

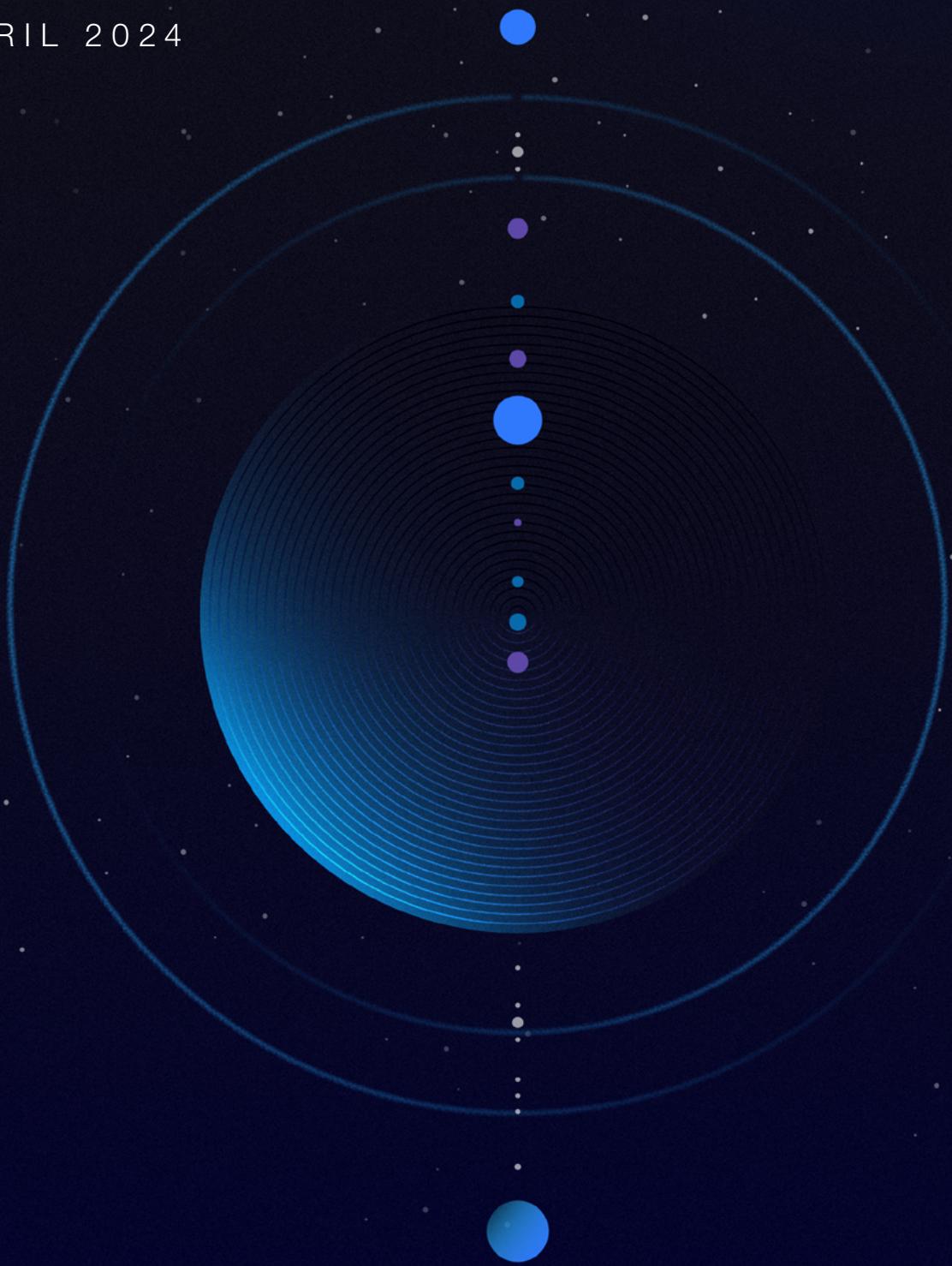
In knowledge partnership with  
McKinsey & Company



# Space: The \$1.8 Trillion Opportunity for Global Economic Growth

INSIGHT REPORT

APRIL 2024



# Contents

Foreword	3
Executive summary	4
Introduction: Moving towards space ubiquity	6
1 The space “backbone” and its “reach” across the world	8
2 How key factors determine the trajectory of the space economy	22
3 How space can change the world	26
Conclusion: Progressing to the North Star	31
Appendix	33
Contributors	49
Endnotes	51

## Disclaimer

This document is published by the World Economic Forum as a contribution to a project, insight area or interaction. The findings, interpretations and conclusions expressed herein are a result of a collaborative process facilitated and endorsed by the World Economic Forum but whose results do not necessarily represent the views of the World Economic Forum, nor the entirety of its Members, Partners or other stakeholders.

© 2024 World Economic Forum. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, or by any information storage and retrieval system.

# Foreword



**Jeremy Jurgens**  
Managing Director,  
World Economic Forum



**Ryan Bruckardt**  
Senior Partner,  
McKinsey & Company

The space industry is approaching the next frontier, with each week bringing news of a major space development from somewhere in the world. From successful tests of new rocket systems to pioneering satellite launches and complex robotic missions to the Moon and beyond, human activity in space is accelerating at an unprecedented pace. We're on the cusp of the super-heavy rocket era, with an ever-increasing number of industry players racing to revolutionize our access to space. Together, these efforts have progressively opened up the world of improved space data and services to the benefit of everyone. We estimate that the global space economy will be worth \$1.8 trillion by 2035, up from \$630 billion in 2023.

Yet while mega rocket launches and record spaceflights are the headlines that capture the public's imagination, routine rocket launches and satellite data services are, in fact, the product of decades of behind-the-scenes innovation. And they are delivering greater benefits to a more diverse

set of stakeholders than ever before – including in industries as varied as food and beverage; retail, consumer goods and lifestyle; supply chain and transportation; and even climate disaster mitigation.

This report by the World Economic Forum, in knowledge partnership with McKinsey & Company, shines a light on the key developments that will shape space and its adjacent industries through to 2035. We have brought together a community of leaders and experts from across space and other sectors to provide the most detailed picture yet of not only the space economy's future trajectory, but also of how space will impact many other sectors – often in indirect ways – through ever improving and expanding technological capabilities.

We hope that this publication will provide invaluable insights for those in the space community and adjacent industries, and helpful guidance on how incumbents and new entrants alike can embrace the opportunities offered by reaching this next frontier.

# Executive summary

The space economy is going from niche to ubiquitous, creating value for multiple industries and solutions to many of the world's most pressing challenges.

The space economy is forecast to soar to \$1.8 trillion by 2035 in an increasingly connected and mobile world, impacting and creating value for nearly all industries on Earth and providing solutions to many of the world's greatest challenges.

But it's about more than rocket science, with space increasingly playing a role in everything from the weather forecast you look at in the morning, to the dinner that gets delivered to your door, and the call you make from your smart watch. Indeed, industries like supply chain and transportation are only going to become more dependent on satellite and other space technologies.

Over the past year, the World Economic Forum and McKinsey & Company have engaged with more than 60 thought leaders from the public, private and non-profit sectors, representing more than 15 industries and most parts of the globe. Using market forecasts, public and private sector estimates, and insights from a global network of experts, the team behind this report has developed original bottom-up estimates for the size of each component of the space economy – including commercial services, infrastructure and support, and end-user equipment, as well as state-sponsored civil and defence applications.

The key findings of the report are:

## 1 Space will be a larger part of the global economy by 2035

The space economy is forecast to reach \$1.8 trillion by 2035, up from \$630 billion in 2023 and growing at an average of 9% per annum – well above the growth rate of global gross domestic product (GDP). This growth will largely be built upon space-based and/or enabled technologies such as communications; positioning, navigation and timing; and Earth observation.

## 2 Space's impact will increasingly go beyond space itself

The share of the total space economy captured by incumbent space hardware and service providers will gradually decrease to the benefit of non-

traditional players such as ride-hailing apps, which would never have reached the global scale they have without satellite-based technology connecting drivers and riders and providing navigation services.

## 3 Space will become more about connecting people and goods

Five industries – supply chain and transportation; food and beverage; state-sponsored defence; retail, consumer goods and lifestyle; and digital communications – will generate more than 60% of the increase in the space economy by 2035. In addition, nine other industries will see space-related revenues reach several billion dollars – creating opportunities for traditional and non-traditional players alike.

## 4 Space's return on investment will be more than financial

Beyond revenue generation, space will play an increasingly crucial role in mitigating world challenges, ranging from disaster warning and climate monitoring, to improved humanitarian response and more widespread prosperity. Collaboration between public and private players will be key to ensure that space capabilities reach this potential.

## How the space economy will continue to transform

While industry opinions differ on the extent to which space-based and -enabled applications have already reached an inflection point, space is set to undergo a major transformation over the next decade. Public sector investments continue to broaden, with countries such as Japan, Peru, Saudi Arabia and Thailand all investing in space initiatives and India becoming the first to land a spacecraft near the lunar south pole.

Meanwhile, private sector space investments continue to drive innovation and access in areas such as in-orbit inspection, maintenance services and commercially funded space stations, while non-space private sector partnerships with space players are also expanding.

The four main drivers for space's increasing prevalence in day-to-day life are:

### 1 Decrease in launch costs

The number of satellites launched per year has grown at a cumulative annual rate of above 50% from 2019 to 2023, while launch costs have fallen 10-fold over the last 20 years – and lower costs enable more launches. The price of data – key to connectivity – is also expected to drop by 10% by 2035, as demand increases by 60%.<sup>1</sup>

### 2 Commercial innovation (e.g. components and software)

Ongoing commercial innovation makes it possible to do even more in space with ever-smaller satellites. Space-based Earth observation, for example, now enables identification of objects at a resolution of 15 centimetres (cm). And these images come at a more affordable price, as cost per pixel has continued to drop.

### 3 Diversification of investment and applications

A broad set of investors have shown interest in the space sector, with private sector investment reaching all-time highs of more than \$70 billion in 2021 and 2022.<sup>2</sup> Meanwhile, space-enabled activities and applications are also becoming more diverse, with applications like space tourism no longer sounding like something out of a science fiction movie.

### 4 Cultural awareness and enthusiasm

Humankind has not stepped on the moon for 50 years, yet space makes the news every day.

Excitement over, and interest in, the latest space developments is evident all over the world, with government and business leaders increasingly considering what space could enable for the future.

### Embracing the opportunities offered by space

Space is already changing the world as we know it, and incumbents and new entrants alike from across sectors should be poised to leverage its economic, social and geopolitical benefits as space-based or -enabled technologies become increasingly prevalent in everyday life.

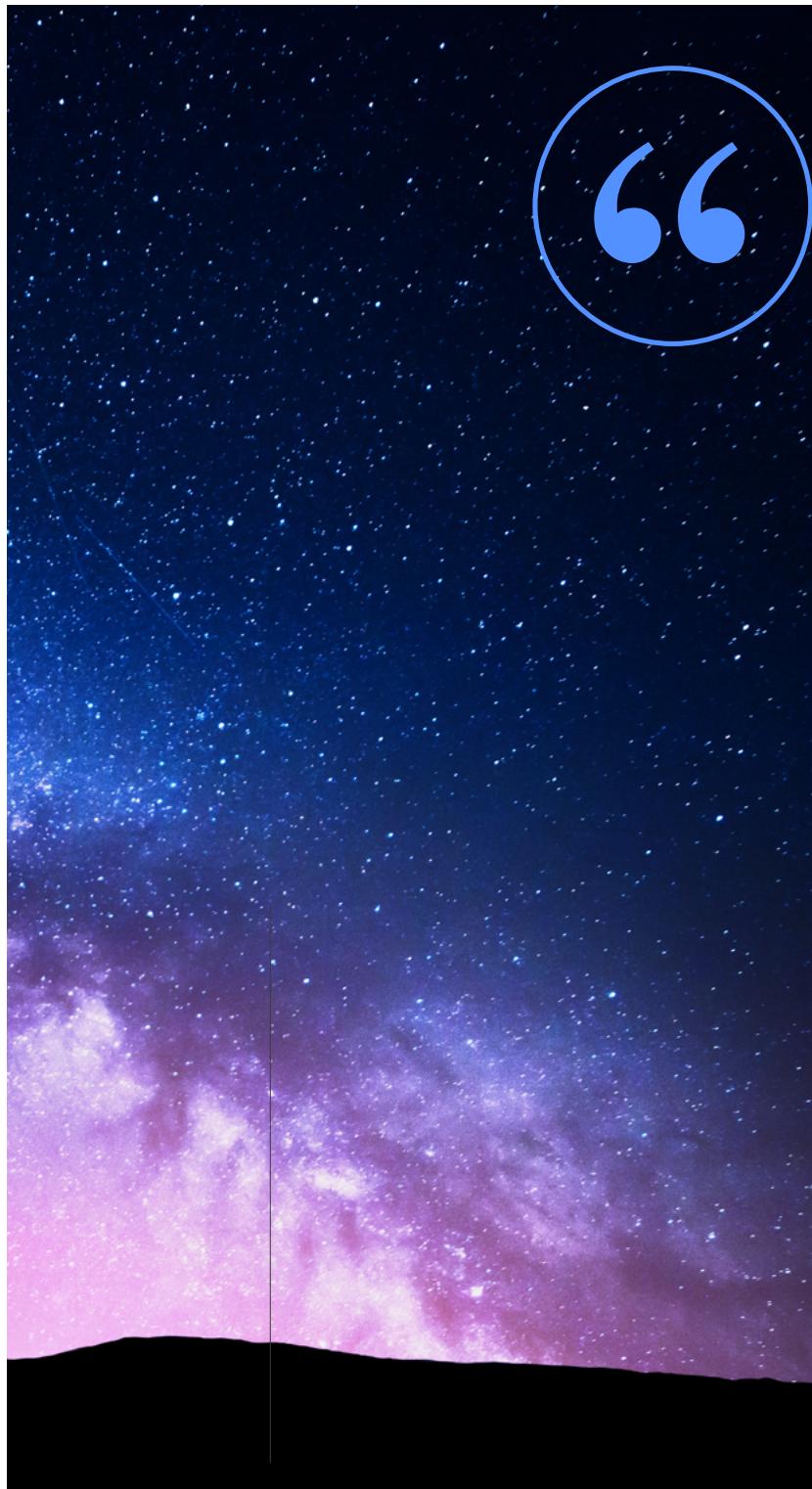
Every industry can be a driver of the space industry by contributing to its standardization and harmonization, accessibility and usability, and awareness and education. Collaboration between stakeholders will be key.

Technological innovation and financial competitiveness will also play vital roles in determining the trajectory of the space economy, with an upside estimate of the space economy being \$2.3 trillion by 2035 based on improved access to space data and reduced cost for space entry. Conversely, stalled access to space, as well as terrestrial technological advancements that reduce the need for space-based technologies, could lead to the lower estimate of \$1.4 trillion by 2035.

By understanding and embracing the full potential of space, public and private industry players can position themselves as leaders in the space economy and unlock its long-term benefits.

# Introduction: Moving towards space ubiquity

Like the internet in its early days, the space industry is standing at an inflection point.



It's the year 1930. Jazz and swing are popular. You walk to a city corner to buy the daily news for five cents, and if you're honest, things have gotten worse recently. In fact, global GDP has shrunk by nearly 20% in a handful of years, and unemployment is skyrocketing. But you hear about this new technology finding a market fit even in the downturn – a radio that can be taken anywhere with no interference – and you realize that one day you could have news and music with you at any time. You start thinking about the possibilities and you know the world is about to change.

...

It's 1984. Reflecting on the past few years as you drive, you're playing pop hits and news on the radio. The world is approaching the end of the Cold War and international institutions are negotiating peace across Europe and beyond – enabling a burst of economic activity and innovation across the world as technologies get cheaper and more ubiquitous. You hear about this new technology – a digital typewriter that can send messages – and you wonder what it would be like to write a note using a machine instead of pen and paper. You start thinking about the possibilities, and you know the world is about to change.

As it turns out, the radio and the personal computer would go on to change the world. In the following decades, the world would see similar expansion with cellular phones and the internet.

These technologies, as path-breaking as the radio and personal computers, moved from niche to ubiquitous at a snowballing rate. Driven by product-market fit, developments in manufacturing and changing world orders, each of these technologies changed the way that business was done and lives were lived.

Could space technologies be next? Imagine a future where every device can connect remotely through satellite networks, where space transport is not only for astronauts, and where access to multiple space data sources revolutionizes entire industries. Although the timeline for reaching the full potential of this transformative curve remains uncertain, the outlook for the next decade is promising.

Since the first moon landings over 50 years ago, space endeavours have been capital intensive, with initial demand driven by government interests rather than commercial opportunities. However, over the last decade, the space sector has seen accelerating growth and market activity, which indicates that space-based and space-enabled applications are reaching an inflection point.

This acceleration is visible across the public, private and non-space private sectors' investments. Public sector investments continue to broaden across international players, exemplified by India becoming the first country to land a spacecraft near the lunar south pole; by Japan partnering with

the United States (US) to augment the accuracy and reliability of positioning, navigation and timing (PNT) technologies in dense urban areas; and by Peru, Saudi Arabia and Thailand investing in space initiatives as elements of their economic plans.

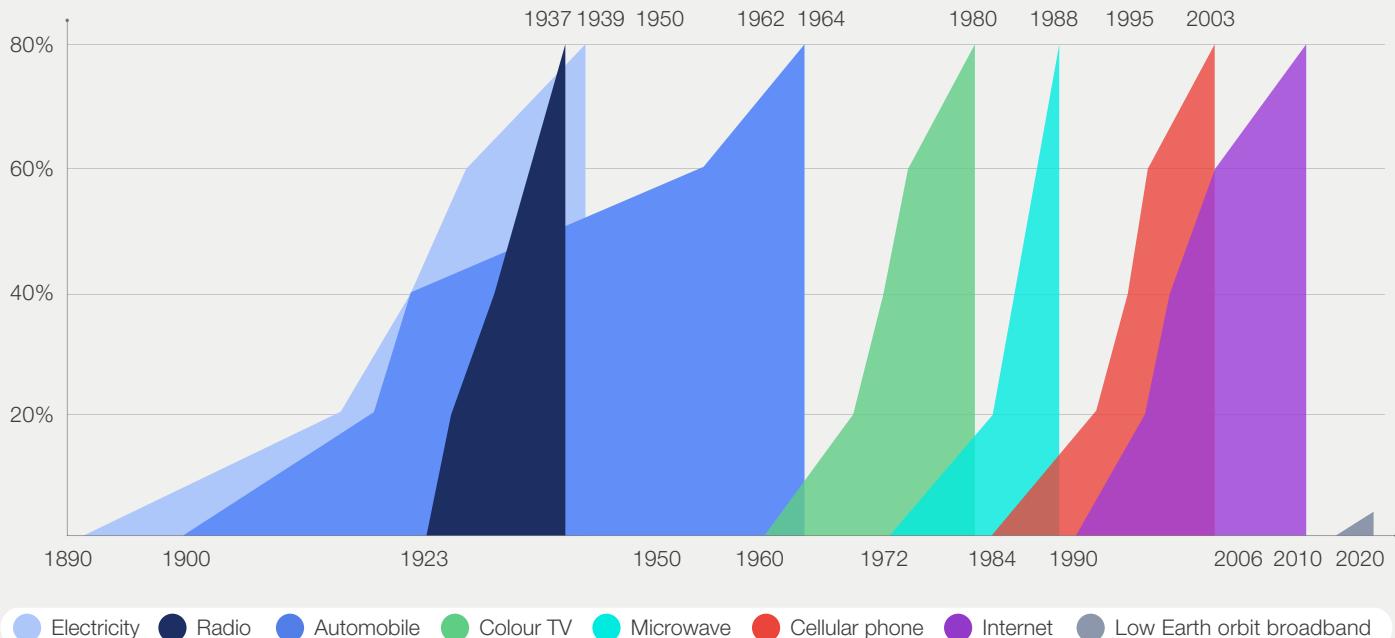
Private sector space investments continue to drive innovation and access including (but not limited to) adoption of in-orbit inspection, maintenance and upgrade services by commercial players, commercially funded space stations, and lunar and cis-lunar (the region of space between the Earth and the Moon, including the vicinity of the Earth and the Moon) applications. And finally, non-space private sector partnerships with space players continue to expand, such as Grimaldi Group's partnership with the European Space Agency's Navigation Innovation and Support Programme (NAVISP) to develop the first satellite-based guidance system for large vessel docking, and Amazon's investments in Project Kuiper to deliver satellite internet to underserved global communities.

As space becomes a growing enabler of terrestrial applications, it is essential to provide transparency for senior leaders in the space sector, as well as other sectors, on future opportunities in space. With this view, this report answers three central questions:

1. How big will the space "backbone" and its "reach" be across the world, by 2035?
2. How will key factors determine the trajectory of the future space economy?
3. How can space change the world beyond revenue growth?

**FIGURE 1** **Spread of innovative products (% of US households)**

**Spread of innovative products (penetration rate in US households, %)**



Source: US Census Bureau; *The New York Times*; Enjeux-Les Echos

1

# The space “backbone” and its “reach” across the world

The global space economy will grow from \$630 billion in 2023 to \$1.8 trillion by 2035, serving an increasingly connected and mobile world.



All numbers in this report apply globally and are in constant US dollars, with inflation estimated at +3% per annum (p.a.) on average for 2023-35.<sup>3</sup>

What is the space economy? If you're picturing satellites, launchers and services like broadcast television (TV) or the global positioning system (GPS), you might only be thinking of half of it. These "backbone" applications – those where revenues accumulate directly to space hardware and service providers – made up slightly greater than 50% of the global space economy in 2023, or \$330 billion.

Meanwhile, space is playing a key role in enabling companies across industries to generate revenues. Entire markets would not exist but for these space technologies, which are considered the "reach" of the space economy. For example, without the combination of satellite signals and chips inside your smartphone, Uber would never have reached such a global scale with its unique ability to connect drivers and riders and provide directions in every city.

The reach of the global space economy is visible across all industries, representing \$300 billion in 2023, roughly the other half of today's space economy. Reach applications are pervasive in everyday life, from weather services to parcel tracking to food delivery.

When evaluating the backbone and reach together, the global space economy could reach \$1.8 trillion by 2035. At a growth rate of 9% annually, this is

twice the rate of GDP growth projected over the next decade (global expectations are pegged at 5% annually).<sup>4</sup>

Comparing across industries, these estimates are similar to those for semiconductors (estimated at \$600 billion in 2021 with 6-8% annual growth into the 2030s),<sup>5</sup> and roughly half of the projection for the global payments industry (estimated to reach \$3.2 trillion in revenues by 2027). This anticipated growth is enabled by the world becoming more and more:

- **Connected – generating demand for satellite internet**, e.g. for providing access in remote areas to e-commerce and online services such as banking and education.
- **Mobile – generating demand for positioning and navigation services**, e.g. for tracking and navigating vehicles and for personal devices.
- **Informed – generating demand for insights powered by artificial intelligence (AI) and machine learning (ML)**, e.g. for disaster response organizations or insurers to determine the impact of natural disasters and improve early trend spotting.

“

**The key enabler for the advancement of civilization is synergy between a supportive space policy framework, pioneering business models, and the development of a vibrant space economy. The future of space is not just about the destinations we build but about the economic ecosystems we create along the way.**

Michael Suffredini, President and Chief Executive Officer, Axiom Space

FIGURE 2

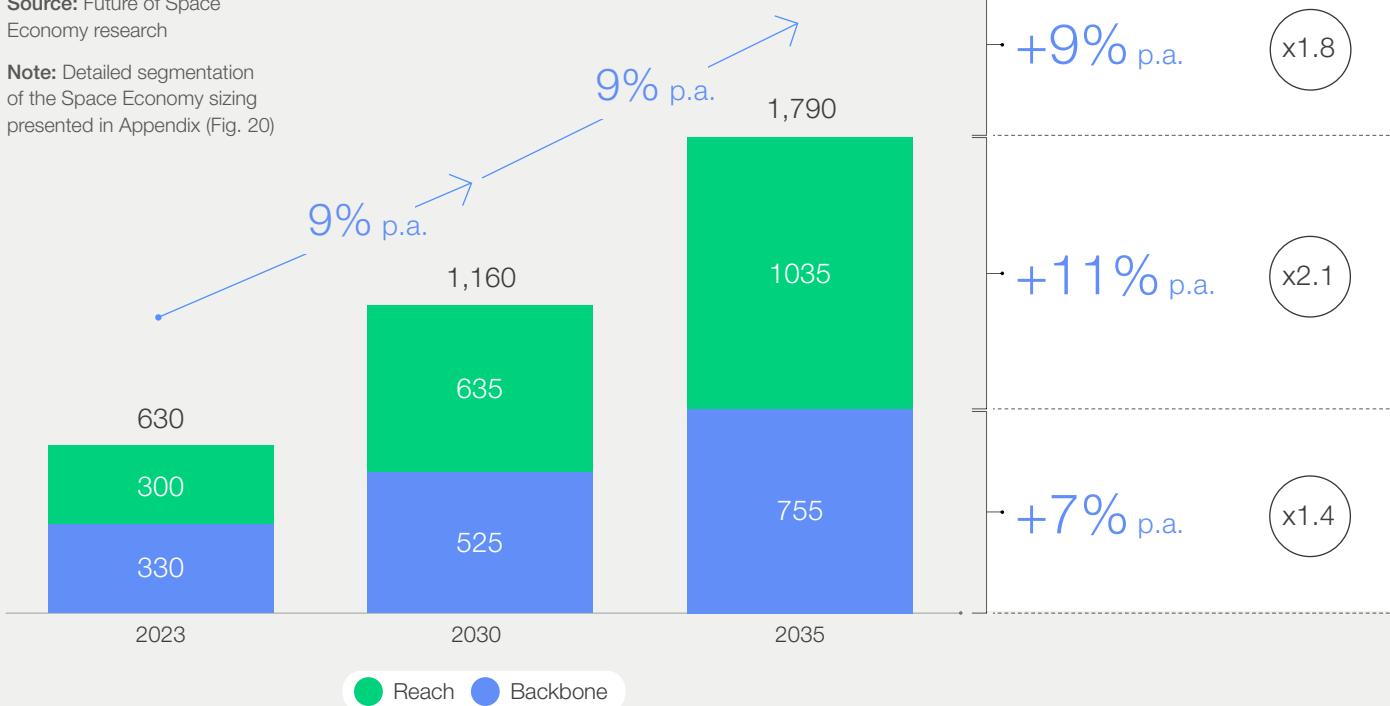
### Space economy size (\$ billion)

For reference: Global nominal GDP growth is forecasted to grow at 5% p.a. over 2023-35

v. global nominal GDP growth, 2023-35

Source: Future of Space Economy research

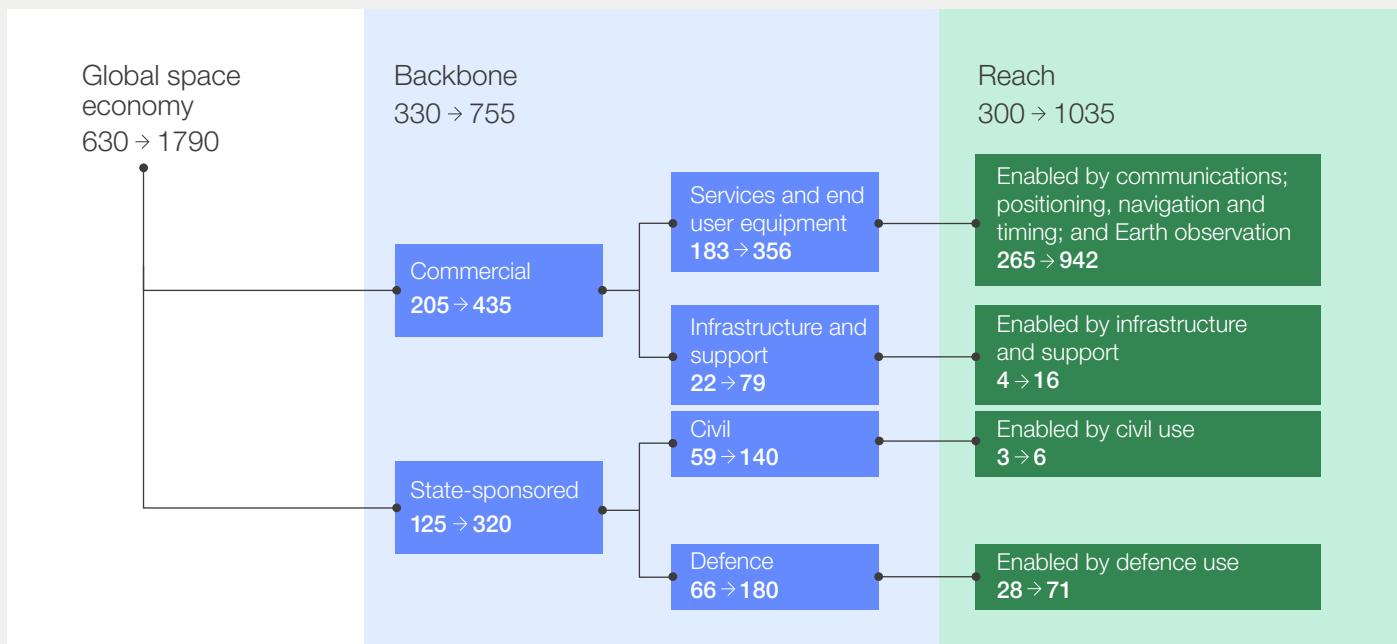
Note: Detailed segmentation of the Space Economy sizing presented in Appendix (Fig. 20)



By 2035, reach will grow 1.5x faster than backbone (11% p.a.), becoming the main driver of the space economy. This report estimates that it will make for nearly 60% of the total space economy in 2035,

affecting a wide range of industries. In parallel, the backbone will continuously grow to provide the underlying infrastructure and commercial applications, though at a slower pace (7% p.a.).

FIGURE 3 Components of space economy (\$ billion)

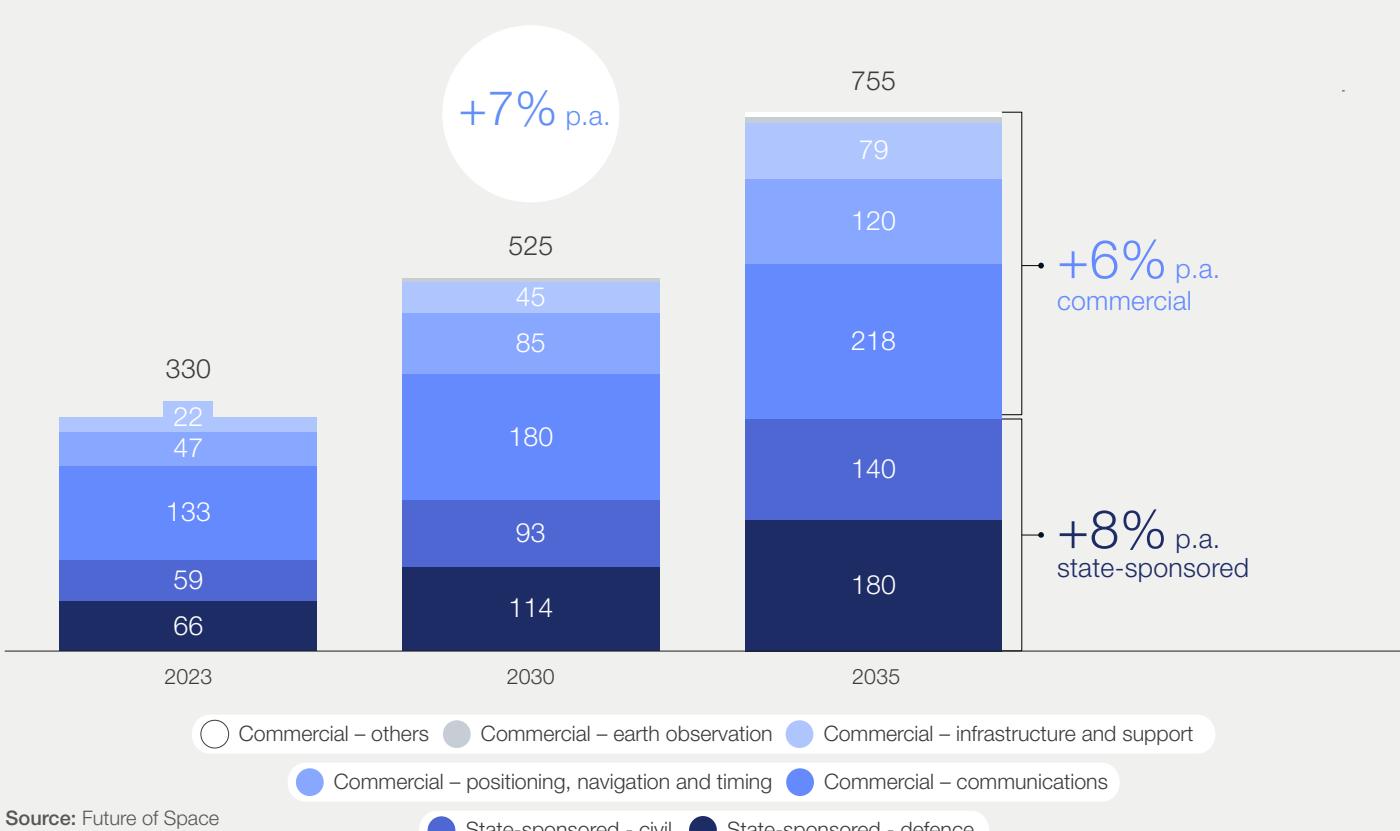


XX → YY Increase in global market size (in \$ billion from 2023 to 2035)

**Source:** Future of Space Economy research

**Note:** Detailed segmentation of the space economy sizing is presented in the appendix (Figure 20)

FIGURE 4 Revenue growth from backbone applications (\$ billion)



**Source:** Future of Space Economy research

## State-sponsored: Civil and defence

The 7% annual growth of the backbone of the space economy will be 1.5-times faster than GDP, driven by public and commercial investments.

State-sponsored investments will remain the cornerstone of the space backbone, with continued growth spurred by both incumbents and new entrants.

Over the next decade, the following developments will gather pace:

- **The established space nations will increase their spending on national security** and autonomy (driving ~75% of state-sponsored value increase by 2035). For instance, the US and China are investing massively in intelligence capabilities.
- **The established civil agencies will increase their use of space applications** for research, risk anticipation and disaster response (driving

~20% of state-sponsored value increase by 2035). For instance, funds for the Artemis programme<sup>7</sup> of the National Aeronautics and Space Administration (NASA) of the US are expected to reach \$50 billion for the 2021-25 period.<sup>8</sup>

- **More and more countries will improve their space capabilities**, with the number of space agencies having grown from 40 in the year 2000 to over 75 today (driving approximately 5% of the state-sponsored value increase by 2035). For instance, the United Arab Emirates has created a space agency, sent an astronaut to the International Space Station (ISS), and sent a probe to Mars – all in less than a decade.

Government agencies are thus expected to remain key customers for backbone players, especially for high-end products and services. (For more details, see the conclusion and appendix of this report.)



**The world faces global challenges stemming from climate change. Space is also critical for many economic sectors, and this will further increase. But many organizations have yet to realize its full potential. To accelerate the use of space, ESA has elaborated three “accelerators” focused on sustainability, economic growth and resilience on Earth and in space.**

Josef Aschbacher, Director General, European Space Agency

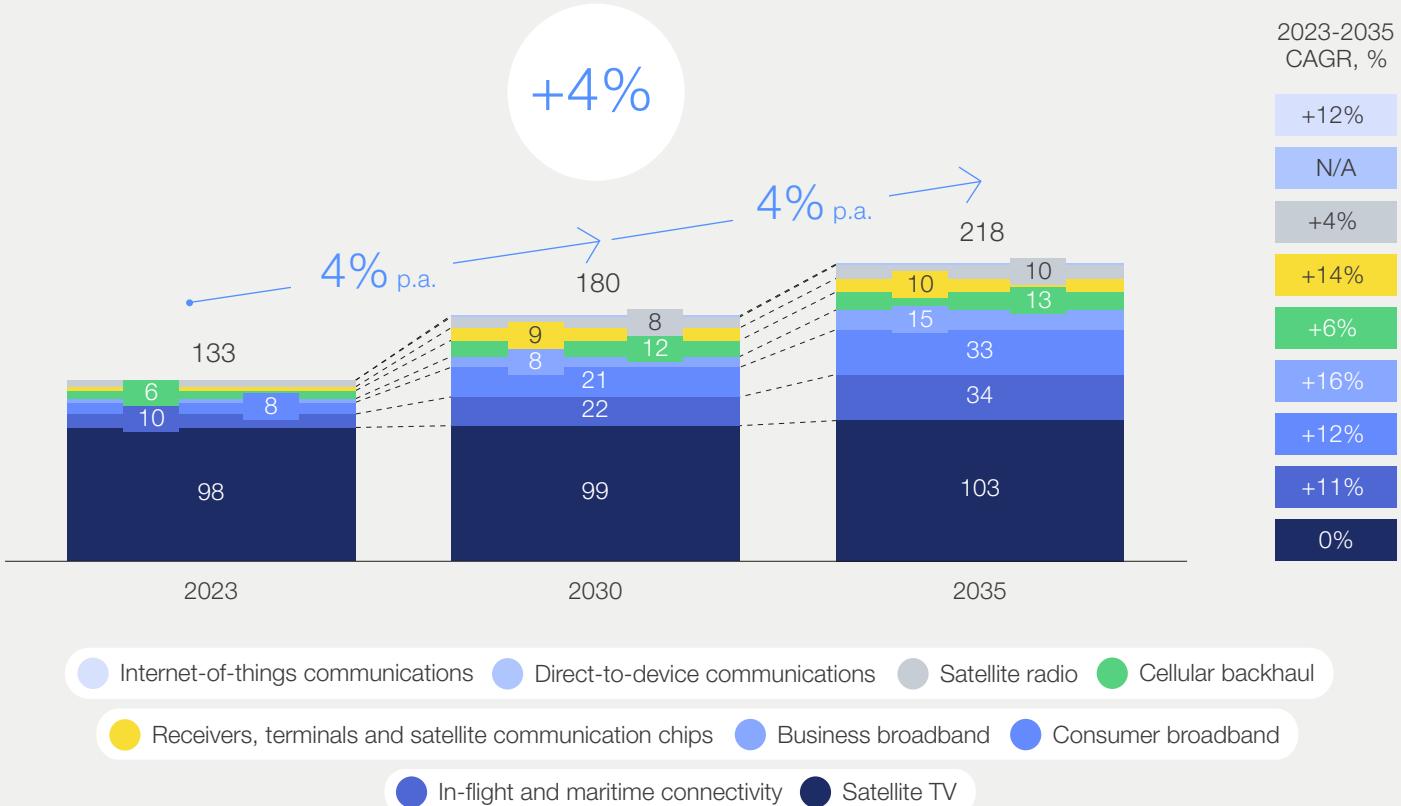


## Commercial: Communications

Communications will remain the largest commercial revenue source, with new constellations expanding the reach of satellite communications (e.g. for mobility in remote areas) and cannibalizing traditional demand for larger satellites.

From \$133 billion in 2023 to \$218 billion in 2035, commercial communications will remain the largest revenue source for backbone players. As large constellations (e.g. SpaceX's Starlink, Amazon's Project Kuiper and Eutelsat's OneWeb) progressively reach full deployment, the market will benefit from the acceleration of broadband and connectivity applications.

FIGURE 5 | Revenue growth from commercial communications (\$ billion)



Source: Future of Space Economy research

However, this expansion will be partially offset by a decline in satellite TV consumption.

- On one side, **satellite TV subscriber numbers are expected to decrease**, after decades of a boom. As consumers shift to online streaming, the demand will gradually erode to the benefit of internet providers, both on Earth and in space. The replacement speed will vary by geographical area, with the steepest declines likely in areas with extensive terrestrial networks (e.g. North America, Western Europe and South-East Asia). The consequent revenue decrease (3% p.a. in current dollars) would only be offset by the long-term effect of inflation.
- On the other side, **broadband connectivity is expected to become the main growth**

**driver** of satellite communications. This will be in large part driven by the deployment of both newcomers' large constellations and incumbents' multi-orbit systems (e.g. Viasat-1, Inmarsat and SES's O3B), providing lower latency and greater coverage. These will drive two balancing effects:

- The data price will gradually decrease by 10% between 2023 and 2035 as constellations reach a critical scale and optimize their operations.
- The demand for data will increase in parallel by 60% (in gigabits per second, or Gbps) between 2023 and 2035 as consumers and businesses increasingly adopt it in remote areas and for mobility applications.

Feature of the future



Per recent announcements, direct-to-device data is expected to surge in the coming years thanks to new chips being integrated into handheld devices. However, these chips are not expected to improve sufficiently to enable high-speed internet consumption. After heavy growth over the next few years, the demand will therefore plateau due to low data throughput and high costs compared to terrestrial alternatives. By 2035, direct-to-device will mainly serve demand for text messages and phone calls in remote, underserved areas, for an annual value of \$2 billion.

To sustain all these applications, receivers and chips must become increasingly ubiquitous, from being included in smartphones to satellite broadband receivers and terminals for connected aircraft and ships. This segment is expected to grow from \$2 billion per annum today to \$8 billion per annum by 2035, mainly fuelled by the adoption of direct-to-device satellite communication (satcom) chips in smartphones (driving more than 70% of the net increase). While direct-to-device data volume will remain limited, receivers will increasingly be incorporated in high-end smartphones to answer demand from consumers for partial connectivity in remote areas.

*Please see the appendix for further details.*

## **Commercial:** Positioning, navigation and timing (PNT)

Commercial PNT applications will continue building on free signal from state-sponsored satellites to equip consumers with mapping and tracking tools.

All over the world, humans are becoming more and more mobile, spurring a growing need: how to locate mobile objects and navigate in unfamiliar settings. Since the full deployment of GPS by the US military in 1995, the unrivalled performance of satellites for global positioning and navigation has made it a favourable solution for commercial applications.

- **Receivers will continue on their path to ubiquity**, with demand ranging from heavy machinery to smartphones and sports watches. Thanks to miniaturization and mass production, by 2035 these chips will be integrated in nearly 3 billion devices manufactured every year (up from 2 billion today). The associated revenues are projected to grow from \$40 billion annually today to \$95 billion annually by 2035.
- **Specific software tools will continue to be developed** to provide user-ready interfaces, ranging from simple maps to sophisticated algorithms with near real-time route optimization. Usually monetized through location-based advertisement or fees per active user, they are expected to grow revenues from \$7 billion per annum in 2023 to \$25 billion per annum in 2035.

When leveraging these capabilities, leaders should remember that they were primarily built for military purposes. This dual mission, together with the tendency to rely on a single system, can create risks for consumers and businesses in the event of a system malfunction. To mitigate this, diversification and redundancy in satellite technology, as well as complementary systems, are crucial.

*For further details, please see the appendix.*

## **Commercial:** Infrastructure and support operations

Commercial infrastructure and support operations will support growing demand for the other segments.

As demand for space services continues to grow, space infrastructure deployment will keep pace, with:

- **More satellites** manufactured to provide more connectivity options (90% of the commercial market by 2035) and observation capabilities (9% of commercial market by 2035).
- **More frequent launches**, with an average of 210 launches annually between 2023 and 2030, and 160 launches annually between 2031 and 2035, partly driven by greater availability and use of reusable vehicles. (Fewer launches are expected annually in 2031-2035 than in 2023-2030 as the use of super-heavy launchers with greater capacity is expected to significantly increase, while heavy, medium and small launcher usage will decline.)

While the market will grow in volume, the impact in revenue for space manufacturers (such as Airbus, Astra and Lockheed Martin) and launch services providers (e.g. ULA) will be partially offset by decreased unit prices as:

- **Satellites become cheaper** as large constellations rely on smaller units and scaled production.
- **Launchers become cheaper** per kilo of payload (40% decrease predicted between 2023 and 2035) as they become more reusable and heavier (with super-heavy launchers expected to capture 70% of market revenue in 2035).

With these factors at stake, the market for commercial satellites is set to triple, from \$4 billion in 2023 to \$12 billion in 2035. The direct beneficiaries of this growth will be both satellite manufacturers and companies whose business models depend on large constellations of satellites (e.g. laser communications payload suppliers). To deploy this increasing volume and mass of satellites, launch vehicles and launch site operations are expected to increase revenue from \$13 billion today to \$32 billion by 2035.

In support of these two market segments, insurance of satellites and space systems will continue to play a critical role. Traditional insurance will increasingly be complemented by insurance for two additional threats affecting satellites: cybersecurity and physical adversary attacks. In addition, dedicated space debris insurance may be available by this time. These factors will take the collective market for insurance premiums from under \$1 billion in 2023 to \$12 billion by 2035.

Feature of  
the future



Finally, deploying more space infrastructure will enable more data flows. Thus, ground operations will become ever more crucial to relay the sheer quantity of acquired data and transmitted signals. This segment is expected to multiply by a factor of

five in revenue between 2023 and 2035, reaching \$11 billion. Just as for satellites, embedding cybersecurity will be a growing requirement for ground operations, as they are more likely to be targeted in adversary attacks.

For decades, launching something into space has been synonymous with years of careful optimization, as minor imprecisions can cost years of expensive satellite life.

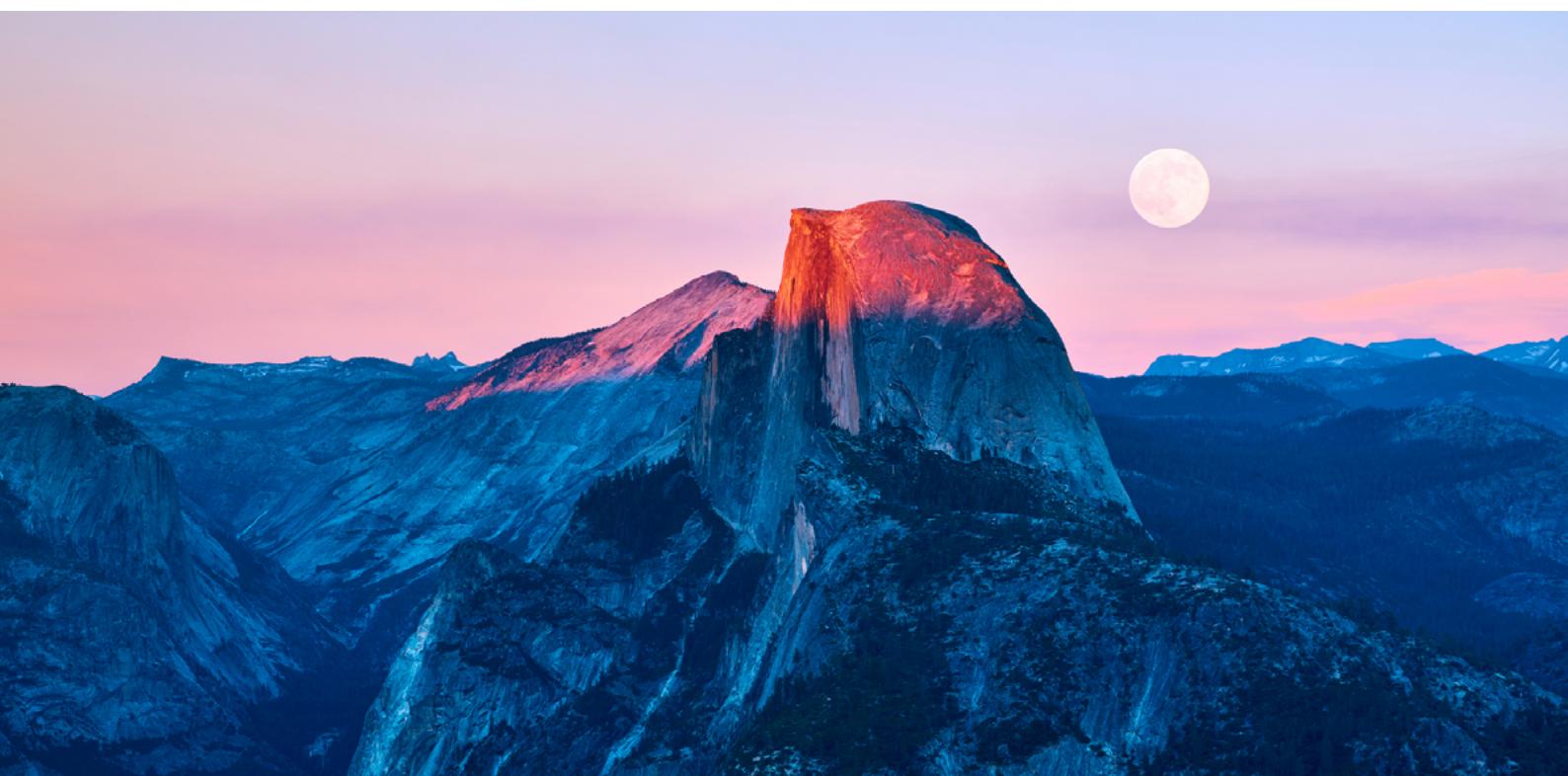
By 2035, however, this will be partly solved by in-orbit servicing – it will become possible to remotely inspect a spacecraft, upgrade its performance or extend its lifetime. This could save satellite operators time and money, eliminating the need for a new satellite in case of a malfunction. As space becomes more crowded, more regulation of in-orbit activity and stricter rules for space occupancy are expected, creating demand for active de-orbiting manoeuvres and space situational awareness.

These services, mainly targeted at higher-end and larger satellites, will increasingly be adopted by commercial players, representing about 50% of this \$5 billion segment by 2035.

“

**In-orbit servicing is central to a thriving space economy, fostering a safe space environment and sustainable infrastructure. It achieves this by facilitating essential activities such as active debris removal, refuelling, life extension and inspection. Furthermore, it serves as a catalyst in shaping the future of space, unlocking the potential of a circular space economy, and expanding possibilities.**

Nobu Okada, Chief Executive Officer, Astroscale



Feature of  
the future



Commercial hardware for space is rapidly expanding to previously institutional-only activities, such as space stations deployment or cis-lunar applications (such as data collection and transport, and demo missions for resource utilization).

These are attracting a lot of ventures and attention from public and private investors. Nevertheless, until 2035, state-sponsored institutions will remain key to such business cases. For the deployment of commercially funded space stations (e.g. Axiom Space Station, and Airbus and Voyager Space's Starlab), annual investments could reach between \$2 billion and \$4 billion annually by 2030-35, with the majority covered by state-sponsored support and services contracts. Similarly, for lunar and cis-lunar applications (e.g. iSpace's Hakuto-R landers and rovers, and Intuitive Machines' Lunar lander), state-sponsored contracts are likely to remain a key driver, capping commercial revenues at \$2 billion annually by 2035.

For the commercial economy to properly take off beyond 2035, three conditions would need to be met:

- **Regulatory frameworks** ensuring the safety and sustainability of these activities.
- **Reliable, flexible and cost-effective transport** enabling logistics to/from low Earth orbit.
- **International and cross-industry cooperation** allowing for optimization of space-based infrastructure and services.

Provided these conditions are met, more innovative solutions from space and non-space players will come to fruition beyond 2035, ranging from energy production (such as space-based solar power) to broader utilization of space resources (such as fuel mining).



**There is no doubt that the expansion of space-based infrastructure in the next decade will contribute to many important economic activities on Earth. As infrastructure around the Earth expands, the ecosystem in space will expand to include the Moon, cis-lunar space and beyond, enabling access to deep space and space resources.**

Takeshi Hakamada, Founder and Chief Executive Officer, ispace

## **Commercial:** Space-based Earth observation (EO)

Space-based EO from commercial operators will continue to provide high-resolution, near-real time data and analytics, becoming an essential tool for leaders' decision-making.

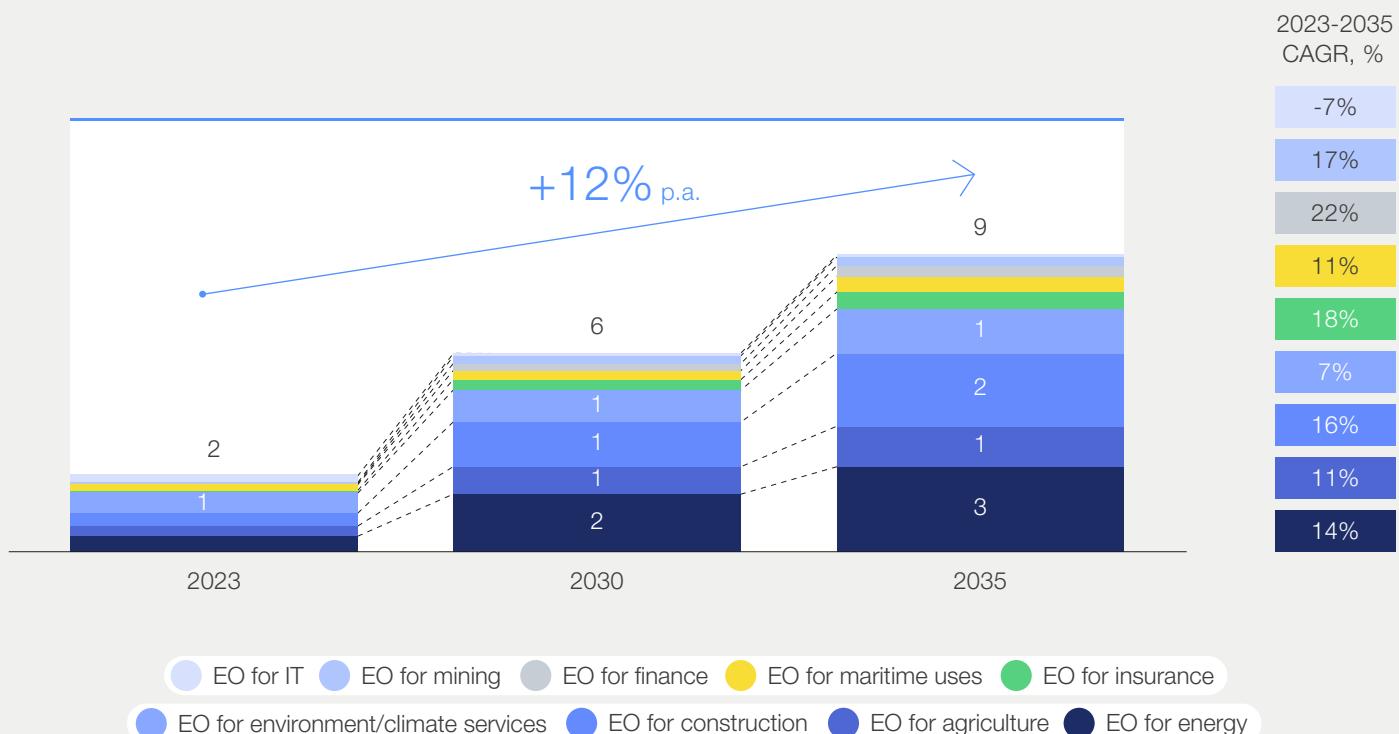
Commercial EO data and services seem today one of the smallest segments of the backbone, at \$2 billion in 2023. However, this only tells a partial story of the widespread demand for space-based

EO because (i) large datasets are available for free to the general public, and (ii) the price of images is depreciating with the development of commercially available sources.

For these reasons, value will continue to shift to data processing, data fusion and tailored products (e.g. Planet's Platform APIs and Maxar's Precision 3D), to meet the growing end-user demand for site-specific and frequent analytics. The total revenue will more than triple to \$9 billion annually between 2023 and 2035, as these insights become essential for business leaders in decision-making.



FIGURE 6 | Revenue growth in space-based Earth observation (\$ billion)



Source: Future of Space Economy research



**For decades, Earth observation satellites were a critical, but narrowly used tool. Now, the cloud computing, data and AI revolutions are enabling EO data to be routinely used in countless day-to-day decisions, in areas ranging from agriculture to ESG reporting.**

Agnieszka Lukaszczuk, V-P Government Affairs, EMEA, Planet Labs

### New commercial ventures: Tourism and manufacturing

By 2035, new commercial activities such as manufacturing and tourism are likely to become possible and expand in space.

Space tourism has been highly publicized for some years now, with some high-profile sub-orbital flights and industrial alliances. This might only be the tip of the iceberg.

The growth of the space tourism industry will depend on several factors, including the capacity to accommodate people in orbit, regulation and legislation, and interest from end-users. In the base case for this report, the accommodation capacity remains a constraint by 2035, with limited launch flexibility to go up and down to the stations.

Until 2035, the market size is expected to remain capped at around \$4-6 billion per year, with most of the space tourism revenues coming from in-orbit stays aboard space stations as ultra-high-net-worth customers purchase their space travel experience. Sub-orbital flights are expected to continue and become more financially accessible, but will represent only a small share of the market (no more than \$1-2 billion per year by 2035).

This baseline could increase significantly if a super-heavy launcher like Starship were leveraged for manned flights for larger groups of people making short stays in orbit. However, the growth potential will remain limited, with most individuals viewing a trip to space as a once-in-a-lifetime experience – thus limiting repeat visitor potential through 2035.

Feature of the future



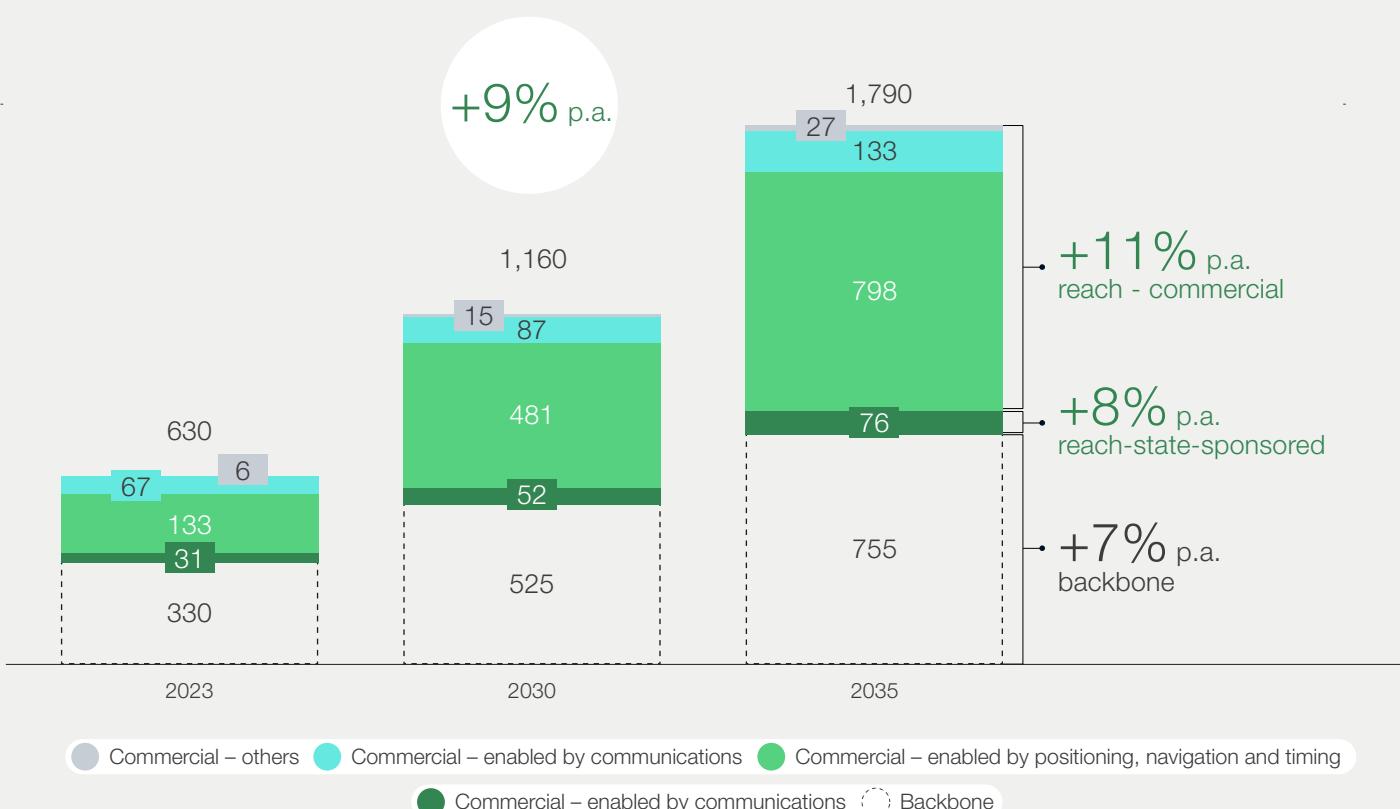
Space-based research and development (R&D) has already shown great potential aboard the International Space Station, from improved performance with advanced materials to drug discovery.

However, to significantly boost adoption, corporate end-users would require more flexibility for crew and cargo, with shorter timelines and lower costs. In the base case for this report, timelines are expected to shorten and launch costs decrease by 2035 just enough to drive the in-orbit manufacturing market to around \$1-2 billion annually.

Beyond 2035, this market could reach a multi-billion-dollar annual potential across health and healthcare, manufacturing, and food and beverage.

FIGURE 7

Revenue increase from “reach” applications



Source: Future of Space Economy research

The reach of the space economy will grow at nearly twice the rate of the backbone, driven mostly by location-based services.

**Similar to the early days of the internet, the true impact of space technologies will extend far beyond the realm of space itself. We are on the cusp of a revolution where space-based applications will permeate diverse industries and economies, creating unprecedented opportunities for growth and societal advancement.**

Kalyan Kumar, Global CTO, HCLTech

## Commercial: PNT applications

Innovations in the space economy will enable revenue generation across multiple industries and levels of the value chain. In many cases, services that improve product quality or access, or drive efficiencies, will be created – or will benefit from – leveraging space-based data.

Commercial applications that leverage free PNT signals to deliver location-based services will be among the most significant growth drivers for the space economy.

With the global increase in mobility sectors and services, positioning and navigation have become critical services for both businesses and end-users. Most of the value will continue to be generated by services catering to individual consumers, with increased global demand for:

- **Flexible forms of mobility** with ride-hailing applications (with revenues expected to grow from \$61 billion in 2023 to \$300 billion by 2035) and vehicle-sharing applications (from \$11 billion in 2023 to \$64 billion in 2035).
- **Efficient last-mile delivery** with applications for perishable goods and food and beverages (from \$100 billion in 2023 to \$334 billion in 2035).
- **Personalized tracking services** for entertainment and sports (from \$2 billion in 2023 to \$9 billion in 2035) provided by a growing offering of smart wearables leveraging PNT data (from \$5 billion in 2023 to \$20 billion in 2035).

The ubiquity of satellite positioning and navigation data has directly contributed to the scale of mobility and delivery services – this report thus includes the revenues generated by these applications as part of the space economy's reach. However, the value of the goods delivered in these cases is an extension beyond what space has enabled, and therefore has not been included in the estimations. (For instance, the delivery platform fee, which covers the integration and utilization of space data, is included, but not the goods that the consumer has selected to purchase via their app.)

PNT services will also increasingly enable supply chains around the world, with:

- **Fleet management services** covering ground, aerial and maritime transport (from \$6 billion in 2023 to \$15 billion in 2035).
- **Supply chain visibility** with track-and-trace services for all kinds of goods (from \$6 billion in 2023 to \$15 billion in 2035).

By improving the efficiency of global supply chains, these services impact the entire spectrum of industries relying on global exchanges of primary and manufactured goods. Beyond generating revenue, leveraging space technologies also greatly improves cost performance and risk mitigation for any company relying on vast supply chains. (However, non-revenue-based value creation has not been included in this report.)



**As the space economy is coming of age, the Earth will become the centrepiece of ubiquitous geospatial analytics. Virtual twins of products or supply chains will be connected through continuous streams of data. These connected virtual twins will become real “Generative Business Universes” that in turn will drive the metamorphosis of different sectors of the economy.**

David Ziegler, V-P Industry, Aerospace & Defense, Dassault Systèmes

Feature of the future



With their many operational benefits, autonomous vehicles will become the new normal by 2035, and space will continue to play a role in this development. Satellite data supports autonomous driving across use cases today. For example, auto-steering for agricultural machinery leverages satellite data to automate crop farming, and adoption is expected to increase from \$4 billion in revenue in 2023 to \$24 billion in 2035. Aboard all autonomous vehicles, PNT signals will provide continuous inputs for mapping and navigation.

However, in most ground, aerial and maritime applications, the PNT receiver is only one of dozens of sensors contributing to the autonomous system (with estimated contribution of 1-2% to the total system) – especially in densely populated areas where more sources of locational data are accessible.

Finally, space remains a critical underlier of the global financial system, with the third service provided by PNT – timing. Every time you use a credit card or withdraw cash, your action is certified by satellite-based time synchronization. While this report does not account for the revenues of all banks and data centres (in the same way that it does not account for the food

delivered using PNT), the resilience and accuracy of PNT remains an enabler of society at large – as evidenced by constant upgrades and deployments of these systems at a global and regional scale.

*Further details can be found in the appendix of this report.*



## Commercial: Communications applications

As more consumers are connected by satellite to the internet economy, sales of consumer goods enabled by space communications will reflect trends similar to those pertaining to the space backbone.

With consumers shifting away from satellite TV, there will be symmetric effects on underlying hardware and services, ranging from lower investments in satellite-aired advertisements to a decrease in satellite dish installations and TV equipment purchases. TV-related reach applications

(e.g. equipment and advertisement) will thus decrease in revenue from \$50 billion in 2023 to \$44 billion in 2035.

However, with satellite-based internet access reaching more and more people around the world, space will enable a larger share of the fast-growing digital economy. Based on consumer trends for those with access to a terrestrial internet connection, satellite broadband users will purchase more online platform services, experience a wider variety and more frequent use of social media, and generate more online payments. Their participation in the internet-enabled economy is expected to grow in revenue from \$16 billion in 2023 to \$84 billion in 2035.

Space will also play a role in making the internet of things (IoT) a more widespread reality. Building on satellite connectivity, applications and services will integrate data from IoT sensors in remote areas to deliver enhanced services to supply chain, energy, agriculture, mining and aerospace players. These are expected to generate \$3 billion in additional revenue by 2035.

## Commercial: Space-based Earth observation and other applications

Several other commercial applications have the potential to generate more than \$10 billion in additional revenue for professional services and space-based EO end-users.

The proliferation of space activity in both backbone and reach uses relies on stakeholders investing in, building and/or abiding by new technological, regulatory and financial frameworks. This report anticipates a growing demand for space-focused professional services across both public and private players (from \$4 billion in 2023 to \$16 billion in 2035).

This category also accounts for revenues directly generated by the utilization of EO data from end-users. For example:

- Weather services leveraging state-sponsored satellite data will continue to be used by a wide array of industries, from media to aviation – with revenues expected to increase from \$2 billion in 2023 to \$6 billion by 2035.
- Across the globe, farmers, energy providers, miners and traders currently leverage satellite imagery and sensing to identify new revenue sources or optimize their production. Given the observed return on investments for EO, these are expected to generate \$3 billion in directly attributable additional net revenues by 2035.

Beyond revenue, EO uses for driving cost efficiencies, managing risk and mitigating the effects of climate change will also generate significant non-revenue-based value, not captured in this report.<sup>9</sup> For example, this team's previous work on space applications in agriculture<sup>10</sup> demonstrates

the impacts of EO for prevention of crop loss, decrease in carbon dioxide emissions and reduction in freshwater use. Broader potential of Earth observation (including economic and climate impacts) for all applications will be detailed in an upcoming report on "Earth Data in the Boardroom: Amplifying the Global Value of Earth Observation".

## State sponsored: Civil and defence

State-sponsored applications represent only a small portion of the reach of space technologies, with a focus on connectivity for defence and civil platforms.

Given that public institutions focus less on monetization and more on needs, they represent limited potential for reach initiatives as of now.

Space will, however, play a critical role in the emergence of "systems of systems", increasingly interconnecting multi-domain activity for both defence and civil needs. This is already spurring investments in hardware and services from non-space agencies. For example:

- **Modules to increasingly integrate defence platforms with space networks** (representing revenue potential up from \$27 billion per year today to \$68 billion by 2035) – e.g. advanced communications and navigation modules embedded in military equipment on ground, air and sea.
- **Satellite-enabled services** for defence and civil situation response (from \$1 billion today to \$3 billion by 2035) – e.g. defence logistics units leveraging satellite data to track military supply chains in remote areas.

These will follow a growth trajectory akin to the backbone, as non-space-focused public institutions increasingly invest in their space-enabled capabilities across the board.

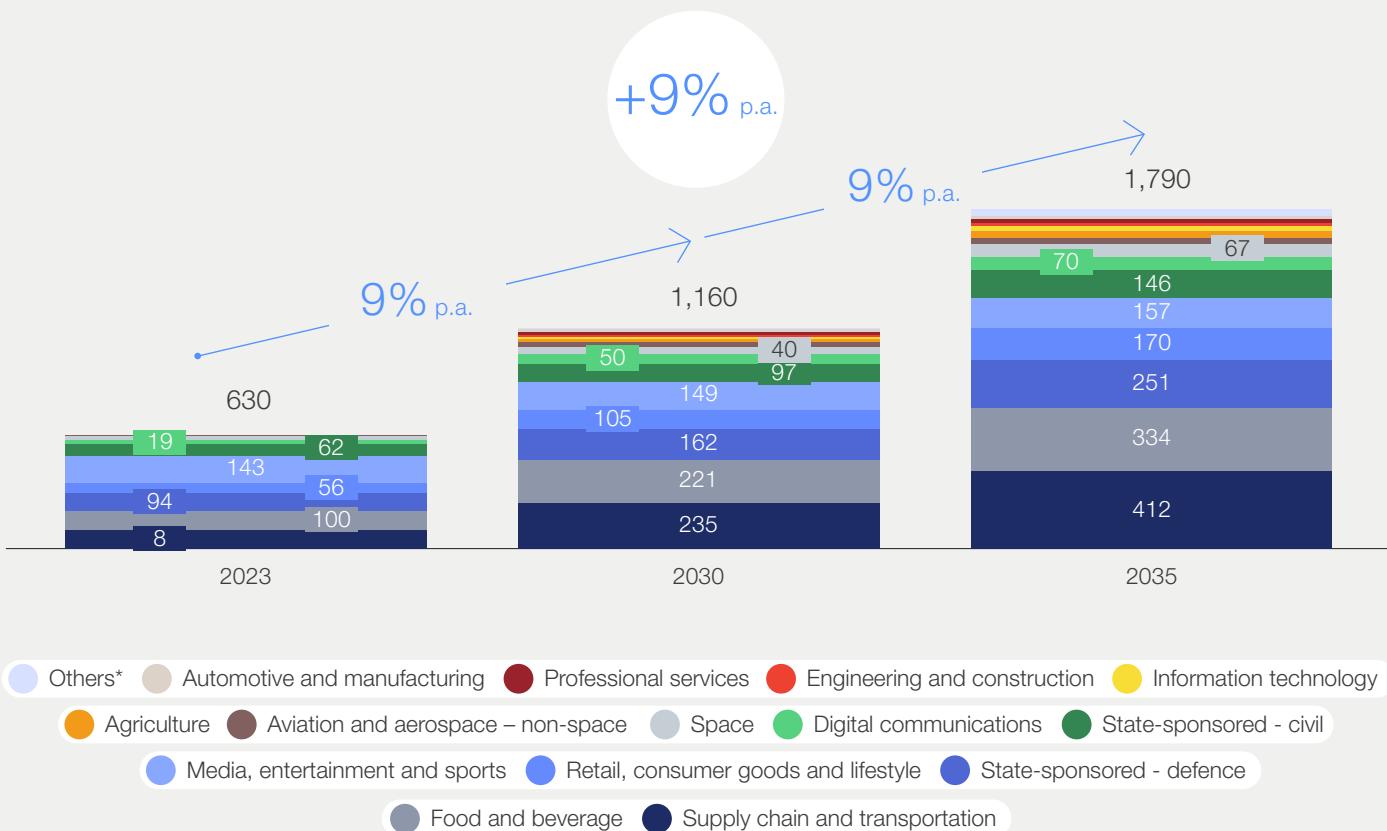
Space agencies will also continue to leverage their research to generate secondary revenues through patent licensing (from \$3 billion a year today to \$6 billion by 2035). As agencies and private companies pursue more public-private partnerships, these will

play an increasing role in transferring knowledge from publicly-funded research centres to privately-developed marketable products – as exemplified by NASA's Technology Transfer Program.

*Further details on the uses of space for public action are discussed in the conclusion of this report. More details on state-sponsored applications are in the appendix.*

FIGURE 8

### Space economy size by industry (\$ billion)



- Others\* ● Automotive and manufacturing ● Professional services ● Engineering and construction ● Information technology
- Agriculture ● Aviation and aerospace – non-space ● Space ● Digital communications ● State-sponsored - civil
- Media, entertainment and sports ● Retail, consumer goods and lifestyle ● State-sponsored - defence
- Food and beverage ● Supply chain and transportation

\* Insurance and asset management, energy (including oil and gas), banking and capital markets, travel and tourism, global health and healthcare, mining and metals, chemicals and materials.

Source: Future of Space Economy research

Zooming out across the backbone and reach for all industries, space has the potential to revolutionize the global economy, with the supply chain and transportation, food and beverage, and defence industries seeing the largest impacts.

Seven industries (listed here in order from largest to smallest share) that represent over 80% of the revenue generated by backbone and reach use cases by 2035 will be at the forefront of the space economy expansion in the following industries:

- **Supply chain and transportation**, for more efficient and cost-effective logistics.
- **Food and beverage**, for growing efficiency of last-mile deliveries of perishable goods.
- **State-sponsored defence**, for surveillance and resilient communications.

- **Retail, consumer goods/electronics and lifestyle**, for consumer electronics and online e-commerce services.
- **Media, entertainment and sports**, for sports tracking devices and online media.
- **State-sponsored civil**, for scientific research, disaster management and environmental monitoring.
- **Digital communications**, for better connectivity.

In addition, several other industries, from agriculture and information technology to insurance and construction, will benefit from multi-billion-dollar revenue, cost efficiencies and environmental benefits from space technologies. The acceleration of the space economy is thus expected to create

opportunities for both incumbents and new entrants across a wide panel of sectors.

*Please see the appendix for further details on the impacts of space across industries.*

“

**Due to its economic, geopolitical and climate-related impacts, space can play a much bigger role in enhanced connectivity, better decision-making and disruptive technologies in areas such as supply chain management, finance, telecom, health and engineering. A continuous dialogue between space and non-space actors is therefore essential to drive technological progress and create new business opportunities.**

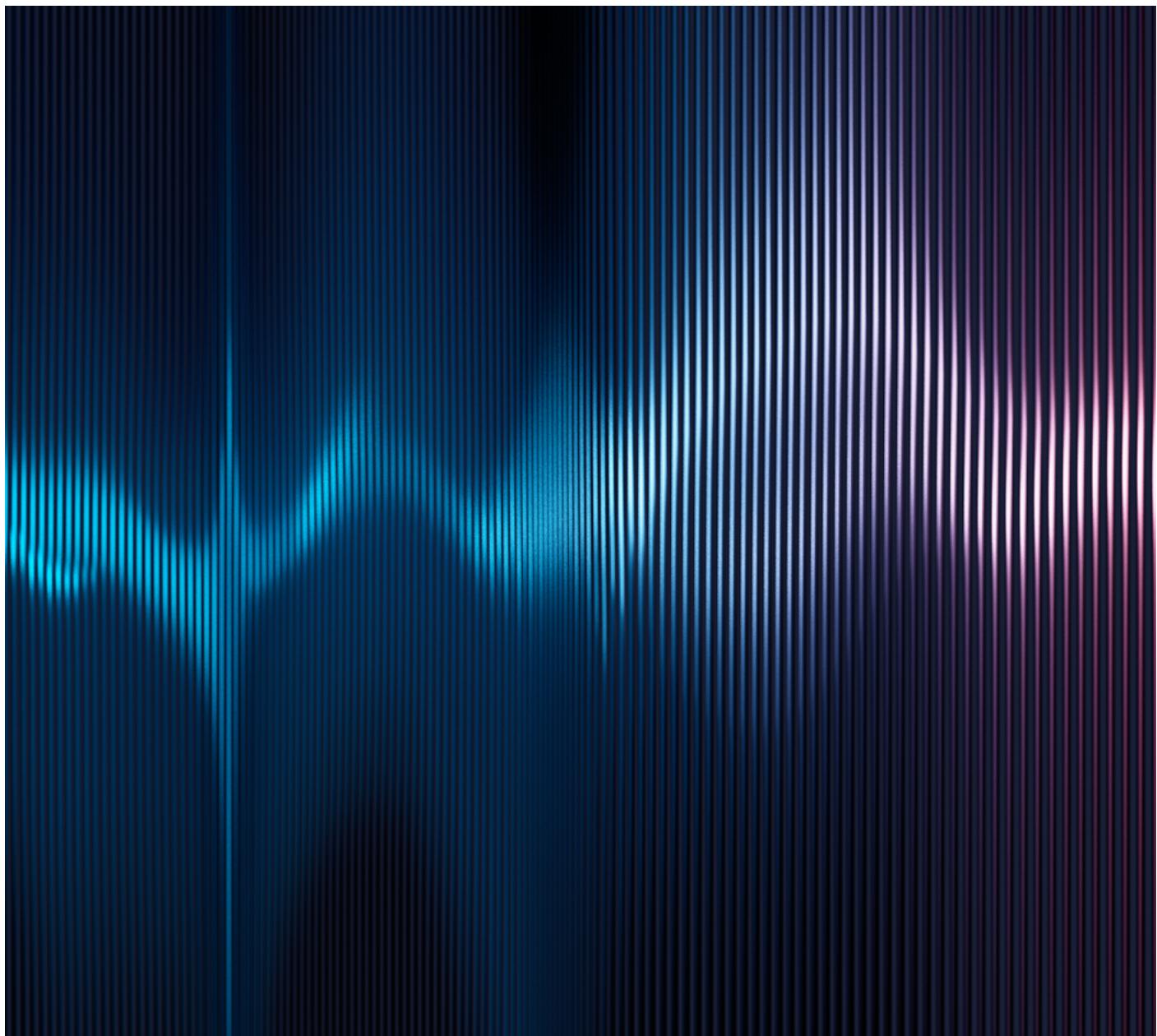
Katharina Wollenberg, Space Sector Advisor & Industry-University Collaboration, SAP



2

## How key factors determine the trajectory of the space economy

Beyond the base case, technological evolutions and financial competitiveness could reshape the space economy by 2035.



The “base case” identified in this section refers to the estimations provided in Section 1 of this report (i.e. \$630 billion annual revenue in 2023, growing to \$1.8 trillion per year by 2035 at a 9% p.a. overall growth rate).

Over the past few decades, space has been described as a cyclical industry, tightly linked to governments’ policies and their evolution. With its growing commercialization and the expansion of downstream services, the space industry is at an inflection point, freeing itself of historical cyclical growth. However, industry projections differ on the potential adoption of commercial technologies and their relative share vis-à-vis government-owned systems. Given this, traditional state-sponsored stakeholders and new commercial entrants also diverge on projections. Accounting for these assumptions, macroeconomic and industry-specific factors can compound and impact the supply and demand of space technologies by 2035.

This research identifies two main factors as determining the trajectory of the space economy: technological evolution and financial competitiveness. It estimates the potential impacts of these two factors on each of the space economy use cases, thus identifying two potential ranges of outcomes for the space economy in 2035:

- **The upside range** that explores how opportunities of increased access and adoption could lead to improved estimates of the size of the space economy of up to **\$2.3 trillion by 2035** (i.e. +27% vs. base case) based on:
  - Improved access to space data: Proliferation of access and harmonization of space data could enable new revenue streams, with AI helping deliver even greater insights

- Reduced cost for space entry: On top of improved access to space data, significant cost reduction across the end-to-end value chain could enable full space accessibility, thereby accelerating the whole of the space economy.

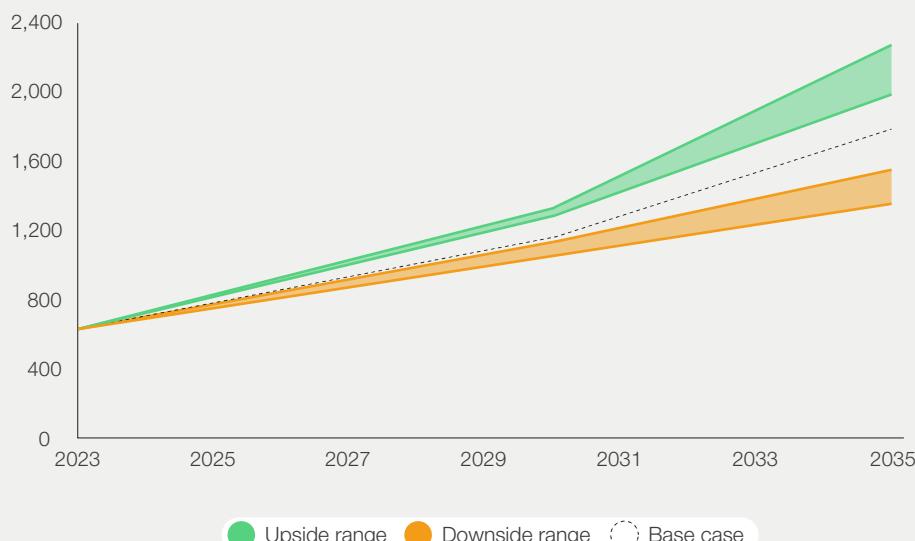
- **The downside range** that investigates risks to the space economy such as constraining regulations or diminished demand that could cap estimates at **\$1.4 trillion by 2035** (i.e. -24% vs. base case), based on:

- Stalled access to space: Steady cost curves and stagnating accessibility could hinder the expansion of space-related activities.
- Competition from terrestrial alternatives: In addition to stalled access to space, technological advancements on Earth could provide viable alternatives to traditional space-based solutions, impacting sectors like satellite communications and navigation even further.

Geopolitical factors could also have an outsized impact on the space economy. However, quantifying these implications lies beyond the scope of this report, due to their geopolitical nature and high variability on a global scale (e.g. allocation of public investments and national policy modifications).

FIGURE 9

Ranges of outcomes for the space economy by 2035 (\$ billion)



CAGR, 2023-30, %   CAGR, 2030-35, %   Delta to base case, 2023-35, p.p.<sup>1</sup>

10-11 %   9-11 %   +1-2 p.p

9 %   9 %   -

8-9 %   5-7 %   -1-2 p.p

<sup>1</sup> percentage points

For reference: Global nominal GDP growth is forecasted at +5% p.a. over 2023-35

The upside range could be driven by widespread availability of space data and end-to-end cost curve improvements.

On the upside range, growth slows post-2030 as most identified use cases reach maturity. However, actual market growth may remain in line with the pre-2030 trend, sustained by unforeseen use cases.

In the base case, a growing market supply of satellite constellations is expected, leading to an increased quantity of available space data, both in private and public sectors. However, technological improvements and increased financial competitiveness could accelerate revenue generation.

Two factors could further boost the use of space data in non-space use cases:

- **Widespread accessibility of space data:** Aggregation of data from multiple sources in easy-to-use tools (such as search engines) could facilitate adoption by non-space commercial players.
- **Enhanced usability of space data:** Global standardization of datasets and shift towards user-focused developments could help reduce the technical barrier often faced by non-space players in using space data, thus facilitating the development of new use cases.

These two factors could enable up to 20% increase in data-focused backbone use cases (e.g. EO value-added services for financial markets) and up to 10% on relevant reach use cases (e.g. PNT-enabled applications for supply chain management). Together, these could result in an increased estimate of the space economy upwards of \$2 trillion by 2035, benefiting mostly downstream players that provide software applications and analytics products. Further reinforcement of global public-private cooperation over the next decade may help improve the aggregation of data and global standardization, increasing the likelihood of achieving this lower bound.

Beyond the proliferation of space data, the ease of access to space could further change by an order

of magnitude by 2035. Currently, access to the space industry is limited due to barriers of entry, such as launch costs and limited re-useability of components, thereby limiting the space economy's growth. However, recent years have seen cost curve improvements as launch costs have fallen and new capabilities have emerged (such as manufacture of reusable launch vehicles).<sup>11</sup> Further end-to-end cost-curve improvement could enable a higher return on investment for all industry stakeholders, with reach commercial use cases benefiting most from reduced barriers to entry. This could grow the space economy to \$2.3 trillion by 2035 by:

- **Fostering use of space-based capabilities:** For instance, super-heavy launch platforms are poised to impact both backbone and reach stakeholders, ranging from innovative commercial start-ups to established space organizations to research companies, as they all gain the new possibility to launch larger, more complex missions.
- **Accelerating capital flow and investment demand from private and public entrants:** These would enable new space capabilities (such as in-orbit data centres), business opportunities (e.g. commercial space tourism) or rapid cycles of innovation (e.g. artificial gravity spacecraft).

The demand signal may increase growth rates across applications in manufacturing, communications, PNT and EO by 50%. Emerging participants in the commercial space economy would benefit from a lower barrier to entry to test minimally viable products. In this highest bound, space access would enable a diversified set of players to thrive in the industry, resulting in the greatest scaling of space outputs. Despite the value at stake, the probability of reaching this upper bound remains limited as reducing technological, regulatory and financial barriers to entry will likely take several years.



**The space economy will continue to grow and will generate attractive returns for investors with the insight to identify promising sub-sectors and the patience to wait out the post-SPAC [special purpose acquisition company]<sup>12</sup> hangover. In addition to rewarding investors, the space economy will help us solve the world's major problems.**

Matt O'Connell, Operating Partner, DCVC

Feature of the future



By 2035, and especially in the upside range, the proliferation of space infrastructure will further increase the risk probability of collision, necessitating effective in-orbit management. To ensure sustained growth, responsible behaviour from commercial actors, coupled with proactive government action and inter-government alignment, will be crucial in addressing these challenges and ensuring the safety and sustainability of space activities in the years to come.

The downside range could be driven by lower accessibility of space and takeover of terrestrial alternatives.

In the base case, the accessibility of space is expected to continue improving with new launch and component capabilities, as well as lowered costs. However, lower financial competitiveness and terrestrial technological evolutions could dampen this.

First, demand for space applications could be slowed by several factors, from launch costs maintained artificially high by a lack of competition to increased risks posed by space debris or restrictive regulations. This would lead to decreased private investments across both the backbone and reach. Demand would be lowered as:

- **Emerging market stakeholders** would have fewer opportunities to test minimally viable products, creating, once again, a barrier to access to the space industry and impacting the development of nascent use cases.
- **Incumbents and governments** would in turn be affected, as they are increasingly reliant on private investments for R&D.

Low demand for space applications or stalled industry access could thus cap the space economy at \$1.5 trillion in 2035. While this outcome is not to be ruled out, current industry trends of improved competition and player diversification make it unlikely.

Second, and beyond stalled access to space, technological advancements that foster adoption of terrestrial data sources over space-based technologies could have a further negative impact on the backbone and reach of the space economy. Advancements in terrestrial precision products (e.g. metamaterial antennas) could shift demand away from the current space-based operators.

While some space-enabled use cases would remain reliant on space solutions (e.g. space-based Earth observation for intelligence), terrestrial alternatives could cause a quick decline vis-à-vis the base case, as consumers prefer terrestrial options to space technologies. The results would include:

- **Reduced demand for space infrastructure** and launch operations impacting space players.
- **Non-space players reaping cost improvement** benefits of turning to terrestrial alternatives for use cases previously provided by satellites (e.g. remote communications and precision navigation).

Across all ranges, increase in space activity without careful management could result in unintended outcomes.



**With so much innovation happening in space, we need to preserve the commons to allow as many of these stories and trials as possible to play out. The last thing that space needs is a competition for the market, or a series of land grabs. With over 90 national space agencies at last count, each with aspirations, we need to build-in sustainability by design.**

James Cemmel, Vice President, Government Engagement, Viasat

- **Public-sector reliance on space-based services stalling**, especially for defence use cases, but likely at a slower rate than for private industry.

Together, this could cap the economy size at \$1.4 trillion by 2035. Ultimately, reaching this lower bound would generate a further downside for the space economy beyond 2035 (e.g. preventing innovative breakthroughs for in-orbit technologies). However, given current technological reliance on space-based capabilities (e.g. navigation, communications and EO), the probability of this outcome remains limited over the next decade.

Some potential unintended outcomes of space activity proliferation are commonly discussed across the industry (e.g. more debris threatening deployed space vehicles, overcrowding of certain orbits limiting continued expansion, and light pollution from satellites affecting astronomers). Furthermore, intentional actions by national actors may pose additional risks, such as geopolitical conflict escalation, and maligned satellite activity affecting both space and terrestrial services. These “known” risks have the potential to limit continued expansion, sustainability and safety of the space industry. However, “unknown” risks likely also exist (e.g. growth in space activity having unintended impacts on atmospherics).

Neither set of unintended consequences, nor their probabilities of occurrence, have been explored in depth in this report. Yet, it is clear that careful consideration, collaboration and management between public and private organizations across the space community is essential to identify and prevent these outcomes.

*As an example of mitigating these “known” risks, the World Economic Forum, in collaboration with the European Space Agency and with support from diverse industry actors, has published a set of recommendations to promote sustainable orbital operations.<sup>13</sup>*

While there is a range of potential outcomes for the space economy by 2035, in each of these, continued investment in space infrastructure will lead to growth of the space economy, greater effects on a wide range of industries, and broader impacts for life on Earth.

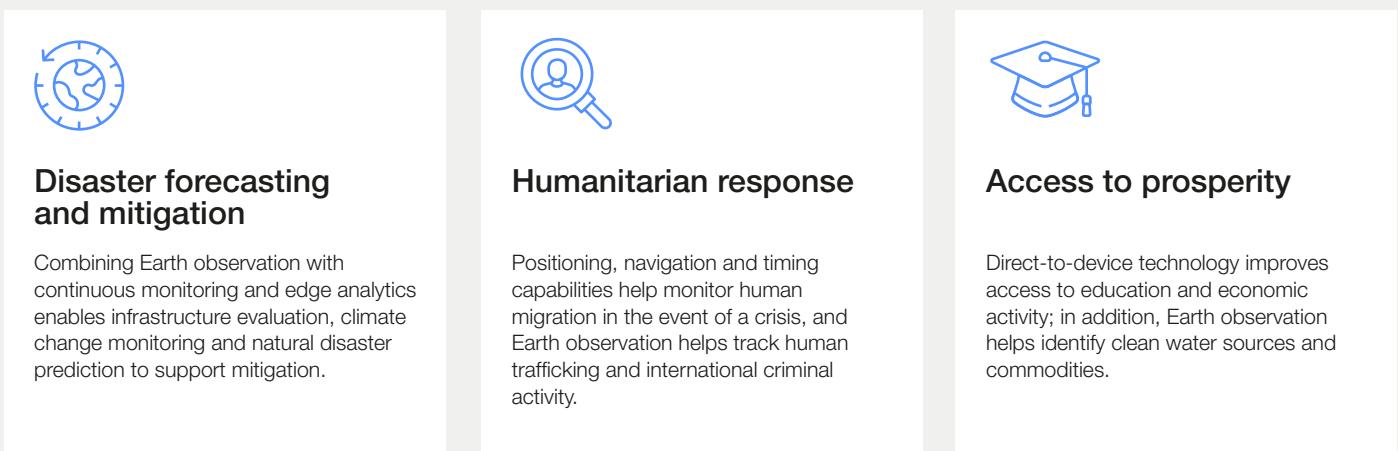
3

# How space can change the world

Not only will space generate revenues across multiple industries and affect everyday lives, the sector also has the potential to address a wide range of economic and non-economic challenges.



FIGURE 10 | How space will help tackle some of the world's greatest challenges



Source: Future of Space Economy research

Harnessing the vast potential of space capabilities can help meet some of the world's toughest challenges.

## Disaster forecasting and mitigation

Space technology could revolutionize early warning capabilities by providing real-time information to mitigate the impact of natural calamities, which are becoming more frequent and severe.

While space-based technology already plays a crucial role in disaster warning and management, this is expected to multiply in the future. Advanced sensors and lower latency will provide more effective response by:

- **Monitoring natural disasters and situations on the ground:** As more satellite imagery becomes available, public agencies will improve assessment of disasters and minimize response times.
- **Ensuring resilient communication networks:** With improved access to satellite communications, first responders can issue early warnings and provide continuous updates, even in remote areas.
- **Tracking ground movements:** With increased satellite positioning data, affected populations can be quickly identified to optimize coordination between first responders and evacuation teams.

Imagine future wildfires of the size and scale of the Maui disaster in 2023, but on a more widespread basis due to ever increasing and prolonged droughts as a result of climate change. Better access and usability of satellite data could significantly improve civil response.

- Satellite data and analytics would allow for prediction of where and under what conditions a fire could start, and the scale it could reach. Mitigation measures of various scales could be put in place, including first-aid resources stationed nearby in advance and early evacuations.
- If the fire were to spread, satellite sensors could bolster detection of new brush fires, enabling first responders to be dispatched more quickly.
- As the fire dies down, satellite data could continuously monitor the ground situation, with real-time maps helping to prioritize emergency relief efforts as well as supporting the post-crisis rebuilding process.

While space can help in disaster response, it also helps much upstream, such as by supporting efforts to monitor and reduce global climate change. For example, methane is a potent greenhouse gas, and fugitive leaks from ageing industrial infrastructure can be a major contributor to climate change. Start-ups are making satellites to detect these leaks, in a way that is more cost effective than deploying sensors along hundreds or thousands of kilometres of pipelines. Scaling this capability would help governments, industries and environmental organizations pinpoint fugitive emissions earlier on and mitigate their effects, potentially saving 6 million tons of methane emissions every year.<sup>14</sup>

With the proliferation of space-based EO, early-warning analytics and low-latency communications, space can become a major enabler of disaster and climate risk mitigation – ultimately saving lives and reducing damage.



## Humanitarian response

Governments and organizations will increasingly leverage space-based capabilities to respond to humanitarian crises and reduce criminal activity.

Utilizing a broad set of space capabilities will increase the effectiveness and reduce the time it takes to respond to humanitarian crises around the world. Bringing together data and deploying analytics, governments and international organizations can:

- **Identify critical infrastructure risks**, including autonomously monitoring structures where failure could cause outsized risk for local communities (e.g. dams and nuclear power plants).
- **Enhance efforts to counter crime and human trafficking**, including by intelligence gathering and border control monitoring.
- **Inform policies** for dealing with migration and refugees, optimizing the allocation and dispatch of resources.

## Access to prosperity

Space is poised to play a pivotal role in addressing inequality by improving access to education, economic activity and natural resources.

Space capabilities will bridge current digital divides, providing access to education and healthcare where needed, and enabling precise monitoring of agriculture, natural resources and environmental changes.

In most remote areas, satellite communications are the only form of connectivity available. With satellite constellations providing cheaper and more widespread connection, populations can gain access to the digital economy. In

addition to fostering economic growth (e.g. through e-commerce, digital innovation and entrepreneurship), this will support remote health and education, reducing human rights inequalities in underserved regions.

EO and PNT capabilities will also foster sustainable and widespread economic prosperity by:

- Enabling monitoring of forests, water resources and minerals.
- Revolutionizing transport and urban planning.
- Empowering and scaling precision-agriculture applications.
- Tracking climate change, such as sea level rise, deforestation and melting of glaciers.

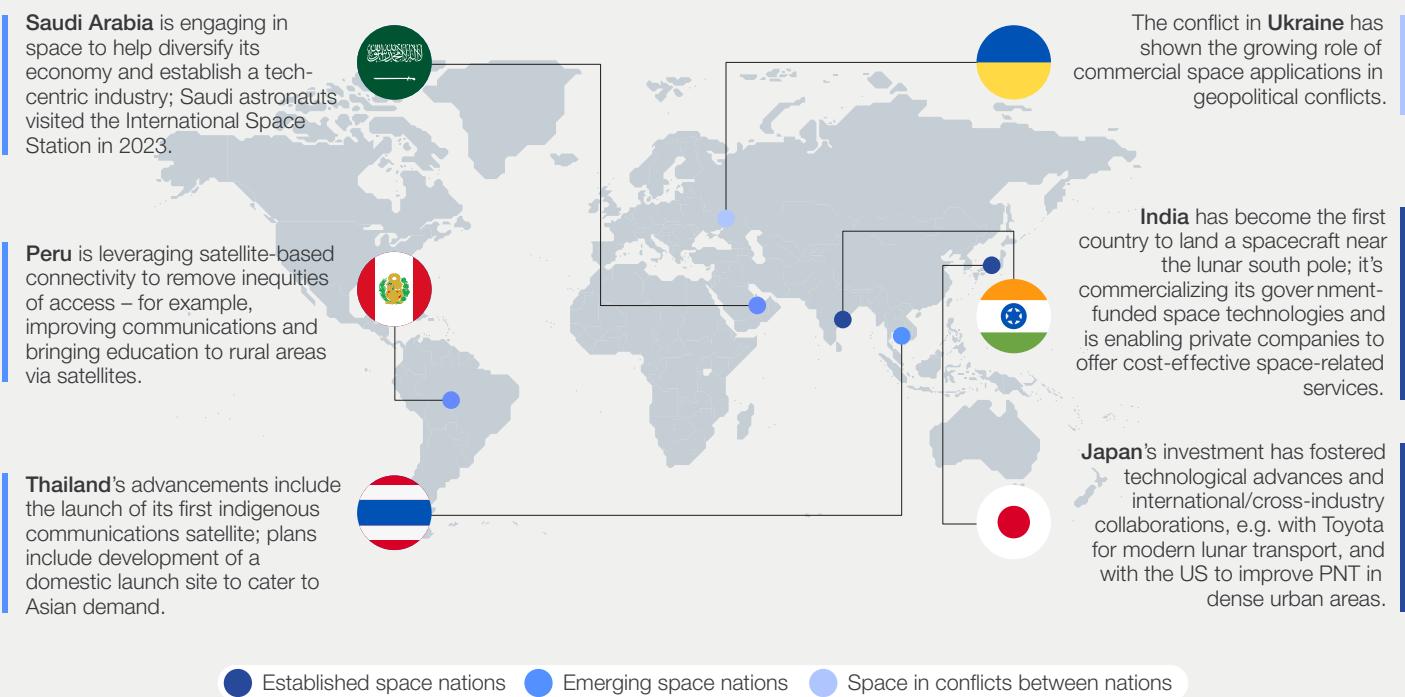
These applications will enable optimized management of natural resources, support fair distribution across populations, and ensure long-term sustainability.

## Enabling these outcomes

In each of these cases, realizing the full potential of space capabilities is dependent on three crucial factors: 1) solutions must be easy to use and tailor, 2) a balance needs to exist between affordability, profitability and risk, and 3) public and private sector expertise must work in unison. Building adapted solutions thus requires close coordination from both state-sponsored and corporate players, and collaboration examples are emerging around the world.

Space capabilities provide governments with unique strategic advantages, while driving innovation, supporting competition and improving diplomatic positioning. Many countries are thus getting involved across the board.

FIGURE 11 | Recent space-related developments around the world



Source: Future of Space Economy research

An increasing number of nations are investing in space capabilities, in-orbit technologies and research to meet current challenges.

## Established space nations

Incumbent space nations have continued to increase their investments in the industry to bolster their capabilities. For example:

- **India** is continuing to invest in its space capabilities, with programmes mostly targeted at meeting the socio-economic needs of its nearly 1.5 billion people.<sup>15</sup>
- The Indian space economy has seen an explosion of activity, notably a lunar programme that has made India the first country to land a spacecraft near the lunar south pole.
- To commercialize its government-funded technologies, India has set up coordination bodies and knowledge-exchange platforms.
- Private-sector companies are pushing ahead with cost-effective satellite launches, space-based communication for a growing population, and imagery data for agriculture and infrastructure development.
- **Japan's** space investment has fostered technological advancements, international collaboration and a prominent role for the country in space exploration, research and navigation.<sup>16</sup>

– Japan has one of the most advanced space industries in the world and is making significant investments in space exploration, notably with the Hayabusa asteroid samples missions and the ISS Kibo module for microgravity experiments.

- The Japanese ecosystem is one of the most cooperative around the globe, leading the way in establishing public, private and international partnerships, such as:
  - Partnering with the US to augment PNT accuracy and reliability in dense urban areas.
  - Deploying cross-industry partnerships to develop capabilities, e.g. with Toyota for modern lunar transport.

## Emerging space nations

With the democratization of access to space, new and growing space nations are also investing in the acquisition of space capabilities. For example:

- **Saudi Arabia** is engaging in space to help diversify its economy and establish a tech-centric industry:
  - The country has made substantial investments in space technology and exploration in recent years, as became

- evident in 2023 when the first Saudi astronauts visited the International Space Station.
- The Saudi Vision 2030 initiative includes plans to develop a space industry and expand its capabilities with a \$2 billion investment over the next decade.<sup>17</sup>
  - These investments aim to diversify the Saudi economy, promote scientific research and bolster national security.
  - **Thailand** is advancing its space technological capabilities to improve the lives of its citizens through innovative solutions:
    - In 2022, Thailand launched a five-year plan to conduct Thai-based satellite design and development research, starting with its TSC Pathfinder satellite for Earth observation.<sup>18</sup>
    - To support these ambitions, Thailand plans to develop a multi-billion-dollar domestic space market and is developing a domestic launch site to support launch demand in Asia.
  - **Peru** leverages satellite-provided connectivity to bridge the digital gap between local communities and to educate its youth:
    - Since 2019, Peru has implemented the “Internet para Todos” programme, leveraging partnerships between space and non-space operators to enhance internet connectivity in rural areas.
    - The Peruvian Ministry of Education has implemented a rural school connectivity programme, to bring investments in internet access and digital educational resources to support remote communities via satellites.<sup>19</sup>

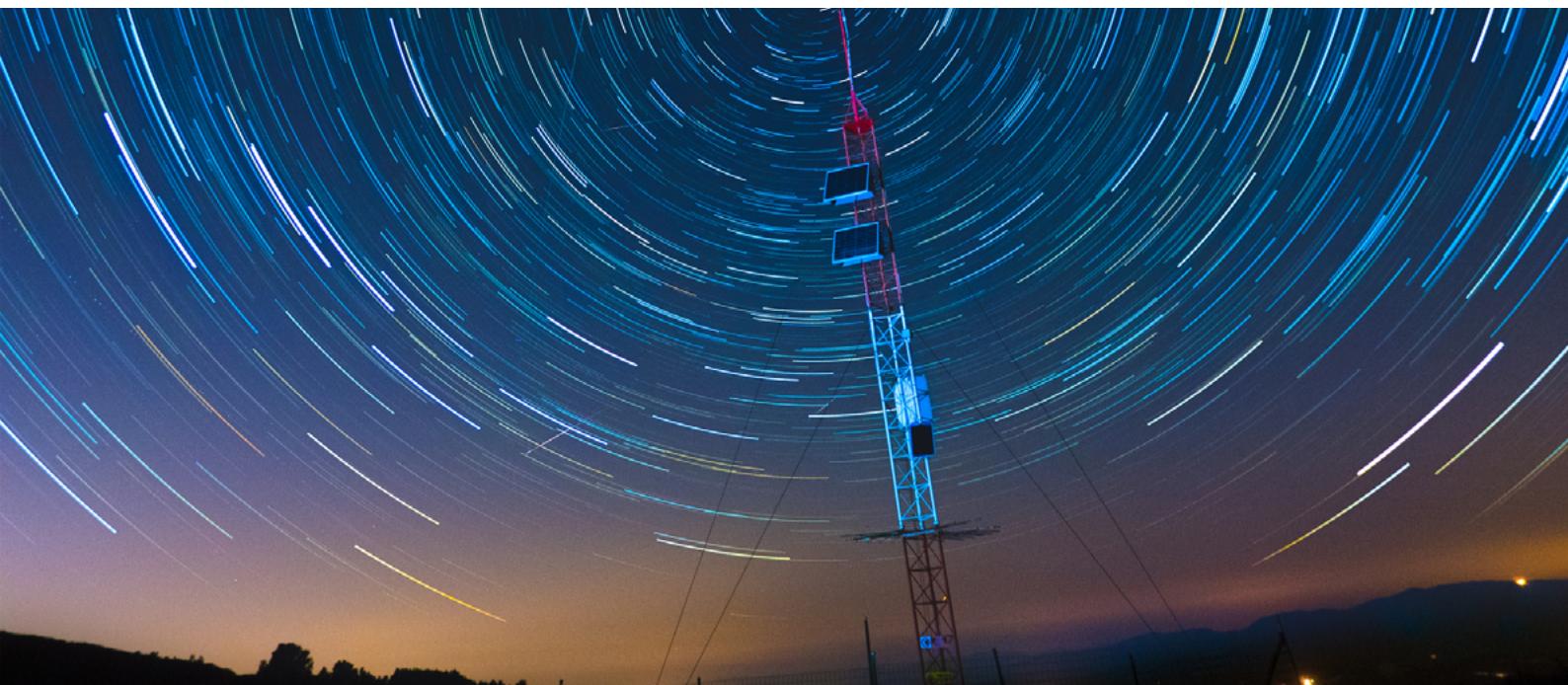
Across all continents, nations have shown similar developments, from Bangladesh deploying its first satellite in 2021 to El Salvador and Rwanda creating their space agencies in 2021. Governments show growing interest in taking part to the space ecosystem, whether by leveraging existing technologies, partnering with other nations or launching their own ventures.

## Space in conflicts across nations

The conflict in Ukraine has shown the growing role of commercial space applications in geopolitical conflicts.

Faced with invasion, Ukraine has leveraged commercial and international partners' space capabilities in its defence. This has included Earth observation data to collect intelligence on troop movements and positions, space-based communications to coordinate military operations and command forces, and PNT to help forces navigate complex terrain in remote regions.

While this conflict has highlighted the importance of commercial operators, it has also revealed the need for close collaboration with state players. In 2022, Starlink denied Ukraine's request to extend coverage to strike a Russian target due to fears of escalation. The military reliance on such space capabilities has also highlighted the need for countries to deploy, protect and defend their space infrastructure.



# Conclusion: Progressing to the North Star

As the analysis in this report shows, the space economy is set to grow rapidly.

By 2035, space will be a trillion-dollar industry, roughly matching the size of the semiconductor industry (expected to reach \$1 trillion around 2030).<sup>20</sup> And, just like semiconductors, space technologies will be increasingly present in every aspect of everyday life.

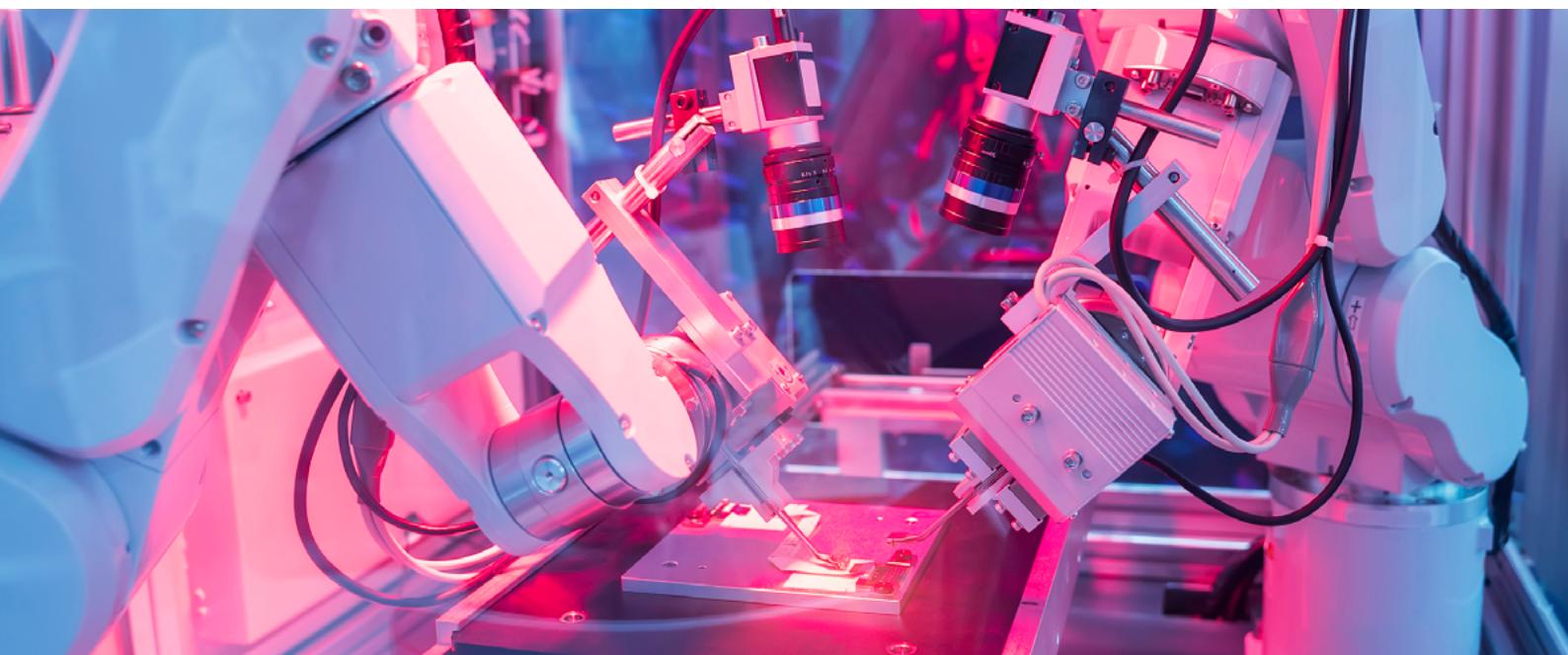
In 10 years, consumers may still not know that it is space technology that makes it possible for them to have a conversation on their smart watch while they are out hiking in the mountains, that provides some high-end pharmaceuticals to save lives, and that enables the alert they got for a looming extreme weather event. But leaders in most industries will.

Similar to the early days of the internet, with new space data, services and access, companies will accelerate how they find ways to generate revenue

and cost efficiencies. And while governments may take up these commercial offerings, they will also continue to invest in defence and civil applications.

But to sustain this take-off, stakeholders across the board must get involved and build a dialogue about the economic, humanitarian and geopolitical dimensions of space. State-sponsored or commercial, space- or non-space focused, every player can be a driver of the space industry by contributing to:

- 1. Standardization and harmonization** to reduce costs across the space value chain.
- 2. Accessibility and usability** to facilitate multiplication of space-enabled use cases.
- 3. Awareness and education** to unlock adoption across industries and regions.



With these three goals in mind, this report encourages public and private leaders to consider the following actions in their business strategies and policy planning conversations.

By embracing these actions, state-sponsored and industry players will position themselves as leaders in the space economy and unlock long-term benefits from this collaborative value creation.

TABLE 1 | Recommendations

Stakeholders	Key takeaways
Non-space industry leaders	<p><b>Get involved in discussions with the space community</b> to provide demand signals for future use cases and chalk out potential developments for the next decade (e.g. analyse how space data could be leveraged for industry applications)</p> <p><b>Partner and invest with tech innovators</b> in the space sector to propel space applicability in non-space industries (e.g. usability and accessibility of space datasets for mapping and monitoring; next-generation capabilities for communications, positioning and monitoring data)</p> <p><b>Find better ways to integrate satellite and terrestrial systems</b> in collaboration with space players (e.g. to ensure continuity of supply chain monitoring; to expand reach of services in remote areas; to adapt to consumers' shift from traditional media to online platforms)</p>
Space industry leaders	<p><b>Explore a “space for non-space” approach</b> by investing in marketing and sales for existing/potential use cases across industries (e.g. demonstration and customization of analytics products and popularization of technological possibilities)</p> <p><b>Consider non-space player partnerships</b> to de-risk development of new hardware and services, and to ensure product market fit (e.g. frequent-revisit Earth observation for ground situation assessment, and enhanced positioning accuracy for autonomous systems)</p> <p><b>Co-create protocols and standards</b> for data formats, security and hardware interfaces (e.g. harmonized protocols for high-speed, low-latency and secure communications; predictable, reliable and harmonized spectrum)</p>
State-sponsored leaders	<p><b>Enact legislation, standardization and policies</b> that enable an environment of competitiveness, safety and sustainability for developing future use cases (e.g. global cooperation on Space Traffic Management and Space Situational Awareness or extra-terrestrial resources)</p> <p><b>Co-invest in space technologies</b> that support industries and the greater good (e.g. for risk mitigation on critical infrastructures and supply chains, or providing remote education, tele-medicine or human trafficking prevention)</p> <p><b>Build partnerships across state-sponsored agencies</b> and knowledge-exchange platforms that facilitate global progress on space-based data and services utilization (e.g. cross-industry meetings to inform public resource allocation)</p>



It's 2035. Reflecting on the last decade as you hike in the mountains, you receive a voice message through a satellite constellation above you. Over the past few years, you've been working on using satellites to monitor fugitive methane emissions, and you think your boss may be following up with you on its success. But instead, they inform you that a new system that captures solar power in Earth orbit and dispatches it to the ground is finally operational – and you imagine what it would be like to power millions of homes, factories and offices with limited carbon emissions.<sup>21</sup> As you consider the possibilities, you realize that your first space project was only just the beginning...

**Space is changing the world.**

# Appendix



This appendix provides deep-dives into the space industry's impact on a wide range of "non-space" industries. Both backbone and reach revenue generation are included for each deep-dive, along with the underlying use cases and growth rates that drive the value from space for each industry.



## Supply chain and transportation

This industry will enhance efficiency by leveraging space data for insights and connectivity.



## Food and beverage

This industry will continue to be transformed by space-enabled services, answering the demand for flexibility and mobility from end-users.



## State-sponsored defence

The application of space technologies in this sector will increasingly become a strategic imperative for countries, turning the focus on resilient communications, intelligence, surveillance and reconnaissance, and space sensing.



## Retail, consumer goods/electronics and lifestyle

This industry will benefit from demand for space-connected electronics and services enabled by satellite internet connections. It includes e-commerce, consumer goods and electronics, with the deployment of space technologies in these sectors poised to reach \$170 billion in 2035.



## Media, entertainment and sports

This industry will benefit from the growth of satellite broadband to reach more users through platforms and applications.



## State-sponsored civil investments

These will remain a critical driver of the broader space economy, helping shape its applications on Earth.



## Digital communications

This segment will benefit from enhanced space-based connectivity to expand in remote areas.



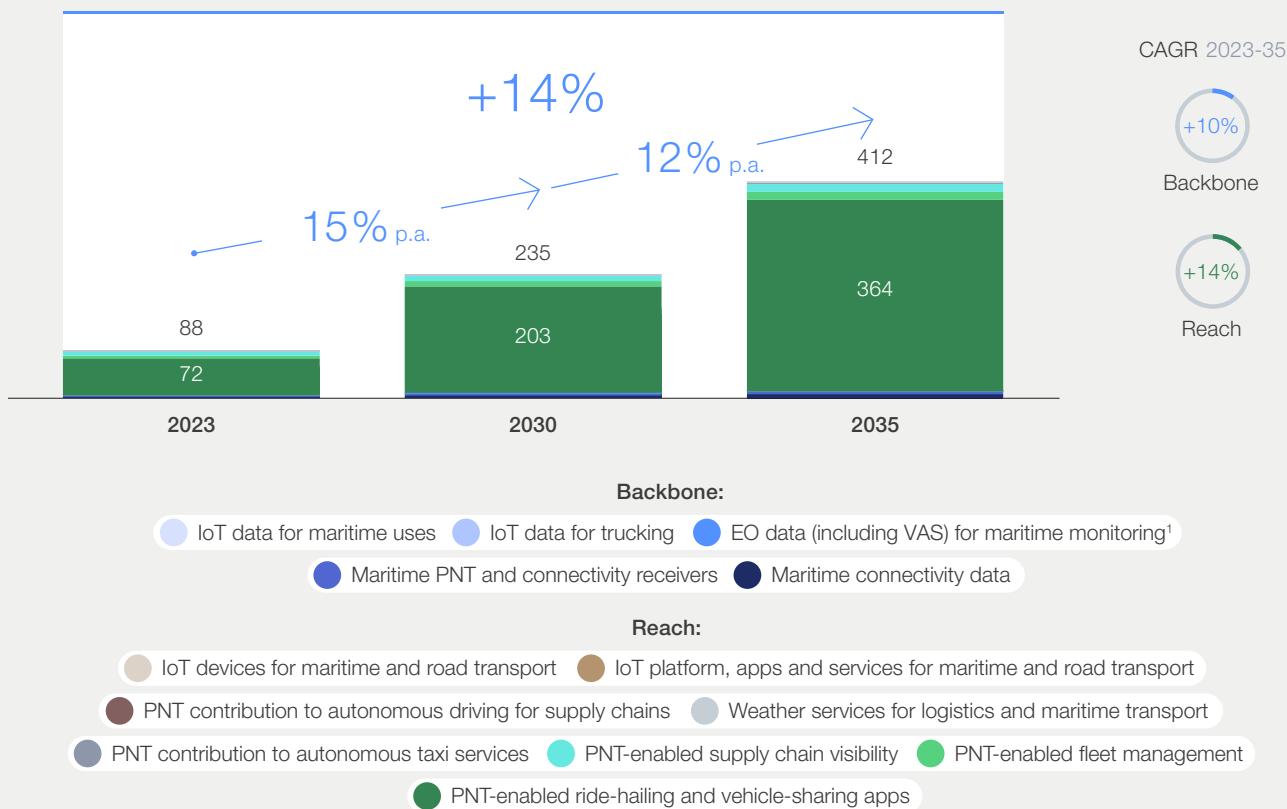
## Impact assessment

With a focus on supply chain and transportation players (excluding automotive manufacturing), the application of space technologies in this sector is predicted to yield **~\$410 billion in revenue by 2035**, contributing significantly to the overall space economy (\$1.8 trillion). Rapid growth is projected, at **14% p.a. during 2023-35**, surpassing the overall industry growth rate.

## Key themes

- 1 **Enhancing mobility services:** PNT can improve tracking and management of vehicles, reducing costs and improving efficiency to allow the successful development of business-to-business and business-to-customer services.
- 2 **Accelerating global supply chain information flow:** Integration of IoT and EO data revolutionizes information flow in the industry, enabling informed decisions, optimized routes and timely deliveries.
- 3 **Anticipating risk and mitigation:** Weather services help anticipate and mitigate risks along transportation routes, minimizing delays and ensuring safety of goods and personnel.

### Valuation by use cases, \$ billion



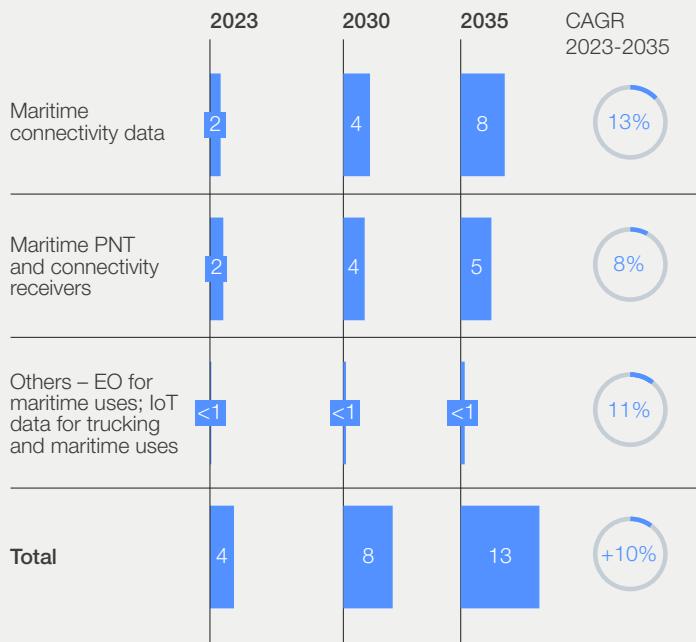
<sup>1</sup> Value-added services

## Leaders should keep an eye on...

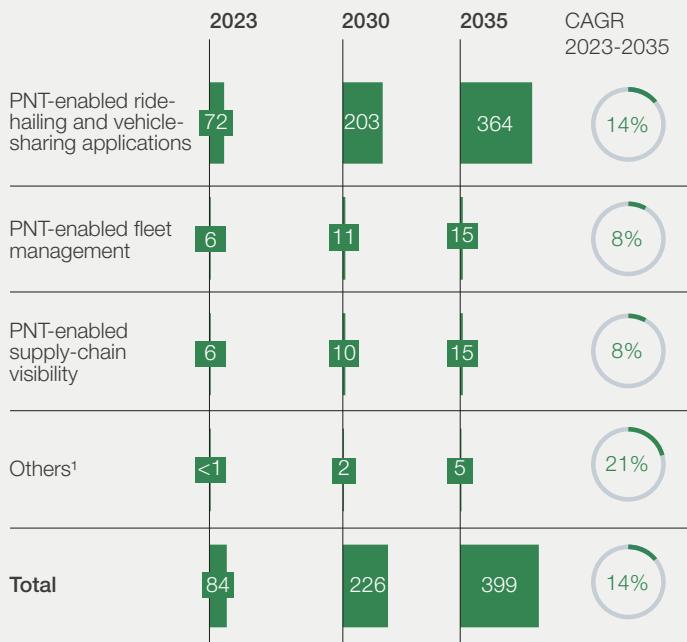
ESA's Navigation Innovation and Support Programme (NAVISP), which is exploring ways to enhance maritime navigation with space-based data. Notable projects include:

- Partnership with Grimaldi Group to develop the first satellite-based guidance system for large-vessel docking, to increase maritime safety and reduce emissions.
- Collaboration with SINTEF and Kongsberg Seatex to establish the first autonomous shipping test site.

## Backbone use cases, \$ billion



## Reach use cases, \$ billion



<sup>1</sup> Weather services for logistics (including maritime), PNT contribution to autonomous taxi services and autonomous driving in supply chains, IoT devices/platforms/applications layers for maritime and road transport

## Key underlying assumptions

- 1 The value for ride hailing and vehicle sharing is derived from industry players' revenues (i.e. excluding value of booked trips) with PNT considered as an essential enabler.
  - Growth is expected at 14% for these platforms' revenues, driven by global adoption in urban/near-urban areas.
  - There is a potential upside from decarbonization policies to support even faster adoption (not accounted for here).
- 2 Fleet management and supply-chain visibility solutions are expected to grow at 10% p.a. over 2023-27 and mature by 2035 (+7% p.a. over 2027-35), with PNT enabling continuity of service across remote and dense areas.
- 3 PNT is considered to enable only 1-2% of revenues for autonomous mobility services, such as robo-taxis, due to combination with multiple on-board sensors and software for navigation decisions.

In 2035 and beyond, the space sector will participate in unlocking:



### Autonomous long-distance and last-mile deliveries

A persistent high-speed, low-latency, low-cost satellite connection has the potential to enable transport modes beyond line-of-sight, such as drones and shipping.



### AI-enabled predictive supply chain optimizations

Real-time PNT and EO data can be harnessed by AI to support better decision-making, increase productivity and improve overall efficiency.

Source: Future of Space Economy research

FIGURE 13 | Food and beverage



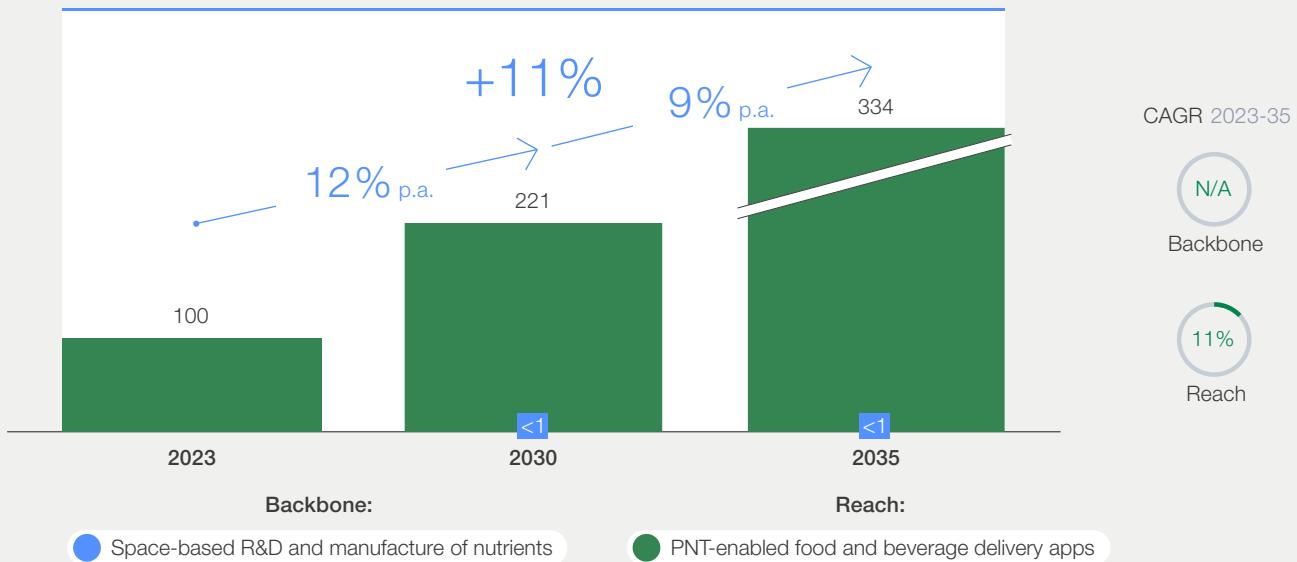
## Impact assessment

For the food and beverage industry, the impact of space technologies is most visible in time-sensitive, last-mile delivery (e.g. of perishable goods). It is poised to make a significant impact, projecting a **revenue of \$330 billion by 2035**. A **robust growth rate of 11%** underscores the potential for dynamic expansion.

## Key themes

- 1 **Revolutionizing time-sensitive delivery of perishable goods:**  
PNT technology is boosting precision and efficiency for players like UberEats and DoorDash – PNT signal integrity is essential to ensure efficient delivery and to fight fraud.
- 2 **Innovating with zero-gravity nutrients:**  
Space-based research is rapidly advancing nutrient development in a zero-gravity environment, opening up possibilities for high-quality functional ingredients.

Valuation by use cases, \$ billion



## Leaders should keep an eye on...

**SERVIR** (a programme powered by NASA and USAID), which helps tackle **food shortages** using **satellite-provided geospatial data** to track factors affecting crops (e.g. water shortages). Partnering with SERVIR can help food and beverage companies gain insights into the **food supply chain** and make informed decisions about **sourcing, logistics and delivery**.

## Underlying assumptions

- Value for delivery apps is derived from industry players' revenues (i.e. excluding the value of delivered goods) with PNT signal as enabler.
- Revenue growth is expected at 12% p.a. over 2023-30 driven by global adoption of these services in urban/near-urban areas, and at 8% p.a. over 2030-35 as the market matures.
- Potential upside from autonomous systems, bringing price down and demand up by 2035 is not accounted for here.

**Source:** Future of Space Economy research

**Note:** Detailed view for backbone and reach use cases is not provided given the limited number of use cases – the two identified use cases are visible in this chart

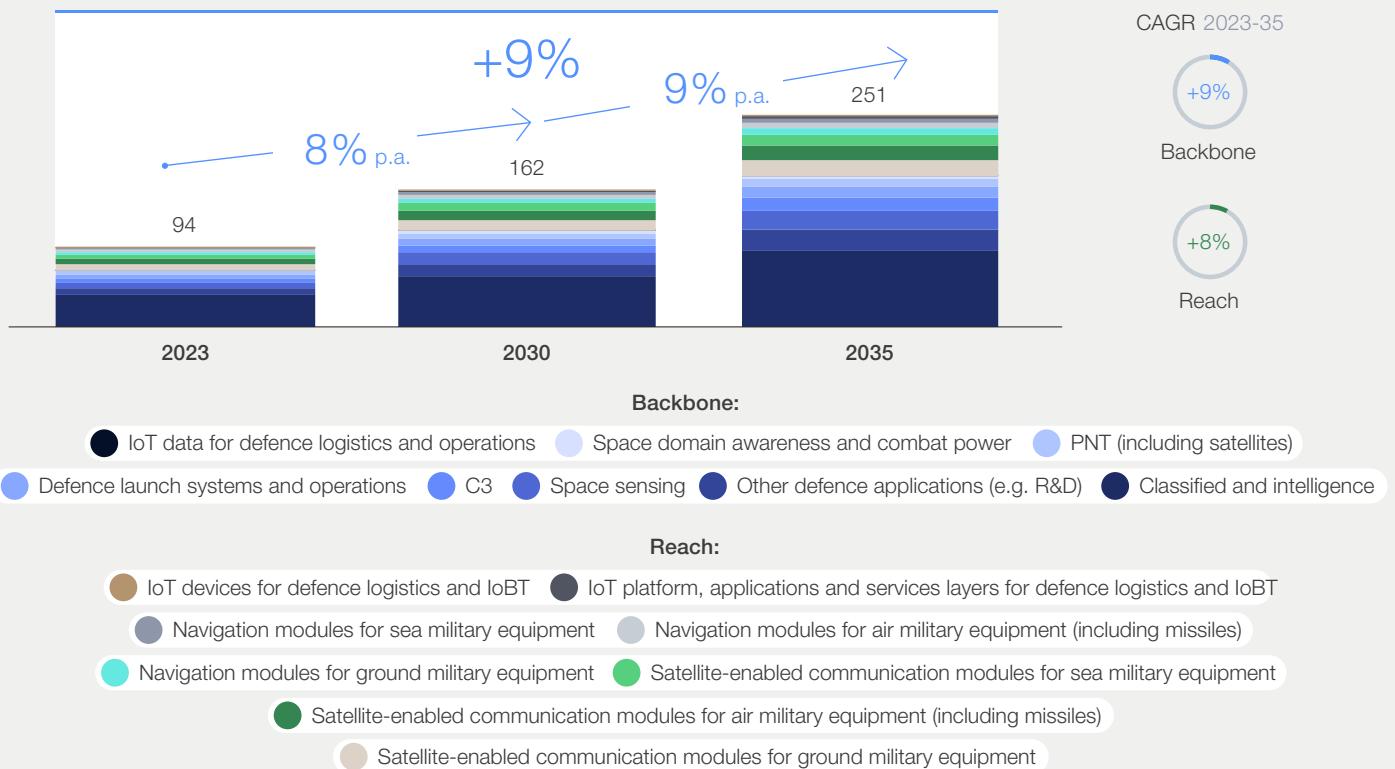
## Impact assessment

The defence space sector, growing at a **9% CAGR**, is expected to attain a market size of **~\$250 billion by 2035**. This growth underscores its increasing importance in global security, driven by **advanced space-based defence technologies**.

### Key themes

- 1 **Improving intelligence, surveillance and reconnaissance (ISR):** The expanding space economy will bolster near-real-time global ISR, supporting rapid deployment, operational efficiency and decision-making processes.
- 2 **Developing command, control and communications (C3) platforms and "Internet of Battlefield Things (IoBT)":** With secure and resilient satellite communications, C3 platforms and IoBT data will ensure seamless information flow.
- 3 **Growing demand in space sensing:** Demand will drive partnerships with leading sensor manufacturers and AI analytics firms, enhancing data acquisition and interpretation capabilities.

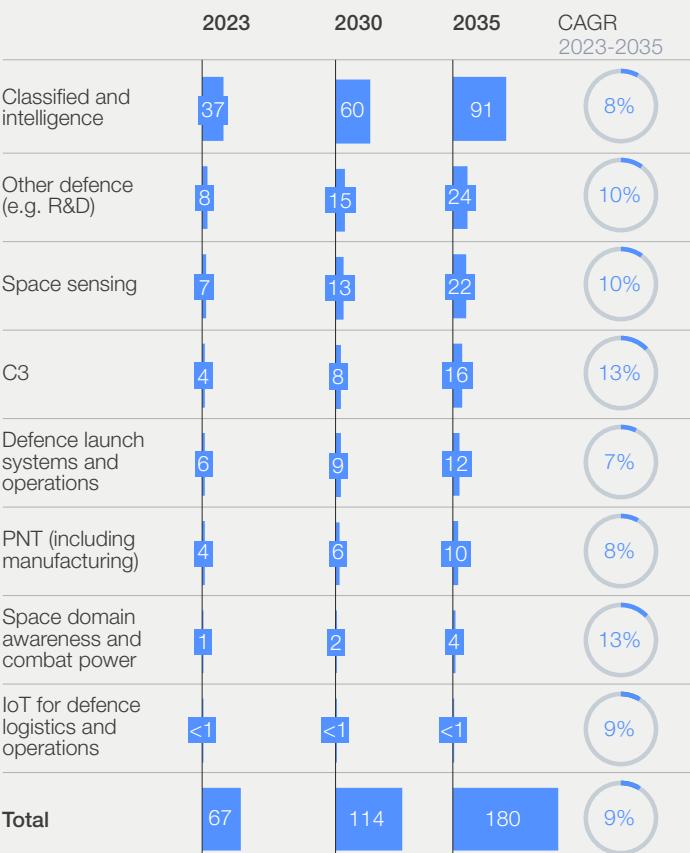
**Valuation by use cases, \$ billion**



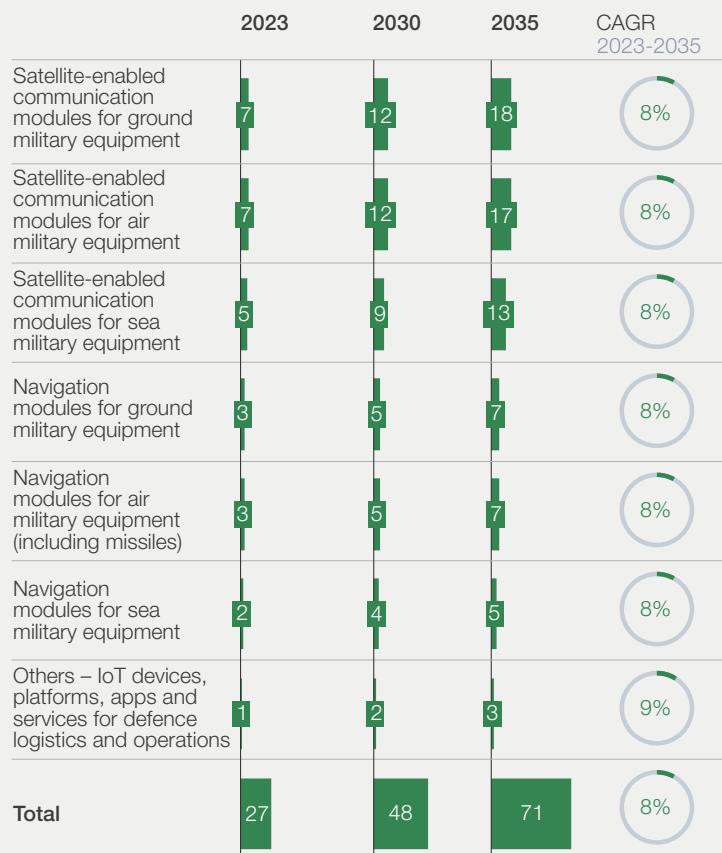
### Leaders should keep an eye on...

- **Anti-satellite (ASAT) capabilities:** As nations advance their space programmes, threats to satellite networks, including ASAT weapons, will surge and become issues of critical importance.
- **Space-based missile defence systems:** With evolving missile technologies, space could become not only a vantage point for monitoring but also for neutralizing long-range missile threats.
- **Quantum communication satellites:** Ultra-secure, tamper-proof communication could herald a new area for strategic communications.
- **AI-driven space surveillance:** Enhanced tracking of space debris, satellite health and potential threats through analytics could exponentially decrease threats.

## Backbone use cases, \$ billion



## Reach use cases, \$ billion



## Key underlying assumptions

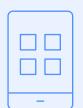
- 1 Increased global defence spend observed over recent years is expected to continue into the 2023-35 period as countries reinvest in their military capabilities.
- 2 Defence budgets are forecasted in a relatively stable geopolitical environment, without considering the impact of potential regional or global conflicts that may drive a global increase in defence spending.
- 3 "Classified and intelligence" budgets are based on assumptions and publicly available estimations.

In 2035 and beyond, the space sector will participate in unlocking:



### Geofencing-enabled border control

Satellite-backed systems providing precise border delineations and real-time monitoring, ensuring heightened security and rapid response to breaches.



### AI-enabled software to predict and monitor geopolitical evolutions

Using satellite imagery and AI-driven analytics, new platforms could specialize in real-time tracking of adversarial troop movements, naval ship congregations or construction activities, providing defence agencies with insights into potential geopolitical actions.

Source: Future of Space Economy research

FIGURE 15 | Retail, consumer goods/electronics and lifestyle



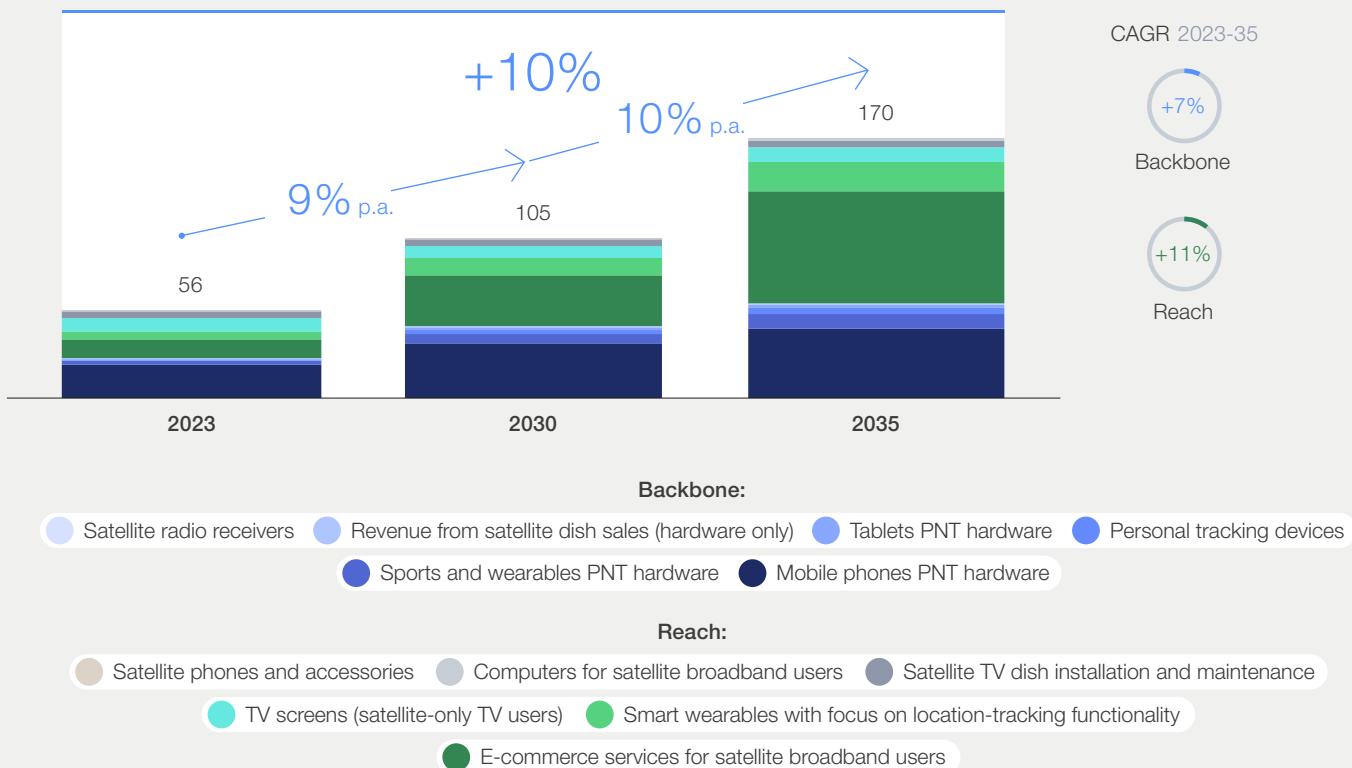
## Impact assessment

This sector includes e-commerce, consumer goods and electronics, where the application of space technologies is poised to reach **\$170 billion in 2035**. Demonstrating robust growth, the use of space technologies in this sector is projected to experience a **10% growth by 2035**, outpacing the overall industry growth rate.

### Key themes

- ① **Leveraging internet connectivity for retail:** Satellites can be used to provide internet connectivity to remote areas, bypassing the need for terrestrial infrastructure. This allows people in underserved regions to access high-speed internet, enabling them to participate in online shopping and e-commerce activities.
- ② **Surging demand for PNT receivers:** As the industries embrace space technology, the demand for PNT receivers is skyrocketing, driven by consumers' growing interest in satellite data-equipped products for enhanced tracking and navigation experiences.

### Valuation by use cases, \$ billion

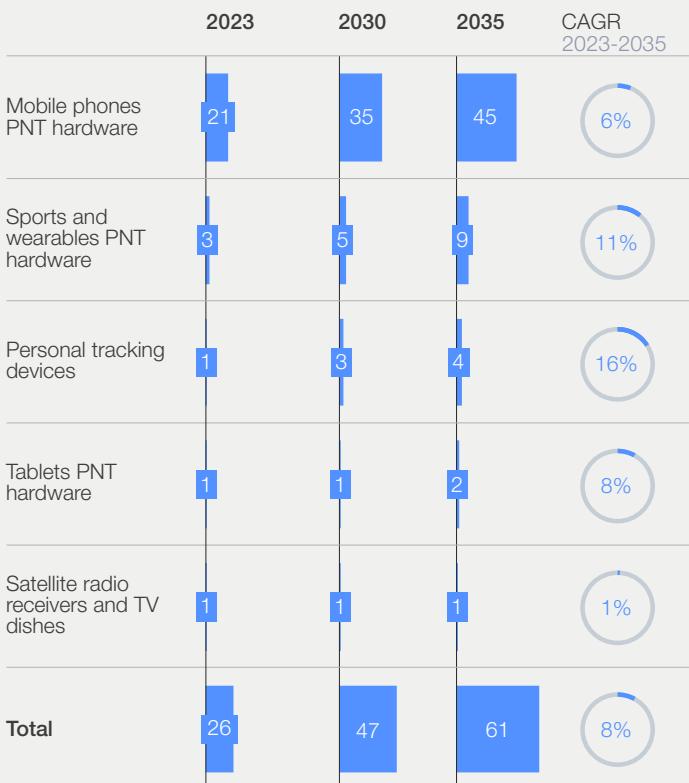


### Leaders should keep an eye on...

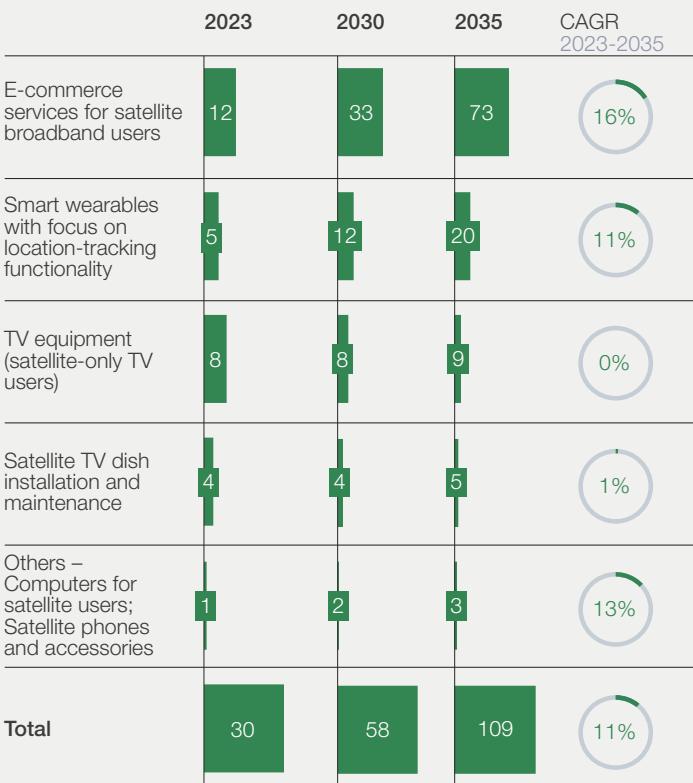
**Amazon**, which is making significant investments in **Project Kuiper**, a satellite internet initiative designed to deliver high-speed internet to underserved global communities. This venture into space technology seeks to bridge the digital divide in remote areas, bringing online both individual and corporate end-users.

More generally, the integration of satellite-based PNT, EO and communication data can enable the identification of early trends, informing strategic decision-making for retail and consumer goods players.

## Backbone use cases, \$ billion



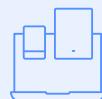
## Reach use cases, \$ billion



## Key underlying assumptions

- 1 Consumer electronics with PNT receivers will grow from 2 billion to 3 billion devices by 2023, driven by feature phones and smartphones representing 75% of devices. Backbone value accounts for value of PNT chip inside consumer electronics.
- 2 E-commerce services (excluding value of goods purchased) are expected to be increasingly adopted by satellite broadband users, with a value increase of 80% by 2035, with the Asia-Pacific, North America and Latin America driving the growth.
- 3 Smart wearables manufacturing value accounts for wearables with a focus on mobility and outdoors applications.

In 2035 and beyond, the space sector will participate in unlocking:



### Smart wearables with functionality for emergency and natural disaster alerts

Enhanced civilian application wearables serve as emergency locator transmitters and provide real-time warnings for impending natural disasters (e.g. avalanches, hurricanes and tornados).

Source: Future of Space Economy research

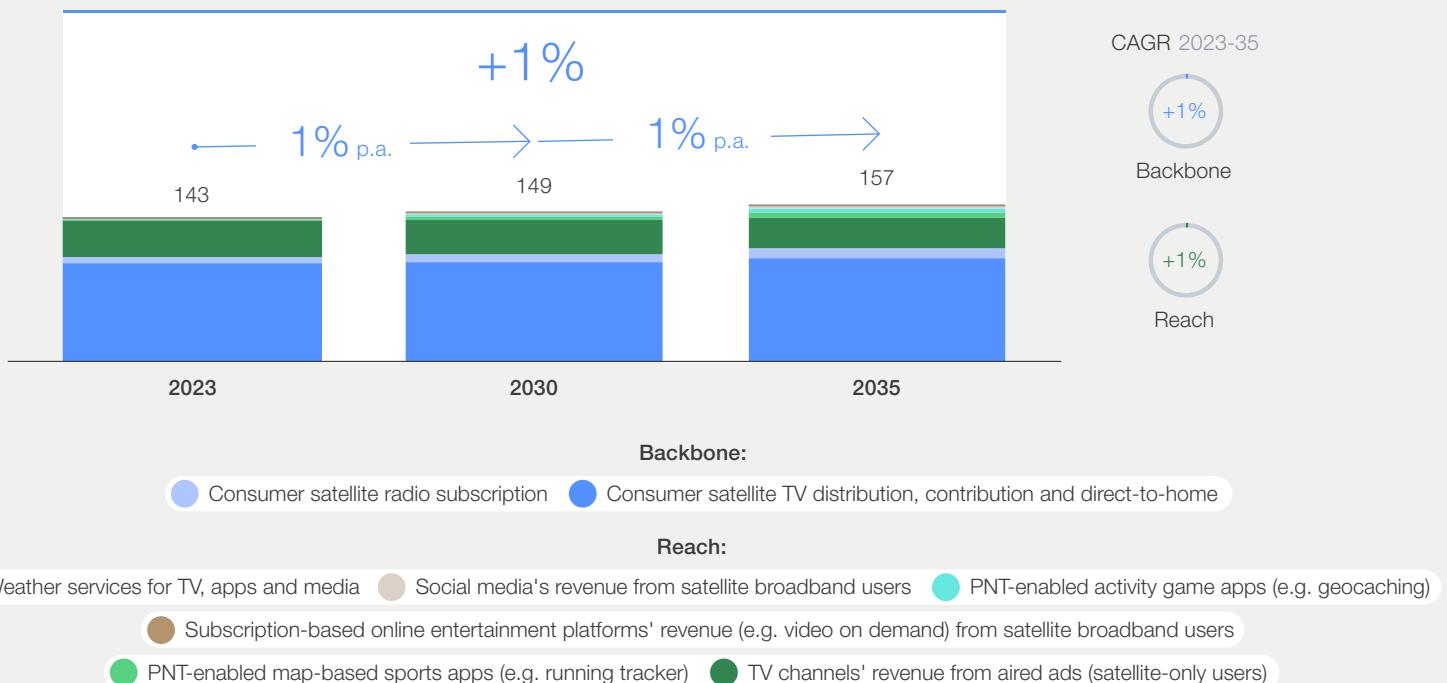
## Impact assessment

For this sector (including media broadcast, entertainment applications and sports applications), revenue from space-tech utilization is projected to stabilize at **\$157 billion in 2035**, about 10% of the \$1.8 trillion total baseline. Unlike other sectors, it is expected to **grow below GDP at 1%**, due to the gradual decline of satellite TV. This implies the need for adaptations and innovations to retain customer demand.

### Key themes

- 1 **Improving content delivery:** For decades, satellites have provided TV and radio services with wide coverage. Now, with consumers shifting towards online content (e.g. streaming platforms), value creation will be redirected towards online platforms increasingly made accessible by satellite-provided internet.
- 2 **Offering location-based services for individual end-users:** Leveraging PNT receivers embedded in consumer electronics, players in the media, entertainment and sports segments are increasingly developing location-based services with tailored experiences (e.g. augmented reality applications and outdoor sports maps).

Valuation by use cases, \$ billion

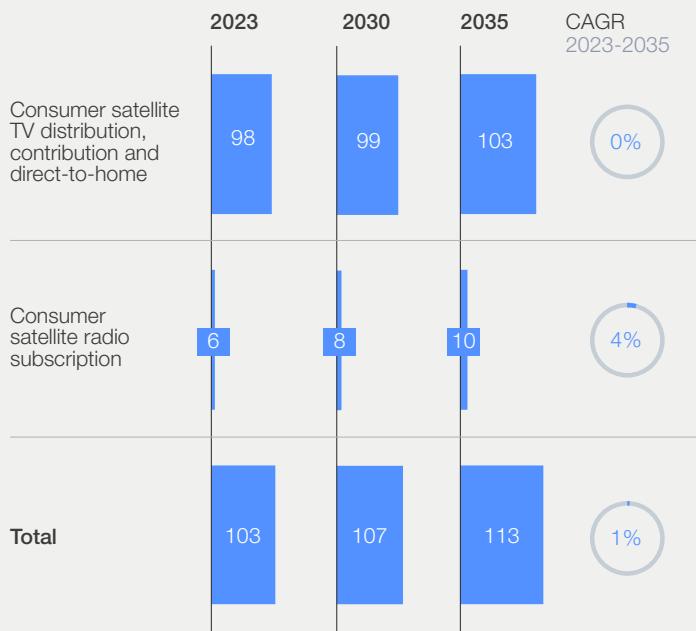


### Leaders should keep an eye on...

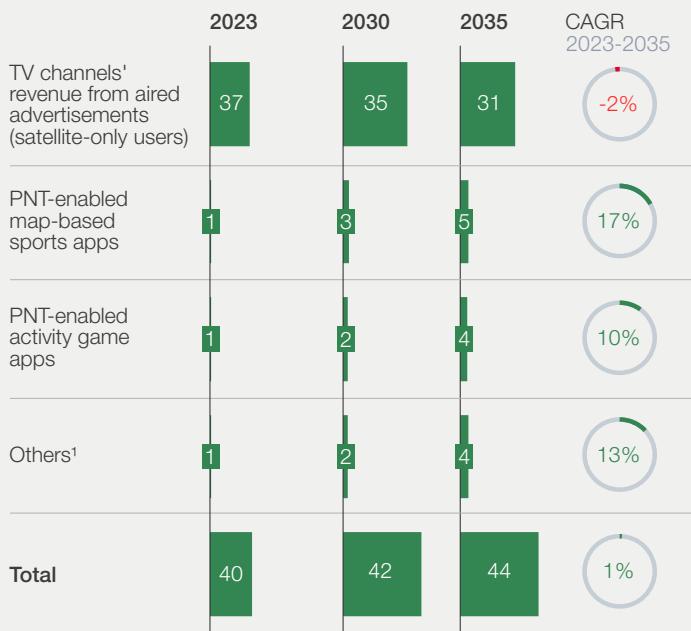
Current market trends in leveraging space technologies to enhance **virtual and augmented reality** (VR/AR). By utilizing **satellite imagery and positioning**, companies can create **immersive** virtual environments and overlay augmented content on **real-world locations**.

While VR/AR adoption has been **slower than anticipated**, any move up the adoption curve could increase relevance of **space-based data** and open up **new opportunities**.

## Backbone use cases, \$ billion



## Reach use cases, \$ billion



<sup>1</sup> Social media's revenues from satellite broadband users; weather services for TV, radio channels and apps; subscription-based online entertainment platforms' revenue (e.g. VOD) from satellite broadband users

## Key underlying assumptions

- 1 Satellite TV services are expected to decrease by 40% by 2035 in North America, Europe and the Asia-Pacific (excluding the effect of inflation) as consumers shift to digital platforms. Africa will see temporary growth driven by its population growth and limited terrestrial alternatives.
- 2 Advertisement spend for satellite TV broadcast is expected to decrease by 2% p.a. by 2035 due to advertisers increasingly reallocating their budgets to digital channels.
- 3 Satellite radio to remain stable in revenue, with slight decrease in listenership (1% p.a.), offset by a slight increase in average revenue per user (2% p.a.).

In 2035 and beyond, the space sector will participate in unlocking:



Space-based media and entertainment (e.g. reality TV shows)

TV shows filmed in space include reality shows such as Who Wants to be an Astronaut and Space Hero.

Source: Future of Space Economy research



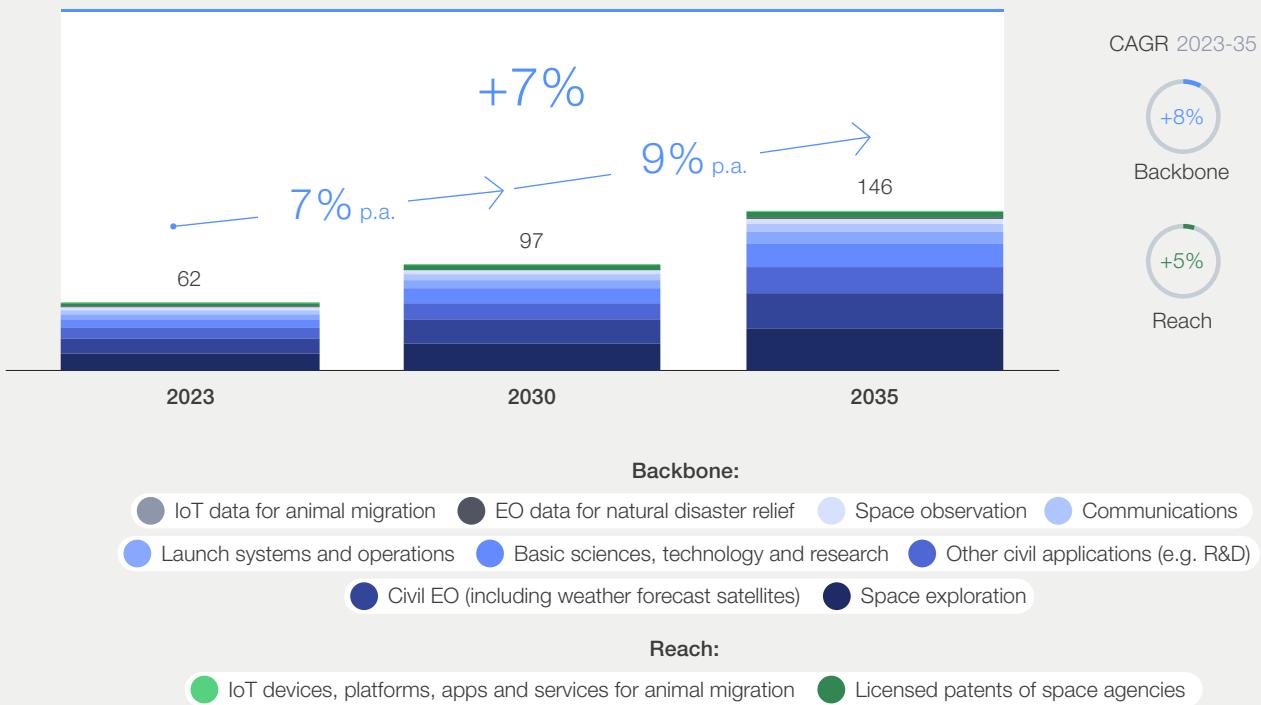
## Impact assessment

Projected to reach **\$146 billion by 2035**, the civil space sector is set for a steady expansion at a **7% CAGR**. This growth, though below the space industry average, highlights its **crucial role** in space exploration and satellite communications.

## Key themes

- 1 **Collaborating for exploration and research:** Emerging partnerships among technology innovators will drive deeper solar system exploration, fostering advancements in space science and related technologies.
- 2 **Advancing observation systems:** Developments in Earth observation technologies will enhance applications in weather forecasting, urban planning and disaster response, offering significant cross-sectoral benefits.
- 3 **Expanding space-based IoT and PNT:** Increased investment in space-based IoT and PNT will revolutionize metropolitan development, biodiversity research and environmental monitoring, contributing to smarter, more sustainable urban and natural resource management.

**Valuation by use cases, \$ billion**



## Leaders should keep an eye on...

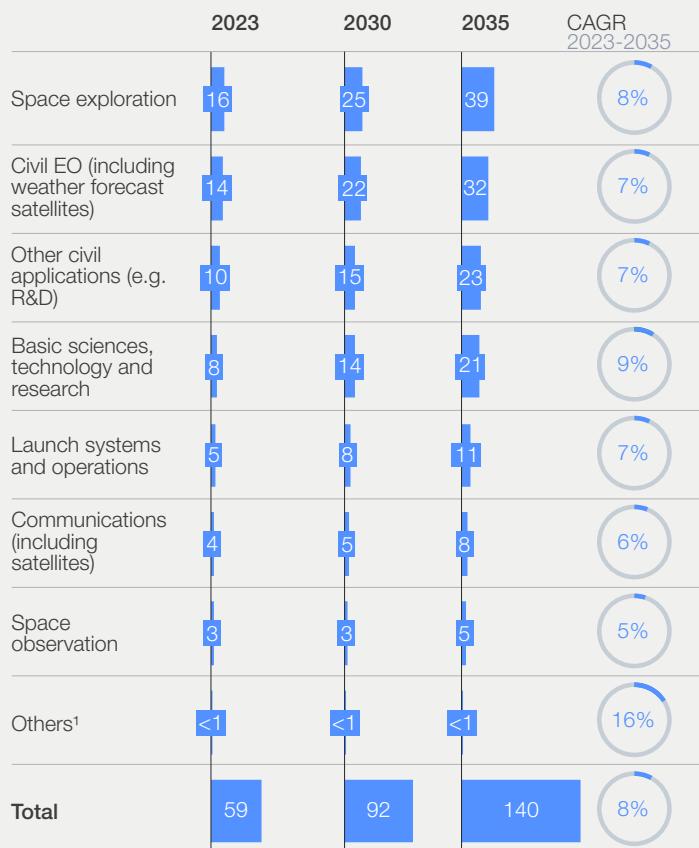
**Deep space research breakthroughs:** Projects like the James Webb Space Telescope and next-generation lunar and Mars missions could rewrite the understanding of space and its effects on humans.

**Space-based natural disaster prediction:** With advancements in EO analytics, earlier and more accurate predictions of natural disasters could save countless lives and infrastructure worth billions.

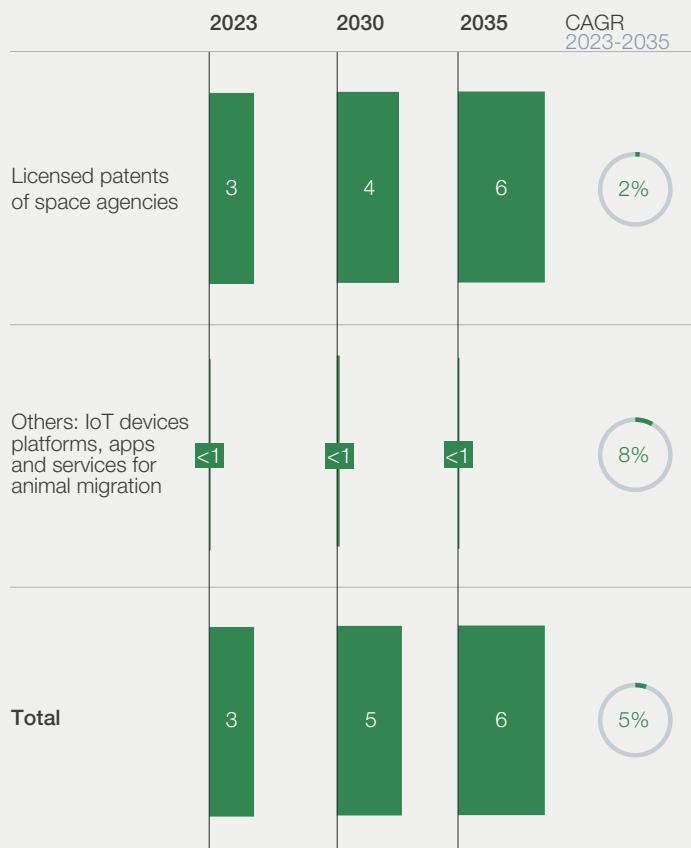
**Space tourism and habitability research:** As space tourism edges closer, research on long-term human habitability in space will gain traction, unlocking new markets and areas of research.

**Lunar initiatives:** Plans for renewed exploration of, and potentially establishing long-term bases on, the moon could spur innovations in space habitation, mining and laboratories in its unique environment.

## Backbone use cases, \$ billion



## Reach use cases, \$ billion



## Key underlying assumptions

- 1 Forecasts for state-sponsored budgets are derived from committed budgets for civil space agencies over the next few years and extrapolated based on countries' space priorities (e.g. focus on exploration). The assumptions rest on a thorough analysis of current forecasts for the next five years and specific resource allocations of civil space agencies globally.
- 2 Civil budgets are forecasted in a relatively stable geopolitical environment, without considering the impact of potential conflicts that could reallocate governmental spending towards defence.

## In 2035 and beyond, the space sector will participate in unlocking:



Space-based analytics for natural disaster prediction and anticipation

Platforms utilizing satellite data and in-orbit analytics to pre-emptively identify, predict and mitigate impending natural disasters.



Space-enabled IoT and PNT for smart cities

Systems optimizing urban life with space data: automating traffic flow, improving transport, pioneering waste management, etc.



Lunar settlements

Long-term human presence on the Moon with associated requirements for construction, energy, food, etc.

Source: Future of Space Economy research

FIGURE 18 | Digital communications

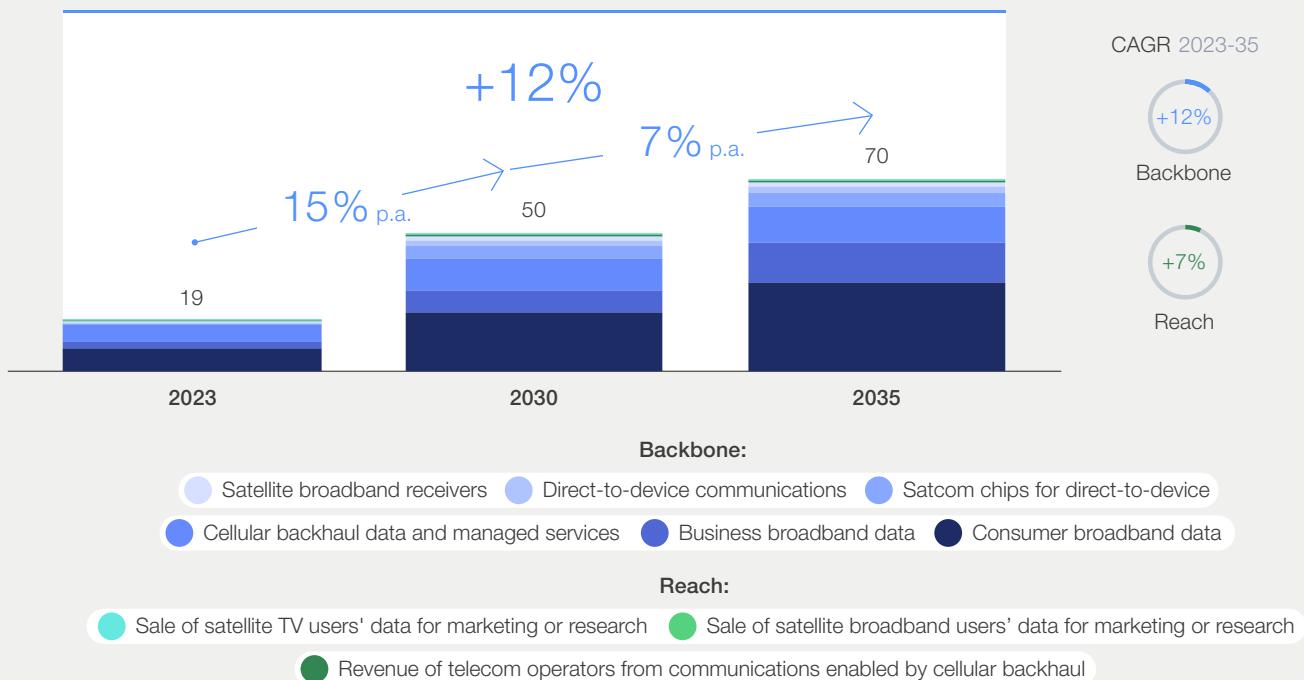
## Impact assessment

Satellite communications will play a growing role in the future of digital communications, reaching **\$70 billion** in 2035, ~5% of the total space economy (\$1.8 trillion). Consumer and business adoption will drive a growth of **12% p.a. from 2023 to 2035**, slowing down in later years as the market matures.

## Key themes

- 1 **Embracing low Earth orbit satellite connectivity:** Constellations will improve connectivity, especially in underserved areas, for use cases ranging from residential internet to IoT and corporate networks.
- 2 **Facing pricing competition:** Satellite operators need to anticipate and adapt to heightened pricing competition with expanding coverage and adopting agile strategies to stay competitive.
- 3 **Forging cross-sector collaborations:** Downstream players explore partnerships with public sector entities and digital communications players to adapt, design and harmonize infrastructure and drive innovation.

Valuation by use cases, \$ billion



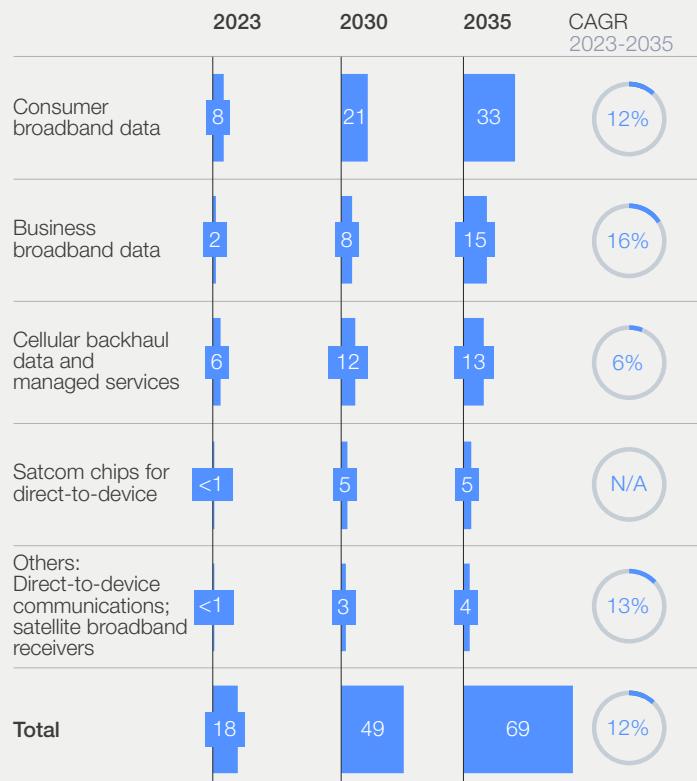
## Leaders should keep an eye on...

**Satellite** internet connectivity, which is expanding with the deployment of low Earth orbit constellations and technology advancements (e.g. inter-satellite links).

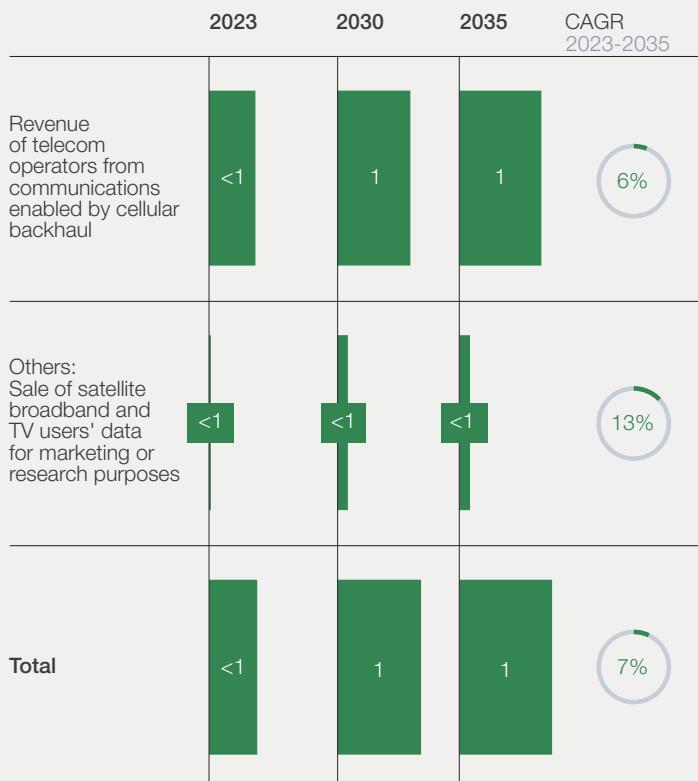
Companies like **Eutelsat's OneWeb**, which are providing high-speed internet to underserved areas through their low Earth orbit constellations. With 600+ satellites launched, the company is rolling out global services, adding 37 countries in 2023.

**Telecom operators and phone manufacturers are getting involved** through alliances and investments (e.g. Apple partnership with GlobalStar's constellation).

## Backbone use cases, \$ billion



## Reach use cases, \$ billion



## Key underlying assumptions

- 1 Broadband adoption is set to soar in remote and rural areas, with the Asia Pacific and Latin America offering the biggest growth opportunities (40% of value increase between 2023 and 2035). As constellations reach critical scale and optimize operations, data prices will decrease (10% between 2023 and 2035), while demand from consumers and businesses will increase by 60% (in gigabits per second, or Gbps).
- 2 Cellular backhaul is expected to grow over the next five years thanks to low Earth orbit constellation adoption, but high price points vs. alternatives and growing fibre deployment will lead to stagnation over 2030-35 (with expected shrinking post-2035).
- 3 Direct-to-device chips will equip all new, high-end smartphone models by 2035 (~40% of market), with cost decreasing by 30% (vs. 2023); data prices are expected to decrease by 40% vs. 2023 but remain above most terrestrial alternatives, thus limiting adoption to 300 million users by 2035.

In 2035 and beyond, the space sector will participate in unlocking:



**Ubiquitous connectivity for business-to-business and business-to-consumer users**

Integration of space and terrestrial networks could provide ubiquitous high-speed internet access for reliable and secure networks.



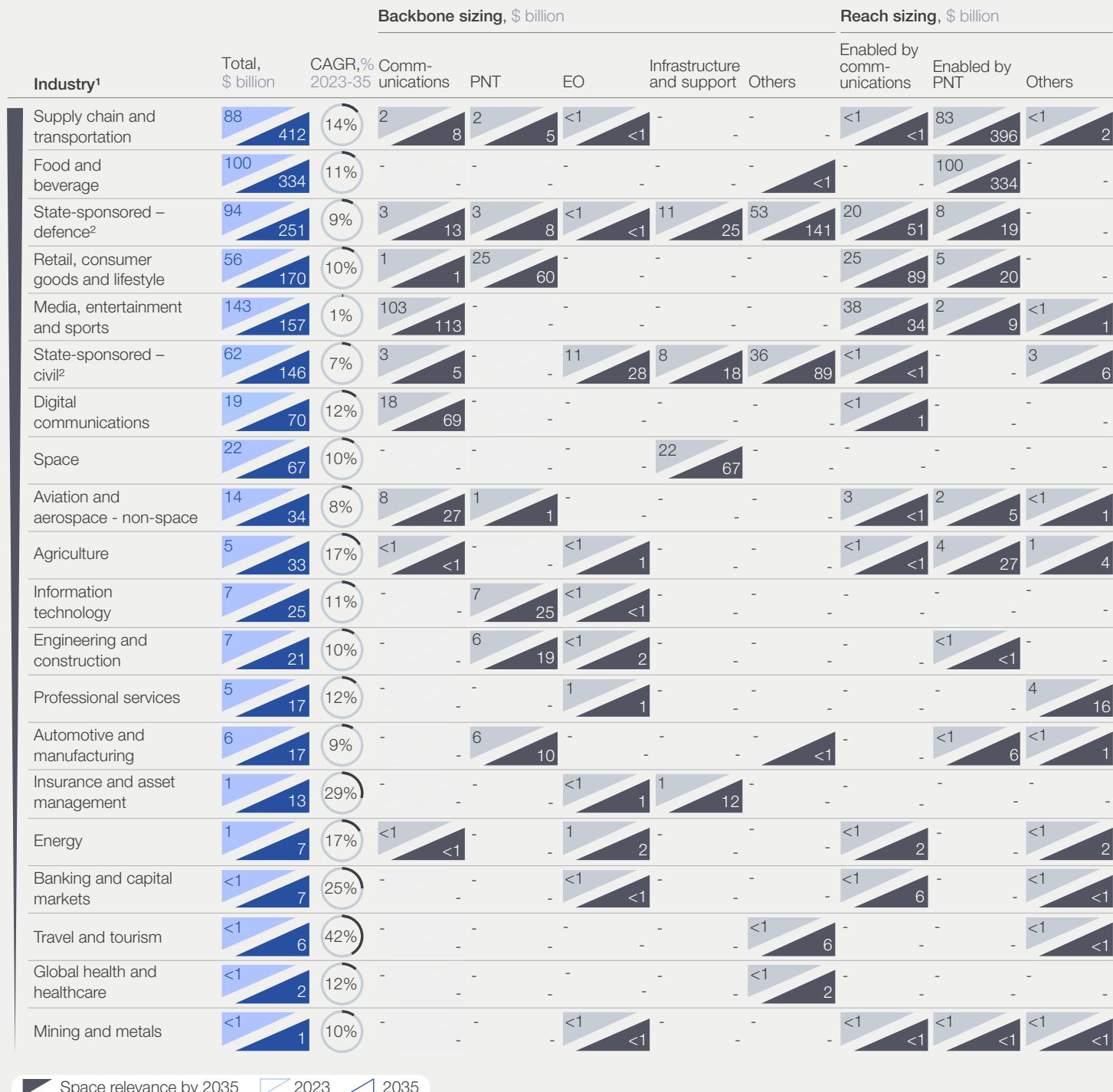
**Decentralized communication adoption**

Space networks could contribute to solving the need for secure and private communication networks, allowing for greater control over personal data, increased efficiency and cost savings.

Source: Future of Space Economy research

Beyond these seven examples, 13 other industries will see annual revenues of over \$1 billion across backbone and reach by 2035.

FIGURE 19 | Detailed sizing by industry (\$ billion)



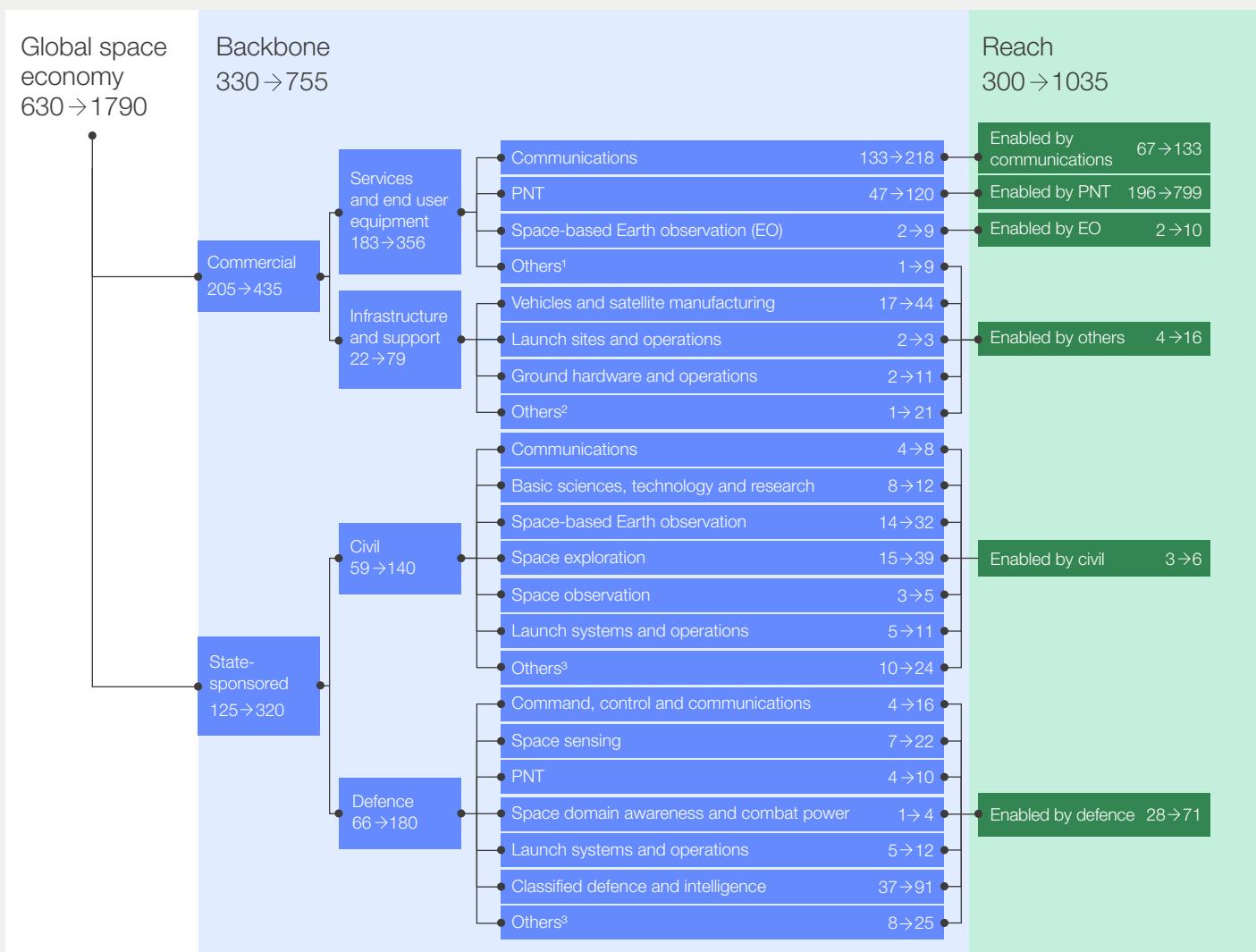
 Space relevance by 2035     2023     2035

<sup>1</sup> State-sponsored: Estimations for “classified and intelligence” budgets categorized as “defence others”; satellite manufacturing for defence and civil applications (communications, PNT and EO) categorized as “others”

<sup>2</sup> Chemicals and materials industry not represented here (no identified use cases)

Source: Future of Space Economy research

FIGURE 20 | Global space economy size (\$ billion)



XX → YY Global market sizing (\$ billion in 2023 → \$ billion in 2035)

<sup>1</sup> E.g. space tourism (aside from launch services), mining, in-space manufacturing

<sup>2</sup> E.g. in-orbit servicing and de-orbiting, insurance for space systems, commercial participation for space stations and lunar missions

<sup>3</sup> Miscellaneous administrative and research costs

**Source:** Future of Space Economy research

# Contributors

## World Economic Forum

**Alizée Acket-Goemaere**  
Project Fellow; Associate, McKinsey & Company

**Richard F. Ambrose**  
Distinguished Fellow, Space Technology

**Nikolai Khlystov**  
Lead, Space Technology

## McKinsey & Company

**Ryan Brukardt**  
Senior Partner

**Jesse Klempner**  
Partner

**Andrew Sierra**  
Associate Partner

**Brooke Stokes**  
Partner

## Acknowledgements

The authors would like to extend their sincere thanks to the space and non-space leaders who contributed their valuable insights and perspectives in workshops and consultations. This report has greatly benefitted from perspectives shared by over 45 leaders from the following organizations:

### Private space sector

Airbus Group  
Amazon – Project Kuiper  
Astra  
Astranis Space Technologies Corp  
Astroscale Holdings  
AXA XL  
Axiom Space  
BAE Systems  
Blue Origin  
ClearSpace  
Exolaunch  
GHGSat  
Hanwha Aerospace  
Hawkeye 360  
Honeywell International  
Isar Aerospace

ispace

Planet Labs

Satrec Initiative

The Exploration Company

Viasat

Voyager Space

### Private non-space sector

Air Liquide  
All Nippon Airways  
American Tower Corporation  
Avanci  
Bharti Enterprises  
Dassault Systèmes  
Hanwha Power Systems Global  
HCLTech  
Hilton Worldwide  
ING Group

Mitsubishi Corporation	National Aeronautics and Space Administration (NASA)
OC Oerlikon	Office of Space Commerce, USA
SAP	<b>Academic and non-profit</b>
Space Hero	Ecole Polytechnique Fédérale de Lausanne (EPFL)
Yara	Indian Institute of Technology Madras
<b>Investors</b>	Massachusetts Institute of Technology (MIT) Media Lab
DCVC Management Co	Massachusetts Institute of Technology (MIT) Mobility Lab
Deutsche Bank	SDA Bocconi School of Management
Nevena Capital	Secure World Foundation
<b>Government institutions</b>	The Aerospace Corporation
European Space Agency (ESA)	University of Tokyo
Federal Department of Foreign Affairs (FDFA) of Switzerland	
Japan Aerospace Exploration Agency (JAXA)	

The authors also wish to thank the Forum and McKinsey colleagues who supported the Future of Space Economy team and contributed to this report:

#### **World Economic Forum**

Sebastian Buckup, Helen Burdett, Valentin Golovtchenko, Andreas Hardemann, Jeremy Jurgens, Hazuki Mori, Soichi Noguchi, Vignesh Santhanam and Minoo Rathnasabapathy.

#### **McKinsey & Company**

Mary Parker Aldecoa, Benjamin Allard, Jacob Andreesen, Alexander Berman, Sylvia Bi, Saskia Boeck, Alexandre Burrus, Jennifer Connors, Ruth Coo, Camaren Dayton, Kevin De la Fuente, Jessie Felde, John Gang, Giacomo Gatto, Alyssa Goessler, Michael Greer, Karl Grosselin, Muriel Jacques, Badr Kassid, Thomas Kiel, Sasha Kolodkin, Kathy Lakes, Jack LaZebnik, Taylor Li, Chloe Mayhue, Bryan Melonis, Carolyn Millenson, Andy Min, Slate Noronha, Celestie Okechukwu, Nirali Patel, Chloe Peng, Chester Pennock, Samantha Pond, Nathan Rigal, Martin Rivet, Ilan Rozenkopf, Cameron Shane, Ted Silberman, Brooke Smilen, James Sorensen, Dmitry Tolstinev and Hawken Wanamaker.

## Production

**Bianca Gay-Fulconis**  
Designer, 1-Pact Edition

**Tanya Korniichuk**  
Illustrator, 1-Pact Edition

**Madhur Singh**  
Editor, World Economic Forum

# Endnotes

1. McKinsey & Company, *Space launch: Are we heading for oversupply or a shortfall?*, 2023.
2. Space Capital, *Q1 2023 Space Investment Quarterly*, 2023.
3. McKinsey & Company, *Global Consumer Price Index Growth Forecast*, 2023.
4. McKinsey & Company, *Global Nominal GDP Growth Forecast*, 2024.
5. McKinsey & Company, *The semiconductor decade: A trillion-dollar industry*, 2022, <https://www.mckinsey.com/industries/semiconductors/our-insights/the-semiconductor-decade-a-trillion-dollar-industry>.
6. McKinsey & Company, *On the cusp of the next payments era: Future opportunities for banks*, 2023.
7. NASA, *Artemis*, <https://www.nasa.gov/feature/artemis/>.
8. Office of Inspector General, National Aeronautics and Space Administration, *NASA's Management of the Artemis Missions*, 2021.
9. World Economic Forum, *Valuing Earth Observation Data*, 2024.
10. World Economic Forum and McKinsey & Company, *Space Applications in Agriculture: Enhancing Food and Water Security, Improving Climate Action*, 2023, <https://www.weforum.org/publications/space-applications-in-agriculture-enhancing-food-and-water-security-improving-climate-action/>.
11. McKinsey & Company, *A new space age*, 2023.
12. Harvard Business Review, *SPACs: What You Need to Know*, <https://hbr.org/2021/07/spacs-what-you-need-to-know>.
13. World Economic Forum, *Space Industry Debris Mitigation Recommendations*, 2023, [https://www3.weforum.org/docs/WEF\\_Space\\_Industry\\_Debris\\_Mitigation\\_Recommendations\\_2023.pdf](https://www3.weforum.org/docs/WEF_Space_Industry_Debris_Mitigation_Recommendations_2023.pdf).
14. McKinsey & Company, *Proprietary research*, 2024.
15. Indian Space Research Organization, *Indian Space Policy*, 2023.
16. Japan Aerospace Exploration Agency, *Global Activities*, accessed 2024.
17. Al-Hazmi, Ritaj Hussain, *Saudi Arabia's next chapter: the space mission*, Arab News, 2023.
18. National Astronomical Research Institute of Thailand, *TSC: Thai Space Consortium*, accessed 2024.
19. Peruvian Ministry of Education, *Minister of Education affirms that there is much to do to improve schools*, 2024.
20. McKinsey & Company, *The semiconductor decade: A trillion-dollar industry*, 2022.
21. European Space Agency, *Space-Based Solar Power overview*, 2022, [https://www.esa.int/Enabling\\_Support/Space\\_Engineering\\_Technology/SOLARIS/Space-Based\\_Solar\\_Power\\_overview](https://www.esa.int/Enabling_Support/Space_Engineering_Technology/SOLARIS/Space-Based_Solar_Power_overview).



---

COMMITTED TO  
IMPROVING THE STATE  
OF THE WORLD

---

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

---

World Economic Forum  
91–93 route de la Capite  
CH-1223 Cologny/Geneva  
Switzerland

Tel.: +41 (0) 22 869 1212  
Fax: +41 (0) 22 786 2744  
[contact@weforum.org](mailto:contact@weforum.org)  
[www.weforum.org](http://www.weforum.org)