REPORT

The low Earth orbit economy

A game-changer for business and society?

LEO CONOMY

Roland Berger

Management summary

The low Earth orbit economy is rapidly transitioning from a visionary concept to a tangible reality. A strategic gateway for humanity's broader ambitions in space exploration, low Earth orbit provides a testing ground for technologies that could soon be deployed on the moon, Mars and beyond. It also has the potential – driven by technological advancements in the space sector and the political ambitions of spacefaring nations such as the United States and China – to unlock innovation, redefine traditional "on-Earth" industries and ultimately create millions of jobs. For example, manufacturing in space is already known to produce superior alloys for critical industries that require advanced materials; the microgravity environment enables breakthroughs in semiconductors and pharmaceuticals thanks to processes only possible in low gravity.

Recent technological developments, particularly the reduced launch costs enabled by heavy-lift, fully reusable launch systems, have made manufacturing in space feasible at scale. Transporting payloads to and from space has become more affordable and practical than ever before. The number of orbital launches reflects this, up from around 85 in the year 2000 to more than 260 in 2024. Increasingly, the space sector is recognized for its potential to generate substantial economic value, with estimates suggesting it could contribute more than EUR 1 trillion to the global economy by 2040.

In this report, written by Roland Berger and LEOconomy, we explore how the low Earth orbit economy can drive radical changes in our modern economies. We delve into real-world applications and immediate benefits. Our conclusion? This transformation is not just about space exploration – it is about revolutionizing industries right here on Earth.

Contents

Fast facts

260+

Number of orbital launches in 2024

>EUR 1 trill.

Contribution of low Earth orbit economy to global economy by 2040

-90%

Reduction in cost per kg delivered into orbit thanks to heavy reusable rockets

1 The low Earth orbit economy

Addressing on-Earth challenges from space

Positioned between 160 km and 2,000 km above the Earth's surface, the low Earth orbital zone offers unique advantages. Technological advancements in space launchers, such as the 90 % reduction in cost per kilogram delivered into orbit enabled by heavy reusable rockets, have now made space more accessible than ever. For example, SpaceX's Starship and Blue Origin's New Glenn in the United States are pioneering this field. Starship, with its fully reusable design, promises to revolutionize space travel by significantly reducing costs and increasing payload capacity. New Glenn became operational in 2025, successfully reaching orbit and demonstrating the viability of reusable heavy launch systems. Similarly, the European Space Agency (ESA) has conducted preliminary research for a heavy launcher in the PROTEIN study, which aims to prepare the development of a next-generation heavy launch vehicle that can compete globally, further driving down costs and increasing accessibility to space.

Beyond space organizations, traditional industries are also increasingly recognizing the potential of the "low Earth orbit economy" for their day-to-day business on Earth. The low Earth orbital zone offers a number of key advantages, such as minimal latency for data transmission, making it ideal for various applications on Earth that require fast data exchange – "IoT from space," for example. Advanced robotics and autonomous systems developed for space missions in low Earth orbit, such as in-space assembly, can be adapted

"As space technologies integrate with Earth's industries, they are starting to create tangible business opportunities that every forward-thinking organization can capitalize on."

Manfred Hader,
Senior Partner – Aerospace & Defense, Roland Berger

for use on Earth, generating new solutions and products in industries such as construction and mining. In addition, the reduced gravitational pull of the low Earth orbital zone enables innovations in manufacturing, allowing for the creation of superior materials and products, particularly in industries such as semiconductors, materials science and processing technologies.

ADDRESSING GLOBAL MEGATRENDS

Beyond supporting business opportunities, the low Earth orbit economy also offers innovative solutions to some of the most pressing challenges on Earth. With regard to megatrends in people and society, such as population growth and migration, it can help humanity build a better future and foster global unity by inspiring common goals. Satellite connectivity can also enable telemedicine for underserved regions, as well as bringing quality education to remote areas. Likewise, in the area of politics and governance, the development of the low Earth orbit economy can encourage democratic nations to actively participate in space so as to ensure balanced global leadership, promoting peaceful cooperation through joint space initiatives.

Environmental and resource-related megatrends, such as climate change, pollution and threats to biodiversity, can also be addressed. The low Earth orbit economy can be used to monitor pollution and climate data in real time, and can even advance clean energy through space-based solar power. Similarly, solutions for **economic and business** challenges, from global trade, value chain and power shifts due to the energy transformation and the debt challenge, can be addressed by the creation of new markets and opportunities in space.

The area of **technology and innovation** faces challenges with respect to the value of innovation, frontier technologies, and the relationship between humans and machines. Here, space applications can accelerate technological advancements, and advanced human-machine interfaces can be developed in space environments. Likewise, characteristics of low Earth orbit such as microgravity can be exploited for high-performance product manufacturing. Microgravity can also be useful for advancing medical research and pharmaceutical production, thereby addressing global **health and healthcare challenges.** In addition, environmental health risks can be monitored from space.

2 Driving innovation across multiple industry verticals

Use cases for low Earth orbit activities

As the low Earth orbit economy continues to mature, it is spawning new opportunities across a diverse range of industries, well beyond traditional satellite deployments. From space tugs and autonomous cargo systems that optimize orbital logistics, to controlled re-entry solutions enabling the safe return of high-value products manufactured in microgravity, a new paradigm for commercial activity is taking shape. Alongside these technological leaps, the sector has the potential to create new jobs in areas such as the operation and logistics of space infrastructure, and the expansion of traditional industries into space.

> **"The next industrial revolution will not be on Earth; it will be in orbit."**
>
> **Matthias Spott,**
> **Founder & Chief Executive Officer, LEOconomy**

We identify four key domains where use cases arise. The first is **in-space infrastructure,** where the use cases range from the construction of spacecraft and space habitats to the building of in-orbit logistical hubs to support space manufacturing. The core of the value proposition here lies in enabling research and exploration activities in space, facilitating efficient space operations through centralized hubs and services, ensuring sustainable space operations by cleaning up orbital debris, and potentially relocating data storage to space to prevent high energy consumption on earth.

A second key domain is **in-space services.** Use cases include experimentation and processing for microgravity materials, and in-orbit servicing, such as space debris removal. The value proposition for these activities is that they enable the creation of advanced materials with unique properties for industrial applications, reduce critical space debris and extend satellite lifespans through maintenance and repairs.

The third domain is **in-space manufacturing,** with use cases including producing high-purity fiber optics, manufacturing high-quality semiconductor crystals and developing superior pharmaceuticals, such as crystallized proteins that cannot be produced on Earth. Here, the value proposition lies in enabling electronic devices to be enhanced with superior materials or revolutionizing medicine with highly effective drugs that cannot be produced on earth.

Finally, in the domain of **technology spin-offs,** use cases range from advanced life-support systems or robotics adapted for Earth applications (for example, in medicine) to space-grade materials applied to Earth industries. The value proposition lies in improving Earth-based life support and environmental systems with space technologies, enhancing product performance in various industries using superior materials developed for space, and advancing machinery with technology originally designed for space missions. ▶ A

A Business transformation – Bridging industry and space

Uncover the potential of microgravity in business

Biotech and pharmaceuticals in space – The next stage in medical research

What is it all about?

Biological processes can be controlled differently in zero gravity than on Earth, opening up new possibilities for drug development, cell research and tissue cultivation under ideal conditions.

Why is it relevant?

The pharmaceutical and biotech industry is facing a paradigm shift. Crystalline structures of proteins, which are distorted by gravity on Earth, grow more precisely in microgravity – a decisive advantage for developing highly effective drugs. Additionally, cells and tissues can be cultivated more effectively in microgravity, enabling groundbreaking advances in personalized medicine.

Who is it relevant for?

- Pharmaceutical companies: new ways to develop drugs outside Earth's gravity
- Biotech companies: research into regenerative therapies and cell cultivation
- Hospitals & transplantation medicine: a basis for artificially cultivated organs
- Investors: access to the multibillion-dollar market for next-generation medicine

Microgravity is not only exciting for astronauts; it could also revolutionize the future of medicine and the pharmaceutical industry – a market currently estimated to be worth around EUR 30 billion.[1]

3D printing of human organs in microgravity – The medicine of the future

What is it all about?

3D printing of human organs is on the verge of a breakthrough. Without the disruptive force of gravity, complex tissue structures and blood vessels can be printed more stably – a decisive factor for future transplants.

Why is it relevant?

On Earth, gravity and surface tension cause cell material to collapse during printing. In microgravity, printed organ structures retain their shape, making it possible to produce functional hearts, kidneys or livers without relying on donor organs. This could revolutionize transplant medicine and solve the global organ shortage.

Who is it relevant for?

- Research institutions & university hospitals: new therapeutic approaches for organ failure
- Biotech & medical technology: a leading role in printed organs and tissues
- Space organizations: bioprinting for long-term missions and deep space exploration
- Healthcare systems: shorter waiting times and less transplant rejection

3D printing organs in zero gravity could save lives and revolutionize medicine – a groundbreaking interface between space travel and biotechnology. In 2020, it was estimated that 150,000+ transplants were performed annually worldwide; this is less than 10% of the global need.[2]

Semiconductor production in space – Perfect ingots for the next generation of chips

What is it all about?

The production of semiconductor crystals ("ingots") requires absolute purity and precision. Defect-free crystals with a perfect lattice structure can be grown in microgravity, a decisive advantage for the chip industry.

Why is it relevant?

On Earth, gravitational forces and convection currents create micro-defects and impurities during the melting process. In zero gravity, the material grows more homogeneously, without structural distortions, allowing for the production of semiconductors with higher conductivity and efficiency. This enables more powerful, energy-efficient chips for AI, mobile communications and quantum technology.

Who is it relevant for?

- Semiconductor manufacturers: high-purity silicon and gallium arsenide crystals for state-of-the-art chips
- Chip design companies: more performance with less energy consumption
- Aerospace & defense: developing radiation-resistant electronics for extreme environments
- Investors & tech giants: a disruptive future technology

Microgravity could fundamentally change the way chips are produced, taking the semiconductor industry – worth USD 600 billion in sales in 2024 – to a new level.[3]

1 Roland Berger 2 Global Observatory on Donation and Transplantation 3 Semiconductor Industry Association

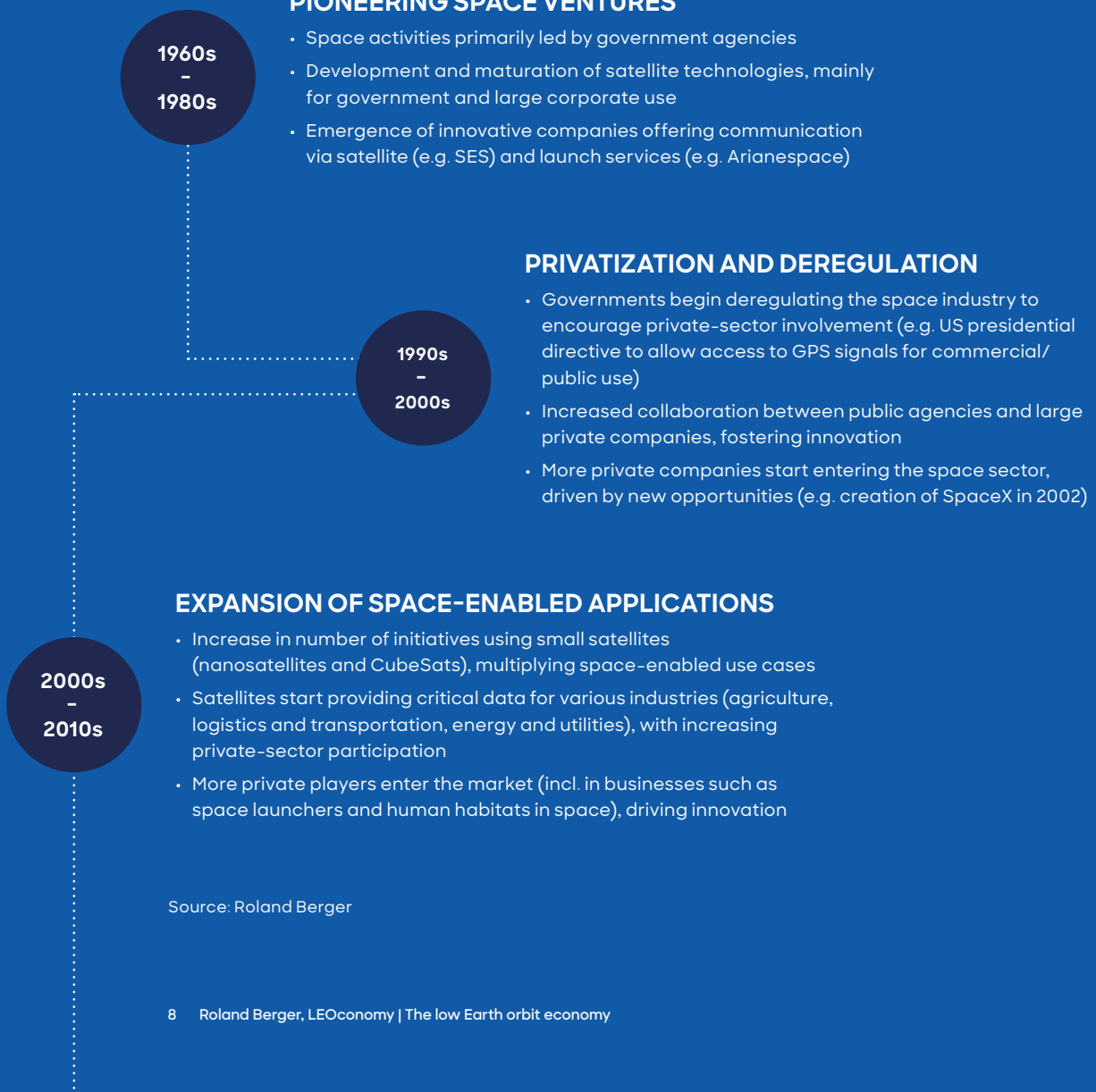
Source: Roland Berger

3 The commercialization of space

Paving the way for the low Earth orbit economy

The commercialization of space began in earnest in the 1960s. Since then, it has passed through several distinct eras, each marked by significant advancements and shifts in industry dynamics. Now, the stage is set for the development of a low Earth orbit economy. In the figure below, we outline the evolution of the space economy, highlighting key eras, anticipated activities and market impacts – from pioneering space ventures, to a future where space is not merely a frontier for exploration but a thriving ecosystem for economic growth and innovation. ▶ B

B Evolution of the space economy



Source: Roland Berger

2020s

GLOBAL CONNECTIVITY

- Both launch and communication services become predominantly private-sector-driven. Government agencies concentrate more on scientific research and exploration
- Seamless connectivity between Earth and orbit, led by private initiatives (e.g. SpaceX's Starlink, Eutelsat's OneWeb)
- Private-sector partnerships with IT giants (e.g. Amazon with AWS and Kuiper) create robust, scalable ground and space infrastructure

2025 – 2035

FOUNDATION CREATED FOR LOW EARTH ORBIT ECONOMY

- Critical technologies for establishing in-space infrastructure develop and mature
- Regulatory frameworks and international agreements established and enforced
- Cost-effective heavy-lift launch vehicles reach maturity
- Construction begins of in-orbit platforms
- Pilot projects launched for in-space manufacturing and services
- First-mover advantage with early entrants shaping the market and setting standards
- First services move from niche to sustainable, for example in-orbit servicing[4] (refueling and repowering older satellites) and commercial microgravity experiments[5]

2035 – 2045

COMMERCIALIZATION RAMPS UP FOR LOW EARTH ORBIT ECONOMY

- Transition from pilot projects to commercial operations
- In-space manufacturing and industrial services scale up
- Supply chains and logistics for space operations strengthen
- New jobs created to support low Earth orbit economy growth, e.g. logistics operations, payload integration
- Increased integration of space into on-Earth business (e.g. development of a buyer/supplier relationship between space and on-Earth business for activities such as R&D or manufacturing[6])

2045 and beyond

SCALING AND INTEGRATION OF LOW EARTH ORBIT ECONOMY

- Large-scale commercialization achieved
- Widespread adoption and integration of space-based services and products into global economies
- Low Earth orbit economy expected to keep on driving continuous innovation on Earth, while expanding into deeper space (e.g. the moon and Mars)
- Seamless integration of space-based businesses with Earth-based industries, creating a unified economic ecosystem
- Circular orbital economy, ensuring sustainability of low Earth orbit operations.[7] This includes repurposing end-of-life orbital assets and proactively removing debris from low Earth and other orbits.

4 The first in-orbit servicing mission was successfully conducted by Northrop Grumman with the MEV-1 mission in 2019. Recurring servicing activities are expected in the coming years from various space players.

5 Commercial microgravity ventures are already underway, with notable examples such as Voyager's Starlab station expected to be operational by 2028, ahead of the International Space Station's decommissioning. Additionally, multinational hotel company Hilton is involved in designing Starlab's comfort and hospitality solutions for astronauts, demonstrating a tangible integration of traditional Earth-based businesses with space ventures.

6 For example, US-based company Axiom Space is expected to launch its Axiom Station, offering different zero-gravity businesses such as research and manufacturing through a dedicated module dubbed RMF. The company plans to complete its space station in the 2030s.

7 In its Vision 2050, the European Space Agency (ESA) aims to rely on circular in-orbit activities to reduce launch masses by taking advantage of material, equipment or even entire assets that are already in orbit. Different ESA studies have been developed in line with this, such as the OMAR study(On-orbit Manufacture, Assembly & Recycle).

4 Unleash the potential

Challenges and key technology enablers

To unlock the full potential of the low Earth orbit economy, a number of key challenges must be mastered. They include the following:

Public ambition: Strong governmental support is needed, rooted in a bold vision on the part of public decision-makers. Government needs to encourage European players to actively participate in space activities and capture the opportunities associated with the low Earth orbit economy. This task may be particularly challenging in the case of traditionally more conservative European space policymakers. Yet, it is precisely these players whose full commitment is needed in order to ensure balanced global leadership in the low Earth orbit economy.

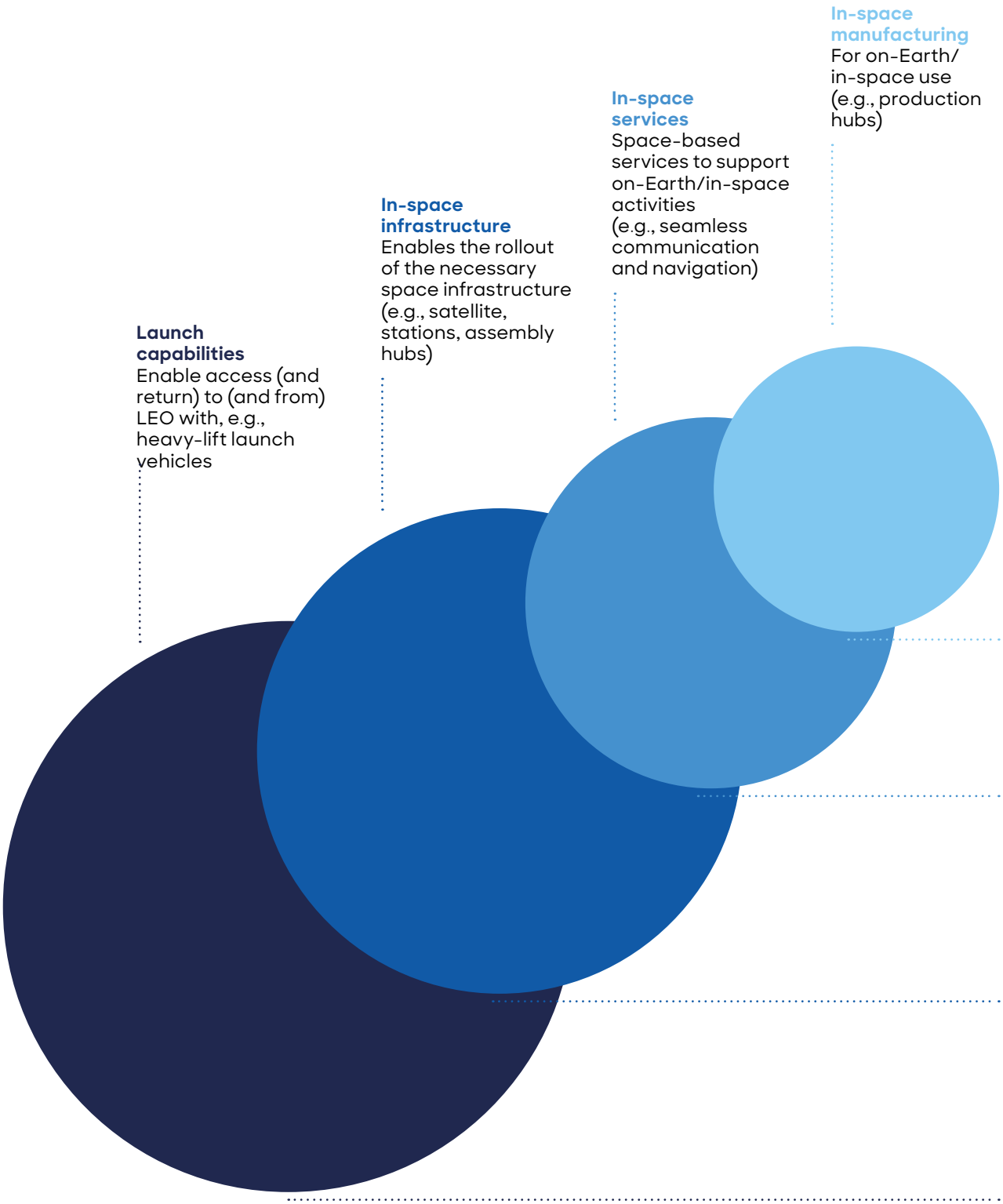
Technology: Public ambition should drive the launch of publicly funded programs that, at least initially, support the development of cutting-edge technologies such as heavy-lift reusable launch vehicles, in-orbit manufacturing capabilities, servicing technology and orbital habitats.

Supporting regulations, especially in space traffic management: Establishing and enforcing international regulations for space traffic management and debris mitigation is vital to prevent congestion in the low Earth orbital zone. This includes developing wider capabilities to ensure sustainable space operations and measures to avoid any hazardous operations that could lead to space collisions, for example.

Funding: Securing investments through public-private partnerships and innovative financial instruments is essential to fund large-scale space projects – projects that can then form the foundation of a sustainable low Earth orbit economy. The US Artemis program is one example that could sustainably trigger wider initiatives and low Earth orbit economy spin-offs, such as logistics from the Earth to the moon, or logistical hubs in low Earth orbit. Public funding of this type is expected to trigger a virtuous circle and, as a consequence, attract private investors.

Awareness: The low Earth orbit economy extends beyond just the space industry. With this in mind, it is necessary to communicate its potential widely in order to unlock innovative ideas and associated resources. A key task now is to raise awareness among the various stakeholders and decision-makers, especially those outside of the space industry – indeed, this report has been written with precisely this task in mind. ▶C

C Key technology enablers for unlocking the potential of the low Earth orbit economy



Source: Roland Berger

5 From vision to action

A roadmap for success

The journey to a sustainable low Earth orbit economy is a long-term endeavor, requiring strategic foresight and sustained effort. However, immediate action is needed to secure a competitive edge in tomorrow's market. Roland Berger and LEOconomy identify a series of short-term initiatives (covering the next two to five years) that should be implemented now to pave the way for future success – actions that are designed to position stakeholders at the forefront of innovation and ensure readiness for the opportunities and challenges ahead.

For the **public sector,** including space agencies and regulators, short-term tasks include developing policies that support the growth of commercial space activities while ensuring safety and sustainability. At the same time, these bodies should work toward international harmonization of space activities (for example, by establishing standards) in order to facilitate global cooperation and innovation. Their role also involves supporting capital-intensive activities so that the foundational infrastructure – launch capabilities, for instance – can be rolled out, and contracting industry players to conduct pilot projects to demonstrate the feasibility and business relevance of low Earth orbit activities.

> **"Europe possesses strong industries, from automotive to energy and utilities, which can reach new heights by leveraging space capabilities."**
>
> **Matthias Wachter,**
> **Managing Director, BDI Initiative NewSpace**

The short-term tasks for the **space industry** – both legacy and NewSpace companies – are somewhat different. We recommend that they start investing now in research and development (R&D) in order to advance the key technologies that will lay the foundation for a low Earth orbit economy. Their tasks also involve identifying and developing new markets for space-based products and services, both in space and on Earth, then showcasing tangible use cases to the market.

We encourage the **non-space** industry – that is, Earth-focused businesses – to start exploring the potential of expanding into the space sector, seeing how it can improve their current business operations on Earth. They may consider partnering with space industries to exploit the mutual benefits and create new business models. In addition, they can initiate small-scale pilot projects to test the integration of space technologies into terrestrial operations (and vice versa), allowing them to assess the feasibility and benefits without yet committing to large-scale investments.

Funding institutions such as banks and other investors may consider establishing dedicated funds for providing capital for early-stage space ventures, as well as fostering partnerships between public- and private-sector players to co-fund space projects and share both the risks and the rewards. They can further play a part in developing the low Earth orbit economy by organizing seminars, workshops and conferences to educate investors about the potential of space technology and emerging opportunities.

Finally, **academic institutions,** be they research institutes or universities, have an important role to play in developing technology in close cooperation with industry. This includes proactively positioning advancements – from fundamental research to commercial applications. They can also contribute by developing educational programs to train the next generation of professionals in space-related fields, ensuring a skilled workforce for the growing space economy.

Recommendation

The low Earth orbit economy is at a turning point, ready to transform industries on Earth, much like satellite communication and navigation did in the past. However, this time, it's not just about signals – it's also about manufacturing and other groundbreaking activities taking place in orbit. To seize this opportunity, we need innovation and dedication from established industries, supported by policy, financing, and technology. This alignment could spark a revolution that extends beyond Earth and reshapes our economic future for generations, fostering shared prosperity.

AUTHORS - ROLAND BERGER

Manfred Hader
Senior Partner
+49 160 744 4327
manfred.hader@rolandberger.com

Eric Kirstetter
Senior Partner
+33 6 08 97 74 41
eric.kirstetter@rolandberger.com

Darot Dy
Senior Project Manager
+49 160 744 2130
darot.dy@rolandberger.com

AUTHORS - LEOCONOMY

Matthias Spott
Founder & Chief Executive Officer
matthias.spott@leoconomy.com

Andreas Hielscher
Co-Founder & Chief Enabling Officer
andreas.hielscher@leoconomy.com

05.2025
ROLANDBERGER.COM
LEOCONOMY.COM

ROLAND BERGER is one of the world's leading strategy consultancies with a wide-ranging service portfolio for all relevant industries and business functions. Founded in 1967, Roland Berger is headquartered in Munich. Renowned for its expertise in transformation, innovation across all industries and performance improvement, the consultancy has set itself the goal of embedding sustainability in all its projects. Roland Berger generated revenues of around 1 billion euros in 2024.

LEOCONOMY HOLDING GMBH is a strategic space-as-a-service provider that connects traditional industries with the emerging commercial space sector. The company focuses on enabling industrial access to low Earth orbit (LEO), leveraging the unique conditions of space – such as microgravity – to drive innovation, grow business and create tangible economic value on Earth. With a strong emphasis on cross-sector collaboration and commercialization of space infrastructure, LEOconomy is developing practical use cases in various areas . LEOconomy contributes to building a sustainable and application-driven space economy.

Publisher

Roland Berger GmbH
Sederanger 1
80538 Munich
Germany
+49 89 9230-0

25_2061_REP