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Global Sector Analyst

The space economy's first journey will be to Earth

Equities
Global

- Private-sector companies have far-reaching ambitions to pioneer a new wave of economic activity in space
- But the journey isn't just about space – it's about space-driven discovery that expands addressable markets on Earth
- Many "in-space" ambitions remain constrained by launch economics, autonomy, and hardware readiness

The next phase of the space economy won't begin with asteroid mining or orbital data centres. It begins with a set of terrestrial developments that (1) create immediate commercial value on Earth, (2) industrialise the enabling supply chains, and (3) pull forward the technology stack – particularly power, semiconductors, and robotics – that later migrates into orbit. In this edition of Global Sector Analyst, we bring together views from HSBC equity analysts on what the development of the space economy could mean for the sectors under their coverage, as well as the opportunities – and challenges – it could create, with the spotlight on SpaceX following its recent IPO.

Change is already underway. Starlink is at decent scale with ~10,200 satellites and ~12.0m broadband subscribers across 167 markets (30 June 2026). **Space-based connectivity** is becoming baseline infrastructure for multiple sectors, supporting better tracking for **shipping and aircraft,** more accurate remote operation (e.g., in **mines**), and better targeting of resources in precision **agriculture**, where adoption benefits are cited as +22.3% ROI and +18.5% net profit.

The build-out of AI data centres is already driving increased terrestrial **power** needs as well as demand for **renewables and grids.** Next-generation **solar** could play a role in planned orbital data centres – but if the latter take off, they could prove a headwind for terrestrial **gas and nuclear** generation.

Many space ambitions are ultimately constrained by two things that have to mature through mass deployment on Earth. To transform satellites from being "pipes" to "intelligent nodes" calls for new "low earth orbit-optimised" **semiconductors** able to operate in challenging conditions, edge-AI inference accelerators (allowing computing to take place in space), and high-performance optical chips enabling rapid data transfer between networked satellites. **Advanced robotics** is vital to enable on-orbit servicing (repair/refuel/upgrade/debris removal), support future in-space manufacturing, and achieve longer-dated ambitions including lunar infrastructure build-out and asteroid mining. This is not just a space story. Investments in these areas could create opportunities for parts of the supply chain, while any developments could prove to have terrestrial applications in the longer term, too.

This is our latest report on the Disruptive Technology theme. If you want to subscribe to any of our nine big themes, *click here*.

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1) Telcos	◆ LEO broadband at scale (**~10,200 satellites; ~12.0m subs; 167 markets**) as a resilience/backhaul layer ◆ More telco–sat partnerships; D2C still gated by spectrum/regulation	◆ Direct-to-device becomes "standard coverage", esp. remote/industrial ◆ Satellite integrated into core telco operating model (multi-orbit, enterprise-first)
2) Tech hardware & semis	◆ Terrestrial fab/packaging build-out; supply-chain tightness (EUV, wafers, ultra-pure chemicals) ◆ Push toward **"LEO-optimised silicon"** + optical comms/SerDes	◆ Orbital inference: satellites shift from "pipes" to intelligent nodes ◆ In-space manufacturing niche ("super-fab") leveraging microgravity for superior crystals/WBG materials
3) Technology	◆ SpaceX intends to launch **100GW of compute** capacity into space every year by 2030 – we believe this creates a surplus of compute capacity ◆ Terrestrial adoption needs to keep pulling the stack forward: partnership models, operating integration, rapid scaling of terrestrial compute	◆ **Terafab concept** as a potential industry shift, accelerating iteration and reducing dependence on incumbents ◆ If "data centres in space" scale, spacefaring robots to maintain assets could be worth "tens of trillions of dollars"
4) Transport & logistics	◆ Always-on connectivity becomes fleet operating standard (already: **Maersk 330+ vessels; 2,500+ aircraft retrofitted**) ◆ Integration into ERP/fleet systems; productivity + safety gains	◆ Autonomous navigation + predictive maintenance at scale (LEO latency **~20-50ms** vs GEO **500-600ms**) ◆ End-to-end supply chain visibility across oceans/deserts/rural corridors
5) Power (utilities/renewables)	◆ AIDC build-out could lift US/EU power demand growth to **~4-5% p.a.** ◆ Clear winners: grids + renewables; terrestrial AIDC capex **USD40-50bn per GW**	◆ Orbital AIDC as hedge if terrestrial constrained; cost convergence targeted **2035/40e** (orbital **~3x** more expensive today) ◆ Space solar scales if orbital compute scales (rule of thumb **~3.5x solar vs IT load**)
6) Industrials	◆ Demand for AIDC enabling kit (turbines/gensets/fuel cells; UPS/cooling/power distribution) ◆ Space supply-chain exposure selective (SpaceX makes **~80-85%** in-house)	◆ On-orbit servicing/assembly/manufacturing becomes an "orbital services economy" ◆ Lunar economy build-out needs autonomy/simulation; infrastructure integrators adapt to orbital environments
7) Chemicals	◆ Scale matters: rising launch cadence turns "small per unit" chemical inputs into meaningful spend ◆ Rare gases for propulsion (xenon/krypton) could bottleneck	◆ If mega-constellations scale (FCC proposal up to **1m** solar-powered sats), sizeable recurring demand (fuel cited **~USD5bn** plus **10-20x** other chem inputs) ◆ More space solar → higher demand for EVA, high-temp polymers/coatings (PEEK/PPS)
8) Agriculture & fertilisers	◆ Rural connectivity unlocks precision ag adoption beyond large farms (reported **+22.3% ROI; +18.5% net profit**) ◆ Focus: affordability + usability/training	◆ Enterprise-grade agronomy platforms at scale (IoT soil probes, imagery, analytics) ◆ Connected robotics/automation on-farm as autonomy improves
9) Metals & mining	◆ Near-term focus on lunar ISRU signals (US DOE to buy **3 litres helium-3** by **Apr 2029**) ◆ Economics hinge on launch cost/cadence (Starship target **USD100-300/kg** to LEO)	◆ New off-Earth mining value chain (logistics → exploration → extraction → processing → offtake) ◆ Potential reshaping of supply: tech-led producers could emerge if autonomy/logistics/legal frameworks mature
10) Healthcare	◆ Faster scaling of telemedicine/remote monitoring + robotic intervention models ◆ More compute supports AI diagnostics + continuous monitoring	◆ Microgravity manufacturing for formulations/materials; commercial stations mature (e.g., first commercial station **Q1 2027** planned) ◆ New clinical "operating system" for extreme environments (radiation diagnostics/protection; regenerative medicine)

Source: HSBC

At a glance – key implications by sector (cont'd)

Section (sector)	What development of the space economy could mean (short term)	What it could unlock (longer term)
11) Insurance	◆ Space insurance continues to mature as an enabling market: currently **~USD600m** global premium p.a. ◆ Helps participants manage balance sheet exposure, satisfy contractual requirements, and meet regulatory obligations	◆ Better actuarial datasets and standardisation improve data homogeneity over time (SpaceX reusability could mean insurers underwrite "the same rocket ship") ◆ Space tourism could also lead to wider cover requirements such as personal accident cover and property (theft) cover
12) Financial Institutions	◆ The space economy could reach **USD1.8trn by 2035** (vs USD630bn in 2023), driven by satellites, gov't support, and new space-enabled applications/industries (McKinsey) ◆ Opportunity set for financial services firms spans capital raising, corporate and wealth advisory, and risk management	◆ Retail investors received a **30% allocation in SpaceX's IPO**, signalling strong demand from wealth/retail channels ◆ Growing appetite for exposure to fast-growing emerging industries; retail exposure may expand through ETFs and increased allocations to alternative vehicles providing access to private companies

Source: HSBC

Summary

- Private-sector companies have far-reaching ambitions to pioneer a new wave of economic activity in space
- But the journey isn't just about space – it's about space-driven discovery that expands addressable markets on Earth
- Many "in-space" ambitions remain constrained by launch economics, autonomy, and hardware readiness

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Out-of-this world ambitions, real-world impacts

Exploring the new space economy
From orbital data centres to lunar bases and asteroid mining, private sector companies aim to spearhead a new wave of economic activity in space. None is more prominent than SpaceX, on which we initiated coverage shortly after its record-breaking IPO (see *SpaceX – Initiate at Hold: Rocket-centric*, 23 July 2026).

In some areas – such as reusable launches, and an extensive constellation of low-earth orbit satellites supporting communications – the ambitions of today's space pioneers are already becoming reality. For other plans to come to fruition, a variety of technological, regulatory and economic challenges must be overcome, and it remains to be seen how quickly this can happen.

It is already clear, however, that investment in the space economy is having real-world impacts, and this influence is likely to grow. We see the new space race triggering a set of terrestrial developments that (1) create immediate commercial value on Earth, (2) industrialise the enabling supply chains, and (3) pull forward the technology stack – particularly power, semiconductors and robotics – that later migrates into orbit.

In this edition of Global Sector Analyst, we bring together views from HSBC equity analysts on what the development of the space economy could mean for the sectors under their coverage, as well as the opportunities and challenges it could create. We start by examining the areas where change is already well underway.

Space-based connectivity is already a commercial reality and used by multiple sectors

Space-based connectivity is becoming baseline infrastructure for multiple sectors
SpaceX's Starlink communications network is already at decent scale, with ~10,200 satellites and ~12.0m broadband subscribers across 167 markets (30 June 2026). It also has 7.4m monthly devices using satellite-to-mobile services across 30 countries as of 31 March 2026. Multiple industries are adopting space-based services to achieve a range of business objectives, including:

- **Transport & logistics**, from maritime and aviation to trucking. Space-based connectivity removes operational blind spots not covered by other telecommunications services. Maersk has enabled 330+ vessels with the technology, while 2,500+ aircraft were equipped by early 2026. One trucking solutions company claims 99.9% coverage in US/Canada, allowing for more effective tracking and logistical management.

- **Agriculture**: Space-based coverage enables real-time communications, allowing for more targeted deployment of water and fertilizer, more timely harvests, and better herd management. Reports suggest adoption of precision agriculture techniques could lead to +22.3% ROI and +18.5% net profit.
- **Mining/industrials,** where space-based connectivity allows for remote and autonomous operations at scale. The Rio Tinto Pilbara autonomous network in Australia, for example, is controlled from 1,500km away using a combination of satellites, sensors, and AI.

In other areas, we look at changes already underway that are prerequisites for the full development of the space economy.

Terrestrial power and grid build-out accelerates

Developments in terrestrial power systems support space ambitions…

The development of terrestrial artificial intelligence data centres (AIDCs), for example, is highly relevant to space ambitions. We think burgeoning AIDC demand has the potential to lift US/EU electricity demand growth to ~4-5% p.a. (compared with a historical base of 2-3%). This is driving investment into new power sources and networks, with renewables and grids as the "clearest winners". In time, abundant and cheap compute capacity could create hypercompetition among large language model (LLM) providers. A rapid expansion of terrestrial data centre capacity could result in near-term over-capacity in the cloud infrastructure market.

These changes are a prerequisite for the success of extraterrestrial ambitions because they fund and industrialise the compute supply chain (chips, cooling, power electronics, networking) that could later be deployed into space.

Robotics and semiconductors become the shared enabling stack

…as do investments in semiconductors and robotics…

Similarly, advanced robotics and enhanced semiconductors are vital for the new space age. As with AIDCs, the same capabilities needed for space ambitions (more rugged hardware, edge compute that for example allows satellites to process data locally, rather than relying on the cloud, and thus operate with greater autonomy) are already being brought forward on Earth. The drive to automate logistics (predictive maintenance, autonomous navigation), mining, and agriculture, and to decentralise healthcare (through remote monitoring and robotic intervention) is creating a reinforcing loop. The more technology is deployed, the more data are available, and the better models become. This supports higher autonomy and, in turn, broader deployment.

Terrestrial breakthroughs needed first in launch, silicon and thermal management

…but there are still technical hurdles to clear

In other areas, we think further specific technological breakthroughs will be necessary to support space ambitions. These include further reducing the cost of launches, allowing for a faster cadence. SpaceX's Starship rocket programme has a target cost range of USD100-300/kg of payload into low earth orbit. This would represent a remarkable (c95%+) improvement in cost efficiency compared with previous launch programmes. A further area for development is new "low earth orbit-optimised" semiconductors able to operate in tough conditions, enabling satellites to progress from being "pipes" to "intelligent nodes". Thermal management, too, requires further progress, with industry leaders flagging "still a lot to figure out" when it comes to dissipating heat in orbital data centres.

What happens in space… doesn't stay in space

What if these problems are solved successfully? While it remains to be seen how quickly the economic and technological challenges might be overcome, in this note we also start to consider what the implications would be if various space-based ambitions were to come to fruition.

Some space developments would be likely to emerge in the medium term…

Smart satellites, capable of processing data locally and acting more autonomously, would drive demand for edge-AI accelerators (because it would be too slow and inefficient for satellites to rely on compute capacity on Earth). Similarly, satellites would need high-performance optical chips enabling rapid data transfer between them, helping them work effectively as a constellation. As and when demand and investment accelerate and lead to breakthroughs in these areas, this would also have implications for terrestrial edge-AI and networking components.

On-orbit servicing is set to become a real orbital services economy. As spacecraft counts rise, repairing, refuelling, and upgrading them becomes increasingly important – as does removal of space debris that could damage them or interfere with their orbit. Fundamentally, this is a robotics story, and orbital robots would be needed to carry out inspection and manipulation. Further advances in high-autonomy robotics are necessary to make this a reality, but – as with smart satellites – we think this could be a medium-term story.

…with others likely having a longer or more contingent timeline…

Other developments would likely have longer timescales. SpaceX targets 100GW of orbital AIDC capacity by 2040, but orbital AIDC is currently around three times more expensive than terrestrial alternatives. Costs would need to converge by around 2035/40e, in our estimates, to support the target. Yet if terrestrial AIDC build-out were to be constrained by policy, grid connections, or emissions trade-offs, then this could add to the incentives for focusing on orbital AIDCs as a hedge.

Similarly, some developments would be contingent on the achievement of other ambitions. Space solar would likely scale only if orbital compute also scales – but in that scenario, its total addressable market could be in the tens of billions. Industry experts have suggested that next-generation satellites may need around ~3.5x solar power vs IT load (example: 340 kW solar for 100 kW IT). But if orbital AIDC demand grows, this would bring forward space solar demand and potentially open up space manufacturing and assembly opportunities.

…and others still at a more nascent stage

Other ambitions still are at a more nascent stage, particularly in-situ resource utilisation (ISRU) – in effect, acquiring resources in space for use in space. The US Department of Energy's Isotope Program has agreed to buy three litres of helium-3 – a valuable rare material found on the moon with applications including quantum computing – with delivery targeted no later than April 2029, and potential additional purchases in 2029-2035. This gives a signal of intent from US authorities about the feasibility and timescale of lunar ISRU. Asteroid mining is explicitly further into the future and would hinge on high-autonomy robotics capable of performing a complex series of operations (reconnaissance, mapping, drilling, transport) on a largely independent basis, as well as the support of an effective logistic network and a conducive legal framework.

A larger permanent presence in space could also allow for more industrial research, development, and manufacturing to take place in conditions that cannot be replicated on Earth. Microgravity, for instance, enables superior crystal formation and material properties. This means microgravity manufacturing could be a route to differentiated products in areas including pharmaceutical and advanced materials/semiconductors.

A connected constellation of developments

In essence, we see a related series of interconnected developments with the potential to enable, and be enabled by, space-related investment:

1. **Connectivity (Starlink) → data-rich operations**
   Space-based communications enable logistics visibility, precision agriculture, remote mining operations, and decentralised healthcare.
2. **Data-rich operations → autonomy/robotics demand**
   Logistics, mining, and healthcare drive forward developments in greater robotic autonomy on Earth; space requires even higher autonomy because real-time control is limited.
3. **Autonomy/robotics + edge compute → semiconductor innovation**
   The development of truly smart satellites forces ultra-efficient compute and networking; those designs feed back into terrestrial edge AI and industrial automation.
4. **Semis + power electronics → power build-out (Earth) and power generation (space)**
   Terrestrial AIDC drives investment grids/renewables first; only later does orbital AIDC create pull for space solar and in-space infrastructure.

When, and only when, these four related developments have occurred could orbital compute, servicing, and eventually ISRU / space mining become widespread, in our view. In this scenario, space would become an extension of the industrial stack, not a parallel universe, with robotics and semiconductors as a common language.

In this report, our equity analysts look across twelve sectors to discuss the impacts of the space economy and explore:

1. What needs to happen on Earth first;
2. Earth developments needed to benefit;
3. Impact of more data centres on Earth;
4. Space developments needed;
5. How semiconductor developments help, and;
6. How robotics developments help.

What is SpaceX trying to achieve?

- SpaceX's mission is to build the systems and technologies necessary to make life multiplanetary
- Near-term goals are: i) a large-scale compute build out; ii) gaining market-share from US telcos; and iii) frontier model development
- Longer-term ambitions include space tourism, lunar mining, Mars colonisation, energy production, and orbit manufacturing

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The overall SpaceX ambition is long-term with a focus on artificial intelligence alongside interplanetary exploration. We would argue that management believe, much like at Tesla, the end goal is currently unknown but that the platform is being built to capitalise on future, albeit as-yet unknown, revenue streams.

> To build the systems and technologies necessary to make life multiplanetary, to understand the true nature of the universe, and to extend the light of consciousness to the stars.
>
> **SpaceX mission statement**

Near-term

Near-term, we argue that SpaceX has three core aims within Space, Connectivity and AI. On top of these, management will have aims to show the "fly-wheel effect", with the whole picture being greater than the sum of the parts.

- **Space:** To remain the largest global launch services provider by mass-to-orbit. Given the scale of ambition within both the Connectivity and AI (including through the use of orbital data centres) divisions, this should remain internal use focussed to place the revenue generating satellites into orbit. Within this, the development of Starship into commercial use is key. The 13th test flight was a success in Q2. Within this, orbital datacentres are priority, albeit as-yet unproven.
- **Connectivity:** Management commentary on the earnings call focussed on taking market share from the US telecom operators through Starlink; with USD600bn of sector revenues to target. Moreover, it aims to compete better in the broadband product across the globe and increase the enterprise revenues, especially in connected vehicles and maritime.
- **AI:** Aspires for its frontier model, Grok, to become the foremost model, alongside becoming the "best engineer globally". Second, the company is looking to start launching orbital datacentres as of next year in a trial phase. Commentary from the Q2 earnings call was for 10GW of compute by the end of 2027, with up to 20GW of non-GPU hardware also in place. The company expects to be at USD100bn ARR by the end of Q4.

As a reminder, HSBC doesn't expect 10GW by the end of 2027 (HSBCe c5GW), nor for orbital datacentres to be required or make economic sense in the near-term.

Longer-term

In addition to the above, SpaceX expects to create new categories of demand over time, fuelled by declining launch costs, more capable satellites, and the growth of large-scale computing. Although, the opportunities are in the nascent stage with uncertain pace and ultimate size. However, SpaceX believes they represent trillions of dollars' worth of economic value.

Long-haul point-to-point terrestrial travel: Starship's exceptional speed, reliability, and cost efficiency have the potential to reshape terrestrial commercial transport by reducing international long-haul journeys to under 30 minutes and enabling travel to almost any point on Earth in an hour or less, according to the company. Despite facing technical, economic, and regulatory hurdles, SpaceX believes it is well-positioned to capture share in terrestrial logistics and transportation.

- **Space tourism:** With the advancement of space technology and orbital flight infrastructure, SpaceX believes that access to space has the potential to create a new category of commercial human tourism, which has historically been limited to professional astronauts.
- **Passenger and cargo transport to the Moon and Mars:** Improvements in reusable launch systems and deep-space transport infrastructure have the potential to enable new forms of interplanetary logistics, including passenger and cargo transport to the Moon and Mars.
- **Energy production and manufacturing on the Moon and Mars:** A sustained human and industrial presence on the Moon and Mars would depend on reliable, large-scale energy. Potential approaches include solar power systems that rely on thin atmospheres, strong solar exposure, and advanced energy technologies. SpaceX believes that progress in planetary infrastructure could eventually enable manufacturing using locally available resources.
- **In-orbit manufacturing:** Orbital infrastructure has the potential to enable high-value production, free from constraints such as gravity, thereby unlocking improvements in precision and efficiency. Microgravity conditions may support advances in areas including pharmaceuticals, advanced materials, and semiconductors. In-orbit facilities could also draw on abundant, uninterrupted solar energy, supporting energy-intensive operations with improved sustainability.
- **Asteroid mining:** Asteroids may contain significant quantities of valuable resources (platinum-group metals, rare earth elements, nickel, cobalt, iron). With advances in reusable launch systems, autonomous robotics, and in-situ processing, SpaceX expects asteroid resources to become more accessible, eventually enabling a new category of commercial space resource extraction.

On what incentives is the CEO remunerated?

The company states in the S-1 filing that Elon Musk generally does not participate in any LTIPs (long-term incentive plans). However, as part of efforts to incentivise him to achieve the firm's long-term business objectives, the board granted him a performance-based award of restricted shares of Class B common stock in January 2026. The restricted shares vest upon:

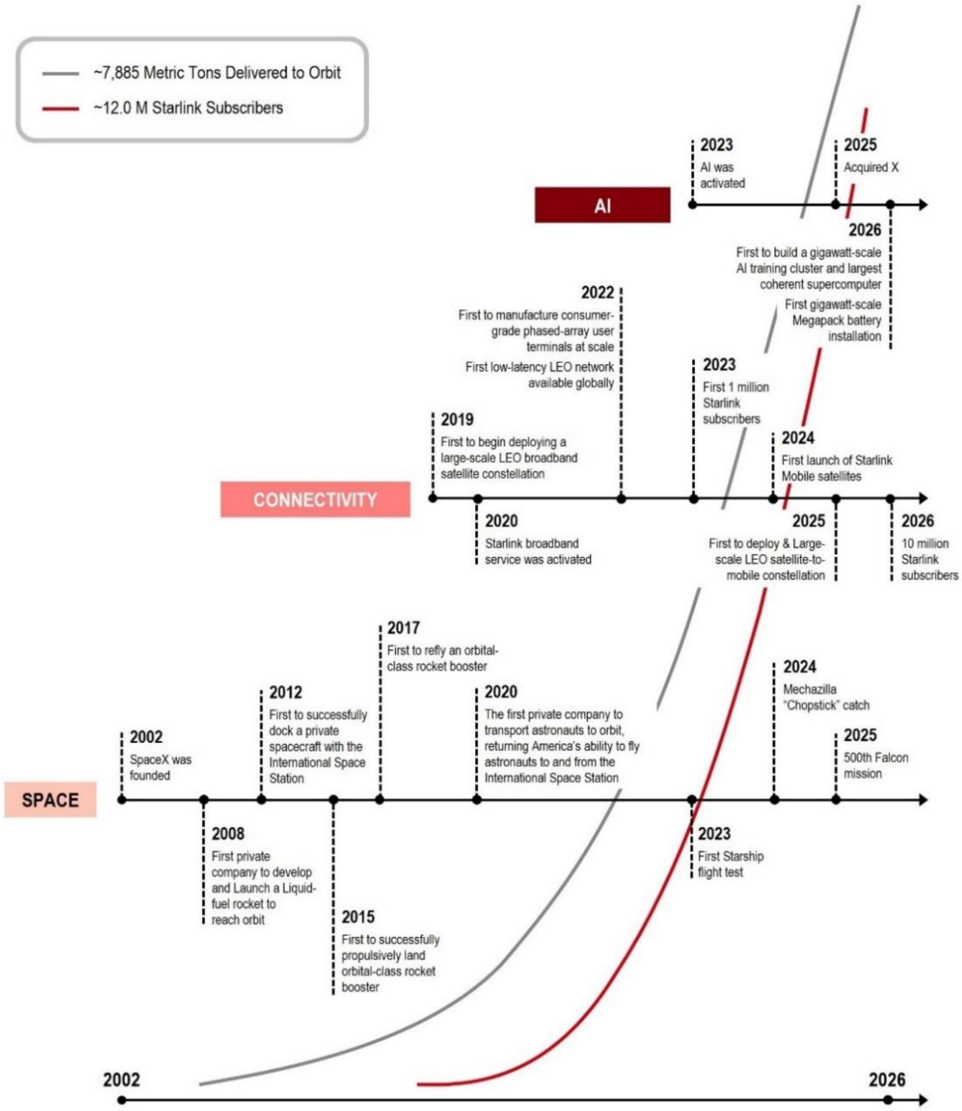
1. The company's achievement of specified market capitalisation milestones (up to USD7.5trn) across 15 equal tranches, and
2. The company's establishment of a permanent human colony on Mars, with at least one million inhabitants.

In connection with the xAI merger, the company assumed a performance stock award originally granted to Mr Musk by xAI in November 2025. It vests upon both:

1. The achievement of specified market capitalisation milestones across 12 equal tranches (up to USD6.6trn), and
2. The company's completion of non-Earth-based datacentres capable of delivering 100TW of compute per year.

The CFO's performance-based stock options vest for each USD10bn of adj. EBITDA added by the business.

SpaceX business history



Source: Company data, HSBC.

Sector layers

Telcos

- With Starlink serving ~12m broadband subscribers worldwide, SpaceX's IPO has raised market concerns about disruption…
- …but we see it as broadly complementary to traditional telcos
- Regulation, technological barriers, and (lack of) government support could limit Starlink's growth in the consumer space

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SpaceX: Connectivity (an introduction)

SpaceX's Starlink delivers global connectivity using a large low-Earth Orbit (LEO) satellite network, extending high-speed internet to underserved rural and remote areas. As of 30 June 2026, it operated about 10,200 satellites, serving roughly 12.0 million broadband subscribers across 167 markets. It also provides satellite-to-mobile texting and over-the-top voice services via partnerships with existing mobile companies to around 7.4 million monthly devices across 30 countries as of 31 March 2026.

Its core consumer product is satellite broadband aiming to offer fibre-like performance (of 1ms-20ms with 1Gbps speed vs Starlink's current performance of around 25 milliseconds median latency and ~225 Mbps median peak-hour download speeds), sold via monthly subscriptions plus an upfront terminal cost. The company plans to deploy next-generation V3 satellites from the second half of 2026 designed for ~1 Tbps downlink capacity per satellite and targets less than 20ms latency, with Starship expected to deploy up to 60 V3 satellites per launch.

Starlink also targets enterprise and government customers needing resilient connectivity for critical operations, remote sites, transport (aviation, maritime, rail), and disaster response. In mobile, the company partners with telecom operators to reduce coverage gaps, charging carriers via fixed or per-user fees that are typically passed on to customers as an add-on feature.

Geographies/countries most suited to Starlink services typically combine characteristics of: a) large, remote areas where terrestrial networks are commercially unviable or impractical to deploy; b) markets with low internet penetration are strong candidates, with satellite connectivity helping to close 'network dead zones'; and c) demand fuelled by enterprise needs for low-latency, high-speed connectivity with high resiliency. This may prompt adoption in developed markets as LEO providers strengthen domestic offerings without major investment in geostationary infrastructure.

1. What needs to happen on Earth first:

Starlink aims to increase revenues on four fronts: 1) gain more subscribers in residential broadband through faster connections delivered through their new satellite launches; 2) enter more commercial **partnership models** in mobile that are seen as **complementary**, rather than a substitute to traditional mobile offering; 3) launch its own competing mobile product to traditional mobile companies starting in the US, which requires more capable satellite launches (planned for 2027) and spectrum in all countries to launch direct-to-cell service; and 4) increase enterprise growth using their global coverage and resilience to their advantage.

Also, the customer's willingness to pay for the higher prices needs to increase as Starlink broadband prices are **~1.4x-3.5x** terrestrial broadband plans in several markets.

2. Earth developments needed to benefit:

Regulatory approvals/spectrum frameworks: Starlink needs more approvals from governments as well as regulators to operate their networks worldwide. They also need to improve their distribution network to increase their product reach, especially in the emerging markets. Examples of headwinds include the EU proposal to reserve **two-thirds** of mobile satellite spectrum for European-based firms, as well as country-specific ownership restrictions (e.g., South Africa **30%** local ownership requirement; Namibia **51%**).

Another key development is the need to integrate satellites into telecom operating models. Examples include Starlink acting as a backhaul for existing telecoms, a back-up connectivity partner where cellular reach is difficult, or in situations when networks become unavailable. Moreover, handset ecosystem needs to evolve to accommodate satellite communication similar to 5G service.

3. Impact of more data centres on Earth:

More AI/data usage increases demand for **resilient connectivity** (enterprise, critical ops, remote sites) – a tailwind for satellite as an "insurance layer" against fibre cuts/power outages/natural disasters.

4. Space developments needed:

Higher-capacity constellation upgrades: In broadband, Starlink **V3** targets a **~1 Tbps downlink per satellite**, with Starship expected to deploy **up to 60 V3 satellites per launch** (from 2H26) and aims to have a more competitive network to a traditional telecom company. In mobile, Starlink aims to deploy its second generation of satellites that provide higher data capability for the existing partnerships with MNOs. Starlink may also need spectrum approvals to launch its own direct-to-cell service.

5. Semiconductor developments help by:

Improving sat payload efficiency and inter-satellite explicitly links future demand to **optical comms ASICs** and **high-speed SerDes**.

6. Robotics developments help by:

Higher data consumption: Ubiquitous connectivity and data throughput help robots make decisions in real time. This could be a key future use case for Starlink.

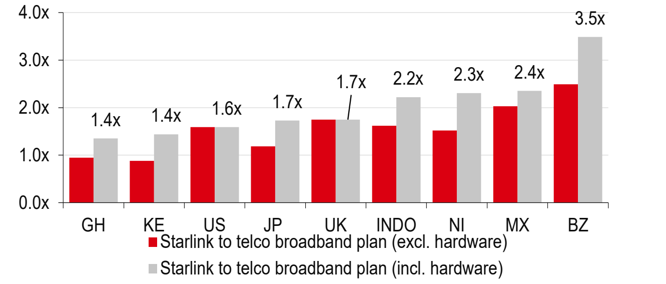
Robotics could also help indirectly by improving the cost of operating satellites. More capable in-orbit servicing reduces replacement frequency and improves constellation uptime.

Read-across for telcos

We see Starlink as a credible partner to traditional telcos in complementing their services by enhancing the reach beyond population centres. Traditional telcos already have strong population coverage but somewhat lacks in geographical coverage due to commercial viability across the geographies, especially in thinly populated and remote areas. However, as communication services have become integral to consumer lifestyle as well as business activities, a wider and pervasive network reach is the need of hour, in our view. We think Starlink could help telcos fill this geographical coverage gap without additional investment burden.

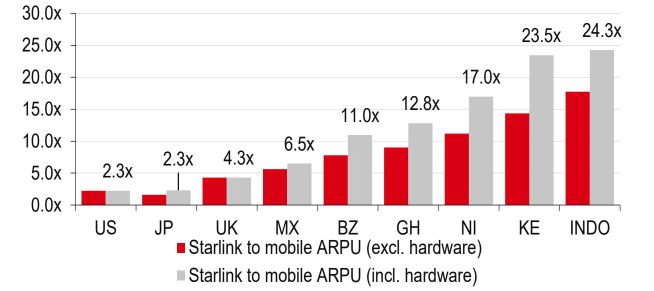
It is notable that Starlink benefits from its space-based links that are largely unaffected by terrestrial power outages, fibre cuts, or natural disasters, providing a resilient communications layer. This helps operators maintain customer connectivity during critical emergencies. In addition, LEO services can support direct-to-device (D2D) connectivity and improve resilience where networks are exposed to disruption from natural disasters (e.g., earthquakes) or cybercrime, enabling more secure communications for both dense urban centres and remote industrial sites.

Starlink plans are 1.4x-3.5x the telco broadband plans in several key global markets



Source: Company data, HSBC

Starlink plans are 2.3x-24.3x the mobile ARPUs in key global markets



Source: Company data, HSBC

MX-Mexico; BZ-Brazil; KE-Kenya; NI-Nigeria; GH-Ghana; US-US; UK-UK; JP-Japan; INDO-Indonesia

4. **Quality of spectrum:** Starlink uses Ku (11-16GHz), Ka (17-30GHz), and E-band (71GHz-86GHz) for data transmission. Each Starlink satellite has five advanced Ku-band phased array antennas and three dual-band (ka-band and E-band) antennas. Ku and Ka band is used for data transfer between satellite and ground terminals (user and ground station). E-band is used for backhauling. New and more capable satellites also use V-band (37.5-52.4GHz) for data transfer. These high frequency bands provide healthy network capacity (throughput) but only for short distances. Moreover, it broadly works on clear line of sight (LOS) and offers weaker coverage and high latency, hence producing a less reliable network. We think that if Starlink intends to become a full-scale telecom competitor, it may need to secure spectrum rights across multiple jurisdictions, which could be another challenge due to different regulatory approaches across the markets.

How Starlink could fit with telcos

Based on recent commentary from telcos, we do not see Starlink as a threat or a competitor but rather as a potential collaborator that can complement their offering and reach. Over the past few years, Starlink has entered D2C partnership arrangements with various telecom players like T-Mobile in the US, Telstra in Australia, Airtel Africa across 14 African markets, KDDI in Japan, Globe in the Philippines, Entel in Chile/Peru, DT in 10 markets, and MTN Group in Zambia. We see continuation of this trend and limited scope of any hostile competition between telcos and Starlink, based on current technology.

We highlight the potential risks and opportunities for telecom sectors by region in our note: *Global Ex-Asia Telecoms: Extra-terrestrial risks and opportunities*, 30 July 2026.

How telcos see competition from Starlink and satellite companies

Operator	Impact from satellites
AT&T	Continues to view satellite as an important complementary role in connecting customers, but doesn't think satellite is a substitute for the speed, reliability and capability of assets.
T-Mobile US	Sees no effective way for [satellites] to compete with a terrestrial network. Limited by the laws of physics.
Verizon	Sees satellite as a complementary service and very hard to compete with terrestrial networks.
AMX	AMX stated in their 2026 investor day that they are looking at partnerships with satellite companies. While they are watching satellite companies' potential to turn as competitors closely, they do not see it as a likely scenario.
Megacable	Satellite does not compete significantly in Mexico and satellite offerings are targeted at more rural areas than urban areas. They also have a much higher price.
Telefonica Brasil	Most of the current broadband net adds for Starlink are in areas that are not connected well and do not see any major competitive concerns.
Entel	Partnered with Starlink to launch direct-to-cell service in Chile and Peru. Around 10% of customers porting into Entel said they choose Entel specifically because of Starlink in 1Q26. Starlink has a very strong value not only in upselling plans, but also in attracting new customers.
Airtel Africa	Airtel Africa became the first African MNO to partner with Starlink, initially launching enterprise and backhaul solutions in May 2025 and planning to expand to D2C services across 14 markets. The initial rollout supports basic data for selected applications and text messaging in remote areas, positioned as a failover rather than a replacement for Airtel's existing network. Management noted they are actively engaging with regional regulators, and deployment will proceed in line with country-specific regulatory approvals.
MTN Group	MTN Group is incorporating satellite technology into its strategy to extend connectivity to underserved communities. MTN's strategy with satellite providers varies by geography and corresponding operating conditions. In some markets, it is in partnerships for backhaul, and in some countries, it compares with satellite operators. In Zambia, MTN completed field testing of direct-to-cell service from Starlink and aims to commercialise it soon. While terrestrial network rollouts and OpenRAN partnerships remain the primary growth levers, MTN plans to run pilot projects using LEO satellite connectivity to complement its existing infrastructure. The group is taking a technology-agnostic approach, deploying the solutions that best enable monetisation while delivering reliable service to African households and businesses.
Mobily	Mobily has introduced D2C services but states that the immediate domestic impact of LEO D2C services in Saudi Arabia will remain limited as domestic approval for these satellite connections is currently restricted primarily to the aviation and maritime sectors. Mobily maintains that traditional terrestrial 4G and 5G networks will continue to deliver superior capacity, latency, and cost efficiency for mass-market usage vs emerging LEO alternatives.
STC	Rather than focusing solely on D2D consumer applications, STC Group is pursuing comprehensive, multi-orbit satellite strategy aimed at enterprise and advanced communication solutions. It has signed a strategic agreement with Telefónica Global Solutions (TGS), the global business arm of the Spanish telecom. This will enable STC to develop and offer customized connectivity services that span across LEO, medium earth orbit (MEO), and geostationary orbit (GEO) networks, ensuring flexible coverage options for diverse enterprise requirements.
Vodafone	"We look at satellites and they offer from satellites as something that is complementary to the offer we have right now in the market […] We think that terrestrial networks will always have a role to play and those will be the fastest and the most reliable to provide the services that our customers."
Deutsche Telekom	DTE see that 99% of the traffic is terrestrial traffic and will not be substituted, nor it will even be able to be handled from a satellite service.

Source: Company data, HSBC

Use cases

1. **Enterprise Mobility excluding connected cars:** We see strong potential total addressable market (TAM) in mobility segment with focus on providing internet for airlines, cargo ships and on highways where traditional terrestrial connectivity is currently a challenge.

2. **Backhaul capacity, Enterprise back-up and failover connectivity:** We believe that Starlink could provide backhaul capacity, especially in areas where telcos have historically been reluctant to deploy investment for commercial reasons. While companies may prefer the terrestrial networks for connectivity, satellite connectivity could provide an additional layer of security with Starlink providing back-up and failover continuity.

3. **Fixed B2B connectivity market:** Starlink serves a broad fixed-site customer base across industries such as retail and financial services that require high availability for critical operations as well as reliable connectivity in remote or hard-to-serve locations.

4. **Government organizations/Military:** For government customers, Starlink provides connectivity services for public services, social impact, humanitarian efforts, and disaster response in even the most remote environments. Separately with Starshield, Starlink developed a secure, dedicated satellite network designed specifically for United States Government customers and national security applications. In May, US Space Force selected SpaceX for two major contracts, one of which is to build a space data network backbone worth USD2.3bn. However, Starlink/military partnership could also raise concerns among other nations around neutrality and safety of sovereign data, in our view.
5. **Remote area connectivity:** One of the biggest advantages of Starlink is that it can bypass geographic barriers such as mountainous terrain and rural areas to offer connectivity without deploying expensive terrestrial network. One recent example is in Kenya, where Airtel Africa tested Starlink Mobile in areas with terrestrial no connectivity to allow users to access calling, navigation, and financial transactions in remote locations.

Geographical presence and service offering

Starlink offers fixed broadband in 167 markets, covering more than 3.3bn people (41% of the 8bn global population and 51% of the 6.4bn population excluding China and Russia).

Starlink vs fixed broadband vs mobile: Comparison of speed and latency

Technology cycle	Starlink			Fixed Broadband			Mobile				
	V1	**V2 Mini**	**V3***	**vDSL**	**Cable**	**Fiber**	**2G**	**3G**	**4G**	**5G**	**6G****
Speed	50 to 100Mbps	Up to 475Mbps; 225Mbps during peak hours	Aiming for more than 1Gbps	Maximum of 350Mbps	Up to 1Gbps with 10Gbps theoretical limit	Up to 10Gbps but higher in enterprises	15-200kbps on average	1-8Mbps on average	15-100Mbps on average with theoretical maximum of 1Gbps	100-500Mbps with theoretical maximum of 20Gbps	Theoretical maximum of 1Tbps
Latency	more than 60ms	25ms to 60ms	Less than 20ms	20ms to 50ms	10ms to 25ms	1ms to 20ms	200ms to 1000ms	100ms to 300ms	20ms to 50ms	1ms to 20ms	Theoretical latency of less than 1ms

Source: Various sources, HSBC; * V3 is yet to launch; ** 6G standards are not yet defined.

We see different target markets with different success rates

We don't expect Starlink to succeed uniformly across the markets due to existing penetration of traditional telecom services (especially in urban pockets), income levels, and regulatory barriers. For these reasons, target market size for Starlink would be less than total population of the country, in our view. Some markets are expected to remain inaccessible or offer limited access (in few segments) to Starlink due to stricter regulatory environment or tighter government control on telecom services (such as China and Russia). From an income level perspective, we see less connected users in high-income economies like United States, United Kingdom, Australia, Japan, and South Korea as strong target markets. Based on our analysis (read: *SpaceX: Initiate at Hold*, 23 July 2026), we see healthy scope for Starlink in markets like Bangladesh, Indonesia, Philippines, Egypt, Angola, Mexico, Ivory Coast, Vietnam, South Africa, Colombia, Algeria, Iraq, and Ukraine.

Some recent telco-Starlink partnerships globally

We have seen several partnerships between telecom players and Starlink/other satellite companies globally. Below we highlight some of the key telco-Starlink partnerships as well as the company's positioning/potential in some of the major markets.

- In **Zambia**, **MTN** completed field testing of D2C service from Starlink ar commercialise it soon.

- **Entel** partnered with Starlink to launch D2C service in **Chile and Peru**. Around 10% of customers porting into Entel said they choose it specifically because of Starlink in 1Q26. As per management, Starlink has a very strong value not only in upselling plans, but also in attracting new customers.
- **Airtel Africa** was the first African MNO to partner with Starlink, initially launching enterprise and backhaul solutions in May 2025 and planning to expand to D2C **services across 14 markets**. The initial rollout supports basic data for selected applications and text messaging in remote areas as a failover to AAF's network. Management is engaging with regional regulators, and deployment will proceed in line with country-specific regulatory approvals.
- In October 2025, **STC Group** announced a 10-year agreement with **AST SpaceMobile (ASTS)**, a peer of Starlink, with a total contract value that could exceed 9% of 2024 revenues (i.e. more than USD1.8bn). As part of the agreement, STC committed a USD175m prepayment. The final contract value is dependent on transaction volumes; STC will receive a percentage of the revenues generated from use of the services. Commercial services are expected to launch in 4Q26, subject to regulatory approvals. Under the agreement, the partnership covers STC's core Saudi market. In addition, ASTS granted STC exclusive rights in Libya, Syria, Lebanon, Djibouti, Tunisia, and Sudan, as well as preferential rights in Kuwait, Oman, Yemen, Bahrain, Jordan, Iraq, Algeria, Morocco, and Egypt (subject to availability).
- **Optus** (in **Australia**) and Starlink are working to expand mobile coverage across Australia using direct-to-mobile satellite technology. They plan to launch with text messaging first, then add voice and basic data as testing progresses.
- Starlink is not commercially live in **India** yet. It has secured its IN-SPACe license to launch commercial operations in July 2025, but spectrum allocation and other clearances remain pending. In March 2025, both **Bharti Airtel** and **Jio** signed deals to explore reselling of Starlink equipment through their retail outlets – subjected to SpaceX receiving its own authorizations to sell its services in India.
- In May 2024, **PT Telkom's** (in **Indonesia**) subsidiary 'Telkomsat' became an authorized Starlink reseller in Indonesia and has previously collaborated with Starlink to provide backhaul services to improve internet broadband connectivity, especially 4G cellular broadband connectivity in rural areas throughout Indonesia.
- Starlink launched in **Japan** in 2022, and it provides fixed residential, roam, business, and maritime plans. Moreover, Starlink has been providing telecom operators with mobile backhaul service since 2022. Carriers also resell Starlink terminals and service to enterprise customers. Japan has near-ubiquitous FTTH, so Starlink is not a mainstream urban broadband substitute. However, Japan's geography (with many mountains and islands) and natural disaster recovery needs give satellite connectivity resilience value. Thus, **all three of Japan's major telcos** have adopted Starlink D2C technology in a B2B2C model, covering 100% of Japan's landmass and territorial waters and enabling a significant portion of their paid subscribers to access Starlink.
- **Telekom Malaysia** (in **Malaysia**) has partnered with Starlink to support rural and enterprise connectivity.
- **Globe Telecom** (in **Philippines**) has partnered with Starlink providing direct-to-cell LTE connection to bridge coverage gaps and backup during extreme weather events.

- **PLDT's** (in **Philippines**) enterprise division reselling Starlink services to its enterprise customers. This service is useful for industries in remote or underserved areas, or those requiring backup connectivity. It is useful in sectors such as logistics, banking, agriculture, disaster response, education, etc.
- **Singtel** (in **Singapore**) enhances its maritime digital offerings by integrating Starlink's satellite connectivity, aiming to accelerate adoption of digital solutions among ship owners and operators.
- Starlink officially launched its residential plans in **South Korea** in December 2025, priced much higher than Korea telcos' 5G unlimited data plans. In the B2B side, **KT Corp** and **SK Telecom** have secured contracts with Starlink to serve clients in remote areas such as maritime shipping fleets.

Tech Hardware & Semis

- SpaceX's plans for integrated semi manufacturing, satellites capable of hosting cloud services, and in-space chip manufacturing…
- …could, if successfully delivered, upend paradigms for data centre hyperscalers and chipmakers
- Likely initial focus on access to skills and materials could exacerbate competition for resources and supply chain vulnerabilities

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Impact on the semiconductor sector

SpaceX's successful execution of its roadmap would represent a fundamental shift for the semiconductor sector, moving the industry from a reliance on terrestrial infrastructure to an integrated orbital ecosystem. By achieving its goals for Starship reusability, Starlink V3, and orbital AI compute, SpaceX is positioning itself not just as a launch provider but as a vertically integrated semiconductor and infrastructure powerhouse that could disrupt 5G telecommunications and challenge traditional data centre hyperscalers.

1. What needs to happen on Earth first:

SpaceX needs to secure uninterrupted, multi-billion-dollar supply chains, particularly for extreme ultraviolet (EUV) equipment, ultra-pure chemicals, and silicon wafers.

The domestic engineering talent deficit in high-end chip architecture, node scaling, and advanced packaging needs to be solved.

2. Earth developments needed to benefit:

Heavy semiconductor fabrication infrastructure, such as advanced wafer fabs and advanced packaging facilities, need to be built out.

3. Impact of more data centres on Earth:

More data centres on Earth fighting for limited supply capacity – particularly advanced foundry, advanced packaging, memory, and substrates – would create severe supply chain vulnerability.

4. Space developments needed:

Achieving a vertically integrated semiconductor model tailored for space-based data centres will require a fundamental shift in how microelectronics are conceived, manufactured, and tested.

- Scaling orbital manufacturing platforms capable of leveraging microgravity and ultra-clean high-vacuum environments.
- Developing proprietary chip architectures and packaging techniques that achieve high-performance computing density without suffering from single event effects (SEEs) caused in space.
- Developing solutions to enable cooling of high-power semiconductors in space.

- Developing packaging technologies that can withstand extreme temperature swings from direct sunlight or deep-space shadow.

5. Semiconductor developments help by:

Advancements in semiconductor technology and SpaceX's vertical integration initiatives are critical enablers for SpaceX's long-term ambitions. SpaceX's evolution from a pure launch provider into an orbital compute titan relies heavily on custom, highly efficient silicon.

6. Robotics developments help by:

Integrating robotics into SpaceX's vertically integrated semiconductor ambitions, such as Terafab, would serve as a critical catalyst for scaling production, optimizing precision, and achieving economic viability.

Terafab initiative

Terafab is a joint venture between SpaceX, Tesla, and xAI to develop a massive, vertically integrated semiconductor fabrication facility (fab) that aims to consolidate every stage of chip production under one roof. If the Terafab initiative succeeds, it would represent one of the most significant paradigm shifts in the semiconductor industry. By attempting to consolidate the entire chip-making value chain – design, logic fabrication, memory, packaging, and testing – under one roof, SpaceX is challenging the current model.

If successful, it could impact the semi-industry in the following ways:

- **Shift from horizontal to vertical integration:** The current industry standard is disaggregated – for example, NVIDIA would design chips using ARM IP, use foundry partners like TSMC to fabricate the chips, who then send chips to third parties for packaging and testing. Terafab aims to bring every step into a single facility. If successful, other companies may seek to replicate this model to ensure supply security.
- **Rapid prototyping and iteration:** By eliminating the logistical delays of shipping components between different specialized facilities, Terafab could theoretically reduce the time it takes to go from a design iteration to a function chip.
- **Reduced dependence on incumbents:** Successful implementation of the Terafab initiative would reduce their dependence on incumbents and motivate other big tech conglomerates to replicate this, leaving the incumbents exposed to order cuts.

Orbital inference

The concept of "orbital inference" represents a significant shift in satellite architecture – moving AI processing from ground-based cloud servers directly to satellites in orbit. If SpaceX succeeds, it would require a fundamental evolution in how semis are designed and manufactured.

- **Creation of a space-grade commercial market:** Traditionally, space-rated semis have been expensive, specialized, and generations behind terrestrial chips because they prioritize extreme radiation hardening over performance. If SpaceX succeeds in orbital AI inference, it will force the semi-industry to define a new performance tier – LEO (low earth orbit) optimized silicon. This could be a middle ground between fragile consumer-grade chips and expensive radiation-hardened processors.
- **Edge AI acceleration:** The industry could see a surge in demand for edge-compute inference accelerators as latency in orbit is sensitive and data bandwidth to earth could be a bottleneck. This could bleed back into the terrestrial market, potentially accelerating the development of highly efficient edge-AI chips.

- **Impact on high-throughput networking:** Traditional satellite constellations are mostly high-bandwidth “pipes.” Traditional satellites act as flying relay stations or "mirrors in the sky". They receive a signal from a ground station, amplify it, change its frequency, and beam it down immediately to another location. If inference occurs on orbit, the satellite would become an intelligent node. To make this work, satellites must communicate at high speeds with one another (mesh networking in space). This could create specialized demand for optical communication ASICs (application specific integrated circuit) and high-speed SerDes (Serializer/Deserializer) chips that can handle multi-gigabit throughout between satellites, independent of ground-based gateways.

In-space manufacturing facilities

SpaceX aims to establish in-space manufacturing facilities that leverage the unique microgravity conditions of space. If SpaceX is able to extend this vision, it likely wouldn’t replace terrestrial fabs but create a specialized “super-fab” sector for the most demanding applications.

Here’s how in-space semiconductor manufacturing could impact the industry:

- **Superior crystal quality (the microgravity advantage):** On Earth, gravity causes currents and sedimentation in molten materials, which inevitably introduces microscopic defects into crystal structures. In microgravity, these gravity-driven forces are absent. Therefore, semiconductors could reach a level of purity that is impossible to achieve on earth.
- **Focus on wide bandgap (WBG) materials:** WBG materials like gallium nitride (GaN), silicon carbide (SiC), etc. are critical for high-power, high-frequency applications like 5G/6G infrastructure, EVs and radar. They are difficult and expensive to grow perfectly on Earth as they require extreme heat and precise conditions. If these could be grown in space, manufacturing of more efficient power electronics and communications hardware would be possible.
- **Space-grade chips built in space:** Currently space-grade chips are subject to expensive radiation hardening processes. If they could be built in their target environment in space, integration of materials and architectures optimized for high-radiation, high-thermal stress environments could be done at the atomic level.

Technology

- If SpaceX delivers on its vision, we could see near-term capex cost inflation for data centers in space helping hardware suppliers
- As Terafab and "data centers in space" visions are realized, a large surplus of semiconductor and power capacity may emerge
- The GPU cloud infrastructure market could become even more competitive; pressuring returns, but offset by expanded tech TAM

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Could drive an overcapacity in cloud infrastructure

Our understanding is that SpaceX intends to eventually launch 100GW of compute capacity into space every year. However, we estimate global incremental compute demand of less than 50GW per annum by 2030e. Thus, adding 100GW of compute capacity into space along with other capacity expansion on Earth could create a surplus of compute capacity.

1. What needs to happen on Earth first:

Terrestrial adoption needs to keep pulling the stack forward: partnership models and operating integration (e.g., satellites as complementary infrastructure), and rapid scaling of terrestrial compute (SpaceX cites COLOSSUS first cluster online in 122 days and COLOSSUS II in 91 days, versus an industry benchmark of ~2 years for a 100MW greenfield data centre). This is what industrialises the supply chain and proves the unit economics before space-scale ambitions become bankable.

2. Earth developments needed to benefit:

- Build-out and integration of the enabling ecosystem: chips, networking, cooling, power distribution, and operating workflows.
- The Terafab concept (a vertically integrated fab spanning design → fabrication → packaging/testing) is framed as a potential industry shift, accelerating iteration and reducing dependence on incumbents.
- Continued maturation of commercial models that monetise connectivity and compute (so deployment is funded by real demand rather than "blue-sky" projections).

3. Impact of more data centres on Earth:

More space-based capacity is both a catalyst and a stressor:

- New at-scale space-based AI compute has the potential to accelerate global AI adoption while reducing costs. Current AI compute supply is far exceeded by demand and is growing exponentially faster than Earth-bound buildouts due to several technology bottlenecks.
- To avoid bottlenecks, one of SpaceX's reasons for going extraterrestrial, is to avoid the energy bottleneck on Earth. In our coverage initiation report on SpaceX (23 July 2026), we note SpaceX's near-term ambition to launch 100GW of solar-powered compute into space per year.

- However, we estimate incremental global AI data center demand at <50GW p.a. by 2030e, suggesting the potential for long-term surplus/price pressure on existing earthbound AI compute if SpaceX's internal needs prove to be less than they build.
- Meanwhile back on Earth, rising levels of near-term capex are already tightening supply chains. As stated in our *CloudNomics* (6 August 2026), we expect that hyperscalers may invest >USD1trn p.a. starting in 2027e, and warn that SpaceX overbuilding could further stress component, power, and skilled labor shortages in the near-term.

4. Space developments needed:

- A shift from satellites as "pipes" to "intelligent nodes" via orbital inference, plus higher-capacity constellations (e.g., Starlink V3 targeting ~1 Tbps downlink per satellite and up to 60 V3 satellites per Starship launch from 2H26).
- Economics gates: lower launch costs/cadence (Starship targets USD100-300/kg to LEO at scale) and solving operational constraints like maintenance and thermal/heat dissipation for orbital compute (noted as "still a lot to figure out").
- Longer-dated: if "data centres in space" scale, it increases the need for spacefaring robots to maintain assets that could be worth "tens of trillions of dollars" (per the report's framing).

5. Semiconductor developments help by:

- Creating a new performance tier: "LEO-optimised silicon" (between consumer-grade and radiation-hardened) to make orbital inference viable.
- Enabling edge-AI accelerators because bandwidth/latency back to Earth can be a bottleneck.
- Powering high-throughput mesh networking in space via optical comms ASICs and high-speed SerDes.
- Potentially expanding the addressable market through microgravity manufacturing (the report highlights superior crystal formation/material properties and points to wide bandgap materials such as GaN and SiC as candidates).

6. Robotics developments help by:

- Making the "real" space economy operational: robotics is the gating layer for on-orbit servicing (inspection, refueling, repairs, upgrades, debris removal), shifting satellites from single-use assets to maintainable infrastructure.
- Supporting later-stage ambitions (in-space assembly/manufacturing; eventually resource extraction), where autonomy is required because of limited real-time human control.
- Creating a new market if orbital compute scales: maintenance robots become a necessity, not a nice-to-have – turning uptime and servicing capability into part of the core economics of space-based infrastructure.

Apart from the increased operational risks from space-based data centers over time, a more rapid expansion of terrestrial data centre capacity could result in near-term overcapacity in the cloud infrastructure market. In fact, SpaceX does indeed have a track record of building terrestrial compute infrastructure at a rapid pace, and further expansion into space could happen more rapidly than markets anticipate. SpaceX claims it brought COLOSSUS first cluster online in 122 days and COLOSSUS II first cluster online in 91 days, versus an industry benchmark of ~2 years to bring online a 100MW greenfield data centre. Therefore, while many investors may see SpaceX's plans for space-based data centers as far out over the horizon, given Mr. Musk's track record we see a much more near-term deployment, but having a somewhat delayed impact to market dynamics.

As explained in *Emerging competition highlights low barriers to entry* (3 July 2026), the entry of another well-funded player with an excellent operational track record is likely to create increased competition for neo-clouds and GPU focussed clouds including CoreWeave, Nebius, and Oracle Cloud Infrastructure. Moreover, a substantial portion of Microsoft Azure and Amazon AWS are also exposed to GPU-focussed cloud infrastructure market and could face increasing pricing pressure. GPU focussed clouds have suffered from weak asset turnover and ROIC, which could face additional pressures if SpaceX adds significant overcapacity.

However, with many GPU contract durations matched to GPU life-expectancy and with exponential AI demand growth continuing for the foreseeable future, we see material adverse impacts of these competitive dynamics as occurring over more of a five- to ten-year timeframe. At the same time, AI is just now working its way into the day-to-day operations of the world's global businesses, and we see demand growth gaining momentum over the next five years. Thus, although we are watching space-based data centers carefully, we think it's too early to judge whether capacity will exceed demand even with a rapid rollout into space.

Cloud infrastructure providers: Asset turnover, non-GAAP operating margin and ROIC

USDm, FYE Dec	2023	2024	2025	2026e	2027e	2028e	2029e	2030e
Asset turnover: Gross assets, ex wip and including leased assets								
Oracle: OCI	26.9%	29.6%	24.4%	20.9%	22.7%	26.2%	28.3%	29.1%
Amazon: AWS	100.6%	85.8%	66.7%	51.4%	41.4%	37.0%	35.7%	36.4%
Google Cloud	NA	NA	NA	NA	NA	NA	NA	NA
Microsoft*	38.9%	37.8%	37.5%	36.7%	36.2%	35.1%	34.3%	33.6%
CoreWeave	NA	NA	22.8%	23.5%	25.8%	26.8%	26.8%	26.7%
Non-GAAP operating margin								
Oracle: OCI*	17.6%	21.6%	25.7%	29.1%	29.5%	30.2%	31.0%	31.4%
Amazon: AWS	36.7%	45.1%	43.1%	44.4%	44.7%	45.0%	44.4%	43.9%
Google Cloud**	5.2%	14.1%	23.7%	35.1%	35.6%	35.6%	NA	NA
Microsoft*	39.0%	39.5%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
CoreWeave	0.3%	18.6%	13.0%	6.9%	14.2%	16.4%	15.5%	15.1%
ROIC (Non-GAAP EBIT/Gross assets, ex wip and including leased assets)								
Oracle: OCI	4.7%	6.4%	6.3%	6.1%	6.7%	7.9%	8.8%	9.1%
Amazon: AWS	36.9%	38.7%	28.8%	22.8%	18.5%	16.7%	15.9%	16.0%
Google Cloud	NA	NA	NA	NA	NA	NA	NA	NA
Microsoft	15.2%	15.0%	15.0%	14.7%	14.5%	14.0%	13.7%	13.5%
CoreWeave**	NA	6.5%	3.9%	2.1%	4.7%	5.6%	5.2%	4.9%

Source: Company data, HSBC estimates. Note: *Even historical numbers are estimated by HSBC. **ROIC rises to high single digits if we include the effect of customer advances.

Increased competition for semiconductor manufacturers

SpaceX has stated its intent to manufacture one terawatt worth of compute hardware every year as part of its Terafab initiative – surpassing 100GW per annum of compute capacity they aim to launch into space. This suggests that it could sell significant compute hardware to Earth-based third parties, intensifying competition. Even if they limit their hardware sale to third parties, they could still offer the compute capacity on rent from SpaceX's cloud offering, which could reduce demand for traditional semiconductor manufacturers.

Increased cost push for capex in the short run

We expect existing hyperscalers to invest more than USD1trn per annum starting 2027e. SpaceX AI segment capex of USD12.7bn in 2025 was c3% of total hyperscaler capex. However, as SpaceX accelerates its capacity build out and benefits from increased availability of funding post IPO, it could exacerbate shortages of components, power, and skilled labour in the short run. In the long run, the effect could be the reverse as Terafab eases semiconductor availability and space-based data centers obviate the need for power, water, earthly real estate, etc.

High and rising data centre capex even before SpaceX joins/leads the bandwagon

CY	2022	2023	2024	2025	2026e	2027e	2028e
Capex (USDm)							
AWS	30,402	31,000	52,638	94,860	165,537	214,503	219,688
Google	31,485	32,251	52,535	91,447	205,000	250,000	312,500
Oracle	6,678	6,935	10,745	35,477	80,128	110,000	110,000
CoreWeave	72	2,943	8,702	10,309	38,675	36,246	28,675
Microsoft	28,400	41,200	75,600	118,000	192,900	252,000	283,800
META	31,186	27,045	37,256	69,691	133,395	137,384	137,384
Total Big 6	**128,223**	**141,374**	**237,476**	**419,785**	**815,634**	**1,000,133**	**1,092,046**
Capex (y-o-y)							
AWS	73.8%	2.0%	69.8%	80.2%	74.5%	29.6%	2.4%
Google	27.8%	2.4%	62.9%	74.1%	124.2%	22.0%	25.0%
Oracle	114.2%	3.8%	54.9%	230.2%	125.9%	37.3%	0.0%
CoreWeave		3,964.9%	195.7%	18.5%	275.1%	-6.3%	-20.9%
Microsoft	3.3%	45.1%	83.5%	56.1%	63.5%	30.6%	12.6%
META	68.0%	-13.3%	37.8%	87.1%	91.4%	3.0%	0.0%
Total Big 6	**40.4%**	**10.3%**	**68.0%**	**76.8%**	**94.3%**	**22.6%**	**9.2%**

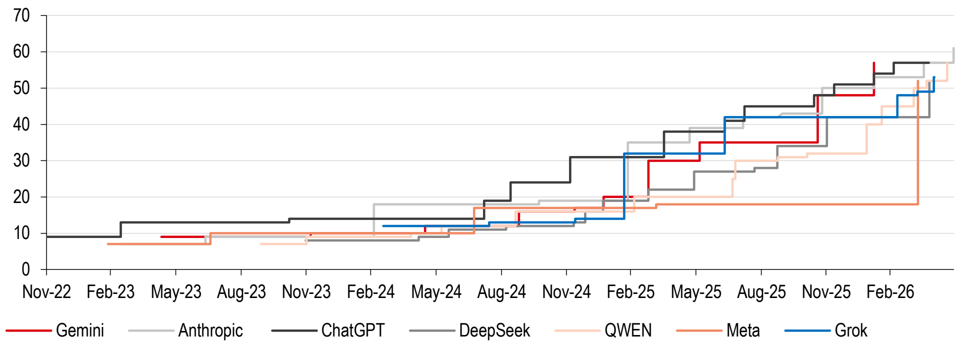
Source: Company data, HSBC estimates

Increased commoditization of LLM models

The availability of compute capacity is the single most important constraint to building better and newer LLM models. Abundant and cheap compute capacity could create hypercompetition among LLM providers, potentially weakening their pricing power. Software companies do have user lock, but they also have the option of switching from one LLM model to another in order to reduce cost/performance and may be able to retain a larger portion of AI value creation, improving margins.

Even before the introduction of SpaceX capacity, the capabilities of various LLM models are converging. Open source models were often able to match the performance of frontier models with a lag of just a few months; however, added SpaceX compute capacity could end up accelerating that trend if more compute is available to open source models.

"Intelligence" score of various LLM model



Source: Company data, HSBC estimates

Intensification of ASIC race

If SpaceX's Terafab initiative begins to bear fruit, it may force other hyperscalers to redouble their efforts at backward integration into ASIC accelerators. The announced plans from SpaceX far exceed any such plans from hyperscalers and could serve as a catalyst for the industry. If SpaceX is able to marshal cheaper chips from Terafab and improve its access to AI chipsets, then it could also jeopardise the hyperscalers' ability to compete effectively in the cloud infrastructure space.

Increased TAM widely across the technology stack

Success for SpaceX could unlock an increased TAM for the wider technology stack.

- The combination of Starlink and space-based data centers can offer internet connectivity and easy/cost effective access to AI servers to underserved areas and people, potentially increasing the consumption of electronic devices, enabling software, AI, social media, etc.
- According to SpaceX: "The microgravity environment of space fosters innovative advancements in key industries, such as pharmaceuticals – where it enhances drug solubility, purity, crystallization, and stability – as well as, advanced materials and semiconductors, allowing for superior crystal formation and material properties unattainable on Earth". Consequently, space-based manufacturing could enable new, superior/cheaper products that make up the US Tech supply chain, lowering tech product costs and widening demand.
- One of the key issues in deploying data centers in space is the inability to carry out maintenance operations on in space at extreme distances. It is plausible that as hundreds of gigawatts of compute capacity, worth tends of trillions of dollars, are deployed in space, there will be an increased need for the deployment of spacefaring AI driven robots capable of maintaining space-based data centers. This could open another new space robot market that could be sizable, in our opinion.
- As space launches become cheaper, we think that more countries would likely look to deploy largely AI-driven defense systems in space, especially in areas such as long-range missile shields. This could increase the demand for related technology hardware and software.
- Significant space-based data centers could also result in sharp demand for wireless, preferably quantum safe communication tools and services.

Transport & Logistics

- Starlink's low-latency, high-bandwidth LEO network closes connectivity gaps across oceans, deserts, and rural road corridors
- It enables always-on ship-to-shore connectivity, improving crew welfare, remote maintenance, and operational efficiency
- Inflight connectivity elevates passenger experiences, redefines new competitive edge, while also supporting more timely cargo updates

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Solving the industry pain points

Starlink is SpaceX's low-Earth-orbit (LEO) satellite internet system. Unlike traditional geostationary (GEO) satellites, which operate at roughly 36,000 km above the Earth, Starlink satellites orbit at around 550 km. This dramatically shortens the signal path, enabling lower latency and higher bandwidth. Starlink ultimately plans to deploy up to 42,000 satellites, providing broad global coverage including remote regions and open-ocean areas that are difficult for conventional communications infrastructure to reach.

For transport and logistics, a long-standing pain point has been the lack of stable, high-speed, affordable connectivity in mobile and remote environments. Whether it is vessels crossing oceans, railways running through deserts and sparsely populated areas, or trucks travelling on rural motorways, connectivity dead zones reduce operational efficiency, increase safety risk, and drive up management costs. Starlink is beginning to change this dynamic. The sections below review its real-world impact across four verticals: maritime, aviation, rail, and trucking.

1. What needs to happen on Earth first:

The key terrestrial prerequisite is about the operating standard. Always-on connectivity has to become the default assumption behind how fleets are run so that continuous asset visibility, real-time diagnostics, remote support, and digital workflows don't pause when the vehicle leaves terrestrial coverage.

Where this shift is implemented properly, it changes day-to-day operations: maintenance becomes condition-based rather than schedule-based, incident response becomes faster and more evidence-led, and performance management moves from periodic reporting to continuous optimisation. The proof point is adoption at fleet scale where once leading operators retrofit hundreds of assets, satellite connectivity becomes a baseline capability and a competitive differentiator for those who get there first. This shift is already happening at meaningful scale: Maersk has equipped more than 330 vessels; while as of early 2026, over 2,500 aircraft globally, across various companies, had been retrofitted with satellite internet.

2. Earth developments needed to benefit:

Beyond installing terminals, the critical development on Earth is tight integration into enterprise systems. Satellite connectivity needs to be embedded into predictive maintenance platforms, cloud migration and data platform strategies, and remote inspection workflows to unlock its full operational and financial value. In trucking and telematics, the market has already produced productised solutions that demonstrate commercial viability. EpicVue, for example, offers 99.9% coverage across the US and Canada at USD99 per month for 250GB of data. That pricing and coverage profile suggests the infrastructure is mature enough to be treated as a standard operating expense rather than a speculative investment. The differentiator will be integration into ERP and fleet management systems so connectivity drives automated workflows and real-time decisions.

3. Impact of more data centres on Earth:

More compute capacity on Earth directly strengthens the business case for data-intensive operations in transport and logistics. With greater capacity available, real-time analytics, high-definition video streaming, telemetry processing, and AI-driven optimisation become easier to run at scale and deliver clearer returns. High-bandwidth, low-latency satellite links such as those provided by Starlink are the enabling layer that connects mobile assets to this expanding pool of terrestrial compute power. As data centres proliferate, the value of continuously feeding them real-world operational data rises, creating a virtuous cycle that further justifies the cost of satellite connectivity.

4. Space developments needed:

On the space side, the primary requirement is continued constellation scaling and sustained performance improvement. The key differentiator is the latency advantage of Low Earth Orbit (LEO) satellites, at approximately 20-50 milliseconds versus 500-600 milliseconds for Geostationary Earth Orbit (GEO), which makes real-time interactive applications viable. Coverage maturity must also extend reliably across open ocean and remote corridors where terrestrial infrastructure cannot reach. SpaceX's planned V3 Starlink rollout in the second half of 2026, with each satellite expected to provide roughly 20x the capacity of earlier generations, highlights the requirement to deliver sustained capacity growth to match transport-sector demand by building a resilient, high-performance network that delivers mission-critical logistics connectivity reliably at scale.

5. Semiconductor developments help by:

Semiconductor progress supports this theme on two fronts. First, it improves terminal and satellite performance directly by enabling higher throughput and more capable onboard processing, which reduces the cost per bit of data transmitted. Second, it enables more powerful edge computing inside vehicles and vessels, allowing them to operate as intelligent nodes that process sensor data locally and take real-time actions before synchronising with the cloud. This aligns with the broader industry shift towards distributed intelligence, where the vehicle becomes a data-processing hub rather than a passive data collector. For example, companies such as Sunway Communication are developing advanced LCP films for mmWave antennas, which are relevant for high-speed satellite communications in AI-enabled vehicles and vessels. In that sense, semiconductors are not merely an upstream supply chain but a core enabler of the intelligent node operating model.

6. Robotics developments help by:

Robotics is changing transport and logistics in practical ways, particularly in long-haul freight and in warehouses and terminals, where operators are prioritising cost, safety, and reliability.

In long-haul freight, Level 4 autonomy is moving towards commercial operation, and the discussion is increasingly about unit economics and scalable delivery. Labour and fuel are typically the largest cost components (often over 70% combined). Autonomous trucking can reduce costs by lowering driver-related expenses and improving fuel efficiency through coordinated platooning on motorway routes. Commercial models are also shifting towards

Transport-as-a-Service (TaaS), where logistics firms buy capacity on a usage basis (for example, per tonne-kilometre) rather than owning vehicles and managing drivers, while cloud dispatch platforms coordinate routing and platoon formation using inputs such as cargo requirements, destination, weather, and road conditions.

In warehouses and terminals, automation is moving from single-purpose machines to coordinated systems that manage multiple robots across workflows. Advances in computer vision and machine learning are improving the ability to identify and handle mixed, irregular items, which supports use cases such as e-commerce returns processing and fresh goods sorting. Humanoid robots may help in tasks designed around human environments and tooling, though cost and operational readiness remain limiting factors. Some providers are also pursuing vertically integrated solutions across ports, yards, and factory logistics, reducing manual handoffs by orchestrating vehicles and warehouse robots through a shared control platform.

Overall, the near-term impact is less about individual robots and more about how automation is integrated into operating models, including procurement, dispatch, maintenance, and process control, so that productivity gains are repeatable and measurable at scale.

Quantifying Starlink's core advantages in logistics

Across these verticals, Starlink's technical advantages over traditional satellite communications can be summarised as follows:

- **Low latency**: GEO satellites at 36,000km typically deliver round-trip latency of 500-600 ms. Starlink's 550km LEO orbit reduces latency to around 20-50 ms. Academic studies report median round-trip latency below 50 ms in both maritime and terrestrial environments. This enables real-time applications critical for remote vessel operations and autonomous navigation.
- **High bandwidth**: Starlink Maritime typically delivers download speeds up to 220 Mbps; Maersk has confirmed speeds above 200 Mbps, and Hapag-Lloyd has reported up to 250 Mbps. By comparison, traditional maritime VSAT services often provide 5-20 Mbps at significantly higher cost.
- **Open-ocean coverage**: Cellular networks cover land and near-shore areas; deep-sea connectivity depends on satellites. While GEO satellites provide coverage, they are constrained by bandwidth and latency. Starlink's LEO constellation offers global coverage from equator to polar regions, enabling high-speed connectivity for commercial vessels across virtually any sea route.

Maritime shipping: from connectivity gaps to fully connected vessels

Maritime is arguably the most visible logistics vertical for Starlink adoption. Traditional ship connectivity has relied on expensive, bandwidth-constrained GEO satellite services, which struggle to support modern digital operations. Starlink's low latency and high throughput are reshaping ship-to-shore communications, especially during emergencies such as vessel breakdowns, severe weather, or onboard accidents.

Looking forward, early adopters view Starlink's high-bandwidth connectivity as foundational infrastructure for next-generation smart shipping, including autonomous navigation trails and AI-powered predictive maintenance systems that require the kind of consistent, low-latency data transmission that legacy satellite systems could never provide.

Deployment by major shipping companies

Since 2025, multiple leading shipping companies have announced or completed Starlink rollouts on their fleet. We summarise the progress below.

- **Maersk** has agreed with SpaceX to install Starlink on more than 330 of its owned and operated container vessels, following successful pilots on over 30 ships. Maersk has positioned the service as supporting both crew welfare and business operations including enabling cloud migration for applications and improving remote support and vessel inspection capabilities. Maersk noted that high-speed connectivity helps seafarers stay in touch with family while accelerating the company's digital vessel operations vision.
- **Hapag-Lloyd**, the world's fifth-largest liner operator, decided to expand Starlink across its fleet after successful trials on four vessels. The company reported that high-speed satellite internet significantly improved crew communications, enabling seamless video calls and streaming. It also cited bandwidth of up to 250 Mbps, supporting both personal use and operational needs such as remote maintenance and inspections.
- **Five major Korean shipping companies** – HMM, Pan Ocean, H-Line Shipping, SK Shipping, and KSS Line – signed Starlink service contracts via SK Telink. These are fleet-wide deployments rather than pilots, signalling commercial maturity. Reported performance includes up to 250 Mbps throughput and latency around one-tenth of traditional GEO systems.

Three practical value areas in maritime

Across these deployments, we see Starlink's maritime value clusters into three themes:

- **Crew welfare and retention**: Most operators cite improved crew connectivity as a key driver. Starlink enables video calls, streaming, and online learning onboard, materially improving quality of life and supporting retention in a demanding profession.
- **Remote maintenance and digital operations**: Low-latency, high-bandwidth links make ship-shore data exchange far more real-time. Remote technical support, equipment monitoring and diagnostics, and predictive maintenance, which is previously difficult to execute effectively at sea, become practical. Maersk has explicitly linked Starlink to cloud adoption and improved remote support and inspections.
- **Foundational infrastructure for smart shipping**: Autonomous vessels and AI-assisted decision-making depend on continuous ship-shore data flows. Polaris Shipping's integration of Starlink with HiNAS Control illustrates how connectivity is becoming a prerequisite for the next wave of maritime innovation.

Aviation: from intermittent connectivity to a seamless experience

The commercial aviation industry has rapidly embraced Starlink as the definitive solution for high-speed onboard connectivity as travellers increasingly treat high-quality Wi-Fi as an essential amenity rather than a luxury. Airlines recognize that slow, unreliable Wi-Fi has become a genuine liability and carriers that still rely on legacy satellite networks could risk losing customers to rivals offering the seamless streaming, cloud-based work applications, and real-time video conferencing that Starlink makes possible at altitudes where traditional cellular networks cannot reach. By early 2026, over 2,500 aircraft including private planes and business jets were already equipped with Starlink, with installations accelerating as major carriers rush to complete fleet-wide deployments.

Airline deployments

Between 2025 and 2026, more than ten major airlines announced Starlink inflight Wi-Fi partnerships. We summarise the progress below.

- **American Airlines** announced on 26 May 2026 that it will install Starlink Wi-Fi on over 500 Airbus aircraft (including A321XLR and A321neo), starting in 1Q27. The service will be free for AAdvantage members and is positioned to support streaming, video calls, gaming, and other high-bandwidth use cases.

- **United Airlines** plans to install Starlink on up to 15 aircraft per month across its Boeing 737-800 fleet.
- **Virgin Atlantic** became the first UK airline to commit to free Starlink Wi-Fi across its fleet. Its first Starlink-equipped A350 entered service in May 2026 on the London Heathrow-New York JFK route. Installations on the 787 fleet are expected to begin in 2H26, with full-fleet coverage targeted by 2027.
- **IAG** (parent of British Airways) has partnered with Starlink to provide high-speed Wi-Fi on over 500 aircraft, covering European short-haul routes as well as transatlantic and global long-haul services.
- **Korean Air** and four affiliated airlines (Asiana Airlines, Jin Air, Air Busan, Air Seoul) plan to introduce Starlink Wi-Fi from after 3Q26, targeting full-fleet installation by end-2027.
- **Copa Airlines** will become the first Latin American airline to offer high-speed internet via Starlink, which should be complete throughout its fleet by 1H27.

Indirect but meaningful impact on air logistics
Although inflight Wi-Fi is primarily a passenger service, it can indirectly improve air cargo operations where cargo carried in the belly hold can be updated more frequently via crew or onboard systems; exceptions can be communicated sooner; and freight forwarders can coordinate ground receiving arrangements more effectively with uninterrupted connectivity. As Starlink becomes more common across fleets, the digital maturity of air cargo operations is likely to rise with it.

Trucking and road logistics: eliminating connectivity black holes

The broader logistics industry stands to gain substantially from Starlink's global connectivity, particularly in bridging the coverage gaps that have long plagued ground transportation and remote supply chain operations. For example, road transport has long suffered from connectivity “black holes” when trucks travel through rural motorways or mountainous routes, mobile signals drop, and fleet managers lose visibility of vehicles and drivers.

By combining Starlink with terrestrial fibre and 4G/5G networks, logistics operators can create resilient, multi-layered connectivity that provides continuous tracking visibility across rail transport, remote depots, and temporary distribution hubs, transforming what were once data blind spots into seamlessly monitored segments of the global supply chain.

EpicVue Starlink solution for truck fleets
The EpicVue Starlink fleet program represents the first satellite communication solution purpose-built for trucking, offering 99.9% data and communication access across the U.S. and Canada, effectively eliminating cellular dead zones that have historically created communication black holes for drivers traversing rural stretches, mountain passes, and remote corridors. For approximately USD99 per month which comes with 250 GB data, fleets can consolidate what previously required up to seven separate SIM cards managing various sensors, ELDs (electronic logging devices), and cameras into a single, high-bandwidth connection, while also enabling streaming entertainment that helps with driver retention.

Australia’s MyFleet Telematics has integrated Starlink Direct to Cell into its fleet management solution. When vehicles leave mobile tower coverage, the system automatically switches to Starlink satellite connectivity, maintaining GPS tracking, engine diagnostics, fuel monitoring, and driver behaviour analytics. This is particularly valuable in Australia, where traditional mobile networks cover less than 30% of land area.

Scaling Starlink as a core connectivity layer for logistics

By addressing the most fundamental information bottleneck in transport and logistics, reliable connectivity in remote and mobile environments, Starlink is materially improving operational efficiency and safety worldwide. From Maersk's 330+ container ships to American Airlines' 500+ Airbus aircraft, Starlink has moved beyond pilots into scaled commercial deployment.

Looking ahead, its value in logistics is likely to deepen. High-speed, low-latency ship-shore links are laying the groundwork for autonomous navigation; real-time vehicle connectivity is turning trucks from moving blind spots into visible, manageable assets; the convergence of IoT and satellite networks is making end-to-end supply chain visibility more achievable; and direct-to-cell satellite connectivity could help emerging markets modernise rail freight dispatch and operations faster than traditional infrastructure rollouts.

Power

- Could AIDC demand boost US and European electricity demand growth to 5% per annum? Renewables and electric grids benefit
- We assume a preference for terrestrial AIDC, especially renewables powered, and see potential for orbital AIDC with space solar
- The gas and nuclear conundrum: terrestrial AIDC is a tailwind, while orbital AIDC might be competition

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In this note we focus on potential opportunities in the power sector implied by SpaceX's orbital AIDC (AI data centre) ambition stated as 100GW by 2040. We split this into five sections: 1) cost comparison between orbital and terrestrial AIDC; 2) blue sky total AIDC demand; 3) beneficiaries of maximising terrestrial AIDC; 4) beneficiaries of orbital AIDC and 5) risks and trade-offs.

We conclude that there is potential upside to terrestrial power demand heavily skewed to US/EU and China and that high AIDC electricity demand could catapult US and European electricity demand growth to 5% per annum, levels typically associated with emerging markets. There is upside potential to solar supply chain from orbital AIDC. While we see renewables and electricity grids as clear beneficiaries of higher terrestrial AIDC demand, the long-term outlook for nuclear and gas bears risk and opportunities. Terrestrial AIDC could be a tailwind especially leading to further lifetime extensions of existing nuclear, while orbital AIDC might be competition for new additions.

1. What needs to happen on Earth first:

Terrestrial AIDC build-out is assumed to be first-choice due to latency/maintenance/scale.

Grid and generation expansion: report suggests AIDC could lift US/EU electricity demand growth to **~4-5% p.a.** (and references **~5% p.a.** levels in scenarios).

2. Earth developments needed to benefit:

Scaling established technologies and networks (renewables, storage, grids; plus gas/nuclear policy execution).

Capex framework: terrestrial AIDC estimated at **USD40-50bn per GW**.

3. Impact of more data centres on Earth:

Clear positive for **renewables and grids** (explicit "clearest winners").

Creates complex second-order effects for **gas and nuclear**: terrestrial AIDC is a tailwind (e.g., life extensions), but orbital AIDC could become competition for new-build.

4. Space developments needed:

Orbital AIDC cost convergence: today orbital is **~3x** more expensive; report suggests gap could narrow by **2035/40e**.

Space solar scaling tied to orbital compute: cited assumption **~3.5x solar power vs IT load** (example **340kW solar for 100kW IT**).

5. Semiconductor developments help by:

Driving IT efficiency (lower watts per compute) and power electronics improvements – key for both terrestrial and orbital economics (implicit in "LCOC convergence" logic).

6. Robotics developments help by:

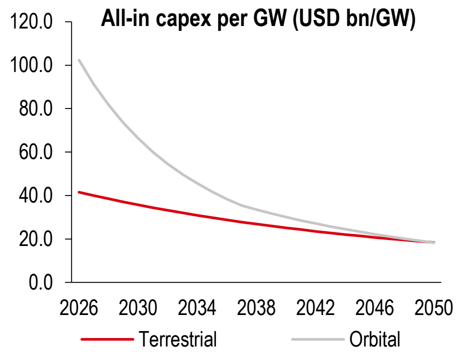
Needed for maintaining orbital infrastructure (servicing/repair), improving uptime, and reducing replacement launches, supporting orbital economics.

Cost convergence could be achieved

Today, terrestrial AIDC is expensive with investment estimates of USD40-50bn per GW. Orbital AIDC is three times more expensive on high launch cost as well as high cost for housing and radiation/redundancy.

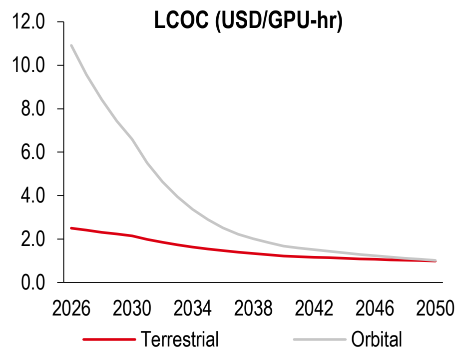
However, if orbital scales up on technology learnings curves, orbital AIDC cost could fall rapidly while terrestrial cost also reduce. Long-term, the capex cost of orbital AIDC (for housing and IT) could be equal to capex cost of terrestrial AIDC (for buildings and IT). The remaining cost of electricity for terrestrial versus launching and radiation shielding for orbital also converges, leading to overall Levelized Cost of Compute (LCOC) that are similar.

As orbital and terrestrial capex converges…



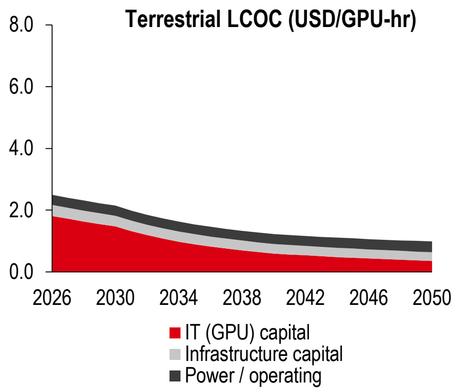
Source: SemiAnalysis, HSBC estimate

… so does LCOC; operating costs could be similar



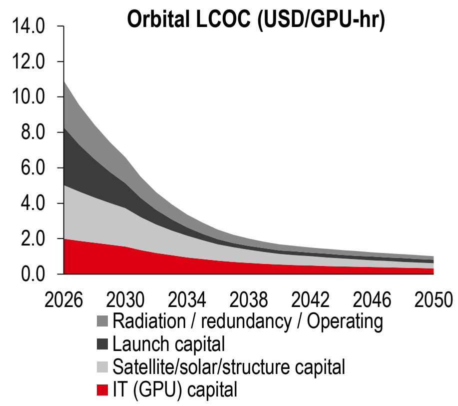
Source: SemiAnalysis, HSBC estimate

IT capex falls for terrestrial AIDC



Source: SemiAnalysis, HSBC estimate

Orbital AIDC costs plummet across categories



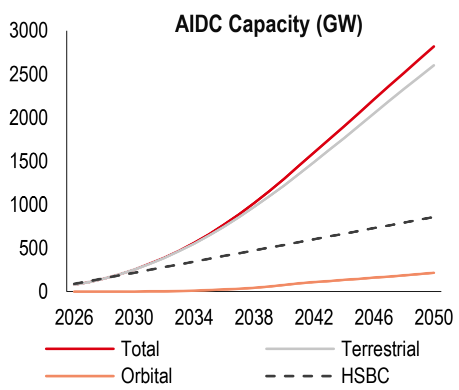
Source: SemiAnalysis, HSBC estimate

We don't necessarily need to believe that orbital becomes cheaper than terrestrial to make the business case: Perhaps it could even remain twice as expensive as terrestrial in a conservative scenario; however, costs need to come down in absolute terms and need to narrow the gap to terrestrial not to be prohibitive. On our numbers, this could be the case by 2035/40e.

Blue-sky: Raising AIDC demand 3x

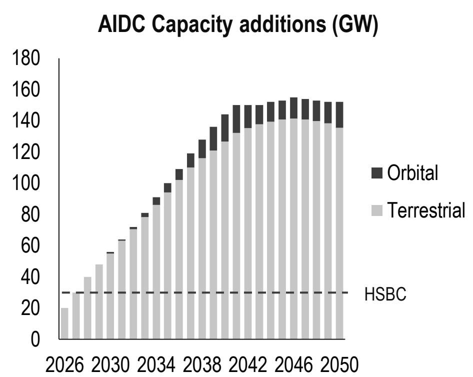
With or without orbital, at least 100GW of AIDC per annum by 2040 is a huge number, and if we think of it as orbital only with terrestrial on top it, it is even bigger. As a blue-sky scenario, we model additions ramping up to 150GW by 2045-50, with 120-140GW of terrestrial additions and 10-30GW of orbital. Cumulative capacity would rise to around 2,800GW by 2050, 3x our current implied forecast of c900GW by 2050. By 2050, annual additions would rise to 4-5x our currently implied level of 30-40GW.

2,800GW AIDC capacity in 2050



Source: SemiAnalysis, HSBC estimate

AIDC additions rise to 150GW by 2050

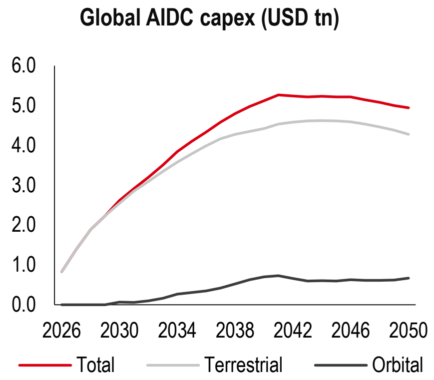


Source: SemiAnalysis, HSBC estimate

We anchor these assumptions broadly in historic IT investment trajectories and as a share of GDP. Additions combined with our cost assumptions imply new and replacement investments could rise from under USD1tn to over USD5tn by 2045-50e. Global technology capex has risen to cUSD600bn in 2026e from an average of USD50-100bn per annum in 1996-2010 (for more details, see *Show Me The Money – HSBC Global Capex Monitor: The tech supremacy* (October 2025)).

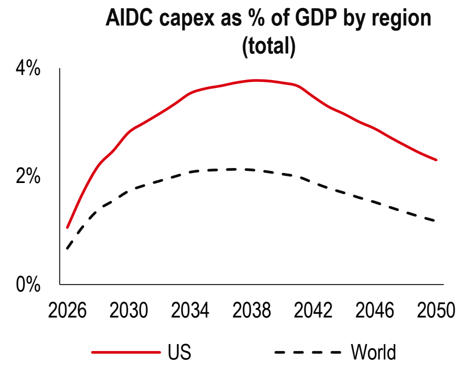
Historically, global technology investments have risen from a 0.2% share of GDP in 2005 to a 0.5% share in 2026e. Our blue-sky AIDC forecast would imply AIDC capex peaking around 2% of world GDP in the 2030s before falling back to a c1% share by 2050e. With a skew of AIDC capacity to the US, it would suggest investments peaking at 4% of US GDP before falling to a 2-3% share by 2050e.

USD5tn of annual AIDC investments by 2040e…



Source: SemiAnalysis, HSBC estimate

… would imply investments peaking at 2% and 4% of world and US GDP, respectively.



Source: SemiAnalysis, HSBC estimate

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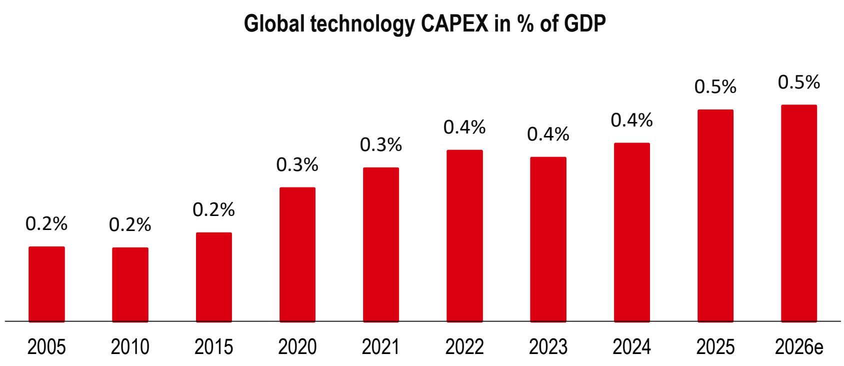


Source: IMF, LSEG Datastream, LSEG IBES estimates, HSBC calculations based on consensus estimates

Arguments in favour of high growth

As a disruptive technology, would AI not deploy according to S-Curves? We are currently still in the early stages, and after the tipping point, volumes could explode. One could also see AI as a self-fulfilling prophecy – in other words, a race that will be seen through to the end. It is highly unlikely that current AI leaders can afford to fall behind, let alone stop, and respective governments would likely agree. This should hold both for supremacy in orbit as well as AI itself.

Critical considerations

Additions in the hundreds of gigawatts seem wildly ahead of expected additions of 30-50GW pa in the next five years. It also seems to be ahead of near to medium-term capex plans of AI labs themselves.

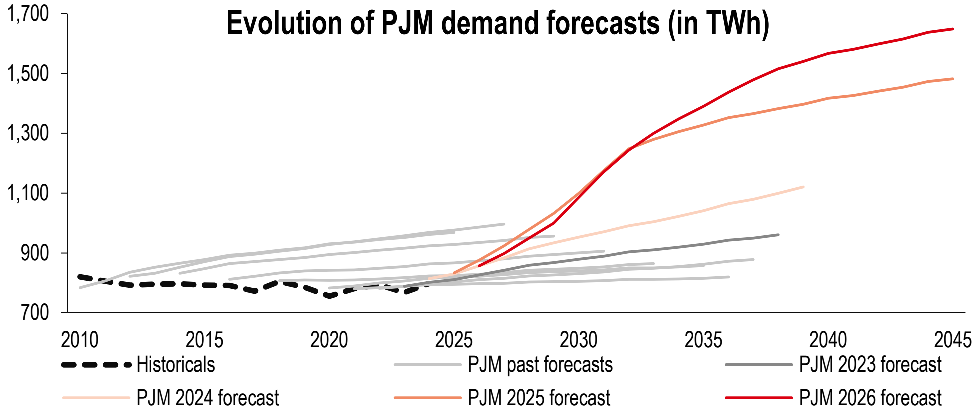
Ramping to more than 150GW pa annum – let's say 300 GW by 2050e – would suggest annual AIDC investment at 5% of USD GDP, or 2% of global GDP at a sustained level.

Power perspective clearly signals growth, but how much?

We note rising estimates for AIDC power demand. For example, PJM – the power region in the US hosting the largest data centre hubs – increased electricity demand growth expectations every year over the past three years, accounting for the growth in data centre connection applications.

It is too early to tell how forecasts will develop; they might well continue to rise. We note that PJM's 2025/26 curves follow an S-shape, implying current expectations of falling rather than linear or accelerating additions by 2040/45. Nevertheless, this could be attributed to poorer forecasting quality further out rather than genuine levelling off.

Power demand estimates are rising



Source: PJM

Dominion Energy Virginia's forecasts show some convergence in more recent expectations, yet also potential for further increases. Dominion is a utility in PJM that is close to data centre alley and has been working with hyperscalers for over a decade.

- Growth forecasts jumped in 2022/23, from no growth expectations in 2021 to c4% annual growth outlook in 2023.
- Since then, in the 2024, 2025, and 2026 outlooks, expectations seem to converge around c5% annual growth (with forecasts inching higher more incrementally).
- Dominion's shape of growth expectations to 2045 is much more linear than PJM's forecast suggesting stable or slightly accelerating annual additions.
- However, Dominion Energy Virginia also notes that existing ESAs (Electric Service Agreements) and CLOAs (Construction Letter of Authorizations) – firm capacity – exceed forecasted demand through 2045. This could imply that forecasts will rise further.
- In addition to 22GW of ESAs and CLOAs in 1Q2026, Dominion Energy Virginia has 30GW (and rising by 3-5% in past two quarters) of SELOAs (Substation Engineering Letter of Authorizations). As some of these convert to CLOAs and then ESAs, growth outlooks could be raised even more and eventually be in line with the blue-sky scenario of rising additions to 2045.

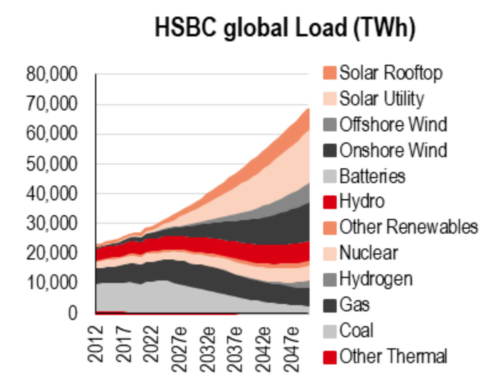
Maximising terrestrial potential

We assume that data centres would prefer terrestrial capacity on lower latency, easier maintenance, and better opportunity for scale even if cost of orbital and terrestrial converge. Therefore, our first layers to absorb higher-than-expected AIDC demand would be all forms of terrestrial power generation apart from coal plus the respective electricity network investments. Only if demand exceeds what can be built on Earth would orbital take off. In later sections, we will challenge these assumptions and discuss trade-offs between orbital, gas and nuclear.

We think terrestrial power could support 120-140GW of AIDC capacity additions by 2045/50e. Hence, for orbital to take off, we would need to believe in additions rising above that level or other strategic reasons. SpaceX might view terrestrial potential as more constrained than we do – let's say at 50-100GW per annum – and thus might see 50-100GW of orbital AIDC potential. This would still be in line with our overall market sizing in the blue-sky scenario of 150GW of additions by 2050e.

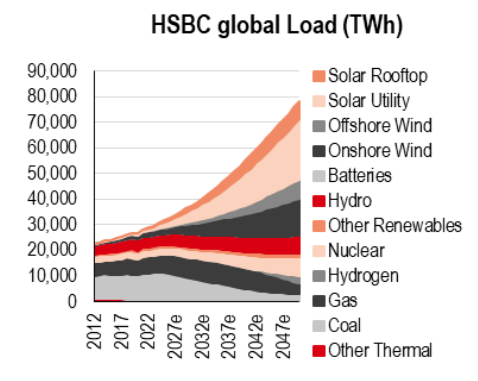
We currently expect global electricity demand to broadly double from c33PWh in 2026 to c69PWh in 2050e. Terrestrial AIDC rising to c2.8TW by 2050 would equate to c10PWh of additional demand (c23PWh gross minus c13PWh of higher efficiencies) and 2050e demand of c79PWh, 14% higher.

Current: Demand at c69PWh in 2050



Source: Ember, HSBC estimate

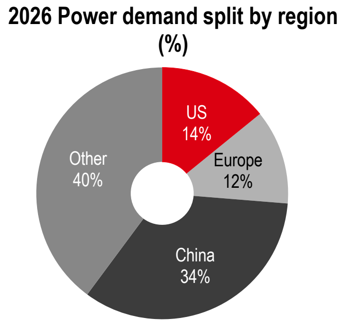
Blue-sky: 2050 demand 14% higher



Source: Ember, HSBC estimate

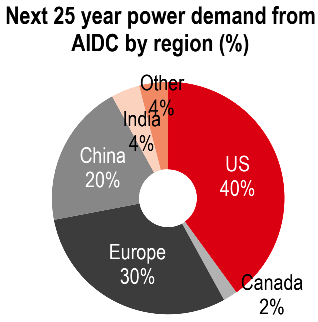
In building our expectations of terrestrial power demand, it is important to highlight our assumptions that AIDC demand is heavily skewed to the US (40%), Europe (30%) ,and China (20%), which is very different from today's power mix, where US and Europe as service/knowledge economies with a low electricity demand to GDP ratio only account for 12-14% of global demand, respectively.

Together, US/Europe account for c26% of power demand today…



Source: Ember, HSBC estimate

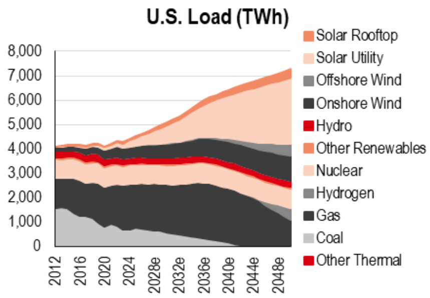
…but could capture 70% of AIDC growth, assuming AIDC demand is skewed to US, EU, other developed markets, and China



Source: SemiAnalysis, HSBC estimate

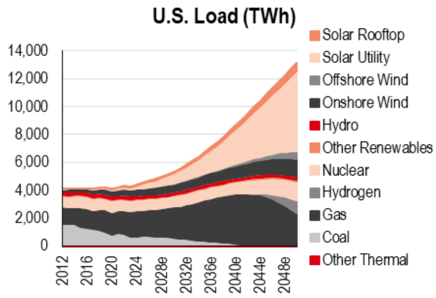
The implication would be an unprecedented power boom market in the US and Europe in which our annual growth expectation for the next 25 years would move from 2-3% to 4-5% and essentially match growth outlooks of emerging markets. Instead of rising by 60%, US power demand by 2050 would rise by 2.8x. European demand would also rise by 2.8x by 2050 (up from expectations of an 80% rise). Chinese demand would increase by 2.4x instead of 2.3x by 2050.

<u>Current:</u> +60% by 2050e



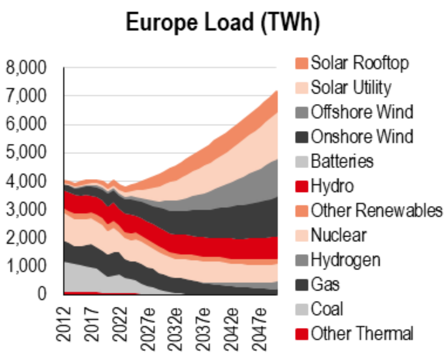
Source: Ember, HSBC estimate

<u>Blue-sky:</u> 2.8x by 2050e



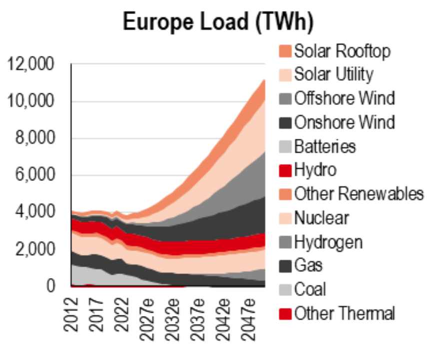
Source: Ember, HSBC estimate

<u>Current:</u> +80% by 2050e



Source: Ember, HSBC estimate

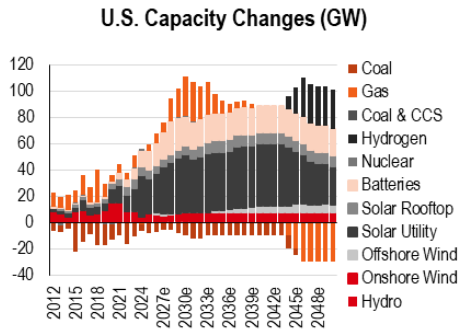
<u>Blue-sky:</u> 2.8x by 2050



Source: Ember, HSBC estimate

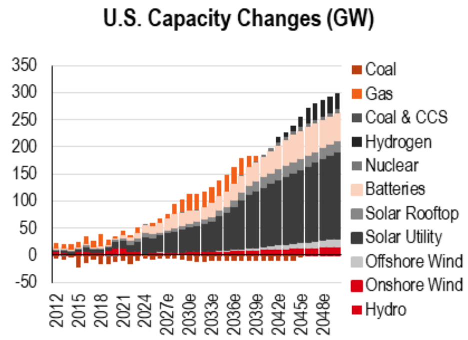
Instead of US capacity addition to top out at around 100GW per annum with a 10-year spurt in gas (eventually started to be replaced by hydrogen) and no net nuclear additions, US additions continue rising to c300GW per annum: Renewables capacity additions are 2-3x higher than before, gas additions extend longer, but in the 2040s are replaced by hydrogen and nuclear additions. The use of gas for growth medium-term implies that carbon emissions stay at current levels in the US power system and continue to fall only when nuclear and hydrogen come into play by 2040.

<u>Current:</u> Additions rise to c100GW



Source: Ember, HSBC estimate

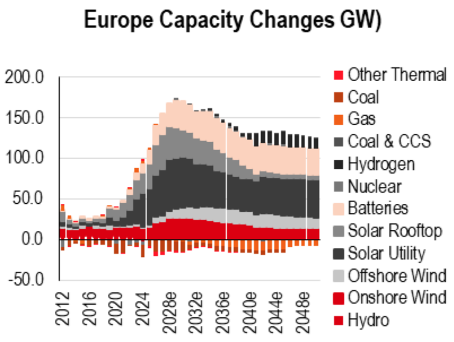
<u>Blue-sky:</u> Additions rise to c300GW



Source: Ember, HSBC estimate

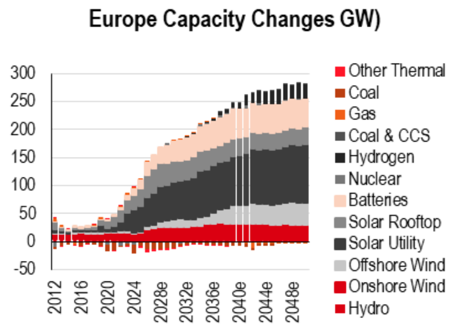
On our current growth assumptions, European capacity additions rise to 170GW by 2030 on decarbonisation and growth and fall to 120GW per annum by 2040 primarily relying on growth as decarbonisation has largely been achieved. In the blue-sky view, on double the growth rate (especially in 2035 onwards) additions keep rising to c250GW per annum rather than falling. We model nuclear capacity of 149GW by 2050 rather than falling to c90GW (versus 115GW today), mainly based on extending life of existing assets plus 16GW of new French capacity (10GW planned for 2038-45 plus 6GW additional in 2045-50e). We double to triple our renewables additions expectations and continue to model hydrogen by 2040+. Incremental growth via zero carbon technologies keeps the power carbon reduction trajectory on target. Compared to the US, we model a higher share of wind (particularly offshore wind) and no additional new gas beyond already existing plans.

<u>Current:</u> Additions rise to c170GW and then fall to 120GW



Source: Ember, HSBC estimate

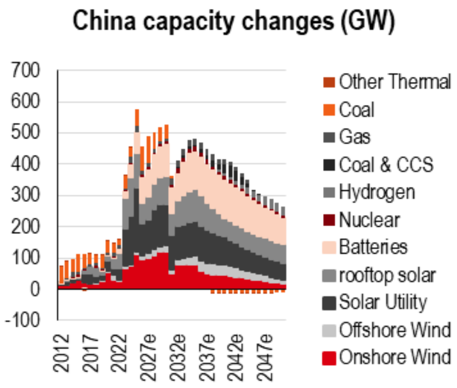
<u>Blue-sky:</u> Additions rise to c280GW



Source: Ember, HSBC estimate

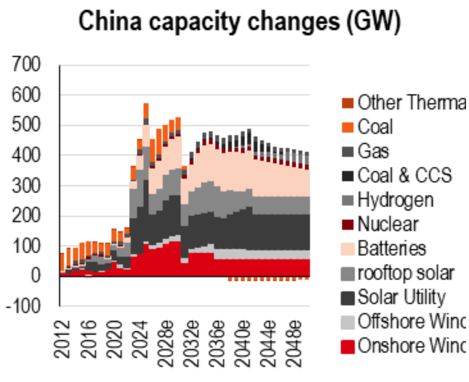
With capacity additions of over 500GW in 2025, China has already scaled up additions to what is needed for substantial growth and decarbonisation. Under our current growth assumptions, 2025 is the peak year of additions, with a long-term falling trajectory. In the blue-sky scenario, we model that the uprate in Chinese demand mainly benefits renewables and nuclear. Higher growth long-term leads to steady rather than falling additions.

Current: Additions fall beyond 2030



Source: Ember, HSBC estimate

Blue-sky: Additions remain steady



Source: Ember, HSBC estimate

Arguments in favour of high terrestrial growth

AIDC demand is facing a power sector that is primed for growth. Storage is at the cusp of a boom, and solar and onshore wind supply chains have overcapacity. The offshore wind market is maturing. While it takes a little while to re-accelerate gas and nuclear in US/Europe (and some government direction for nuclear), gas and nuclear can contribute to growth. Networks need to be built as well, which might require some ramping in the US, yet we expect this can be addressed by 2030/35. Given there are no strategic bottlenecks and no new technologies that need to be developed; it is rather scaling of established businesses. We see Small Modular Reactors (SMRs) as an evolution, i.e., downscaling for industrial production of known large scale nuclear technologies. Since SMR is one option, not achieving it on time or a lack of competitive economics would not change the sector's ability to support AIDC growth. Yet it is an important point to note: power technology – nuclear/SMR and otherwise – is not static and there will continue to be technology progress across all segments – from solar and storage to wind and gas – which would support higher growth.

With or without additional long-term terrestrial AIDC demand, on our numbers China has already reached a new plateau of additions, and companies are looking for export opportunities that could support continued ramping of US/EU growth.

If India and China can do it, why not the US/EU? While 4-5% CAGR for power demand is unheard of in Europe and the US, more than that has been business as usual for India or China in the past decade. European and US capacity supply chains and additions are already booming on decarbonisation alone, and we see the lack of growth as a downside risk to additions post 2030. China has scaled power additions from less than 100GW per annum in 2010-2020 to over 500GW per annum in 2025. Why wouldn't the US and Europe be able to continue to scale additions to 250-300GW pa by 2050 when additions have already scaled from 30-40GW per annum 10 years ago to 50-100GW pa today with expectations of reaching 150-170GW pa by 2030?

Critical considerations
While it is technically possible, the build-out in some segments such as networks or nuclear might still be structurally too slow.

Growth for nuclear, offshore wind, and a re-acceleration for onshore wind might require more supportive US energy policy and in the case of nuclear potentially guarantees and state investments – consistently so for decades.

Recent nuclear projects in US/Europe have a track record of cost and timing overruns. There is general construction risk.

Power perspective – orbital could be a sensible hedge against policy & execution risk
While a marked scale up of power capacity additions is technically possible, there are policy and execution risks including timeliness. Orbital AIDC might be a good hedge.

Orbital AIDC benefits solar supply chain

Companies and investors maintain cautious view on orbital AIDC. Yet, on 3.5x solar per IT load and 3x solar cost versus Earth, even moderate volumes could be an attractive market in dollar terms

We have previously taken deep dives into how space solar would power and benefit from orbital AIDC and commented on Tesla's 100GW per year of solar manufacturing capacity goal in three years. In our two most recent such reports, we summarize feedback and views from different companies during SNEC (Photovoltaic Power Conference & Exhibition in Shanghai).

- **Space solar:** We saw various space-level perovskite cell products from different companies during SNEC. However, we believe adoption in space could be difficult and slow given concerns over reliability and the time needed to gather enough data from space to perfect the product. As a result, we believe the adoption of perovskite cells here on Earth will be quicker. Compared with silicon-based solar cells, perovskite cells are lighter and can generate 10-18% more power in weak-light environments. These features make them ideal for applications such as building integrated PVs (BIPVs), power for smart door locks, and portable electronic devices. For more details, see *China Renewables SNEC takeaways: ESS strong, solar weak*, 9 June 2026.
- **Conservative around SpaceX's 100GW per year of solar capacity goal:** Following our earlier report on space solar, we found that messaging from the SNEC tour implied conservative attitudes from both companies and investors regarding SpaceX and Tesla's 100GW per year of solar manufacturing capacity goal in three years in the US. For more details, see *China Solar: Takeaways from SNEC 2026*, 9 June 2026.

Other previous reports have examined technology aspects, ambitions, upside to the solar supply chain, and milestones. Industry experts think that SpaceX's AI Sat Mini may require on average 3.5x solar power over compute power load – that would be 340kw of space solar to run the 100kw IT load per satellite. As solar cells in space would likely still be 3x more expensive than the solar module on the ground in 15 years, the total addressable market (TAM) of space-based solar could be worth tens of billions. For more details, please see *Space-based Solar: Read-across from SpaceX's latest dynamics* (1 June 2026) and *China Aerospace: Rocketing high* (12 February 2026).

Nemesis or best friend? The gas and nuclear conundrum

Hype cycles
The power sector is familiar with hype cycles. In the past, this has encompassed differing technologies such as coal, gas, nuclear, renewables and hydrogen. It typically follows the same pattern of an initial focus on total addressable market (as we are doing now) with estimates testing

the upper bounds of what could be possible. Supply chains do ramp up (to some extent) on positive outlooks to be disappointed later as demand is below maximalist expectation and overheating competition does the rest – this holds for technology competition as well as on the company level.

The power sector is familiar with hype cycles, and it typically starts with initial focus on total addressable market (as we are doing now)

In situations of overcapacity after a potential hype cycle, supply chains may suffer more than utilities (if less diversified). Technologies with longer lead-times such as nuclear (less likely to scale up) or fuel cost such as gas (dispatched last) carry more risk. The good news is that sharing of risk and contracting is markedly different today: there is a very high share of long-term contracts, thus offtakers carry a higher share of risk versus earlier hype cycles when utilities took on the risk of overcapacity via exposure to power markets and political risk.

If orbital AIDC gets built for strategic reasons such as a stepping stone for further space ambitions (i.e., scale-up is not only driven by economics), it could contribute to oversupply and thus margin pressure.

Trade-offs in favour of other regions

We note that we find it easier to model growth in the European power system (compared to US) given the visible and concerted effort of network investments as well as consistent energy policy. Policy towards data centres is largely positive with governmental growth ambitions and utilities (and governments) vying for AIDC business. Thus, our modelling implies some spill-over of US AIDC to Europe on easier grid connections and greener power.

Another trade-off could imply more AIDC outside of US/EU/China. Would we go to orbit before building data centres is other regions of the world?

Trade-offs in favour of orbital

If SpaceX timelines hold, orbital AIDC might beat US/EU nuclear/SMR on timeliness

We think renewables would benefit from higher AIDC demand no matter what and solar most – terrestrial and orbital. However, as SpaceX's orbital AIDC business evolves, could this pit the company's interests against nuclear, SMRs, and gas?

- The more growth we put in our power model, keeping gas output higher for longer or even leading to new gas generation, the further we move away from achieving emission reduction in the power sector, particularly in the US. Considering emissions, would orbital AIDC beat new gas additions on Earth?
- Might terrestrial nuclear in US/Europe lose the race to orbital AIDC? Nuclear is zero carbon, but faces other challenges such as waste management, high cost in the US/EU (of up to EUR10-15bn/GW), and by far the longest ramp-up time of all technologies. In Europe and the US, 2035 is the timeline for early stage SMR prototypes and not quite yet for industrial production, which is more likely by 2040+, if there ever is a business case. In 2026, France and EDF announced plans for c10GW of new nuclear capacity, which would be available at the absolute earliest by 2037-41e. Yet, only a few months after the announcement, the timeline seems to be slipping already on lengthy approvals, and we model these 10GW by 2041-45. In parallel, EDF would also manage a large life extension program for the existing fleet. Hence, we rather see risks of timelines slipping, even beyond 5 years (as has been the case in EDF's recent projects), as opposed to an ability to accelerate. If SpaceX timelines hold, orbital AIDC might beat US/EU nuclear/SMR on timeliness.

In an alternative blue-sky scenario, we could also envision terrestrial AIDC scaling up to 100GW of additions and orbital AIDC reaching 50GW of additions per annum. In this scenario, we would model higher orbital AIDC to the benefit of space solar and at the expense of nuclear ramping in 2040ies and long-term gas/hydrogen output, before cutting renewables additions.

Industrials

- We see selective opportunities for direct supply chain exposure to SpaceX given the company's very high level of vertical integration
- Building a lunar economy will require autonomy, robotics, and simulation; flagging CAT and HON as current space suppliers
- Orbital AI compute, asteroid mining, and in-space manufacturing all create supply chain opportunities

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Key read-across to our coverage

Overview

1. What needs to happen on Earth first:

Terrestrial AIDC infrastructure build-out continues. Benefits AIDC powering and infrastructure supply chains (turbines, gensets, fuel cells; UPS/cooling/power distribution).

Spacecraft components suppliers scale production to meet commercialization needs of space travel. Worth noting that SpaceX is known for vertical integration and manufactures an estimated 80-85% of its spacecraft and rocket components in-house.

2. Earth developments needed to benefit:

Mature autonomy/simulation capabilities for lunar economy build-out.

Terrestrial AIDC power chain scaling (gas turbines, gensets, SOFC).

3. Impact of more data centres on Earth:

Benefits AIDC powering and infrastructure supply chains (turbines, gensets, fuel cells; UPS/cooling/power distribution).

4. Space developments needed:

Orbital AI compute deployment (positive read-across for powering demand).

Integrators like **Vertiv**, **Schneider**, and **Eaton** are potential beneficiaries for UPS/BESS/cooling loops even in orbital context.

On-orbit servicing, assembly, manufacturing markets becoming economically valuable.

5. Semiconductor developments help by:

Enabling robust compute payloads and comms hardware in harsh environments (ties back to "LEO-optimised" silicon and space networking components).

6. Robotics developments help by:

Enabling in-space manufacturing.

Enabling on-orbit servicing (inspection/refuel/repair/debris removal) and autonomy of lunar infrastructure equipment.

Spacecraft components – selective overall opportunity
SpaceX is known for vertical integration and manufactures an estimated 80-85% of its spacecraft and rocket components in-house. This limits the overall opportunity for supply chain plays on SpaceX technology. That said, SpaceX does rely on a global supply chain for raw materials and commercial off-the-shelf parts from largely undisclosed suppliers. Some examples of identified supply chain beneficiaries to SpaceX are:

- **STMicroelectronics** (STMPA FP): semiconductor manufacturer that supplies specialised microelectronics such as radio-frequency chips to SpaceX.
- **Filtronic** (FTC LN): manufacturer of customised microwave devices for wireless communications announced a supply deal power amplifiers for SpaceX's Starlink satellites in 2024.
- Taiwanese satellite component suppliers that have confirmed they are suppliers to SpaceX include **Chin-Poon Industrial** (2355 TT), **Wistron NeWeb Corp** (6285 TT), and **Universal Microwave Technology** (3491 TT).
- **Lens Technology (300433 SS):** though this manufacturer of optical products is not a confirmed supplier to SpaceX, chairman Zhou Qunfei has flagged commercial space as a new growth driver and met in Beijing with Elon Musk in May 2026.

Lunar economy – CAT and HON as beneficiaries
Regarding SpaceX's plan to establish the lunar economy, including cargo transport, manufacturing, and energy production on the Moon, we think Caterpillar (CAT US) will be a key beneficiary. Caterpillar isn't building spacecraft, but it supports space missions by sharing and developing technologies NASA needs to work on the Moon – especially autonomy, robotics, remote operation, and advanced simulation. Through a long-running collaboration, Caterpillar helps NASA explore how to excavate and build lunar infrastructure by using Caterpillar's experience with autonomous machines and its simulation tools to model tough conditions like lunar soil and test robotic excavator designs before they're used in space.

We also see Honeywell as well exposed to the lunar economy, although it supplies NASA and competitors rather than SpaceX directly. Honeywell is a key supplier for NASA's Artemis missions, providing the full navigation and guidance system for the launch vehicle, data handling, avionics software, and components to control the rockets and thrusters of the Space Launch System. It also provides avionics and navigation, cockpit systems and vehicle management, amongst other services, to the Sierra Space Dream Chaser.

Orbital AI compute
Orbital AI compute means putting AI computing infrastructure in Earth orbit – typically as satellites that carry compute hardware (chips/servers), power systems (solar), and communications links, so AI workloads (training or inference) can be processed in space and the results sent back to users on Earth via a network such as Starlink.

We think SpaceX's plan to deploy orbital AI compute at scale is a clear positive read-across for AIDC (AI data centre) buildout and the sustainability of AIDC powering demand. Beneficiaries along the AIDC powering supply chain include GE Vernova (GEV US, gas turbines) and Siemens Energy (ENR GR, gas turbines), Caterpillar (CAT US, gas gensets) and Weichai (2338 HK, gas gensets), Bloom Energy (BE US, SOFC) and Ceres Power (CWR LN, SOFC).

Furthermore, we would assume the main AIDC infrastructure integrators – Vertiv, Scheider, Eaton – also stand to benefit as power supply, UPS, BESS, and liquid cooling loops (connected to radiators) will still be needed in orbital data centres (though Vertiv mentioned at its 20 May investor day that there is still a lot to figure out regarding heat dissipation from chips on orbital data centres).

On-orbit servicing, assembly and manufacturing
For decades, satellites were launched as single-use assets, with limited repair and maintenance options once they suffered damage or ran out of fuel. As a result, many decommissioned satellites are either parked in graveyard orbits, or left drifting and spinning out of control, putting other space systems at risks. With the number of spacecrafts rising rapidly, in-space servicing is gaining traction. It uses orbital robots to carry out inspections, on-orbit refuelling, hardware upgrades and repairs, and active debris removal. On-orbit servicing is transforming space into an industrial, service-based economy where satellites are maintained, upgraded and repurposed instead of being replaced.

Key robotic players in this field include Northrop Grumman (NOC US, developed MEV-1/2 that dock aging satellite to provide propulsion and altitude control, extending their orbital lifespan), MDA Space (MDA US, developed MDA Skymaker for on-orbit repair, assembly and lunar rover), and GITAI (private, developed Inchworm Robot to dock spacecraft, manipulate payload, and inspect and repair).

Asteroid mining
Asteroid mining involves extracting minerals and other raw materials from asteroids, either to transport them back to Earth or to deploy them directly in space as fuel, life-support supplies, or construction materials (in-situ resource utilisation). Given the difficulty of building large-scale human presence in space and the lack of real-time interplanetary communication, asteroid mining will have to rely on robots with a high level of autonomy. These systems integrate AI, sensor networks, autonomous navigation, and robotic manipulator to operate in harsh conditions with minimal interventions. They can run end-to-end mining operations including reconnaissance, resource mapping, drilling, excavation, sample collection and transportation.

Notable robotic players in this space include AstroForge (private, developed DeepSpace-2 to support asteroid mining and extraction of platinum group metals and other critical minerals), TransAstra (private, specialised on optical mining that uses concentrated sunlight to extract resources from asteroid, without consumable chemicals or mechanical drilling), and Honeybee Robotics (private, developed a 4-DOF robotic arm for drilling, scooping and landing pad construction on the moon, as well as a 3-DOF robotic arm for iron ore blasthole sampling).

Conventional mining gear cannot function in space given the low gravity for traction and the time-lag for remote control. That generates potential demands for autonomous robots. The China University of Mining and Technology's six-legged robot has passed the Earth-based microgravity trials, showing that it can drill, sample, and traverse extreme terrain under the microgravity environment.

Robot arms in space
We also see demand for robot arms in space. Space robotic arms are currently used to handle spacecraft capture and berthing, station assembly, payload handling, maintenance, and astronaut support, significantly reducing the need for risky extravehicular activities. Their future role is shifting toward on-orbit servicing (OOS) – satellite life-extension, refueling, component replacement, debris removal, and on-orbit assembly – as well as deep-space autonomy for lunar and Martian infrastructure.

Canada's MDA built Canadarm2 (17.6 m, 7 DoF) and the dexterous Dextre on the International Space Station (ISS). Canadarm2 has performed nearly 50 captures of visiting vehicles. MDA is now developing the highly autonomous Canadarm3 for NASA's Gateway, designed to operate with minimal human presence 400,000 km from Earth.

In-space manufacturing

In-space manufacturing (ISM) refers to the fabrication, assembly, or processing of materials and products in environments beyond Earth's atmosphere, such as Moon and Mars. It is typically enabled by robotics and automated systems for three core applications:1) 3D printing and additive manufacturing; 2) microgravity processing; and 3) in-space assembly.

To date, most ISM efforts are still “space-for-space”, aimed at producing parts or materials to support operations and infrastructure in space. SpaceX, on the other hand, outlined a more disruptive “space-for-Earth” concept. It targets to establish a satellite manufacturing base on the Moon, use lunar resources to build satellites, and then launch them into Earth orbit via an electromagnetic mass driver.

In theory, lunar launches are materially more efficient than launches from Earth. The Moon’s lower gravity and naturally vacuum environment could help reduce energy required to reach the orbit. Furthermore, more stable solar energy on the lunar surface could support a higher launch cadence, potentially scaling to dozens of launches per day. More importantly, this model could help ease the increasingly severe space-debris challenge in near-Earth orbit.

In-space manufacturing applications and related companies

Applications	Details	Companies involved
3D printing and additive manufacturing	Enables on-demand production of tools, spare parts, and potentially habitat components in space. Feedstock can be launched from Earth or sourced in-situ like regolith.	Redwire (RDW US)
Microgravity processing	Leverages microgravity to eliminate gravity-driven issues like sedimentation, buoyancy and thermal convection, hence enabling the manufacture of ultra-pure semiconductors and the growth of highly ordered protein crystals for pharmaceutical manufacturing.	Space Forge (private, for semi), Varda Space Industries (private, for pharmaceuticals)
In-space assembly	Combines separately launched components into larger functional structure, helping to overcome rocket-firing volume constraints.	Intuitive Machines (LUNR US), Northrop Grumman (NOC US)

Source: Company data, NASA, HSBC

Chemicals

- Chemical inputs are embedded within satellite sub-components and propulsion systems
- Reusability and scale could expand the market for satellites and in the long run for orbital infrastructure
- Rare gases in propulsion could become a bottleneck; engineering thermoplastics could be another key demand beneficiary

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Chemistry in orbit

1. What needs to happen on Earth first:

Chemical inputs represent a relatively small portion of the overall cost base for both satellite manufacturing and launch. At today's cadence, chemicals look small on a per-unit basis, but scale is what changes the investment relevance. Launch cadence needs to keep rising and satellite manufacturing needs to keep scaling because that is when small chemical inputs per unit compound into meaningful, recurring spend lines.

2. Earth developments needed to benefit:

The most direct chemical exposure is in the industrial gases and propellant supply chains. Helium and nitrogen gases are critical for ground testing, equipment pre-cooling, and tank pressurisation. A second, higher-value niche is rare gases for satellite propulsion, with electric propulsion typically using xenon or krypton. SpaceX has used krypton as a lower-cost alternative for Starlink Hall-effect thrusters, and as satellite constellations scale, tight supply/demand in rare gases could become a bottleneck.

3. Impact of more data centres on Earth:

SpaceX's plans around AIDC (AI data centres) also present an upside in space solar consumption. Chemical compounds like EVA (Ethylene-Vinyl Acetate) are used to chemically bond and seal the solar cells between the glass and backsheet, accounting for around 10% of total solar panel costs. Similarly, chemicals like Polyether ether ketone (PEEK) and Polyphenylene Sulfide (PPS) have very good thermal stability, strength, and fatigue resistance; thus, they are used in thermal coatings.

4. Space developments needed:

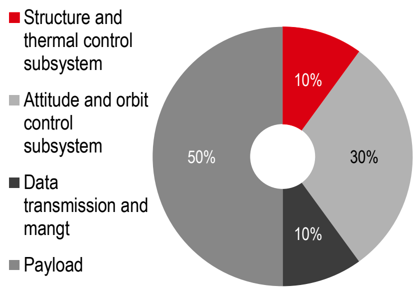
As previously mentioned, the current state of chemical inputs might be small; however, higher launch cadence makes fuel and chemical spend meaningful. For example, if a full-sized V2 Starlink satellite costs around USD1m, with the launch cost per kg ranging from USD1,500-2,500 (a V2 weighs about 1,250 kg), that would result in another USD2-3m in launch costs. So, for a launch vehicle with payload capacity of 100t and propellant requirement of 1,600t, the fuel cost is less than 0.5% of satellite cost.

Fuel cost calculation

Fuel cost calculation	
V2 Starlink satellite cost (USDm)	1
Launch cost (USD/kg)	1,500-2,500
V2 Starlink weight (kg)	1,250
Launch cost (USDm)	2-3
Fuel cost calculation (USD)	183,636
Methane	58,436
LOX	125,200
Number of satellite per launch	50
Fuel cost per satellite (USD)	3,673
Fuel cost as % of satellite cost	**0.4%**

Source: SpaceX, Spacenews, HSBC calculations

Satellite manufacturing cost breakdown



Source: Antesky, HSBC

Scale will alter those numbers with SpaceX having filed an FCC proposal to launch a constellation of up to 1m solar-powered satellites operating as orbital data centers. Assuming successful execution, this would imply cUSD5bn expenditure on fuel costs and an additional 10-20x spent on other chemical inputs.

5. Semiconductor developments help by:

More compute payloads in orbit increase demand for electronic materials and high-performance polymers/thermal coatings used around electronics and power systems. Semiconductor manufacturing uses over 150 chemicals and more than thirty gases and minerals across the production. It uses hydrochloric acid, sulfuric acid, and ammonium hydroxide to clean the surface of the wafer, and certain specialty gases such as silane, phosphine, tungsten hexafluoride (in relatively small quantities) as precursors to deliver a substance onto the wafer. Semiconductor progress, in that context, is not just smaller nodes; it is higher performance per watt and higher integration density, and thereby expands the addressable space for specialty chemical formulations.

6. Robotics developments help by:

Robotics supports in-space maintenance and servicing, reducing waste and improving asset lifetimes; thus, it can change the replacement curve for a scaled constellation. The global satellite servicing market is estimated to be USD3.1bn in 2026 and expected to grow at a CAGR of c10% through 2033, of which, robotic services account for c46% (Persistence Market Research, May 2026).

That matters for chemicals because, once the system is operating at high volumes, any improvement in lifetime and in-orbit repairability reduces the rate at which satellites need to be rebuilt. Therefore, it influences the steady-state run-rate demand for polymers, coatings, propulsion gases, and other chemical inputs embedded in each new unit.

Agriculture & Fertilisers

- SpaceX could offer services into the Precision Agriculture domain primarily through connectivity solutions
- Starlink could act as a key enabler in improving satellite broadband and mobile connectivity in rural and remote areas
- In the long-run, SpaceX could increasingly support enterprise-grade precision services for agribusinesses

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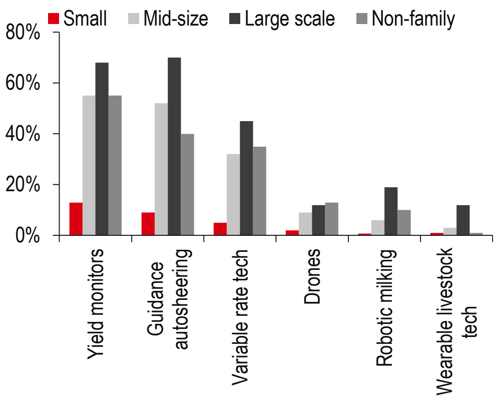
Space-enabled agronomy

1. What needs to happen on Earth first:

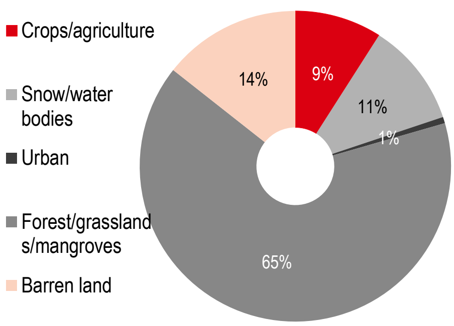
In the agriculture and fertiliser sector, SpaceX could offer services into the Precision Agriculture domain primarily through connectivity solutions. But first, precision agriculture needs to move from early adopters into the long tail of smaller landholdings. Over time, precision agriculture has become a productivity lever, increasingly tied to both profitability and sustainability. Precision agriculture supports a shift away from conventional farming methods that treat entire farms and fields as uniform, and instead uses GNSS guidance, sensors, remote sensing and analytics to manage in-field variability. An analysis of 1,472 farm observations indicates that adopting precision agriculture technologies increases average return on investment by 22.3% and net profit by 18.5% (MDPI Agriculture Journal).

Precision agriculture adoption in the US



Source: USDA; Farm size-wise adoption

Global land cover



Source: FAO, HSBC; Data as of 2023

Despite proven benefits, adoption remains limited. Precision agriculture penetration ranges from 50-70% on mid- to large-scale commercial farms (e.g., in North America), but penetration drops to under 10% for smaller landholdings.

There is significant opportunity for growth in developing regions, small/mid-sized farms as well as potential to increase agricultural coverage, which stands at less than 10% of global land cover.

Key deterrents to adoption include: a) high initial costs, including equipment and subscription fees; b) training/complexity, as farmers can find tools difficult to use; and c) connectivity constraints in remote areas.

2. Earth developments needed to benefit:
The immediate terrestrial prerequisite is rural connectivity that is both reliable and affordable. The Starlink tailwind is explicitly contingent on the widespread availability of affordable smartphones and data plans; without that last-mile affordability, satellite broadband's theoretical coverage advantage doesn't translate into mass adoption in developing regions or among smaller farms. If connectivity is intermittent or expensive, the value proposition of real-time monitoring, over-the-air updates, and always-on decision support degrades quickly, and subscription models remain concentrated in the best-covered, highest-ARPU geographies.

In parallel, the industry needs better usability of precision tools to reduce the training and complexity barrier. Lower-friction workflows and more automated insights are what make connectivity "stick" economically for smaller operators and emerging markets.

3. Impact of more data centres on Earth:
More data centre capacity and cheaper compute reinforce this adoption pathway by improving the performance and economics of AI/IoT agronomy platforms. Faster analytics and more automation increase the value of continuous data streams, which in turn raises the opportunity cost of being offline. In other words, as models improve and decision loops shorten, always-on rural connectivity becomes more valuable. Thus, it is not merely broadband availability, but also dependable, low-latency connectivity that can sustain cloud-based monitoring, analytics, and automated recommendations at scale.

4. Space developments needed:
SpaceX's Starlink could be a key enabler of the next phase of precision agriculture by underpinning connectivity and real-time monitoring. In particular, low-Earth-orbit (LEO) satellite networks are starting to close coverage gaps in remote regions, allowing data from in-field IoT sensors to be transmitted in near real time where terrestrial networks are unavailable. Many precision agriculture tools are connectivity-dependent, including machine telemetry, cloud agronomy platforms, IoT soil probes, and rapid ingestion of satellite and drone imagery. Reliable rural broadband can raise effective adoption by reducing downtime, enabling over-the-air updates, and making subscription models viable beyond the best-covered regions.

Affordability is also crucial. SpaceX has stated it has already cut launch cost per kg by 85-95% vs historical average costs of USD18,500 (1970-2000) and is targeting a reduction to around 1% of historical costs via Starship. V3 satellites, which are currently under development, are expected to increase bandwidth per launch by over 20x vs V2 satellites. This could help in making satellite internet economically viable, supporting coverage of remote areas at more affordable rates.

5. Semiconductor developments help by:
Semiconductor progress supports the same thesis through the edge. Cheaper and better sensors and connectivity modules reduce the cost of deploying the connectivity-dependent tools. As the unit cost of sensing and communication falls, precision agriculture becomes less capital intensive and easier to scale beyond large farms.

6. Robotics developments help by:
Robotics is still at a very early stage in precision farming, and it is only as scalable as connectivity and autonomy allow. On-farm automation depends on reliable connectivity for monitoring, updates and data exchange, alongside sufficiently capable models to operate with higher autonomy. The broader flywheel is straightforward: more data improves models, better models raise autonomy, and higher autonomy broadens deployment across crops, terrains, and farm sizes.

The precision agriculture market is currently valued at less than USD20bn (including hardware and application services) and is forecast to grow at a low-to-mid teens CAGR through 2030 (Technavio, June 2025), supported by AI/IoT integration and a growing population. This could receive a further tailwind from the evolving space industry and advances in AI.

Metals & Mining

- Space mining is gaining momentum, but commercial-scale projects are years away due to major technology, capital & logistics hurdles
- The Moon appears to be the near-term focus (helium-3, water ice), while asteroid mining is still at a nascent stage
- If space mining becomes a reality, a new supply chain will emerge with different, specialised producers

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Mining in space – the final frontier?

Interest in "mining beyond land" has been building for some time, with two primary frontiers attracting attention: deep-sea mining and space/asteroid mining. Rapid technological progress – particularly the growth in private-sector space launches – has accelerated debate about the commercial feasibility of extracting resources beyond Earth.

We believe a successful space-mining project remains years – potentially decades – away and will depend on substantial technological breakthroughs and significant capital investment. Material hurdles still exist, both at a macro level and within specific segments of the sector. That said, if these barriers are overcome, space mining could fundamentally reshape the mining industry, which has operated in broadly the same structure for centuries. Notably, it is plausible that major technology companies could ultimately emerge as some of the world's largest producers of metals.

Current debate on off-Earth extraction centres on the Moon, Mars, and near-Earth asteroids (NEAs). The Moon is believed to contain meaningful reserves of water ice, alongside materials such as oxygen and silicon, and metals including iron, aluminium, and titanium. Mars is also thought to hold substantial water ice, as well as silicon, aluminium, calcium, and magnesium. Beyond water, asteroids may provide access to a range of precious, rare earth, and industrial metals, depending on their composition. Asteroids are commonly grouped into three broad categories:

- C-type (most common) – Mainly consist of clay and silicate rocks, rare earth metals, etc
- S-type – Made of silicate materials, nickel-iron, copper, etc
- M-types – Predominantly metallic, nickel iron, PGMs, rare earth metals, etc

1. What needs to happen on Earth first:

Prove the model with early exploration and offtake signals.

Establish logistics economics: Starship as key enabler with **USD100-300/kg** target to LEO (vs Falcon 9 **USD2,940/kg**, Falcon Heavy **USD1,520/kg** table cited).

Extracting resources such as hydrogen, oxygen, and helium-3 from **lunar regolith** appears more achievable in the near term than many other space-mining concepts. While large-scale production is still likely several years away, a growing number of companies are developing the enabling technologies and the early foundations of associated supply chains. NASA has announced plans to establish a Moon base in the lunar South Pole, delivered through a phased approach.

Asteroid mining is also moving beyond theory, with multiple organisations attempting to transition from concept to execution. AstroForge launched the Odin mission to obtain critical images of asteroid 2022 OB5 as an initial reconnaissance step, aimed at identifying a metallic asteroid that is likely rich in PGMs (platinum group metals). Odin launched on 26 February 2025 aboard a SpaceX Falcon 9. However, communications were lost shortly after launch, and the mission was declared over in March 2025; AstroForge had flagged from the outset that the mission carried only a 30% probability of success.

Another indicator that the market is edging closer to commercial reality is the emergence of offtake agreements with defined timelines. These early contracts begin to establish price signals for space-derived commodities and help seed a nascent midstream and trading layer.

Overall, the emerging lunar and asteroid mining ecosystem appears to be fragmenting into specialised layers – including logistics, exploration, extraction, and processing – rather than immediately consolidating into fully integrated “mine-to-market” players. This pattern mirrors early-stage terrestrial mining markets, where risk capital typically funds initial resource definition and enabling infrastructure, and integration follows once unit economics are proven. To move from concept to scalable execution, each specialised layer will need to demonstrate clear progress on both the technical and economic dimensions.

- **Logistics**: Transporting hardware to space and returning materials to Earth. SpaceX could be a key player in this layer. Heavy-lift launch and lunar transport are likely to be concentrated among a small number of providers. Starship is the strongest candidate: it is often cited at c150t to Low Earth Orbit (LEO), with industry analyses suggesting cUSD100-300/kg at scale – implying a c95-98% reduction versus early Falcon 9-era pricing and many incumbents.

Launch vehicle cost comparison (2026)

Vehicle	LEO payload (kg)	List price (USD)	Cost to LEO (USD/kg)
Starship (target)	150,000	TBD	USD100-300 (target)
Falcon Heavy	63,800	USD97m	USD1,520
New Glenn	45,000	cUSD85m (est.)	cUSD1,900
Falcon 9	22,800	USD67m	USD2,940
Neutron (est.)	13,000	cUSD50m (est.)	cUSD3,850
Ariane 64	21,650	cUSD115m	cUSD5,310
Vulcan Centaur	27,200	cUSD120m (est.)	cUSD4,410
H3 (Japan)	6,500	cUSD50m	cUSD7,690
Electron	300	USD7.5m	USD25,000

Source: SpaceNexus Research, HSBC

- **Exploration and resource assessment (upstream)**: Resource mapping, exploration, and locating concentrated resources in space. A growing ecosystem of “space explorers” is forming around lunar and asteroid targets, analogous to greenfield explorers on Earth. AstroForge’s Odin mission illustrates an “asset-light” model focused on proving resource potential rather than owning transport or refining infrastructure.
- **Beneficiation & Manufacturing**: Developing extraction processes and transferring ore to processing sites.
- **Surface infrastructure**: Building infrastructure to support mining activities, including autonomous robotics, haulers and trucks, and specialised structures to support personnel and equipment.

- **Offtake and midstream (downstream).** Early offtake contracts are beginning to appear, providing initial price signals for space-derived commodities and seeding a nascent midstream/trading layer. Interlune's agreements to supply three litres of lunar helium-3 to the US Department of Energy's Isotope Program by 2029, alongside larger multi-year volumes to Maybell Quantum and interest from Bluefors, are early examples of term offtake with delivery windows extending into the 2030s.

Space mining value chain and companies

Layer	What it does	Private companies	Public companies
1) Logistics & Launch	Transport hardware to orbit / cislunar	Blue Origin	SpaceX (SPCX US) Rocket Lab (RKLB US); Intuitive Machines (LUNR US); Redwire (RDW US); AST SpaceMobile (ASTS US); Planet Labs (PL US)
2) Exploration & Resource Assessment	Find/characterise lunar/asteroid resources (mapping, imaging, sampling)	AstroForge; TransAstra; Asteroid Mining Corporation; Moon Express; Interlune; OffWorld	Planet Labs (PL US)
3) Extraction & ISRU	Hardware/process to extract & process resources in situ (drills, plants, oxygen/water)	Paragon Space Development; Honeybee Robotics (Blue Origin); BlazeTech; Teledyne Energy Systems; OxEon Energy	Redwire (RDW US); Intuitive Machines (LUNR US); Rocket Lab (RKLB US)
4) Beneficiation & Manufacturing	Off-Earth processing + in-space manufacturing (3D printing, structures)	TransAstra; OffWorld; SpaceFab	Redwire (RDW US); Rocket Lab (RKLB US)
5) Downstream & Offtake	Buyers signing offtake for space-derived resources	Maybell Quantum; Bluefors; US DOE Isotope Program	NA
6) Government & Agencies	Funding, contracting, regulation, test facilities	NASA; ESA; Luxembourg Space Agency; CSIRO	NA

Source: Companies data, HSBC

2. Earth developments needed to benefit:

Legal and governance clarity: Outer Space Treaty sovereignty limits vs US Space Resource Exploration and Utilization Act (ownership rights for extracted resources).

Continued advances in remote/autonomous mining on Earth (report cites Rio Tinto Pilbara autonomous network controlled **~1,500 km** away using satellite + sensors + AI).

Beyond the clear technical, physical, and economic hurdles, legal and regulatory frameworks will be a critical area of development as space resource extraction moves closer to commercial reality. On Earth, government control over sub-surface resources is a recurring risk for the mining industry. In space, the position is more complex: under the Outer Space Treaty, no nation may claim sovereignty over celestial bodies. However, the US Space Resource Exploration and Utilization Act provides that US citizens may own resources obtained through commercial space extraction. This creates a pathway for both private and public actors to retain extracted materials, but it also increases the likelihood of jurisdictional disputes as activity scales and competing claims emerge.

While conventional mining groups are not yet making direct investments in space mining, they are increasingly deploying space-enabled technologies and AI across terrestrial operations. Mining robotics on Earth is rapidly shifting from basic automation towards end-to-end operational autonomy, driven by the need to improve safety in high-risk environments and to deliver productivity gains as ore bodies become more complex. **As these capabilities mature, they may provide a practical foundation for operating assets remotely and at distance – a requirement that closely aligns with future space-mining operating models**.

Advanced exploration is also accelerating. More than 35 companies are now using sophisticated exploration platforms that combine satellite connectivity, edge-processing sensors, and artificial intelligence to generate high-resolution 3D models of the Earth's surface.

In parallel, major miners are beginning to use satellite connectivity to run autonomous equipment and manage operations at scale. A leading example is Rio Tinto's autonomous mining network in the Pilbara region of Western Australia, where autonomous trucks, trains, processing plants, and drills are managed from a single control centre located 1,500 kilometres away, supported by satellite imagery, sensors, and AI.

3. Space developments needed:

Near-term: lunar ISRU maturation; early signal: US DOE Isotope Program agreed to buy **three litres of helium-3**, delivery **no later than April 2029** (and additional purchases **2029-2035** referenced via other buyers).

Asteroid mining: sustained exploration despite high failure rates (AstroForge Odin cost **~USD3.5m**, built in **<10 months**, mission lost; exploration framed as inherently uncertain).

While there have been some initial advancements towards lunar and asteroid mining, further developments are required. Resource extraction within NASA's Moon base programme sits under Phase 3. In Phase 3, NASA intends to progress from early In-Situ Resource Utilisation (ISRU) demonstrations towards more sustained deployment of ISRU technology. ISRU refers to extracting and using local resources on planetary bodies to support propulsion, energy generation, life support, and other operational needs for sustained activity in deep space. Phase 1 of the programme focuses on testing technologies and preparing for surface operations. Phase 2 includes assembling semi-permanent infrastructure and initiating early habitation and logistics operations by 2029. To move from early ISRU demonstrations to more sustained implementation – using lunar materials to support exploration and surface operations – capabilities such as uncrewed cargo return from the lunar surface to Earth and end-to-end logistics to support ongoing lunar surface operations still need to be developed.

AstroForge's Odin mission was lost shortly after launch, and the mission was declared over in March 2025; however, AstroForge had indicated only a 30% probability of success from the outset. This outcome is not unusual in a mining exploration context: even on Earth, early-stage exploration is inherently uncertain, and many programmes do not progress. As exploration is the starting point for any mining project, Odin still represents a meaningful early milestone in the pathway towards asteroid-based resource extraction. AstroForge stated that Odin was built in under ten months at a cost of approximately USD3.5m, which is modest compared with the exploration budgets often required to advance new mining projects on Earth. Separately, TransAstra is developing technologies intended to enable the extraction of resources from asteroids. As a result, further exploration activity is still needed to identify and characterise suitable asteroids, before advancing extraction technologies, proving surface operations, and building the logistics required to retrieve asteroid-derived resources.

4. Robotics developments help by:

Direct gating factor: end-to-end autonomous mining operations (recon → mapping → drilling/excavation → sample handling → transport).

Given the practical constraints on establishing a large-scale human presence in space, alongside the absence of real-time interplanetary communications, space mining will need to rely heavily on highly autonomous robotics. These systems combine AI, sensor networks, autonomous navigation, and robotic manipulators to function in extreme environments with minimal human intervention. In principle, they can support end-to-end mining activity, including reconnaissance, resource mapping, drilling, excavation, sample collection, and transport.

Companies such as Honeybee Robotics are developing robotic arms and related tooling to dig, collect, and process samples for in-situ analysis. The firm's hardware has been deployed to cut through rock and ice on Mars and to drill holes on the Moon. Meanwhile, organisations such as Crow Industries are building robotic systems intended to operate on the Moon and Mars, supporting missions that include resource extraction, infrastructure development, and logistics.

5. Impact of more data centres on Earth:

More AI compute improves autonomous navigation, mapping, resource modelling, operational optimisation – critical because space mining must be robot-led (report: "will have to rely on robots with high level of autonomy").

AI – and by extension AI data centres (AIDC) – could play an important enabling role for extraterrestrial mining, primarily by providing the computational capacity required for autonomous navigation, resource modelling, and operational optimisation. Earth-based AIDC would also support the processing of large volumes of extraterrestrial data, converting raw sensor and imaging outputs into actionable insights for exploration and mine planning. A parallel can be seen in today's mining industry, where companies already use advanced platforms to analyse satellite imagery and generate high-quality geological and operational intelligence.

While edge computing deployed in space could help reduce latency and support time-sensitive decision-making, Earth-based data centres are still likely to remain essential for critical workloads that are difficult to perform off-planet. Constraints around power availability, logistics, cost, and system maintenance mean that many compute-intensive tasks would continue to be hosted on Earth, with edge systems acting as complementary capability rather than a full substitute.

6. Semiconductor developments help by:

Enables high-performance onboard compute for autonomous systems with limited comms latency and bandwidth (ties to "LEO-optimised silicon" and edge inference).

Low-Earth Orbit (LEO) satellite networks can extend high-speed connectivity to underserved rural and remote regions, while also delivering lower latency than traditional geostationary satellites. As many mining operations on Earth are located in isolated areas, LEO connectivity can materially improve the responsiveness and reliability of communications, supporting safer and more productive remote operations. The same logic applies beyond Earth: LEO-style architectures (and broader non-geostationary constellations) could be critical for communications and telemetry links supporting mining robots, ISRU plants, and in-space processing facilities.

Edge inference can further strengthen these operating models by shifting time-sensitive decision-making closer to the point of activity – whether on Earth or in space. By processing selected data locally, edge inference reduces dependence on high-bandwidth backhaul and helps mitigate latency constraints, enabling faster control loops, greater autonomy, and more resilient operations when connectivity is intermittent.

What will be SpaceX's role in the space mining?

SpaceX's infrastructure is central to any credible extraterrestrial mining scenario. SpaceX is already being used for early space mining/resource exploration experiments (e.g., AstroForge's Odin probe to 2022 OB5 launched on Falcon 9 in February 2025). Starlink could provide low-latency broadband across remote regions and could form the backbone of communications/telemetry for mining robots, ISRU plants, and in-space processing facilities operating in space. Over the medium term, SpaceX's AI segment (could support extraterrestrial mining indirectly via providing computational power for autonomous navigation, resource modelling, and operational optimisation.

Healthcare

- Whilst biopharma R&D in microgravity is not new, an integrated end-to-end service and better computing power could drive innovation
- Most applicable would be telemedicine, remote monitoring, surgical robotics, regenerative medicines & radiation diagnostics, in our view
- That said, cost of innovation and regulatory pathways are likely to remain major hurdles

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Space-enabled Healthcare beyond launch: Why space travel will shape future medicine

SpaceX could play a major role in biotechnology and healthcare, in our view, as it has shown interest in manufacturing pharmaceuticals in orbit. With no gravity pull, buoyancy is removed in turn avoiding fluid settling and mixing currents. Production of crystal growth could be purer with uniform protein and chemical structures. This could enhance drug stability and shelf life and possibly delivery precision. Using space is not completely new as pharma companies like Merck & Co[1] (for Keytruda), Novartis, and Lilly have carried out biopharma R&D at the International Space Station. AstraZeneca and Sanofi have worked on immunotherapy and vaccine development in collaboration with ISS National Lab. ISS has been a medical R&D lab for a long time where pharma has been focusing on improving drug targets, delivery, and nanoparticles, as well as modelling for advanced tissue and disease. In 2025, 13 patents and six products including tumor-on-a-chip system were related to ISS National Laboratory (source: Center for the advancement of Science in Space, ISS National Laboratory). In May 2026, Varda Space Industries announced a collaboration to focus on space-based drug formulations for rare pulmonary diseases. The company has already successfully crystallized anti-HIV drug ritonavir in orbit. Vast, in partnership with SpaceX, will launch its first commercial space station in Q1 2027.

The likely focus areas would be: 1) drug research and development in orbit; and 2) developing better ways to protect and treat people exposed to weightlessness and space radiation. Over time, these advances could improve healthcare both in space and on Earth.

The most promising healthcare areas are telemedicine, remote monitoring, and regenerative medicines, but radiation diagnostics, high-precision sterile manufacturing, and surgical robotics also feature. The most interesting second-order winner may be the broader class of therapies aimed at preserving muscle, bone, and metabolic health under extreme stress and no gravity. Space travel, if it scales, would not just export rockets, but it would also export a new clinical operating system for medicine on Earth.

[1] Reichert, P., Prosise, W., Fischmann, T.O. et al. Pembrolizumab microgravity crystallization experimentation. npj Microgravity 5, 28 (2019).

1. What needs to happen on Earth first:

- Scale telemedicine, continuous monitoring, and robotic intervention models (report frames this as the first/immediate impact).
- Regulatory pathways for medicines made in space becoming clearer (report notes regulators are beginning to set routes).

2. Earth developments needed to benefit:

- Deployment of wearable sensors, AI-assisted diagnostics, remote imaging, and robotic systems in terrestrial settings (rural care, home-based care, emergency response).

3. Impact of more data centres on Earth:

- More compute supports the data-heavy healthcare model (continuous monitoring and AI diagnostics), which could accelerate decentralised care delivery.

4. Space developments needed:

- Commercial stations mature and launch costs continue to fall (enabling microgravity manufacturing and long-duration missions).
- Capability to manage radiation risk and weightlessness implications at scale would require extensive monitoring and protective/treatment options.

5. Semiconductor developments help by:

- Better sensors and edge processing for continuous monitoring; more efficient compute for autonomous medical systems in constrained environments.

6. Robotics developments help by:

- Core to robotic intervention and remote/autonomous procedures when specialist access is limited by distance/delay.

Telemedicine, continuous monitoring, and robotic intervention
A first and immediate impact is likely to be a convergence of telemedicine, continuous monitoring, and robotic intervention into a highly autonomous healthcare model. Long-duration missions cannot rely on immediate access to physicians, hospitals, or specialists. It hence creates demand for advanced wearable sensors, AI-assisted diagnostics, and remote imaging, as well as robotic surgical systems capable of operating with minimal human oversight. Starlink is projected to have over 19 million subscribers by early 2027, which could help SpaceX with better remote healthcare monitoring, particularly in rural and underserved communities. In terms of second-order impact, we would imagine technologies developed for astronauts would have direct terrestrial applications in rural healthcare. This would include technology such as home-based care, military medicine, and emergency response. The result could be a healthcare ecosystem that is more decentralized, sensor-driven, and automated with care increasingly delivered remotely rather than within traditional hospital settings.

Microgravity: Drug manufacturing, regenerative medicine, bioprinting
Another likely impact is drug manufacturing in microgravity. Without gravity, convection, and sedimentation, buoyancy becomes irrelevant, and diffusion is the way molecules move around. Microgravity allows molecules to assemble slowly and uniformly, resulting in highly ordered crystal structures. As the healthcare field moves to more biologics formulations, we think this is important given the large size of macromolecules. Potential benefits include improved bioavailability, enhanced stability, improved delivery methods, and increasing efficiency. In orbit, the lack of gravity reduces settling and mixing effects that can interfere with how medicines

form. One practical benefit is that better crystal quality may allow simpler drug delivery and could improve formulation options in some cases, which can reduce burden on patients and clinics. SpaceX has recently introduced the Starfall programme, which focuses on a reusable re-entry capsule capable of returning up to 2,200 pounds of cargo to Earth. Designed as an alternative to the International Space Station (ISS), Starfall is intended to support the in-orbit production of pharmaceuticals and specialised materials, providing organisations with a self-contained floating factory for research and manufacturing in space. By mass-producing these capsules and launching them on Falcon 9 or Starship, SpaceX aims to offer an integrated, end-to-end service covering the full lifecycle of launch, orbital manufacturing, and return to Earth.

Microgravity provides a unique environment for tissue engineering because 3D-printed cells can grow without the structural collapse caused by Earth's gravity. Research conducted on SpaceX resupply missions is also exploring the scale-up of hematopoietic stem cell production; on Earth, these cells often lose their ability to develop into multiple critical cell types during laboratory expansion, whereas microgravity appears to better preserve that capability while increasing production volumes for potential use in treating blood diseases and cancers. In addition, recent missions have successfully bioprinted kidney, liver, and cartilage tissues, along with nerve repair implants, which are being used to study blood vessel development and to create models for testing novel RNA-based medicines ahead of clinical trials. This might be important for prolonged stays in space where microgravity leads to enhanced cellular ageing. Finally, work on bone-forming stem cells and 3D-printed medical implants aims to advance solutions for bone health, supporting new approaches to treating osteoporosis and nerve damage on Earth.

Metabolic health

As space travel scales up, weight becomes a cost and safety issue. Every kilogram matters for fuel, life support, and mission planning. This creates a strong incentive to manage weight and metabolic health for passengers and crew. Weight-management medicines may therefore become part of routine space medical planning, not only to reduce payload costs but also to lower health risks. A related second-order effect is that prolonged periods in microgravity can mimic extreme inactivity, which may quickly worsen blood sugar control and other metabolic markers. This increases the case for preventive metabolic care during longer missions.

Another major challenge is loss of muscle and bone in low or zero gravity. It should hence be noted that the current generation of anti-obesity medications potentially can cause meaningful muscle losses (up to c40% of weight loss can be muscle loss). Some of the new mechanisms of action such as amylin, which are expected to produce lower muscle losses, might be more suitable for the application in such a scenario. Even with structured exercise, people can lose muscle strength and bone density at a pace that would be unacceptable in most Earth settings. This has increased interest in medicines that help the body hold on to muscle and bone by adjusting key biological signals involved in muscle growth and repair. Progress on Earth may accelerate progress for space because demand for muscle-preserving treatments (myostatin agents) is rising alongside weight-loss therapies that can also reduce lean muscle. In parallel, space research is also testing more advanced options, including cell and gene-based approaches, to reduce muscle wasting.

Radiation therapy development

Radiation is a longer-term concern as missions extend beyond low-Earth orbit. Space radiation can damage DNA and raise cancer risk. It could drive demand for better monitoring and protection. This includes personal radiation trackers and medicines that protect healthy tissues before exposure or help recovery afterwards. A key knock-on benefit is on Earth: if these protective medicines work well, they could help clinicians deliver more effective radiotherapy while reducing harm to healthy organs, which is especially important in hard-to-treat cancers.

All sounds great, but who will pay for it?
The biggest negative effect, in our view, is that healthcare may be forced to solve a harder problem set faster. A large human presence in space would raise the baseline incidence of exposure-related disease and orthopaedic decline, but also fluid shifts, immune dysfunction, and emergency-care complexity far from Earth. That creates a market opportunity, but it also raises safety, ethics, and reimbursement questions. Who pays for continuous monitoring? The price for ISS is expensive (USD250k-500k) per experiment/launch.[2] Who carries liability for autonomous procedures? How much risk would be considered acceptable in a civilian space economy? The most important lesson is that space travel would not simply create new medical products, it would change the definition of what good medicine looks like when distance, delay, and fragility all rise at once.

That said, even with innovative treatments that are effective today, the cost of innovation (be it drug prices, or cost of overall Healthcare) remains a key challenge for society, especially with ageing demographics. The US political narrative around disproportionately paying for innovation is creating downward pressure on drug prices that potentially is limiting the ability of the industry to back existing pipeline drugs. Whilst this sci-fi version of the future sounds exciting, the geopolitics of funding such innovative development will remain a key bottleneck to navigate.

[2] When the ISS comes down, will its drug R&D be lost in space?, PharmaVoice, Lead Editor: Meagan Parrish, June 3, 2026

5. Semiconductor developments help by:

- Higher reliability and redundancy in satellite systems reduces failure probability and stabilises underwriting assumptions (aligned with report's emphasis on bespoke assets and limited repairability).

6. Robotics developments help by:

- On-orbit servicing and repair reduce "total loss" outcomes by making partial remediation possible (servicing theme is explicit elsewhere in the report).

Where does insurance come in?

- **Pre-launch insurance.** Risk in a space programme begins well before a rocket engine is ignited. The period leading up to launch includes the manufacture of the satellite, its movement through a complex supply chain, and a sequence of handling, integration and testing activities that must be executed with precision. Each aspect introduces potential points of failure. Pre-launch insurance is intended to provide broad protection during this stage, typically covering physical loss or damage while the satellite and related systems are being assembled, tested, and prepared for flight.
- **Launch insurance.** The launch phase remains the most critical and highest-risk stage of any satellite mission. Although launch reliability has improved over time, the fundamental physics and engineering constraints of ascent mean there is limited tolerance for error. A failure can occur at multiple points, including ignition, stage separation, guidance and navigation, fairing deployment, or the initial steps of orbital insertion. Launch insurance is structured to protect against failure during ascent and early orbital deployment and commonly extends through the initial in-orbit testing period.
- **In-orbit insurance.** Once a satellite is operational, it continues to face a range of risks throughout its working life. In-orbit exposures include component failures, power system degradation, software faults, and other environmental hazards associated with operating in space. Some failures are sudden and catastrophic, while others emerge gradually, reducing capacity, shortening mission life, or limiting the satellite's ability to deliver contracted services. In-orbit insurance is designed to address both abrupt failures and progressive performance decline. For operators, in-orbit insurance can support financial resilience by mitigating the impact of unexpected degradation and enabling more stable planning.
- **Third-party liability.** Launch operations, ground activities and in-orbit events can, infrequently, result in damage to third-party property or injury to individuals. Liability exposures may arise from incidents at launch sites, during transportation and handling, or from orbital events such as collisions or debris-related damage. Given the potentially significant financial consequences, third-party liability insurance is an important component of a comprehensive space risk programme.
- **Additional covers.** In addition to the core categories of pre-launch, launch, in-orbit and third-party liability cover, the broader space insurance landscape includes several related products that address specific commercial needs. The economic impact of a partial or total failure during launch or in-orbit operations can exceed the physical value of the satellite itself, particularly where service disruption leads to contractual penalties, lost customers, or reduced revenue. Loss of revenue cover, which resembles business interruption insurance, is designed to indemnify the insured for financial loss actually sustained. A typical use case would be the loss of contractually fixed revenue following material loss or damage to a satellite transponder, where the operator can demonstrate a direct link between the insured event and the revenue shortfall. This type of cover is particularly relevant for operators whose business models depend on long-term service contracts and predictable capacity delivery.

How big is the insurance market, and how fast is it growing?
In terms of market size, Howden estimates that the global premiums in the space insurance sector are estimated at approximately USD600 million per year, with projections suggesting growth of around 9% per annum over the course of this decade, based on Howden estimates. This remains a relatively small class of business: to put into perspective, the global non-life insurance market is over USD3 trillion according to Allianz, and the overall specialty market is roughly USD170bn according to the London Market Group. Despite its relatively modest premium base compared with other insurance classes, the market is relatively fast growing compared to more mature insurance classes such as motor insurance, and for small specialty players it can be significant.

Space insurance is a specialized niche dominated by syndicates and underwriters in the London Market, particularly through Lloyd's of London and the specialty arms of large insurance players such as Munich Re and AXA.

What are market conditions like?
Market conditions have also demonstrated how quickly sentiment can shift. According to the specialist broker Gallagher Specialty, the space insurance market was in a "survival" mindset in the fourth quarter of 2024 following a series of large claims and substantial market losses. By the fourth quarter of 2025, sentiment had improved materially. Premium rate increases implemented in 2023 and 2024 were being earned through 2025, claims activity was historically low for much of the year, and capacity remained ample. The reduction and settlement of claims from 2023 and 2024 provided insurers with greater clarity on ultimate loss costs and helped rebuild confidence in the class.

However, the inherent volatility of space insurance remains a defining feature. The total loss of SpainSat NG-2 in late December 2025, insured for more than USD400 million, materially altered the market's 2025 underwriting loss ratio, moving it from approximately 15% to approximately 75%. Even so, the timing of the loss meant it arrived too late to significantly disrupt 2026 reinsurance renewals and capital provider commitments. Overall support for the class has increased, with theoretical capacity rising year on year. Looking into 2026, premium income is expected to decline due to fewer large geostationary (GEO) launches and limited buyer appetite for insuring constellations, a combination that may increase volatility. At the same time, competition for established, "heritage" in-orbit business is intensifying, which is likely to extend rate reductions as insurers seek premium volume and portfolio diversification, while remaining selective on new technology and "New Space" risks.

A challenging insurance class to underwrite
The sector faces structural challenges that distinguish it from many other lines of insurance. Most satellites are effectively bespoke assets, built to precise specifications and not previously tested under real operating conditions. As a result, even a minor defect can lead to severe consequences, including total loss. Moreover, the space insurance market does not benefit from a large, homogeneous pool of exposures. Traditional insurance pricing often relies on actuarial analysis derived from pooling many similar risks to estimate loss probabilities with confidence. In space, the number of insured commercial launches is relatively small, averaging around 30 to 40 per year, and the technology continues to evolve rapidly. This limits the availability of statistically meaningful data and makes it difficult to estimate failure probabilities using conventional methods. Consequently, insurers place significant emphasis on qualitative and technical assessments, including the reliability records of launch vehicles and satellites, which become key determinants of pricing and capacity.

For operators, deploying a satellite remains a high-stakes undertaking. Satellites are rarely reused, and most programmes are designed from the ground up to meet specific mission requirements. These assets are highly sensitive and technologically complex, and they are exposed to potential damage at every stage, including production, transportation, assembly, and testing on the ground. Once in orbit, the inability to conduct meaningful repairs means that even limited damage or performance degradation can translate into a total loss from a commercial perspective, potentially undermining the viability of the entire project.

SpaceX could change the insurance landscape

SpaceX is manufacturing reusable rockets by landing and reusing the booster stages. If successful, insurers will be required to underwrite the same rocket ship. The burden with underwriting bespoke launches will come down, and the data over time should become more homogenous – which should improve the ability to apply more rigorous actuarial techniques.

Insurance solutions also exist for human spaceflight, although these are typically placed outside the mainstream commercial space insurance market. Looking ahead, space tourism is frequently cited as a potential next stage in the commercialisation of space, in which SpaceX could be a significant player. Space tourism could also lead to wider cover requirements such as personal accident cover and property (theft) cover.

Financial Institutions

- Space goes mainstream: SpaceX USD75bn IPO; space economy seen at USD1.8trn by 2035 (vs USD630bn in 2023)
- Capital intensity means elevated funding needs, driving opportunities for banks and alternative asset managers
- Broadening access to retail investors/the emergence of a new entrepreneurial class could help drive wealth opportunities

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Will the space economy provide rocket fuel for financial services growth?

SpaceX's initial public offering (IPO) was a watershed moment, turning the space sector into an investable asset class accessible to retail investors. It also put a spotlight on the sector's shift from a state-led domain to a fast-evolving commercial ecosystem with a sizeable addressable market. A 2024 McKinsey report estimates the space economy could reach **USD1.8trn by 2035, up from USD630bn in 2023**, driven by satellites, government support, and new space-enabled applications and industries.

This evolution creates a broad opportunity set for financial services firms – spanning capital raising, corporate and wealth advisory, and risk management.

We outline what we see as the primary opportunities, reflecting near-term growth in space exploration, space-based AI infrastructure, and satellite services, alongside the longer-term development of a broader commercial space economy. We don't attempt to forecast the industry's precise trajectory or quantify each pool of opportunity; our aim is to highlight where financial institutions may be able to participate. We think global investment banks, alternative asset managers, and wealth and traditional asset managers could all benefit from the rise of the space economy.

1. What needs to happen on Earth first:

- Capital markets access: SpaceX IPO cited at **USD75bn** raised; underwriting fees estimated **~USD500m**; proceeds will fund expansion of AI compute infrastructure, scaling the Starlink constellation, enhancements to reusable launch vehicles (including Starship), and repayment of a **USD20bn** bridge loan.
- Build financing structures for capital intense endeavors (debt, venture debt, project finance/SPVs).

2. Earth developments needed to benefit:

- Mechanisms to broaden investor access: **30% retail allocation** in SpaceX IPO; growth of thematic ETFs and increased wealth management to private assets.

3. Impact of more data centers on Earth:

- Increases capital demand across the AI/compute stack, reinforcing fee pools in ECM/DCM and structured finance (project finance and programmatic SPV).

4. Space developments needed:

- Space economy scaling (McKinsey estimates that the space economy could reach **USD1.8trn by 2035** vs **USD630bn in 2023**) sustains debt and equity issuance activity, M&A, and wealth creation.

5. Semiconductor developments help by:

- Expands the investable capex cycle (chips, packaging, power electronics), supporting larger financing needs and broader sector participation.

6. Robotics developments help by:

- Creates new investable verticals (on-orbit servicing; autonomous infrastructure), expanding the TAM and associated financing/advisory opportunities.

Banks and alternative asset managers can help meet capital needs

Launching payloads and building orbital infrastructure is capital intensive. Financial services firms can support these funding requirements in numerous ways.

Equity capital markets. SpaceX's IPO raised **USD75bn**, making it the largest IPO in history. The underwriters are estimated to have earned c**USD500m** in underwriting fees. According to the prospectus, proceeds will fund expansion of AI compute infrastructure, scaling the Starlink constellation, enhancements to reusable launch vehicles (including Starship), and repayment of a **USD20bn** bridge loan. SpaceX's listing could catalyse further IPOs and follow-on equity issuance across the sector. Moreover, we note that the SpaceX IPO is occurring amid a backdrop of other potentially historically large IPOs coming to market, notably those of Anthropic and OpenAI, both of which have filed draft registration statements, or S-1s, with the SEC, in addition to Alphabet's recent cUSD85bn equity raise to scale up its AI compute infrastructure and respond to rising demand for cloud and generative AI.

We also note that future IPOs may not be limited to US issuers. Since end-2025, China's rocket developers have reportedly been granted a fast-track route to list on the Shanghai STAR Market, with criteria that exempt them from profitability and minimum revenue thresholds. LandSpace's IPO filing was accepted by the Shanghai Stock Exchange (SSE) at end-2025, and other companies – including Galactic Energy, CAS Space, and iSpace – are also in the IPO process (see *China Aerospace: Rocketing high*, 12 February 2026)

Debt capital markets and loan syndication. The sector's capital intensity is likely to drive ongoing demand for debt issuance and syndicated borrowing, creating additional fee opportunities for investment banks. Given many issuers are loss-making, debt can bridge heavy investment cycles to future profitability – potentially alongside equity issuance – and may require more complex structuring (e.g., credit facilities, bridge loans, equipment financing).

Venture debt. Long timelines between R&D/capex and cash generation suggest venture debt will remain important for early-stage companies in the space economy. Venture debt typically extends runway without diluting founders, is often sized at 20-50% of initial equity raised, and is structured as a term loan with an interest-only period. A range of alternative asset managers and banks with innovation/technology banking teams are active providers of ventured debt.

Project finance and programmatic SPVs. The unprofitable nature of companies in the sector can make it well suited to asset-based financing, where capital is tied to discrete revenue-generating assets (e.g., satellites or data platforms supported by recurring revenues). While venture debt is typically raised at the enterprise level (with risk at the parent-company), financing may evolve towards asset- and project-level structures.

Project finance commonly uses bankruptcy-remote special purpose vehicles (SPVs) linked to specific assets. Some argue, however, that "programmatic SPVs" – standardised, repeatable templates that can be deployed for each new asset in a portfolio – could broaden the investor base beyond traditional venture credit, effectively creating a continuous "capital formation engine"[3].

The emergence of an asset class – and a push to democratize access

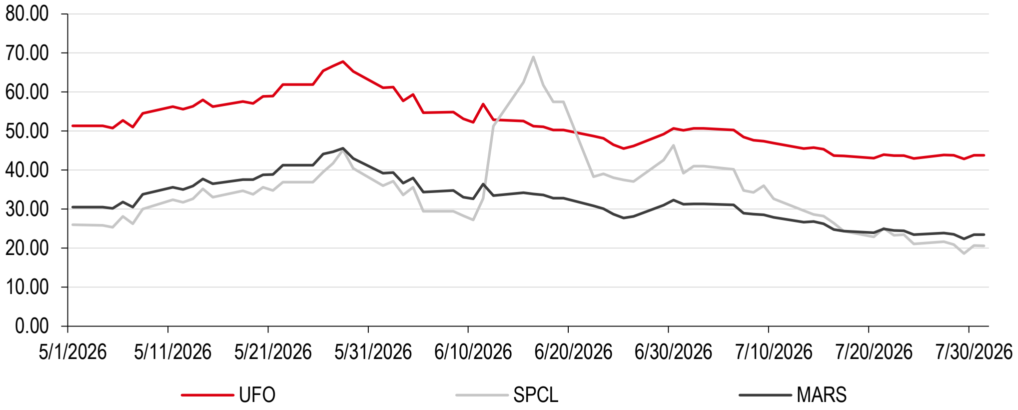
Retail investors received a 30% allocation in SpaceX's IPO, signalling strong demand from wealth and retail channels. We think the IPO's visibility and valuation underscore growing appetite for exposure to fast-growing emerging industries. Over time, retail exposure may expand through both ETFs and increased allocations to alternative vehicles providing access to private companies.

Thematic ETFs should continue to grow. Space-focused thematic ETFs have already gained traction, offering exposure via public "proxies" where direct private investment isn't possible. A successful IPO and strong aftermarket performance from SpaceX could further lift interest. Notable products include **Tema Space Innovators ETF (NASA)**, which combines public equities exposure with a regulated SPV structure that enables retail investors to gain fractional exposure to private SpaceX shares. Other major space ETFs include **Procure Space ETF (UFO)**, **Defiance Pure Space Daily 2X Strategy ETF (SPCL)**, and **Roundhill Space & Technology ETF (MARS)**.

[3] Mondaq, The Next Frontier of Space Finance: Programmatic SPVs and Regulation A as a Distribution Layer, 7 April 2026.

We note these ETFs rose following the SpaceX IPO announcement on **20 May 2026** but sold off following a broader technology-sector drawdown.

Space ETFs rallied on the announcement of the SpaceX IPO, but have since sold off since May 2026



Source: LSEG. Note: Prices are in USD. Priced from 1 May 2026 through 31 July 2026.

Wealth allocations to private assets. ETFs broaden access to listed space exposure (and, in NASA's case, fractional exposure to SpaceX). However, continued growth in the space sector could reinforce the secular shift towards higher private-asset allocations in wealth portfolios. Companies are staying private for longer, preventing most retail investors from sharing in a significant proportion of the value creation of US and global companies.

Over time, the space economy's growth – and its public visibility – could accelerate demand for private-market exposure, pushing wealth platforms towards more specialized funds targeting early- and late-stage space companies. Investment trusts already provide some indirect access: for example, **Scottish Mortgage Investment Trust** reportedly holds SpaceX as its largest position (**c18%** of assets), while **Seraphim Space Investment Trust** offers exposure to a curated portfolio of early- and growth-stage space technology companies.

Wealth advisory opportunities for a new entrepreneurial class

A commercial space boom would likely drive a wave of liquidity events, creating a new cohort of ultra-high net worth space-tech entrepreneurs with complex tax, estate, and investment advisory needs. Winning in this segment may require integrated coverage models that connect investment and corporate banking with private wealth services – tailored to the specific needs of space-tech founders and executives.

Valuation and risks: SpaceX (SPCX US, Hold, CMP USD140.00)

Valuation

We value SpaceX's business segments separately and derive a valuation of USD151bn for AI, USD272bn for Connectivity, and USD387bn for Space. We then apply an 'innovation premium' of 2.0x (unchanged) to the overall valuation to reach a TP of USD117.00 (all unchanged).

Our methodology is fully described in our initiation report: *SpaceX – Initiate at Hold: Rocket-centric* (July 2026).

Our TP implies c16% downside from current levels, and we retain a Hold rating as we think the company still has a lot to deliver from a technology standpoint to deliver its long-term ambitions.

HSBC SOTP valuation

USDm	EV	Year taken and multiple	Rationale
AI			
X	6,237	2x 2026e revenue	In-line with tier-2 social media peers such as SNAP and PINS
Grok	90,656	3.63x 2030e revenue	In-line with OpenAI's recent funding round
Compute offtake by Anthropic	4,781	Present value	Good deal, but likely to be short lived. Six months' EBIT discounted to today
Compute offtake by Google	4,472	Present value	Good deal, but likely to be short lived. Eight months' EBIT discounted to today
Compute offtake by others	20,506	10x 2030e non-GAAP EBIT	Year-taken to allow contracts to mature
Cursor	24,450	2.83x 2030e revenue	In-line with recent Anthropic funding raise. Acquisition cost removed at group level
Terafab	-		Still at a framework agreement stage
Orbital AI	-		Not necessary in the foreseeable future
AI valuation	**151,102**		
	150.00		
Connectivity			
Residential	94,381	5x 2028e revenues	2x that of US telecoms
Enterprise	97,136	7.5x 2028e revenues	3x that of US telecoms
Residential mobile	24,887	5x 2040e revenues discounted back	In-line with residential above, 2040 taken for business to reach maturity
Futuristic venture	55,407	10x 2040e revenues discounted back	10x to reflect high growth from new business opportunities, 2040 taken for business to reach maturity
Connectivity valuation	**271,810**		
	250.00		
Space			
Total launches incl. Starlink	92	2030e	Take total launches to correctly value optionality to wider business
Implied GLV revenues	40,018	2030e	
Segment adj. EBITDA margin	48.3%	2030e	HSBC forecast margin
GLV EBITDA	19,329	2030e	
EBITDA multiple	20.0x	2030e	Reflects high-market share
Space valuation	**386,571**		
Total EV	809,483		
Innovation premium	2.0x		
Valuation EV	1,618,967		
Less upcoming acquisitions	(76,900)		
Net debt (cash)	(1,851)		
Implied market cap	**1,540,216**		
Number of shares (bn)	13,176		
TP (USD)	**117.00**		

Source: HSBC estimates

Upside risks to our valuation

Space: Starship commercial deployment starts faster than expected; Starship expansion to 200t payload occurs faster than expected; contract wins beyond our expectations from external customers.

Connectivity: Greater-than-expected consumer take-up; faster-than-expected Enterprise take-up; faster delivery of a meaningful mobile segment.

AI: Anthropic and Alphabet deals last longer than we forecast; X social media platform outperforms its peers and moves to a tier-1 status; Grok consumer take-up and revenues outperform our expectations; Terafab and orbital AI start to meaningfully support earnings faster than we expect.

Company basis: Supportive FX scenario; lower-than-expected capital costs.

Downside risks to our valuation

Space: Starship commercial deployment delayed; failure of a Falcon launch; competition including Blue Origin building up operation faster than expected; large government contract losses.

Connectivity: Regulatory constraints (spectrum) capping the B2C opportunity; low enterprise take-up outside the US due to geopolitical factors; further progress of terrestrial networks (including 6G).

AI: Grok not gaining scale fast enough or spending too much capex to compete effectively against LLMs; X social media platform losing users due to low moderation or trust issues; Terafab and orbital AI projects discontinued.

Company basis: Unfavourable political environment; unfavourable FX environment; higher-than-expected cost of capital.

Companies mentioned in this report

BBG ticker	Company name	HSBC rating	CMP	Currency
MAERSKB DC	A.P. Moller - Maersk	Buy	20,700.00	DKK
298690 KS	Air Busan		1,487.00	KRW
AAF LN	Airtel Africa	Hold	3.29	GBP
ALV GR	Allianz		442.70	EUR
GOOGL US	Alphabet A	Buy	345.90	USD
AMZN US	Amazon.com	Buy	262.65	USD
AMXB MM	America Movil	Buy	20.01	MXN
AAL US	American Airlines Group	Buy	14.83	USD
AJG US	Arthur J Gallagher		251.21	USD
020560 KS	Asiana Airlines Inc		7,190.00	KRW
ASTS US	AST SpaceMobile		70.98	USD
AZN LN	AstraZeneca	Hold	114.60	GBP
T US	AT&T	Hold	24.89	USD
CS FP	AXA		45.05	EUR
BHARTI IN	Bharti Airtel	Buy	1,992.00	INR
BE US	Bloom Energy A	Buy	229.94	USD
CAT US	Caterpillar	Buy	856.57	USD
CWR LN	Ceres Power		4.39	GBP
2355 TT	Chin-Poon Industrial		41.90	TWD
CPA US	Copa A	Buy	135.87	USD
CRWV US	CoreWeave A	Reduce	105.26	USD
DTE GR	Deutsche Telekom	Buy	28.67	EUR
D US	Dominion Energy		68.77	USD
ETN US	Eaton	Buy	451.51	USD
LLY US	Eli Lilly	Reduce	1,180.16	USD
ENTEL CI	Empresa Nacional /CL		3,780.00	CLP
FTC LN	Filtronic		2.56	GBP
GEV US	GE Vernova	Hold	1,063.25	USD
GLO PM	Globe Telecom		1,750.00	PHP
HLAG GY	Hapag-Lloyd	Reduce	132.40	EUR
011200 KS	HMM		21,250.00	KRW
HON US	Honeywell International	Buy	233.96	USD
IAG LN	International Consolidate		4.44	GBP
LUNR US	Intuitive Machines A		19.01	USD
272450 KS	JIN AIR		5,320.00	KRW
JIOFIN IN	Jio Financial Services		250.00	INR
9433 JP	KDDI		2,877.50	JPY
003490 KS	Korean Air Lines		26,300.00	KRW
044450 KS	KSS LINE		10,360.00	KRW
030200 KP	KT Corp	Buy	53,400.00	KRW
300433 CH	Lens Technology		35.74	CNY
MDA CN	MDA Space		48.86	CAD
MEGACPO MM	Megacable	Hold	56.35	MXN
MRK US	Merck & Co	Buy	135.84	USD
META US	Meta Platforms A	Buy	589.85	USD
MSFT US	Microsoft Corp	Buy	495.40	USD
EEC AB	Mobily (Etihad Etisalat)	Buy	63.00	SAR
MTN SJ	MTN Group	Buy	194.09	ZAR
MUV2 GR	Munchener Ruckversicherungs		517.80	EUR
NOC US	Northrop Grumman		585.87	USD
NOVN SW	Novartis	Reduce	122.44	CHF
ORCL US	Oracle	Buy	150.52	USD
028670 KS	Pan Ocean		5,790.00	KRW
PL US	Planet Labs A		24.69	USD
TEL PP	PLDT		1,170.00	PHP
RDW US	Redwire		13.58	USD
RIO LN	Rio Tinto	Hold	70.59	GBP
RKLB US	Rocket Lab		80.25	USD
SAN FP	Sanofi	Buy	75.52	EUR
STC AB	Saudi Telecom	Buy	43.58	SAR
SU FP	Schneider Electric	Buy	306.40	EUR
300136 CH	Shenzhen Sunway Comm		68.30	CNY
ENR GR	Siemens Energy	Buy	160.72	EUR
ST SP	Singapore Telecom	Buy	4.45	SGD
017670 KP	SK Telecom	Hold	100,500.00	KRW
SPCX US	SpaceX	Hold	140.00	USD
STMPA FP	STMicroelectronics	Buy	46.69	EUR
VIVT3 BZ	Telefonica Brasil	Buy	29.74	BRL
T MK	Telekom Malaysia	Reduce	7.91	MYR

BBG ticker	Company name	HSBC rating	CMP	Currency
TLKM IJ	Telkom Indonesia	Buy	2,620.00	IDR
TLS AU	Telstra Group		4.78	AUD
TSLA US	Tesla	Reduce	342.27	USD
TM US	T-Mobile US	Buy	182.61	USD
UAL US	United Airlines Holdings	Buy	125.34	USD
3491 TT	Universal Microwave Tech		1,375.00	TWD
VZ US	Verizon Communications	Hold	48.48	USD
VRT US	Vertiv Holdings A	Buy	293.84	USD
VOD LN	Vodafone Group	Buy	1.22	GBP
2338 HK	Weichai Power	Buy	35.02	HKD
6285 TT	WNC		245.00	TWD
Private	Air Seoul, Inc.			
Private	Anthropic Ltd.			
Private	Asteroid Mining Corporation Limited			
Private	AstroForge, Inc.			
Private	BlazeTech Corp.			
Private	Blue Origin Washington, LLC			
Private	Bluefors			
Private	CAS Space Technology Co.			
Private	Galactic Energy Aerospace Technology			
Private	GITAI, Inc.			
Private	H-LINE Shipping Co., Ltd.			
Private	Honeybee Robotics Ltd.			
Private	Interlune Corporation			
Private	iSpace Global, Inc.			
Private	Landspace Technology			
Private	Lloyd's of London			
Private	Maybell Quantum Industries, Inc.			
Private	Moon Express, Inc.			
Private	MyFleet Telematics			
Private	OffWorld, Inc.			
Private	OpenAI Foundation			
Private	OxEon Energy LLC			
Private	Paragon Space Development Corp.			
Private	Polaris Shipping Co., Ltd.			
Private	Scottish Mortgage Investment Trust Plc			
Private	Seraphim Space Investment Trust Plc			
Private	SK Shipping Co. Ltd.			
Private	Space Forge Ltd.			
Private	Spacefab.US, Inc.			
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Private	Varda Space Industries, Inc			
Private	Virgin Atlantic Ltd.			

Priced as of 14 August 2026. Source: HSBC, Bloomberg, LSEG Workspace.

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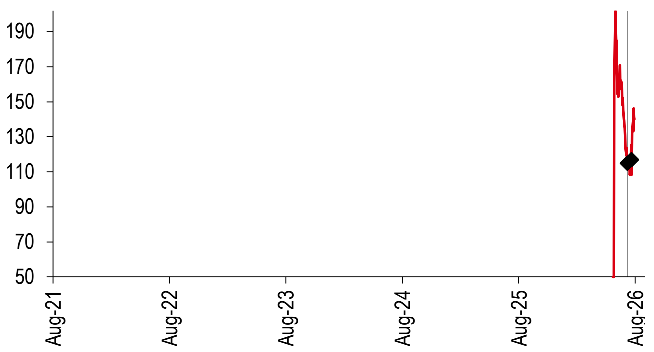
Share price and rating changes for long-term investment opportunities

SpaceX (SPCX.N) share price performance USD Vs HSBC rating history



Source: HSBC

Rating & target price history

From	To	Date	Analyst
N/A	Hold	23 Jul 2026	Nicolas Cote-Colisson
Target price	**Value**	**Date**	**Analyst**
Price 1	115.00	23 Jul 2026	Nicolas Cote-Colisson
Price 2	117.00	05 Aug 2026	Nicolas Cote-Colisson

Source: HSBC

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Company	Ticker	Recent price	Price date	Disclosure
SPACEX	SPCX.N	140.00	14 Aug 2026	7

Source: HSBC

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