers), SpaceMD (Redwire's subsidiary for drug discovery) and others.

5.3 Founded with Classification

Figure 4 plots the founding years of entries in the database together with the classification.

In the last two years, in-space transportation (space tugs), cargo transportation (re-entry vehicles), space utilities (space solar power, space data relay, space data centers), and in-space manufacturing (for Earth and space) have seen the highest company formation. These are widely seen as the strongest near-term commercial opportunities.

Space situational awareness, classified under miscellaneous, has also been growing. The lower barriers of entry, often limited to software platforms and analytics, have enabled many startups to enter. However, the long-term market potential remains uncertain, since sustainable revenue depends on integration with and dependence on regulatory frameworks and overall operational adoption.

By contrast, space station and habitat categories saw little new activity as firms consolidated around existing flagship projects due to high capital requirements. Surface spacecraft and lunar rovers added relatively fewer entries also, following repeated lander failures, but are likely to take off as transportation to lunar surface opportunities improve.

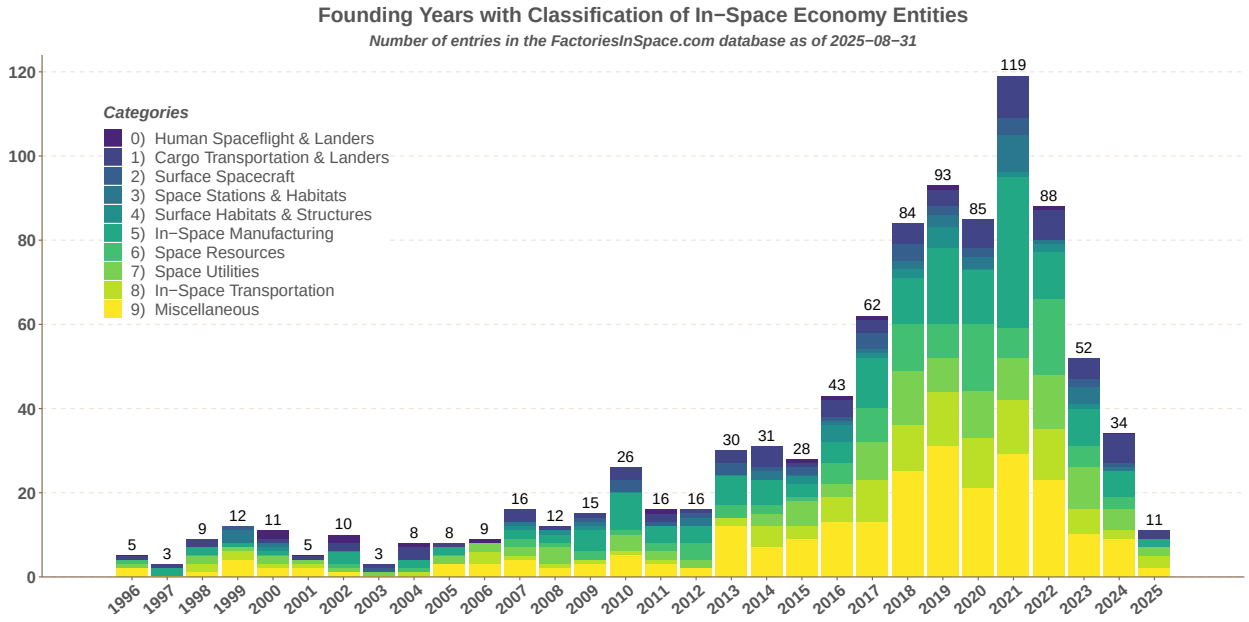

Figure 4: In-Space Economy Organisation Founding Years by Classification

5.4 Funding with Classification

Figure 5 collects company funding amounts in the defined ranges with categories. As a change from 2023, organisations with multiple entries often have the funding for secondary entries marked as "Not applicable". This approach makes it more challenging to analyze funding levels per classifications, but avoids the duplication of significant amounts.

The funding levels are the total amounts and the exact investments for in-space economy may be unknown in case of larger companies. The "Unknown" category is for not-announced funding and it is likely they have no or very small amount of capital.

Largest VC rounds since Oct 2023 include Impulse Space's $300M Series C in mid-2025,[124] Varda with $187M in 2025[209] and Firefly's IPO for $868M.[210]

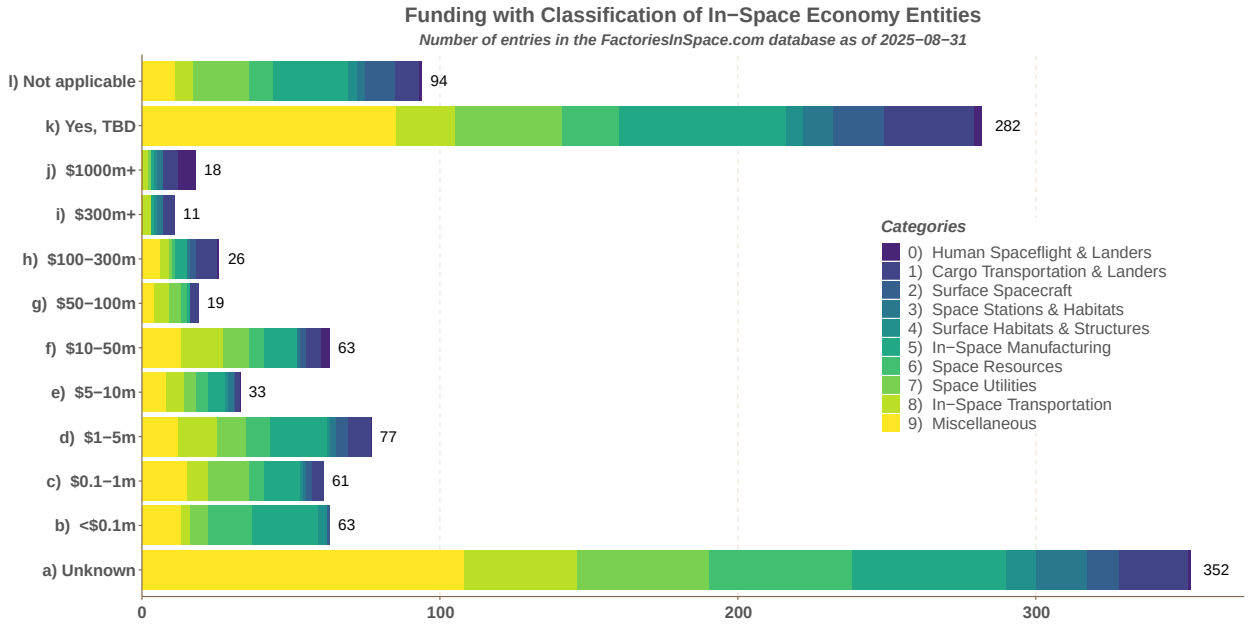

Figure 5: In-Space Economy Organisation Funding Levels by Classification

5.5 First Launches

The year of first missions and demonstrations in space have been plotted on Figure 6. The goal in this section is to collect the maiden launch year of the activity most relevant to the in-space economy fields. Henceforth, entities may have launched hardware to space even before the years referenced here.

Knowingly cancelled and dormant entities have been marked with "Dormant". "Not applicable" includes organizations, which are not planning own space missions. "Not announced" are companies that do not seem to have announced a planned year for their first missions or activities in space. The large unknown amount correlates to the prevalence of companies in the idea and early stages.

Example first launches in 2023 have been Varda, Exotrail, Starfish Space, Turion Space, Redwire's payloads, Kepler Communications and others. In 2024, Airbus (metal 3D printer), Astrobotic, GITAI, Intuitive Machines, Lonestar, Orbital Matter, The Exploration Company, ThinkOrbital, SpaceX, True Anomaly and many others.

In reality, as the launches happened or currently planned schedules:

- First launches in 2025 have been AstroForge, Atmos, Dymon, Intuitive Machines (hopper), Inversion Space, Lunar Outpost, SpaceForge, Starbase Brewing and others.
- First launches still knowingly planned for 2025 are Astrobotic's CubeRover-1, Astrolab Venturi, DCUBED, Axiom Space (data center payload), Starcloud, UARX and others.
- Planned launches for 2026 include Aetherflux, Blue Origin (BlueRing), Catalyx Space, Exobiosphere, Portal Space Systems, Vast and many others. Many delays from 2025 are likely.
- Notable delays during the 2 years are Axiom space station module to 2027, Space Rider to 2027, Impulse Space's and Relativity's commercial Mars lander to unknown date etc.

5.6 Geographical Distribution

Distribution of the in-space economy companies by locations of headquarters is on Figure 7.

Approximately half of the 1099 entries have headquarters in the United States, expanding from approximately 440 entities to 580. Largest founding rounds are also skewed towards the United States. Many in-space economy fields are very capital intensive, and at the same time do not have large existing or immediate markets, making them higher risk.

The previous paper had a long list of examples, which have not been repeated.

Relative growth is visible in the United Kingdom, France, Germany, and Japan, which all added a number of new entities. Emerging activity is also clear in India and Australia.

Some new countries were added also, including Argentina, Egypt, Estonia, Latvia and Ireland.

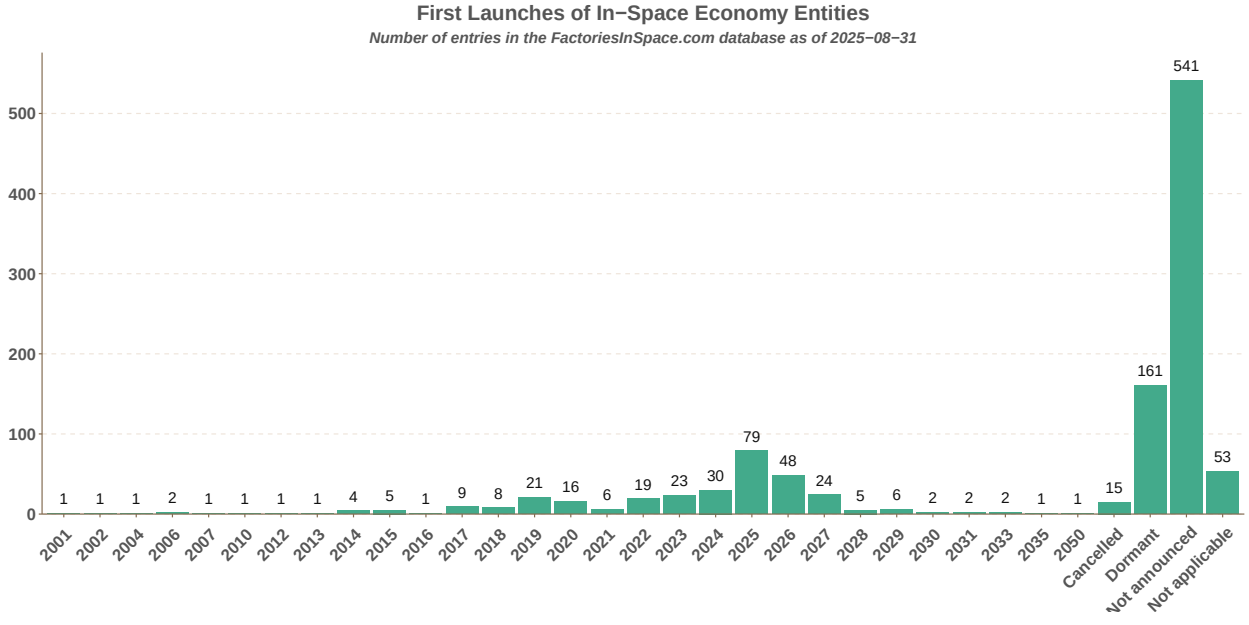

Figure 6: In-Space Economy Organisation First Space Launch Years

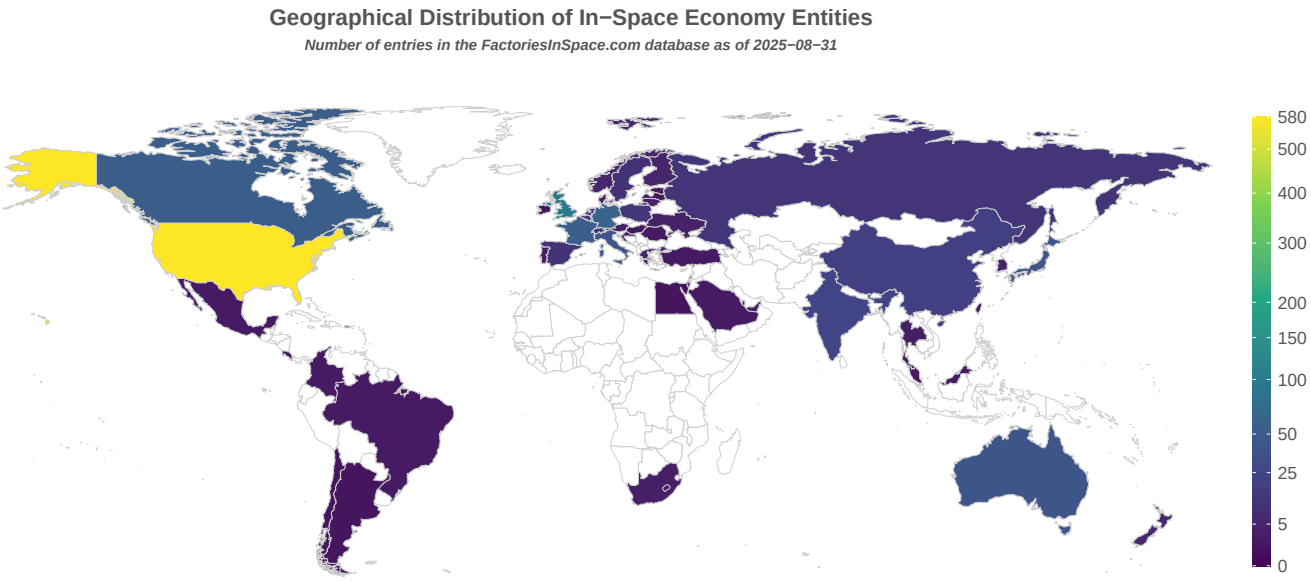

Figure 7: In-Space Economy Map of Entities

6. DEEP DIVE: IN-SPACE TRANSPORTATION

In-space transportation covers orbital transfer vehicles, space tugs, mobility and logistics, satellite servicing, active debris removal, propellant reloading/refueling and other related fields involving maneuverability capabilities. With over 132 companies in the database, it is presently likely to be one of the boom and hype fields of NewSpace and in-space economy, and worth a closer look.

6.1 Founding (In-Space Transportation)

Figure 8 shows the founding years of the 132 projects together with the current activity status. The growth started around 2014, which coincides with the first Falcon 9 reusability tests, first constellation batch deployments (Planet, Spire) and Skybox sale to Google. The main surge is during 2017-2022, similarly to other NewSpace fields such as small launchers and constellations.

D-Orbit has been the most active with 19 missions flown since 2021.[122] Several others have flown demonstrations, including Impulse Space, Exotrail, Rocket Lab and Astroscale. Vast acquired Launcher and their space tug was cancelled. Atomos was acquired by Katalyst in 2025.

6.2 Funding (In-Space Transportation)

Figure 9 summarizes the funding levels of the 132 entries together with their status. 41 are in the unknown bin, which generally means very small amounts. 21 clearly have funding based on activities but exact amounts have not been disclosed. "Not applicable" is a database limitation for companies with multiple entries, where the funding has not been duplicated to avoid overall double counting. Most of them likely have notable amounts of capital.

Large fundings include Impulse Space with $525 million, Astroscale with over $443 million, D-Orbit with over $200 million and Momentus with over $170 million. Blue Origin, Firefly and Rocket Lab are beyond $1 billion in total funding, but those amounts have not been exclusively or majority directed towards in-space transportation.

6.3 Market and Outlook (In-Space Transportation)

Financial viability and economic sustainability remain unproven but would be key long-term. Most missions have been funded by investments and government contracts. Transported satellites and hosted payloads have generated revenue but mission costs have also been comparatively high.

For space tugs, an emerging segment will be LEO to GEO orbital transfer, which is yet to be demonstrated commercially, but has been claimed to be a good opportunity. Reusable space tugs and Starship should also improve economics of most in-space transportation segments but are yet to be demonstrated in service. First commercial propellant sales and in-space transfer would also be a positive milestone as well as further satellite servicing missions.

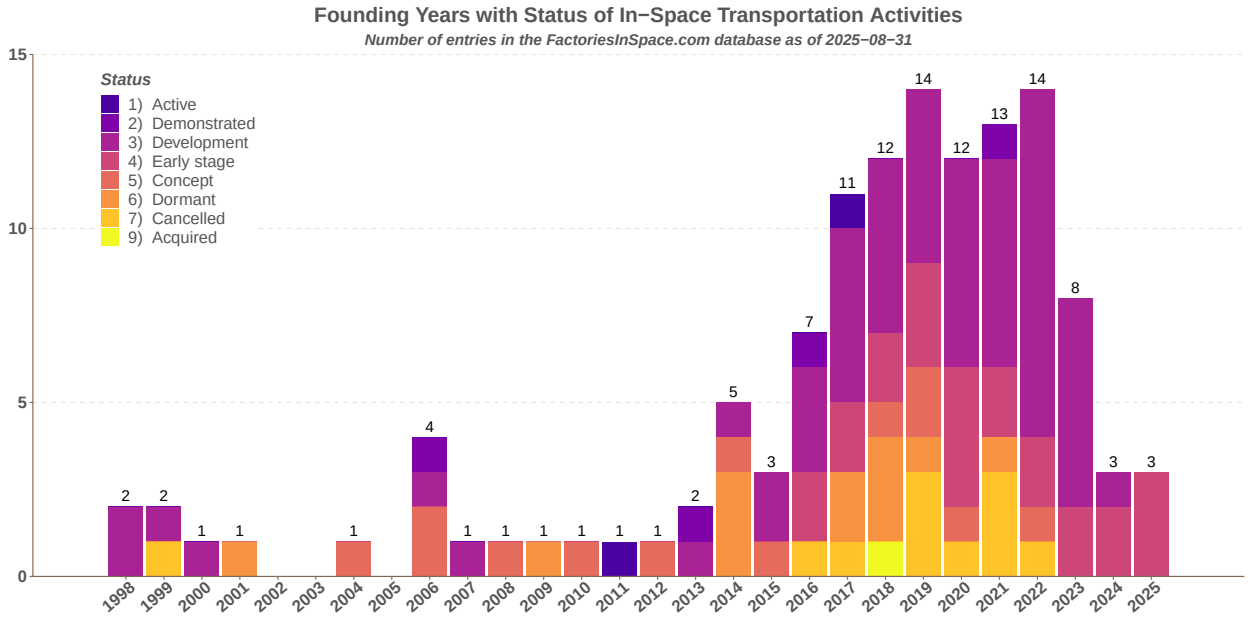

Figure 8: In-Space Transportation Organisation Founding Years

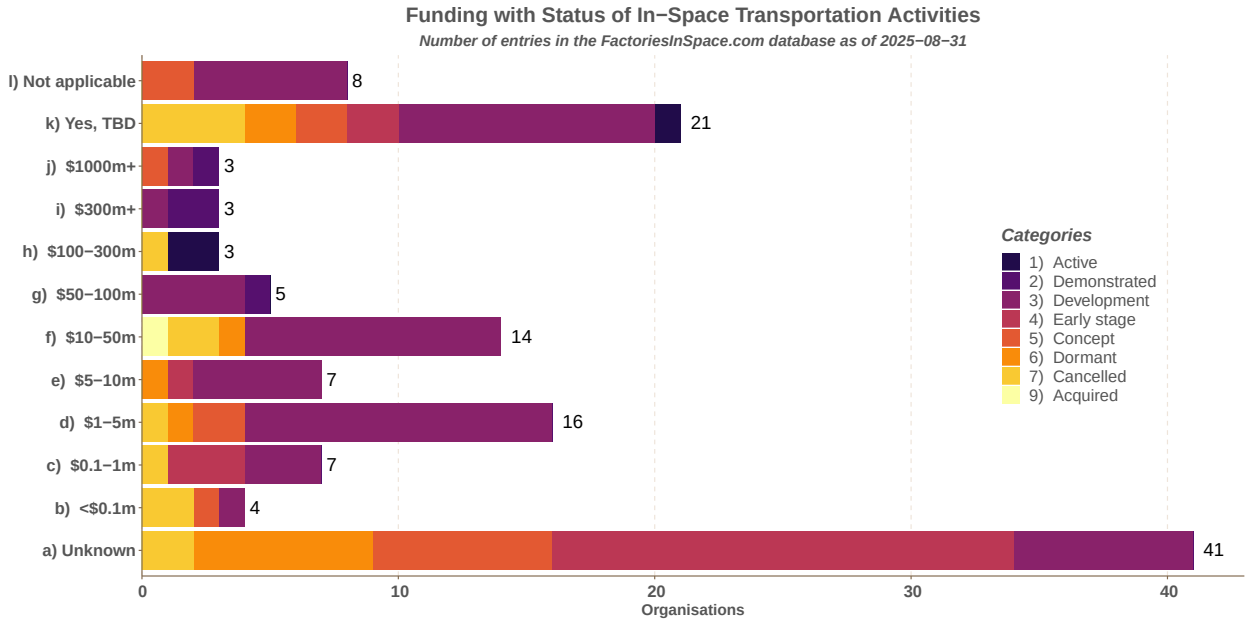

Figure 9: In-Space Transportation Organisation Funding Amounts

7. DEEP DIVE: RE-ENTRY VEHICLES

Re-entry vehicles, as part of the high-level Cargo Transportation & Landers category, may also be progressing through a boom and hype cycle. Current designs include small capsules with fixed, deployable or inflatable heat shields or lifting body spaceplanes.

7.1 Founding (Reentry Vehicles)

Figure 10 shows the founding years of 76 reentry vehicles together with their status. Three waves are visible. A small wave happened in the early 2000s in relation to the ISS build-out. Small capsules were envisioned to bring back experiments on-demand.

Second wave happened in the late 2000s and early 2010s in relation to the impending Space Shuttle retirement. Before SpaceX Dragon started flying, Sojuz could have been the only and very limited means for downmass from ISS. Similarly, returning on-demand experiments was envisioned.

A third and current wave rises from 2014 onward and accelerated after 2018, similarly to many other NewSpace segments. The peak is in 2022 but company formation is stable on average and continuing.

Several have performed demonstrations. SpaceX Dragon has been flying nearly 15 years. Among newcomers and small vehicles, Varda is active with 4 missions launched and 3 returned. The Exploration Company, ATMOS, Inversion Space, Airbus have also launched missions but those have been at best partially successful and none have been recovered.

7.2 Funding (Reentry Vehicles)

Figure 11 plots the funding levels of 76 projects together with the company status. SpaceX is represented with multiple entries, all of which have also received significant funding: Dragon and Dragon 2, DragonLab, Crew Dragon and Starship. Sierra Space has two entries, Dream Chaser and the smaller Ghost. Blue Origin's solution is marked as a concept.

Varda has raised over $328 million.[211] Stoke has also been included thanks to being a fully reusable rocket and has raised over $436 million.[212]

7.3 Market and Outlook (Reentry Vehicles)

Primary uses of reentry vehicles are space station resupply and return, microgravity experimentation, hosted payloads, on-orbit manufacturing, worldwide cargo delivery, and hypersonics flight tests. Another potential use case is reusable satellites.

Challenges include flight rate, re-entry licensing and landing zones and recovery.

Short-term signals to watch are increasing flight cadence, focus of missions (e.g., in-space manufacturing vs hypersonics research), unit economics, and government purchases of downmass services outside ISS cargo programmes.

Medium-term growth depends on in-space manufacturing (finding the killer app), growth of the microgravity experiments market, commercial space stations and whether hypotheses about reusable satellites are proven.

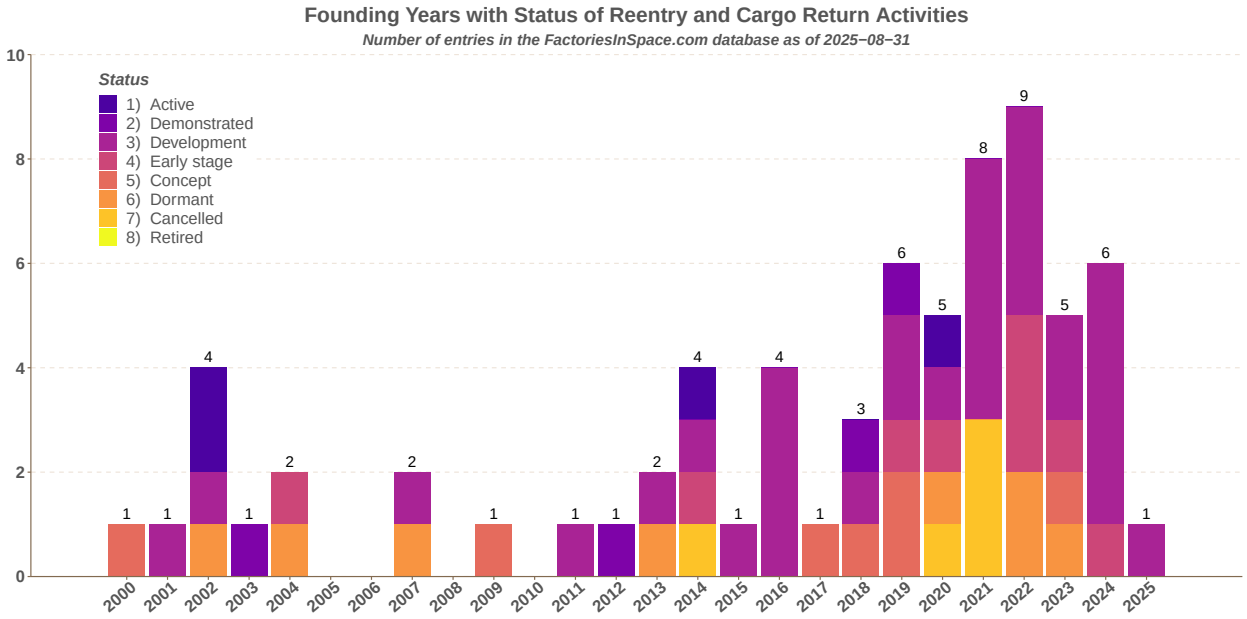

Figure 10: Reentry Vehicle Organisation Founding Years

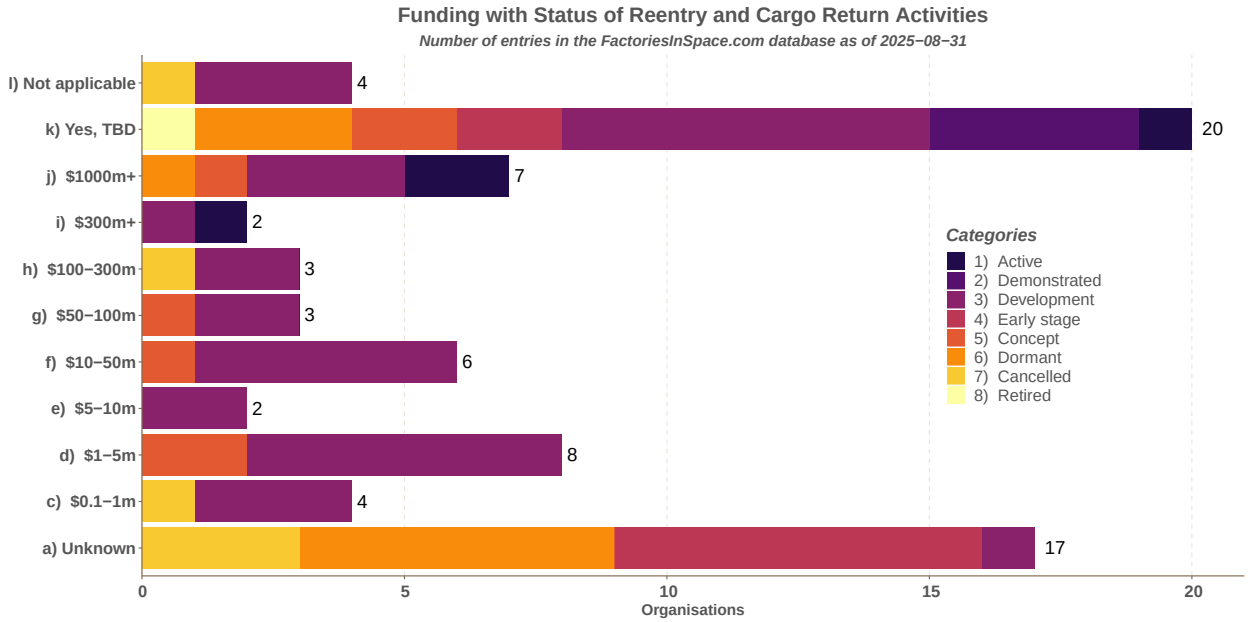

Figure 11: Reentry Vehicle Organisation Funding Amounts

8. CONCLUSIONS

A statistical overview of 1099 in-space economy entries and approximately 1000 unique organisations has been presented. An increase of nearly 300 since 2023 autumn. Selected major news and developments since 2023 were also described.

The goal was to leave a snapshot from 2025, after previous works in 2021 and 2023,[1,2] to continue discovering trends and popular new space industries.

- New in-space economy entities are continuing to emerge and the pace is increasing, but the number of related launches to space or commercial revenues remain relatively small.
- Most additions are in in-space transportation, space utilities and in-space manufacturing.
- SpaceX has now performed 18 crewed missions, including Polaris Dawn first commercial spacewalk and Fram2 polar mission.
- Firefly achieved the first fully succesful commercial landing on the Moon. Intuitive Machines has survived but tipped over twice and were not operated long. ispace has failed twice and Astrobotic failed to attempt a landing.
- At least several commercial lunar rovers have flown but the lunar landers crashed or failed.
- In-space transportation and reentry vehicles may be going through a boom & hype cycle.
- Numerous milestones are yet to be achieved. For example, the first commercial propellant sale and transfer. Satellite servicing beyond Northrop Grumman and GEO. First commercial LEO to GEO transfer. Commercial space stations. In-space manufacturing use cases that justify recurring and scalable activities.
- Starship has performed 10 flights with the 11th planned in the next weeks.
- Space solar power is doing relatively well in terms of private fundraising, despite ESA's SOLARIS program cancellation and skepticism.
- Space data centers has emerged as one of the most popular new potential industries.

The intention is to keep repeating this study annually as a whole or as deep dives into specific categories, e.g. in-space manufacturing,[205] space solar power,[213] space habitats, and surface spacecraft.

The database and figures are viewable online and planned to be updated multiple times per year.

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