28 July 2023

Space race continues…

Nations and companies enabling LEO tech

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Global

- The space economy is estimated to be worth USD464bn
- The US and China currently lead in launches…
- …but India, the UK, and Europe are in the modern space race too

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Whilst the House of Representatives in the US has been holding a panel about unidentified anomalous phenomenon (UAPs) this week, we focus this summer update on more identifiable space technologies, namely low Earth orbit (LEO) satellites.

The space economy was worth at least USD464bn in 2022 and it is likely to reach USD737bn within a decade, according to estimates from Euroconsult. North America and Asia currently dominate the sector, with Europe not far behind in terms of revenue share. However, India has placed the space sector as a key pillar of its aim to become a world technology superpower. And the UK government acquired OneWeb to bolster its space sector.

Why now? The cost of space travel has fallen significantly. SpaceX's Falcon Heavy rocket launched in 2018 at a cost of USD1,500 per kilogram, compared with USD5,400 per kilogram for NASA's Saturn V rocket used between 1967 and 1973. SpaceX's Starship rocket could lead to a further significant drop in costs by lowering the cost per kilogram to below USD100 by 2030.

Hurdles remain… In 2021 the European Space Agency estimated there were >130m pieces of debris larger than 1mm in orbit and this figure is even higher when considering debris that is too small to track. Even relatively small pieces of debris can cause LEO satellites serious damage when travelling at many kilometres per second.

The full note takes a look at the current players in the industry.

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The future of space

- The space economy is worth at least USD464bn in 2022
- The US and China are currently dominating space launches, but India, the UK, and Europe are looking to enter the space race
- The cost of space travel has dropped significantly in recent years, but concerns still remain over debris and de-orbiting

The space race continues…

> **Many years ago the great British explorer George Mallory, who was to die on Mount Everest, was asked why did he want to climb it. He said, "Because it is there." Well, space is there, and we're going to climb it.**
>
> **President John F Kennedy**

In this summer update, we explore the use cases of low Earth orbit satellite constellations.

Exploring, researching, understanding, managing, and utilising space

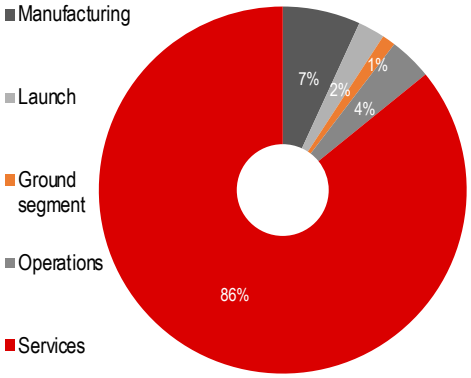
What is the space economy?

The OECD defines the space economy as any activity that involves exploring, researching, understanding, managing, and utilising space. The European Space Agency has claimed that space infrastructure has benefited a number of sectors, particularly: meteorology, energy, telecommunications, insurance, transport, maritime, aviation, and urban development[1].

- In October 2021, Amazon announced a partnership with Verizon to use its Kuiper constellation to expand rural broadband access in the US[2].
- In June 2023, OneWeb partnered with Telstra, the agreement will see up to 25Gbit/s of LEO capacity being delivered to the most remote areas in Australia[3].
- In August 2022, SpaceX announced a partnership with T-Mobile to enable satellites-to-cell connectivity which would help to close gaps in cell networks in rural and remote regions[4].

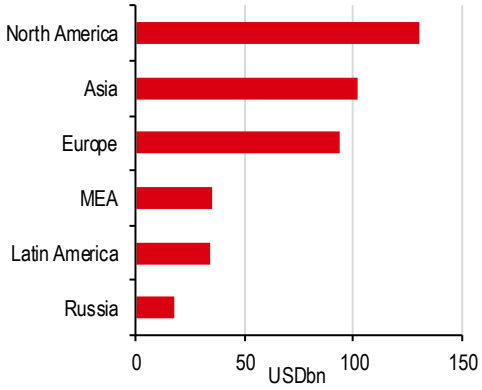
[1] The space economy is booming. What benefits can it bring to Earth?, World Economic Forum, 19 October 2022
[2] Verizon partners with Amazon to use tech giant's satellite internet system for rural broadband, CNBC, 26 October 2021
[3] Telstra and OneWeb seal deal on delivering new satellite solutions, OneWeb, 19 June 2023
[4] SpaceX gets U.S. approval to deploy up to 7,500 satellites, Reuters, 1 December 2022, Satellite Today, 25 August 2022

Services make up the largest chunk of the space economy…



Source: Euroconsult

…and North America, Asia, and Europe dominate the sector



Source: Euroconsult

86% of the market is made up of space-based end-user applications

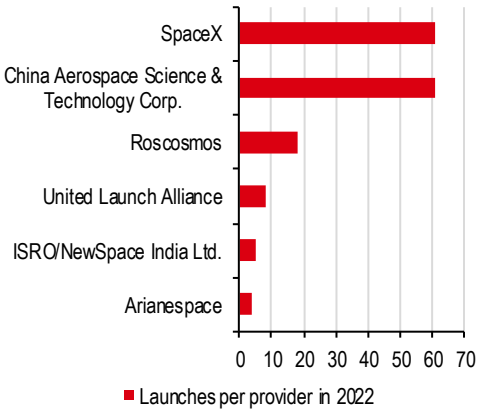
According to Euroconsult, the space market (i.e. commercial space revenue and government procurement) was USD424bn in 2022 and the space economy (i.e. also including government organisations spending to conduct space activities) was USD464bn. Euroconsult also expect the space economy to reach USD737bn within a decade. And moreover, 86% of the market is made up of space-based end-user applications, for example telecommunications or satellite navigation. North America and Asia dominate the sector making up USD131bn and USD102bn, respectively. With Europe just behind at USD94bn[5].

Regional breakdown

India puts space as a key pillar on the way to becoming a technology superpower

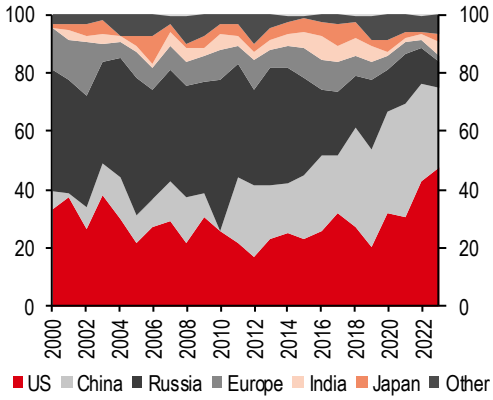
We have previously discussed India's growing ambitions in the space race. We have also covered the setbacks the UK has had in its aim to become a global space player, for instance, the failed Virgin Orbit launch in January 2023.

US and China dominate the space race, but India offers an alternative…



Source: SpaceTec Partners

…Europe remains a relatively small player and Russia's space sector is constrained by geopolitics



Source: Gunter's Space Page

[5] Value of Space Economy reaches $464 billion in 2022 despite new unforeseen investment concerns, Euroconsult, 9 January 2023

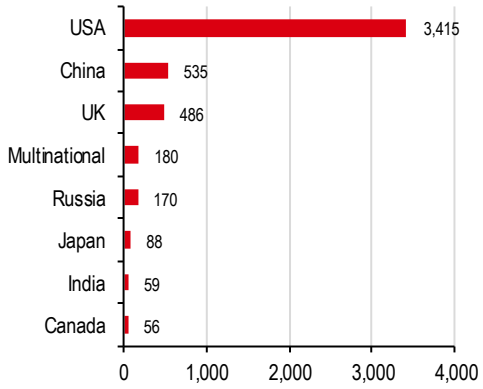
For now, the US and China are the dominant players in launches

For now, the big players are the US and China making up 47.6% and 27% of orbital launches, respectively. SpaceX makes up the bulk of the US launches and in 2022 SpaceX launched 61 orbital missions (approximately, a launch every six days). This cadence, doubled the company's previous record of 31 launches in 2021. In 2022 34 of these 61 launches were for the purpose of expanding SpaceX's megaconstellation. The remaining 27 were on behalf of its clients (e.g. NASA, International Space Station). The company has suggested that the aim is for up to 100 launches in 2023 (around 2 launches per week)[6].

SpaceX is the dominant company launching LEOs

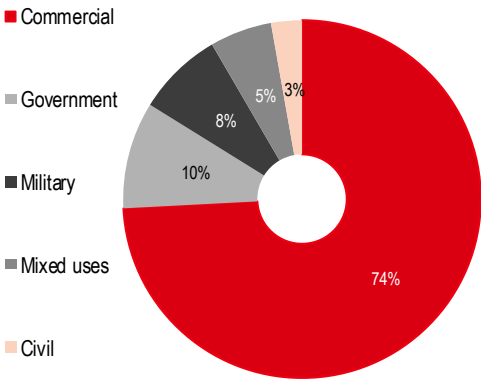
In May 2023, it was announced that SpaceX now had over 4,000 Starlink satellites in low orbit. Since 2019 the company has launched 4,340 Starlinks with 4,023 still in orbit and 3,988 of those operational. SpaceX has permission from the Federal Communications Commission (FCC) to deploy 4,408 Ku-band satellites and 7,500 V-band Gen2 satellites, with pending approval for 22,488 next-gen satellites in the future[7].

US is by far the leader in the number of satellites in space…



Source: Union of Concerned Scientists, Statista

…most of the world's satellites are for commercial purposes



Source: Union of Concerned Scientists, Statista

The US has the most satellites in space and most satellites in space are LEOs

The Union of Concerned Scientists, who advocate for multinational cooperation in space said that as of May 2022 the US accounted for 3,433 of the 5,465 operating satellites in space (68.5%), with China on 541 (10.7%), UK on 486 (9.7%), and Multinational satellites with 180 (3.6%, where 60 of which are European Space Agency run). Of the 5,465 satellites in space, 4,700 were LEO satellites (86%), 565 Geostationary (10.3%), 140 MEO (2.6%), and 60 elliptical satellites (1.1%)[8].

Commercial satellites make up 74% of all satellites in space

Of all the satellites, commercial satellites make up 74% of all satellites (4,047), government 10% (527), military 8% (424), mixed uses 5% (306), and civil 3% (152). Of the US satellites in space 87% of them were commercial satellites (2,992), 7% were for military purposes (237), 5% for government (172), 31 civil satellites (<1%), and 2 were mixed use (c.0.05%).

The cost of space travel

The cost of space launches has fallen >95% in the past 40 years…

The cost of space launches into low orbit has dropped significantly since the 1960s. NASA's Saturn V used between 1967-1973 cost USD5,400 per kilogram and the Space Shuttle used between 1981-2011 first cost USD65,400 per kilogram. In 2010 SpaceX's Falcon 9 rocket cost just USD2,600 per kilogram and the Falcon Heavy launched in 2018 cost USD1,500 per kilogram[9]. This amounts to a greater than 95% drop in the cost of a US space launch.

[6] 61 rocket launches! SpaceX celebrates record-breaking 2022, Space.com, 4 January 2023
[7] Milestone SpaceX Launch Raises Starlink Constellation to Over 4,000 Satellites, Yahoo News, 4 May 2023
[8] UCS Satellite Database, Union of Concerned Scientists, 1 May 2022
[9] Cost of space launches to low Earth orbit, Our World in Data

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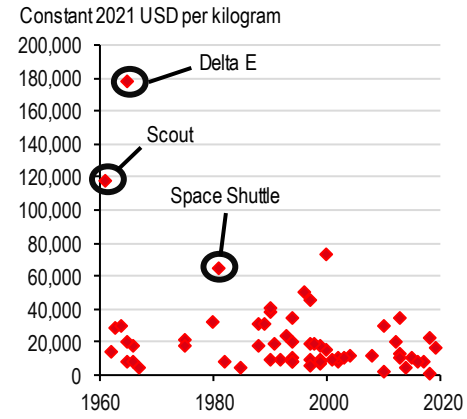
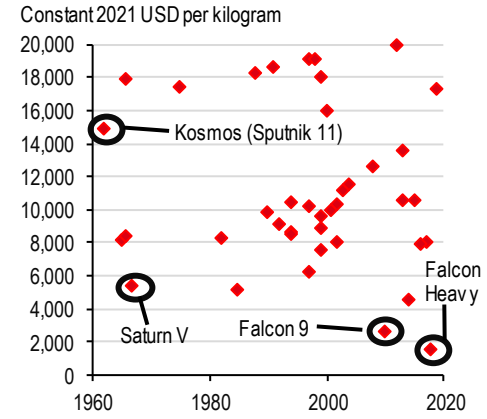


Source: Our World in Data

Note: In constant 2021 USD per kilogram i.e. cost to launch 1kg of payload mass into LEO as part of a dedicated launch

…SpaceX's Falcon Heavy took cost per kilogram down to USD1,500 in 2018



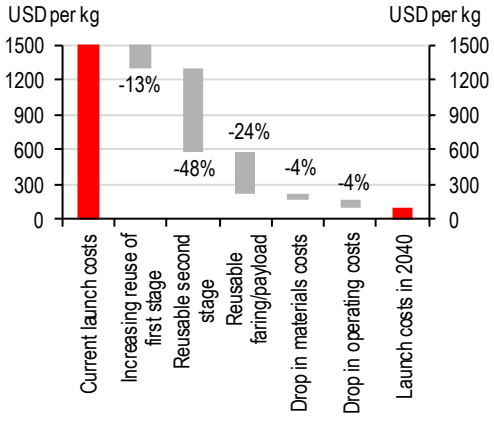
Source: Our World in Data

Note: In constant 2021 USD per kilogram i.e. cost to launch 1kg of payload mass into LEO as part of a dedicated launch

SpaceX's Starship aims to reduce the cost to USD100 per kilogram

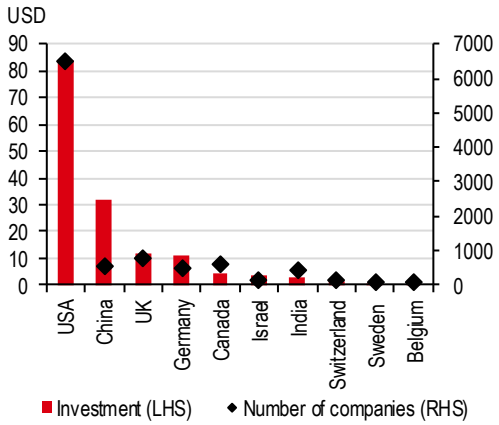
As we discussed previously, SpaceX recently conducted its first test launch of its Starship. The goal of the Starship is to launch daily with the ability to carry over 100 tons into orbit per launch. This would amount to a launch cost as low as USD100 per kilogram, though this is unlikely before 2030[10].

There could be a further >90% drop in launch costs due to re-usability…



Source: Indxx

…as US companies receives the most investment into SpaceTech



Source: SpaceTech Analytics

Cost savings are set to come from a reusable second stage and reusable payloads

According to Indxx, the current launch costs are c.USD1,500 per kg. By 2040 Indxx estimates the cost to drop to c.USD100. Largely brought about by sizeable costs savings from a reusable second stage (reducing costs 48%) and reusable faring/payloads (reducing costs 24%).

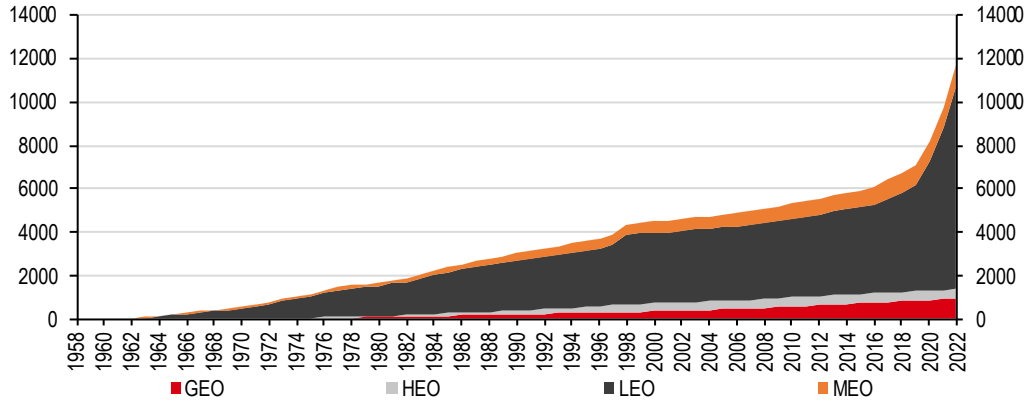
[10] Elon Musk says he's 'highly confident' that SpaceX's Starship rocket launches will cost less than $10 million within 2-3 years, Business Insider India, 11 February 2022

What is in space, where is it and debris dangers ahead?

In the 1990s there were three LEO players but the market was too immature then

We mentioned in a report published on January that in the 1990s there were three major players (Iridium, Teledesic, and Globalstar) who aimed to bring about LEO constellations for mobile phone communications. However, the market was too immature to succeed at that time and all three companies entered bankruptcy at some point.

Number of payloads and rocket bodies in space in low Earth orbit spiked in 2019 and has continued to rise sharply since then…



Source: Our World in Data

Note: LEO = <2,000km above Earth, MEO = between 2,000km and 35,586km above Earth, GEO = between 35,586 and 35,986km above Earth, HEO = >35,986km above Earth

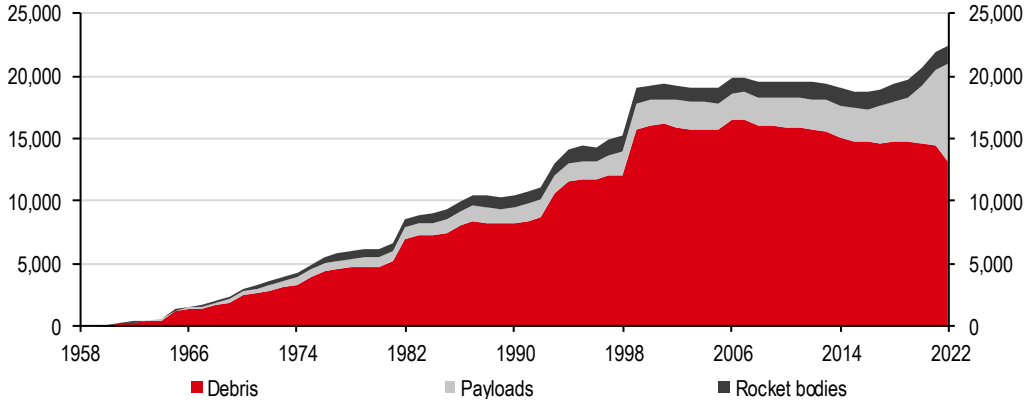
The LEO market returned in the 2010s and continues to take off (literally!)

LEO constellations made a comeback in the 2010s with new constellations such as OneWeb, SpaceX, and Amazon. Improved technology, miniaturisation, and terrestrial broadband adoption has made these newer projects viable; as well as the large rise in demand for telecommunications and digital divide which LEOs seek to close.

Low Earth orbit has long been the busiest area of space for human activity

We can see in chart below the uptick in activity in LEO that begins in the late 2010s as these constellations (particularly SpaceX) ramp up their launches. Before these constellations began being launched there was still a lot of activity in low Earth orbit, with most artificial objects in outer space existing in low Earth orbit. Some famous examples of human activity in low Earth orbit include the International Space Station and the Hubble Space Telescope.

Number of tracked objects in low Earth orbit, by type …



Source: Our World in Data

Note: Payload is typically a satellite, space probe, or spacecraft carrying humans i.e. the carrying capacity of the launch vehicles or aircraft. Rocket bodies refers to the abandoned rocket bodies that have not been de-orbited after delivering their payloads.

Space debris could begin to become an issue if left unaddressed

Debris left in low orbit has caused concern amongst scientists that this debris could cause issues such as collisions with other satellites and also lead to environmental concerns such as ozone depletion. In 2021, the European Space Agency estimated that there were >130m pieces of debris objects larger than 1mm. And there are many more times more debris in low Earth orbit that are not being tracked, with some scientists claiming up to 100trn pieces of debris are circling the Earth untracked which could render low Earth orbit unusable[11].

Even low Earth orbit has a limited amount of space. Humans must clean it up

According to the European Space Agency, there are also 900k space fragments between 1-10cm in size, 34,000 fragments larger than 10cm, 21,000 unidentified debris objects and fragments, 2,850 defunct satellites, and 1,950 discarded rocket stages. Even the smaller pieces of debris can cause serious damage to satellites because they are travelling at many km/second[12].

This is a Free to View version of a report with the same title published on 28-Jul-23.

The Full note takes a deeper look at the major players for Low Earth Orbit satellites, from the differences in business models to industry status.

Please contact your HSBC representative or email us at AskResearch@hsbc.com for more information.

[11] Scientists call for binding treaty to protect Earth's orbit from space debris, Metro, 9 March 2023
[12] The space economy is booming. What benefits can it bring to Earth?, World Economic Forum, 19 October 2022

Disclosure appendix

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