

An aerial photograph of a landscape featuring a river, agricultural fields, and a lake. The year '2030' is overlaid in large white text.

2030

Slovenian Space Strategy



REPUBLIC OF SLOVENIA
GOVERNMENT OF THE
REPUBLIC OF SLOVENIA

2030

SLOVENIA

Small on Earth, big in space

Slovenian Space Strategy



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Summary

This document outlines the Slovenian Space Sector's strategy for 2023–2030. The strategy is the result of an 18-month process involving a thorough market analysis and stakeholder consultations conducted by the newly established Slovenian Space Office in partnership with SpaceTec Partners.

The slogan "Small on Earth, big in space" underscores Slovenia's focus on **boosting the competitiveness of our industry** and ensuring that our emerging leadership in specific space domains can be built upon and enhanced. The strategy defines the bold direction that Slovenia wants to embark on, and **acts as a guiding tool for optimising our investments in the industry**.

The space sector encompasses a wide range of technologies with diverse concrete applications. The use of space technologies has shown clear potential to unlock **far-reaching socio-economic benefits and impact every industrial sector in the economy**, as well as many other governmental policy areas.

Our core vision is to support Slovenian space and non-space industries to seize the significant **commercial opportunity** of the space sector, while providing new resolve regarding efforts towards **digitalisation** and **the green transition** across all economic sectors.

The Slovenian Space Office will continue its close collaboration with the space ecosystem, including its industry, academic and cultural institutions. Aligned with **the principles of NewSpace**, the office will maintain its **agile** and **flexible** approach.

The strategy's vision is broken down into five strategic pillars that will drive the concrete implementation of the space strategy. Three pillars drive the programmatic priorities:

1. Encourage and evolve **space technologies** and R&D, including by exploiting new capabilities

in the **satellite communication** domain on Earth and beyond.

2. Broaden participation in responsible **international space exploration and research efforts**, further developing knowledge and technologies enabling human and robotic exploration missions.
3. Foster the development and uptake of **space applications** for a stronger commercial, sustainable and creative future, leveraging **next-gen technologies**.

Furthermore, two additional pillars focused upon enabling and strengthening the Slovenian space ecosystems have been defined:

4. Secure **the future generation of scientists, engineers** and young space professionals, encouraging the uptake of **STEM and related subjects** and strengthening the curricula of field-relevant study programmes at universities.
5. Stimulate entrepreneurship as well as university and RTO spinoffs through **dedicated space innovation programmes**.

Building upon our past successes in the sector and boosted by this strategy, Slovenia wants **to achieve full membership in ESA** (the European Space Agency). Furthermore, to continue fostering the expansion of the sector we will look to implement concrete actions in line with the targets set out in this document as soon as practicable. The strategy will undergo periodic review in order to maximise its impact by evaluating and reassessing our approach to the rapidly evolving international space sector.

Introduction

"Since the beginning of time, mankind has considered it to be an expression of its Earthly weakness and inadequacy to be bound to the Earth, to be unable to free itself from the mysterious shackles of gravity..."

These words opened Herman Potočnik Noordung's seminal book *The Problem of Space Travel*, published in 1928. With his pioneering vision, he defined one of the earliest concepts of crewed space stations, of exploiting radio communication between the ground and satellites, and of conducting remote sensing of the Earth's surface with orbiting spacecraft.

Almost one-hundred years later, we look to space and its many uses **with renewed conviction in its boundless potential**. The Slovenian Space Strategy 2030 has been developed to provide direction and support to our bustling space industry and research and creative activities. This document is the result of a comprehensive analysis of the Slovenian space sector conducted by SpaceTec Partners. Over 35 interviews and several workshops were conducted with industry, universities, research institutions and government stakeholders.

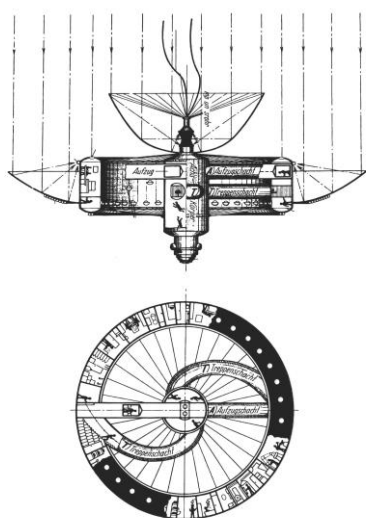


Figure 1: Herman Potočnik Noordung's visionary concept diagram for a rotating space station capable of sustaining human life in orbit, 1928.

The global space sector: continuous development and expansion

The global space sector has undergone steady and continuous expansion and development. The space sector includes not only launcher systems and space exploration, but a swathe of concrete applications in, e.g., satellite communication, satellite navigation and Earth observation.

The OECD (source: OECD – The Space Economy in Figures How Space Contributes to the Global Economy) estimates the total market size of the space sector is close to €400 billion. The industry is set to reach €1 trillion by 2040 and it is growing at a higher annual rate than global GDP. In 2000, the number of countries with registered satellites in orbit was around 40. However, this figure has more than doubled to over 90 countries, which now includes Slovenia. Spurred by the increased proliferation of satellites, space technologies and applications, the sector's impacts and benefits have multiplied, and now include diverse economic, technological, societal, creative and environmental benefits.

The sector's sustained expansion has been propelled by **ever-increasing interest by both governmental and private players**, and has shown great resilience in the face of tough economic challenges. According to current estimates, each €1 invested into space (sources: ESA – The socio-economic impact of space activities (October 2019), ESA – About the General Support Technology Programme (GSTP), ESA – the ESA TIA ARTES programme's continuous boost to the commercial markets and European competitiveness) generates approximately €4–5 in the wider economy, and helps to create or sustain over 11 jobs, both directly and indirectly.

More than just economic rewards, space is unique in its capability to unlock a variety of other benefits. Several different advances can be achieved through a more systematic approach to space activities and applications. Public and private investments into space **unlock technological advancements** for different applications and industries, **societal** benefits in terms of education and a skilled workforce, **security** and defence, as well as **environmental** benefits by boosting knowledge of climate change and its effects on Earth.

More recently the global space sector has shown a renewed interest in **space exploration**, with several leading states gearing up for ambitious missions to explore the Moon, Mars and beyond. These visionary programmes, such as ESA's Terrae Novae, require meaningful and profound **international collaboration**, as no single entity is capable of exploring space independently. The best example is provided by NASA's Artemis programme, which includes several contributions from ESA and its member states, including Slovenia.

Security from and in space has also taken centre stage. **The protection of key space assets** from the dangers of collisions in space, space weather and harmful interference is a key international priority. The European Union (EU) has also recognised this, setting Space Traffic Management (STM) as a key component of its space programme.

The EU Space Strategy for Security and Defence, which addresses the important issues of critical space technology and infrastructure resilience, as well as space-related vulnerabilities and threats, will significantly influence the execution of EU space programmes. It will bolster the security and defence aspects of ongoing programmes and unlock new possibilities for developing space technologies and services to bolster the EU's defence and security goals. Consequently, it will hold great significance for ensuring security, defence and protection against natural disasters and other threats, further strengthening the EU's autonomy in the space domain.

The deployment of satellite mega-constellations in Low Earth Orbit (LEO) providing **ubiquitous broadband connectivity** has been involved in the vast majority of launches in the past couple of years. The trend is set to continue in the perceivable future, especially with the development and deployment of the EU's IRIS² constellation for secure connectivity. Finally, another key trend of the global space industry has been the continued focus on Earth observation (EO) activities, enhanced by artificial intelligence (AI) and Machine Learning (ML) data processing capabilities. These activities have been increasingly carried out through small satellite constellations deployed by private actors, who complement systems such as Copernicus, which remains a key global provider of EO data.

As shown by these key trends, space is no longer the playground of governments alone. Private companies have taken a leading role in space, propelled by NewSpace processes such as technology miniaturisation and the use of commercial-off-the-shelf components. NewSpace is characterised by the shortening of development and business cycles, compressing the traditional space technologies S-curve towards a closer resemblance with the general/commercial technologies curve. The clearest example is found in the SatCom industry, where the focus is shifting from using a small number of large and expensive satellites with a long lifetime in geosynchronous equatorial orbit (GEO) to a large number of small and cheaper satellites for broadband connectivity in LEO.

NewSpace has prompted various disruptive approaches which helped propel space into a commercial market.

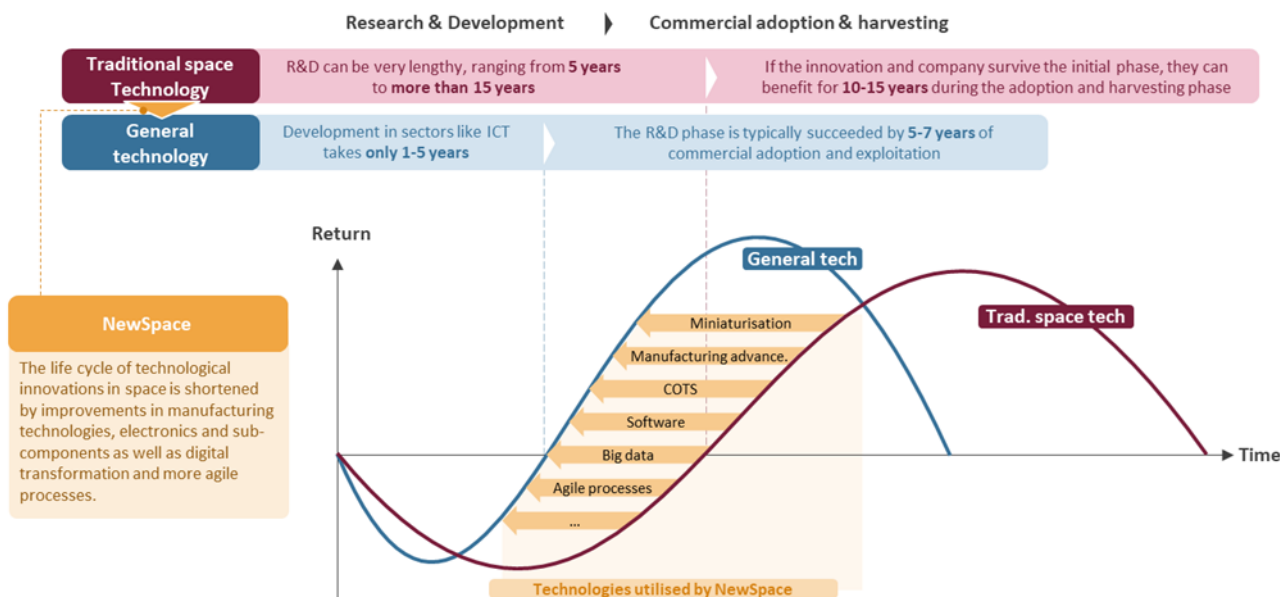


Figure 2: The NewSpace S-curve compression towards general technologies Source: SpaceTec Partners

Complementing the technological shift in development described above, NewSpace has also seen a significantly higher risk appetite and more risk taking. This has resulted in a large increase in public and private interest in space, with new actors and increasing national space budgets as clear proof of the importance of space. NewSpace has boosted the potential for technology spin-out from space to non-space and vice versa spin-in from space-adjacent industries. With this strategy and our continued efforts, Slovenia aims to contribute towards assimilating and exploiting these trends to propel the expansion of the sector and introduce more non-space actors.

The Slovenian space sector: a thriving ecosystem

Slovenia has successfully developed a diverse space sector, with both industry and research institutions active throughout all segments of the space value chain, from the manufacture of components to the exploitation of space data. The number, quality and impact of our companies and research institutions actively engaged in space activities has constantly increased in the last decade.

Our space industry primarily comprises start-ups and Small and Medium Enterprises (SMEs), with many players in both the upstream, i.e. satellite, and downstream, i.e. ground/application, segments initially born in the cradle of our academic sector. In addition, Slovenia also counts established companies as an important part of its space sector.

Many of our enterprises have successfully broached the European space industry by leveraging their agility in meeting and adapting to market trends. One of the best examples is **the increasingly seamless intertwining of Industry 4.0 technologies in the Slovenian space sector**. Companies have progressively implemented tools and capabilities such as AI as well as High Performance Computing (HPC) in their products and services, propelling the sector towards a more comprehensive Space 4.0 approach.

As shown in the figure below, Slovenia possesses several **areas of excellence** within different parts of the space technology tree and value chain. Industrial and academic excellence is established in the development of satellite-based systems (on-board data systems), including



telecommunication/radio technologies, as well as in EO products and Industry 4.0 technologies for data processing (HPC and ML/AI data processing). Furthermore, several industrial actors have proven extensive capabilities in the development of equipment for ground infrastructure and of ground stations.

There are multiple domains where both space and non-space entities can utilise their technical skills to actively support the growth of Slovenia's space sector. These include, for example, the manufacture of satellite structures and mechanisms; expertise in composite materials has been extensively proven in diverse on-Earth applications and industries, including the automotive, manufacturing, aerospace, and defence industries. The core goal of our strategy is to support the materialisation of the many potential areas of technical expertise in proven space technologies and capabilities. We will actively encourage space and non-space companies to pursue further technological development, leveraging relevant ESA programmes as well as other international R&D funding sources, including various EU R&D schemes.

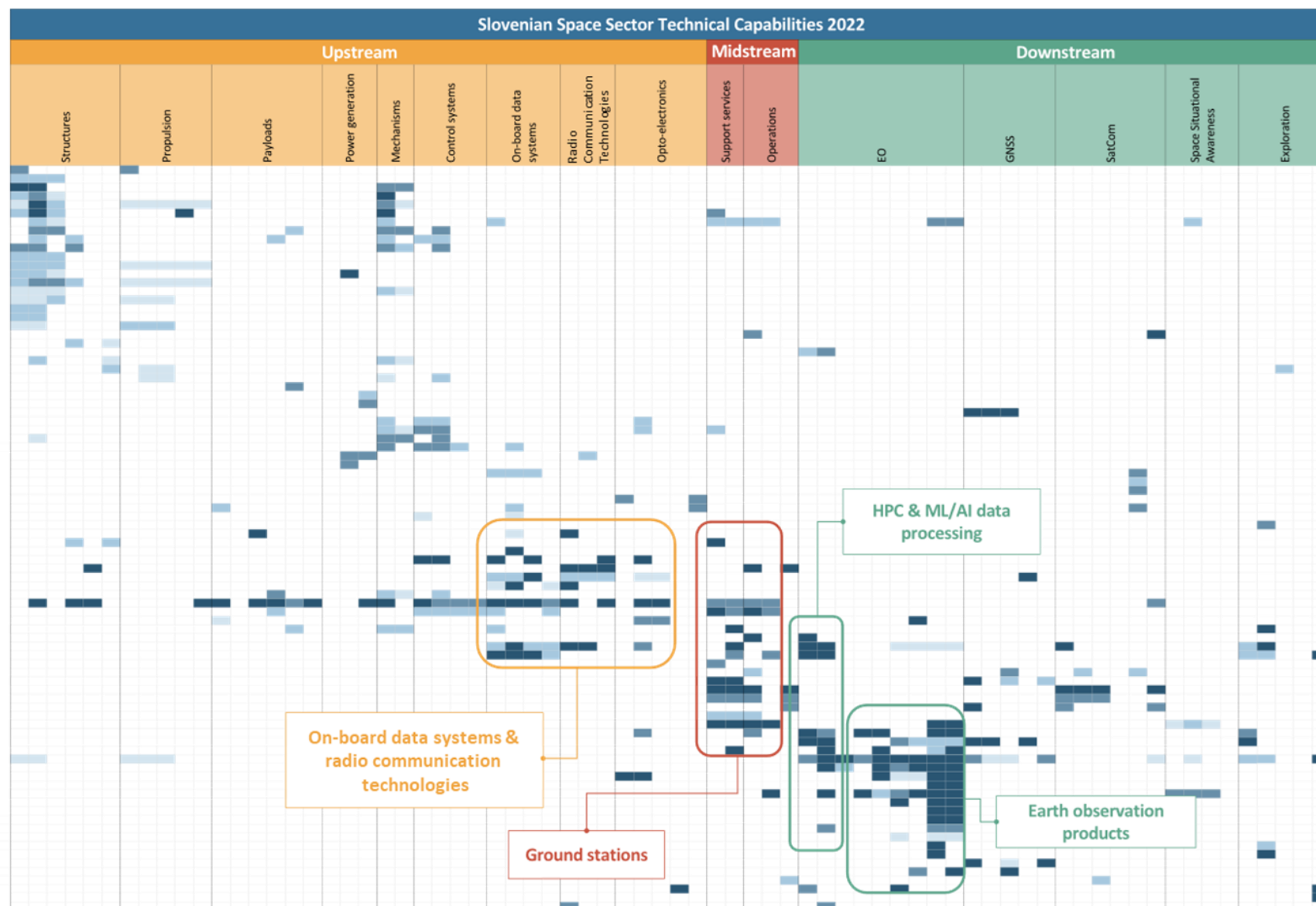


Figure 3: Technical capabilities of the Slovenian space sector from 2022 Source: SpaceTec Partners

As shown in the technical mapping above, our national space sector can count upon several key strengths. Our industry is active in all segments of the value chain. Many of our universities and research institutions are both relevant players in space and recognised amongst the leading regional education actors. One of our goals is to also leverage our significant strength in academia to further position Slovenia as a thought leader in space research and education. Additionally, Slovenia's public institutions proactively support the continued development of the sector, having dedicated significant financial and human resources to space.

Following this trend, the **Slovenian Space Office**, which operates in the framework of the Ministry of the Economy, Tourism and Sport, has been established to facilitate our contribution to the development of the sector. To this end, several key opportunities have been identified. For instance, international partnerships and events have been pursued to build and maintain an international network of contacts. In addition to bilateral agreements, we set up events such as the Slovenian Space Week and ESA Days, both independently and partnering with ESA and system integrators.

Slovenia is also looking to expand its support business ecosystem, assisted by key public

institutions such as SPIRIT Slovenia, the Slovene Enterprise Fund (SEF), the SID Bank and others.

The expansion of business and national funding opportunities will help alleviate access to financing for young start-ups and SMEs looking to develop space products and services, in addition to companies active in other industries.

A key area which this strategy considers is **talent attraction**. Despite our excellent academic sector, attracting talent to the space sector as well as other STEM industries has been identified as a challenge. Furthermore, access to finance as well as funds from international programmes has been highlighted by our industry as a second key challenge. More generally, growth opportunities supporting the development of our industry have not yet been exploited to their fullest potential, which is a key area of improvement tackled by our strategy. **Talent attraction** and **stimulating entrepreneurship** are set out as strategic enabling pillars. Securing the future generation of scientists, engineers, creatives and young professionals working in space is set out in pillar 4, while boosting our business support ecosystem and creating a fertile ground for start-ups, SMEs and established companies to grow is enshrined in pillar 5.

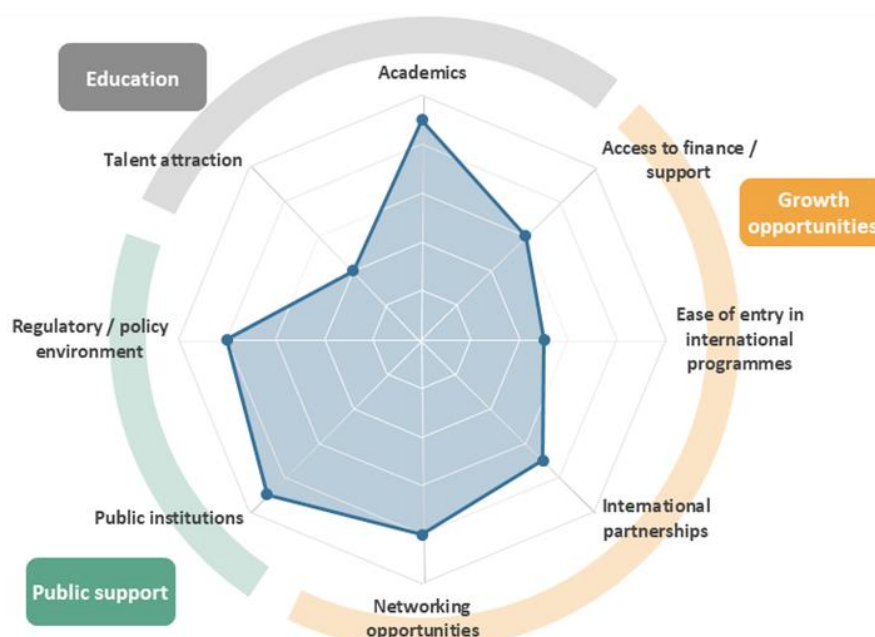


Figure 4: Mapping the strengths and weaknesses of the Slovenian space sector and its enablers Source: SpaceTec Partners

Anchoring Slovenia in international collaboration networks

Slovenia has actively contributed to European space efforts since we signed the first Cooperation Agreement with ESA in 2008. This was soon followed by the European Cooperating State Agreement (PECS) in 2010, and in 2016 with the Association Agreement, which was upgraded in 2020. This agreement granted Slovenia our current status of ESA associate member. Several key milestones have been achieved, including **the launch of Slovenia's first three satellites** (NEMO-HD, Trisat and Trisat-R), membership in the UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 2021, and the ratification of the Slovenian space law, i.e. the 2022 **Space Activities Act**. We are well-aligned with Slovenia's Development Strategy 2030 and European priorities set out in key strategic documents, including the ESA's Agenda 2025, and also closely follow the EU Space Strategy for Security and Defence. Additionally, Slovenia actively participates in the EU Satellite Centre (SatCen), the European Defence Agency (EDA) and other relevant institutions (e.g. GOVSATCOM).

Overall, as of December 2022, Slovenian entities have signed more than 60 contracts based on ESA tenders, with consistent growth in terms of the year-on-year total value of contracts. Building upon these and other milestones, Slovenia is striving to achieve **full membership in ESA**. This will further deepen our relationship with the agency, its member states and European industry. Additionally, it will help us unlock various benefits through increased contacts with partners as well as access to mandatory ESA programmes.

Our faith in the potential of space has led to a significant increase in contributions to ESA programmes during the 2022 ESA Ministerial Council. A two-fold increase in the yearly budget has amounted to **approximately €20 million in contributions for 2023–2025**. Slovenia pledged funding to the European Exploration Envelope Programme (E3P), the General Support Technology

Programme (GSTP), Future EO-1, Digital Twin Earth, the programme for the development of innovative and commercial EO products (InCubed), Business Applications and Space Solutions (ARTES BASS), the PRODEX scientific programme and the Requesting Party Activity (RPA) for Slovenian players. These programmes have been specifically selected after close consultations with our industry and research institutions, taking into account their interests, capabilities and expertise.

In addition to the programmes exclusively managed by ESA, we also collaborate in the flagship programmes of the EU, especially in Copernicus and Galileo, in addition to participating in EUMETSAT. Slovenian actors have also engaged with different international RDI frameworks, including Horizon2020 and Horizon Europe. In Copernicus, Slovenia supported the expansion of midstream services, i.e. support, and demonstrated excellence in the development of value-added downstream services, i.e. the ground/application segment. These contributions include playing a key role in the consortium that will establish the Copernicus Space Component Data Access (CDAS) system, contributing to one of the EU's largest ever projects for remote sensing data infrastructure. Within EUMETSAT, Slovenia has participated in both mandatory and optional programmes as full member since 2008, contributing to a better understanding of weather and the climate.

Slovenia fully recognises **the importance of international collaboration in space**. Slovenia has pursued the establishment of various bilateral partnerships with both leading European spacefaring states and the global industry. This approach, which also includes an active role for Slovenian diplomacy, has led to an increase in visibility for our industry, helping it expand its reach within the European and global space network. The deepening of these relationships will provide opportunities for Slovenia **to make a meaningful contribution in the international space value chain and participate in European and international projects**.

The Slovenian space sector for our future

Vision

Slovenia's policy priorities have long focused on the need to protect our environments as well as on supporting a greener way of life. We have taken key steps to accelerate our digital transformation, updating, adapting and expediting processes across sectors. On the one hand, Slovenia clearly recognises the alignment between these goals and space activities. On the other, we also appreciate the economic, technological, environmental, and societal benefits to be reaped through the sustainable, responsible, creative and collaborative use of space.

Slovenia's space sector strives to expand the frontiers of knowledge and innovation and inspire a green, digital and sustainable future.

Mission

Our ambitions will be realised in the context of a support ecosystem in which diverse actors can contribute to the expansion of the sector and the attainment of the many socio-economic benefits inherent to effective space activities.

Slovenia, which is emerging as a dynamic space economy, would like to foster an enabling environment for innovation and technological development in order to be a visible part of the global space sector. Within this sector, government, academia and businesses are working to raise the profile of their potential and competences on the international stage, including through the use of local expertise.

Guiding principles

The vision and mission will be implemented by following the overarching guiding principles derived from Slovenia's Development Strategy 2030 and directly from our priority goals of supporting a green, digital, sustainable and creative future. Slovenia will leverage space data in support of environmental sustainability at multiple levels. The development and monitoring of government policies, the implementation of environmental activities and the push for a green transition in different industries and fields will be supported by space applications. These initiatives will be complemented by activities in support of better protection of the space environment, thus safeguarding its future use.

Building upon efforts in both Europe and Slovenia, we will boost digital transformation efforts and the digitalisation of services in the public and private sectors. We will look to exploit space applications to their full potential, including key technologies, such as AI, HPC and other Industry 4.0 technologies.

Slovenia will support not only projects working towards the green and digital transformation, but also ones which display clear commercial potential to achieve economic sustainability and drive innovation. On the one hand, we will encourage industry to leverage ESA's role as a unique broker with international business partners. On the other, Slovenia will ensure alignment between our bilateral partners, the EU, the European Commission, the EUSPA, NATO and international industry, encouraging our players to think beyond the projects' scope towards a strategy for technology commercialisation. Ideally, funding from international RDI programmes, including but not limited to those funded through ESA, should strive to develop products and solutions for space and non-space industries, investigating possibilities for spin-out towards adjacent applications.

Strategic pillars

Our ambitions set forth in the vision and mission of the Slovenian space strategy have been distilled in a series of long-term policy objectives, forming the strategic pillars sustaining the sector's development. Three pillars are aimed at tackling programmatic priority areas: space technologies, space exploration and research, and space applications. Two pillars have been defined to bolster ecosystem enablers: encouraging the uptake of STEM education among future generations, and expanding Slovenia's entrepreneurship support capabilities.

Through the implementation of this strategy, Slovenia is looking to:

1. Encourage and evolve **space technologies** and R&D, including by exploiting new capabilities in the **satellite communication** domain on Earth and beyond.
2. Broaden participation in **responsible international space exploration and research efforts**, further developing knowledge and technologies enabling human and robotic exploration missions;
3. Foster the development and uptake of **space applications** for a stronger commercial and sustainable future, leveraging **next-generation technologies**;
4. Secure **the future generation of scientists, engineers** and young space professionals, encouraging the uptake of **STEM and related subjects** and strengthening the curricula of field-relevant study programmes at universities;
5. Stimulate entrepreneurship as well as university and RTO spinoffs through **dedicated space innovation programmes**.

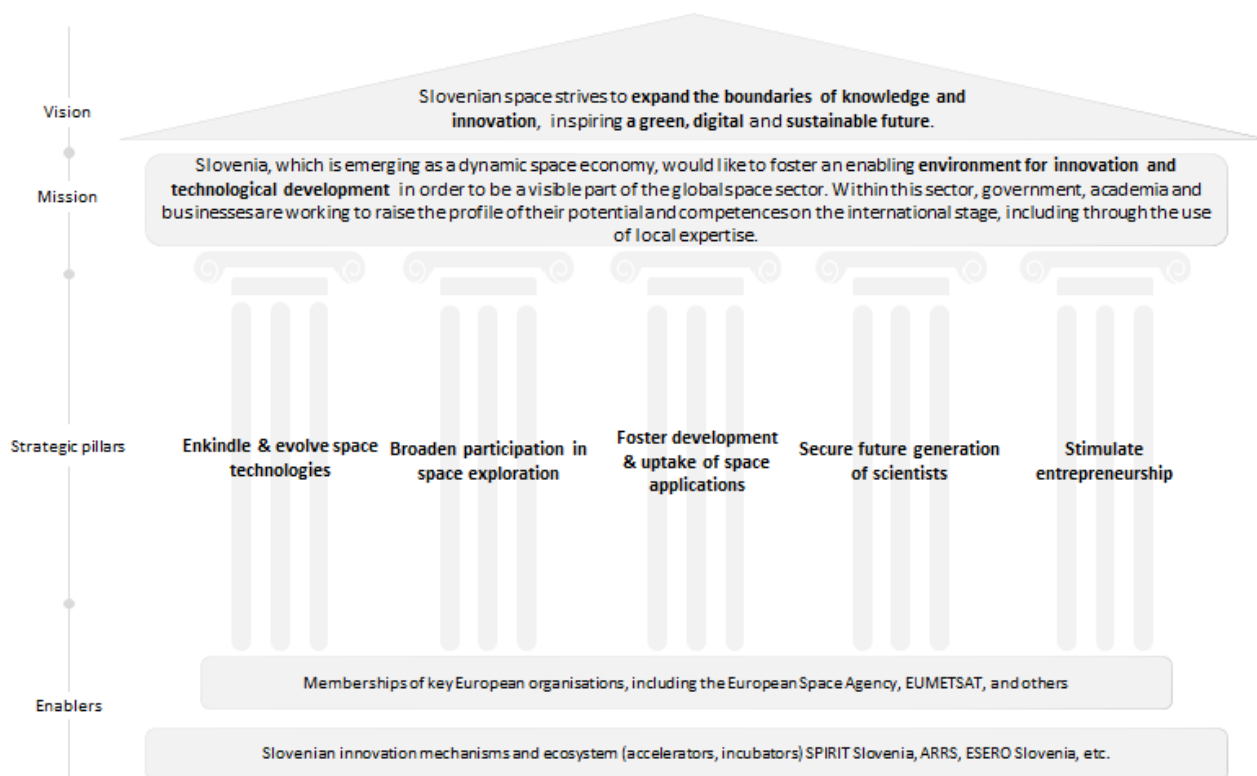


Figure 5: Full overview of Slovenian space strategy, with strategic pillars supporting the achieving of our mission and vision

1. Encouraging and evolving space technologies and R&D

Substantiation

With the intense proliferation of commercial activities in Earth's orbits as well as renewed global interest in exploring the solar system, demand for **innovative space technologies** has surged. This strategic pillar focuses on leveraging and expanding existing capabilities in the upstream segment to help our industry and researchers develop commercial products for diverse applications. Slovenia seeks to strengthen its industrial base throughout the value chain by pursuing the development of space-qualified products demonstrating clear commercial potential.

This strategic objective reinforces past successes in various ESA and EU programmes. Its core purpose of pursuing commercially viable space-qualified products will ensure greater economic sustainability for our space sector. We encourage **the transfer of knowledge** from well-established industries, such as automotive, aviation, manufacturing and defence industries, to favour the **spin-in** of non-space technologies.

Scope of application

The activities pertaining to this objective will focus on hardware and software development to strengthen existing capabilities and act as a breeding ground for future areas of expertise. Current capabilities in Slovenia, including, for instance, expertise in the deployment of higher fault-tolerance techniques and **protection against radiation effects for satellite subsystems** and the development of satellite avionics and **communication modules**, will be built upon to provide meaningful contributions to the satellite communications market. One of our key goals is to position Slovenia **as a valued provider of tailor-made satellite subsystems and radio frequency (RF) products** capable of contributing to various activities carried out in the Earth's orbit and beyond, including for secure communication. Furthermore, in close alignment with the Slovenian Ministry of Defence, we will leverage our excellence

in EO and jointly explore our future contribution to the EU SST by developing national technological solutions for observation. Finally, we will continue to encourage observance of international standards on space traffic management (STM), including the UN guidelines for the long-term sustainability of outer space activities and ESA's zero debris policy.

Funding mechanisms

Projects under this pillar will primarily be based on ESA tenders in a number of relevant frameworks, including all technology development programmes such as GSTP, InCubed, and Slovenia's RPA. The funding will be leveraged as much as possible from the available national and international sources of R&D funding.

Moving forward, we will expand our role in the upstream space market by **accessing ESA's Technology Development Element programme** and exploring possible further contributions to various optional programmes, such as **ESA's ARTES Core Competitiveness programme**. We will continue to support our companies and research institutions in accessing opportunities in other European and international RDI frameworks, and help them to expand their network of contacts with foreign industry and RTOs.

Long-term aspirations

Building upon current space and non-space areas of excellence, Slovenia will become **an established provider of commercially successful space technology solutions for various space segments**. In the long-term, these programmes will strengthen Slovenia's ability to independently design and manufacture increasingly advanced satellites.

Key information

- Focus on **upstream technology development across different applications**.
- Support solutions with **clear commercial potential**.
- Promote the **spin-in** of non-space technologies to the space industry and the **spin-out** of space technologies to non-space applications.
- The expansion of ESA funding mechanisms planned **after achieving full membership**.

2. Broadening participation in international space exploration and research

Rationale

The exploration of space, both to satisfy the human thirst for knowledge and to develop technologies to improve life on Earth, has been one of the main historical drivers behind the space sector. Today, efforts to explore the Moon, Mars, and our Solar System are attracting renewed interest. This strategic pillar focuses on **broadening Slovenia's participation in international space exploration and research efforts**, building on the knowledge and technologies that enable human and robotic exploration missions.

Slovenia is an important member of ESA's Human and Robotic Exploration programme. Our key assets include the **Planica Planetary Habitat Simulation Facility**, which houses ESA's human centrifuge, and the Planetary Habitat Laboratory, which conducts bedrest studies. We are one of only three ESA members to house a short-arm human centrifuge and to conduct such studies. Furthermore, our industry has developed sought-after expertise in several applications, such as robotics, 3D (bio)printing, micro-coolers, and control equipment.

Scope

Various activities will serve to support this pillar. Overall, our ambition is to participate regularly in various activities, making Slovenia a relevant contributor to the exploration of our solar system. We will also look to leverage applied space technologies to unlock environmental, health and commercial benefits for Earthly applications.

Building on our achievements to date, we will heighten the impact of research efforts on both commercial operations and outreach activities. For example, while the research conducted at the Planica Nordic Centre is primarily focused on supporting human exploration of space, we will encourage research into potential applications in Earth-based domains, such as healthcare.

In addition, we will leverage our well-established academic sector to further position the country as a relevant regional player in both space and Earth sciences and work **to raise Slovenia's scientific profile**. We will strengthen relations with our neighbours, building on our current contacts with national space agencies such as ASI, CNES, DLR, NASA and industry-leading system integrators. In line with our vision and the national and European focus on environmental sustainability, Slovenia will promote research on environmental variables leveraging space data.

Funding mechanisms

We have continued to fund ESA's Human and Robotic Exploration programme. This has been complemented by funding for ESA PRODEX, which gives universities, research institutions and industry access to ESA experiments and science missions. These programmes are designed to not only improve the results of Slovenia's research and exploration efforts, but also to further prepare our ecosystem for ESA's mandatory science missions once Slovenia achieves full membership. Slovenia has also committed to provide funding for the Future EO-1 programme, which is expected to support both commercial EO applications and research into environmental sustainability. We will ensure the efficient mobilisation of funds from all available sources (e.g. Horizon Europe).

Long-term aspirations

Slovenia will **participate regularly in scientific activities**, consolidating academic and industrial players **as relevant contributors to space science and applied space technology**. We will raise our international profile through forward-looking activities both on Earth and in space, from supporting climate action to developing exploration vehicles for scientific and commercial missions to the Moon and beyond.

Key information

- Focus on space and Earth science **missions** and **research**.
- Raise **Slovenia's scientific profile** and unlock socio-economic benefits for on-Earth applications.

- Deepen **international cooperation** and promote **internal collaboration, with both industry and public institutions**.

3. Fostering development and the uptake of space applications

Rationale

Space data and signals have great potential to support the decision-making of private and public actors and the implementation of activities in various industries. While their leverage is till partly untapped, data from remote sensing and navigation satellites are becoming increasingly available, including from Copernicus and Galileo/EGNOS, promoting greater uptake of space applications in downstream segments.

Slovenia is fully aware of the potential for leveraging data and information from space, and is committed to fostering the uptake of space applications as a strategic pillar. We also recognise the benefits that greater use of space data can bring in terms of **economic sustainability, a green and digital future**, and in terms of contributing to the achievement of the UN Sustainable Development Goals (SDGs). Space applications will also contribute to security, defence and rescue operations, in both Slovenia and Europe.

Industrial actors and public research institutions have carried out a number of related activities, especially within the domain of EO, one of Slovenia's areas of excellence. For example, several commercial companies have successfully **integrated EO data from the Copernicus programme into their applications** and developed tools and services for various applications used in agriculture and water management.

Scope

We will continue to encourage a further increase in the uptake of space applications **by promoting their use by various national public entities** and by incorporating these technologies into public activities and services. Our ambition is to propel systematic improvement of processes through

digital space-enabled services. This will include better policy development and monitoring for different ministries and public bodies. We will promote the use of space applications for more environmentally friendly economic activities, including in sectors such as agriculture, infrastructure, tourism and others. Ministries will be encouraged to proactively support the research and development of services leveraging space data, thereby boosting both the green and digital transition of public services.

Slovenia will strive not only to build on its excellence in EO, but also to expand its industrial activities in other sectors. The wider aspect of the dual-use of space technologies for defence purposes, natural and other disaster prevention and other security purposes is also important.

We will encourage greater use of navigation data in commercial applications, building on the industry's success in international funding schemes and on prizes won in innovation competitions. Slovenia also recognises the potential of SatCom trends such as ubiquitous satellite connectivity and the Internet of Things, and will encourage space and non-space actors to explore relevant opportunities.

The implementation of this strategic pillar will inherently push for the further digitalisation of our public and private services, fully embracing the national and European priority of comprehensive digital transformation. The Slovenian space sector is well positioned in this endeavour, as it can leverage the existing **Industry 4.0 knowledge and expertise** in various relevant applications, such as AI, HPC and cloud technologies. Past successes and proven capabilities at the intersection of downstream space and Industry 4.0 will be upgraded and expanded, fostering not only their uptake but their further development by supporting companies in their R&D processes.

Funding mechanisms

At the ESA Ministerial Council in 2022, Slovenia pledged contributions to several programmes dedicated to fostering downstream applications. We have earmarked funding for the Future EO-1

programme, with the aim of building on well-developed downstream Earth observation capabilities and supporting projects that develop both commercially viable services and research on environmental sustainability.

We will leverage our capabilities in Industry 4.0 applications to meaningfully contribute to the **Digital Twins of Earth** as part of ESA's specific programme as well as the broader European Destination Earth (DestinE) initiative. Slovenia has also committed to the InCubed programme, looking to support both upstream and downstream projects.

In addition, we will support our space industry by allocating funds for ESA's Business Applications and Space Solutions (BASS), to further diversify their scope and activities, including through equity funding and by enabling them to benefit from ESA's technical and commercial guidance. We will explore the possibility of joining the **Civil Security from Space (CSS) programme** to activate services in support of security, rescue, and emergency management operations. Services leveraging space data within BASS and CSS will not be limited to the Earth observation sector, as Slovenia believes in the potential of new services leveraging SatCom and navigation data.

Finally, we will deepen our relationships with key European stakeholders and expand our participation in the EU's flagship space programmes. This will include supporting the development of the CDAS for Copernicus, as well as promoting the integration of data and signals from Galileo and IRIS² into commercial applications for industries ranging from agriculture to forestry, from water and urban management to security, defence and rescue.

Long-term aspirations

Slovenia's goal is to push **the boundaries of commercial applications and help spearhead the further evolution of Space 4.0**. We will implement space-based services within various ministries and

other public entities to push for comprehensive and far-reaching digitalisation of public services.

Key information

- Focus on **using space data and signals** to develop innovative applications.
- Promote the **green and digital transition** of the Slovenian economy through the use of space technologies.
- Promote the integration of **innovative applications** leveraging space signals in public and private services.
- Broadening participation in various European schemes and cooperation with international actors, including NATO.
- The importance of space for **defence and protection against natural and other disasters**.



Figure 6: Bled, Slovenia from space: Copernicus Sentinel-2 satellite image

EO information is used in various domains and applications, from water management and forestry to defence and beyond.

4. Securing the future generation of scientists, engineers and young space professionals

Rationale

Slovenia's academic sector is one of our key strengths. Between 2000 and 2021, Slovenia saw one of the sharpest increases in the share of 25-34 year olds with tertiary education. While the OECD average increase in tertiary attainment was 21%, Slovenia's share rose from 19% to 48%, one of the highest shares in Central and Eastern Europe and well above the EU average (source: Education at a Glance 2022, OECD). We achieved good results for the total number of graduates in STEM; in 2020, just under 21 per 1000 Slovenians aged 20-29 were STEM graduates, in line with the EU average. Slovenia has consistently had the highest share of STEM graduates among all EU countries (source: OECD Science, Technology and Innovation Scoreboard), with 22.5 per 1,000 women aged 20-29 in 2022. One quarter of young women in the EU study STEM subjects, **compared to around one in three in Slovenia**.

Scope

Slovenia will use the space domain's magnetic pull on primary and secondary school students to increase the uptake of STEM subjects. Space is uniquely suited to stimulate interest in science, engineering and mathematics. Interdisciplinary approaches will also be explored, fostering a deeper understanding of the relevance of space for different applications. Slovenia has started the process of establishing its own national European Space Education Resource Office (ESERO), which will be co-funded by the Slovenian Ministry of Education and the Ministry of the Economy, Tourism and Sport, and implemented in cooperation with other national institutions. We will support outreach activities both locally and in partnership with ESA, including at key sites such as the Gravitational Physiology Laboratory and the Center of Space Technologies Herman Potočnik Noordung. The Center Noordung serves as a unique platform to raise public awareness of the

applications of space technologies in our daily lives and education. It will act as a connecting bridge, facilitating collaboration between various space-related entities in Slovenia, particularly in arts, culture and tourism.

Our efforts will focus on promoting higher education opportunities within academic programmes and lifelong learning pathways, such as micro-credentials. The aim is to foster the development of the competencies essential in the realm of space technology and their seamless integration across different academic disciplines and to strengthen this domain as an integral part of universities.

We are also dedicated to supporting the mobility of students and graduates in the space sector in order to enhance the internationalisation of the Slovenian space industry.

We will support partnerships between Slovenian knowledge institutions and world-renowned universities and work towards securing additional funding for scholarships targeted at STEM students, with a particular focus on those studying space technologies. We will seek to stimulate interest in internships with international actors, such as ESA, the EU, EUSPA and UNOOSA.

Funding mechanisms

Budget funds will be allocated to establish the ESERO National Office and to organise various complementary outreach activities and education events. Supported by a wide range of resources, the Slovenian ESERO will stimulate students' interest in science and technology subjects and will provide regular training for teachers to improve their ability to engage meaningfully with students. Attracting talent from primary school pupils to university students will require a concerted effort by the Slovenian space office, the Ministry of Education, academic institutions and other national stakeholders.

Long-term aspirations

Slovenia will work to develop **dedicated space education** and achieve a better gender balance in technical engineering courses to increase the pool of STEM graduates. We will nurture in-demand talent with a passion for space to take **our industry and academic institutions** to ever greater heights in the global space sector.

Key information

- **Attracting talent** to STEM education and careers.
- Targeted development of interest in space regarding **primary** and **secondary schools**, and training for teachers.
- Establish and support **dedicated initiatives**, such as the ESERO and the Center of Space Technologies Herman Potočnik Noordung.
- Promote the internationalisation of the space industry through relevant **tertiary** education courses.

5. Promoting entrepreneurship and university and RTO spinoffs

Rationale

Our entrepreneurial ecosystem has long been working to increase the country's innovation potential, and we have achieved significant successes in strengthening our position both in Central and Eastern Europe and in the EU as a whole. Slovenia ranks in the top half of EU Member States on a number of key European Innovation Scoreboard indicators (source: EC – European Innovation Scoreboard 2022), including the number of innovators (11th), direct and indirect government support to business R&D (7th), and exports of medium-high tech products as a share of total product exports (6th). Overall, Slovenia ranks 13th in

the EU in the integrated index of the European Innovation Scoreboard, and 12th, together with Estonia, leads the Central and Eastern Europe region, as shown below.

Slovenia fully recognises the importance of ensuring a fertile ecosystem for entrepreneurs, both in the space sector and in innovative industries in general. Entrepreneurship support is crucial for fostering innovation and economic growth, as it provides aspiring entrepreneurs with the necessary resources, skills, and networks they need to start and scale successful businesses. Without such support, many potentially high-impact ideas, inventions and innovations may never come to fruition.

Scope

Building on our past successes and established position, the Slovenian space strategy aims to **promote the emergence of a fertile entrepreneurial ecosystem and to encourage the creation of spin-offs and the transfer of knowledge and technology from universities and RTOs**. The rising commercialisation driven by NewSpace processes has led to growing opportunities for both technology spin-in from space-adjacent industries and spin-out to non-space industries.

By providing entrepreneurship support, Slovenia will not only benefit individual entrepreneurs, but also unleash spill-over effects on the wider economy. By creating jobs, fostering innovation, and increasing competition, entrepreneurship support can lead to increased economic activity and growth, as well as improved skills of the workforce. We also hope to create a virtuous cycle in which successful entrepreneurs act as role models and mentors, inspiring and guiding the next generation of aspiring entrepreneurs.

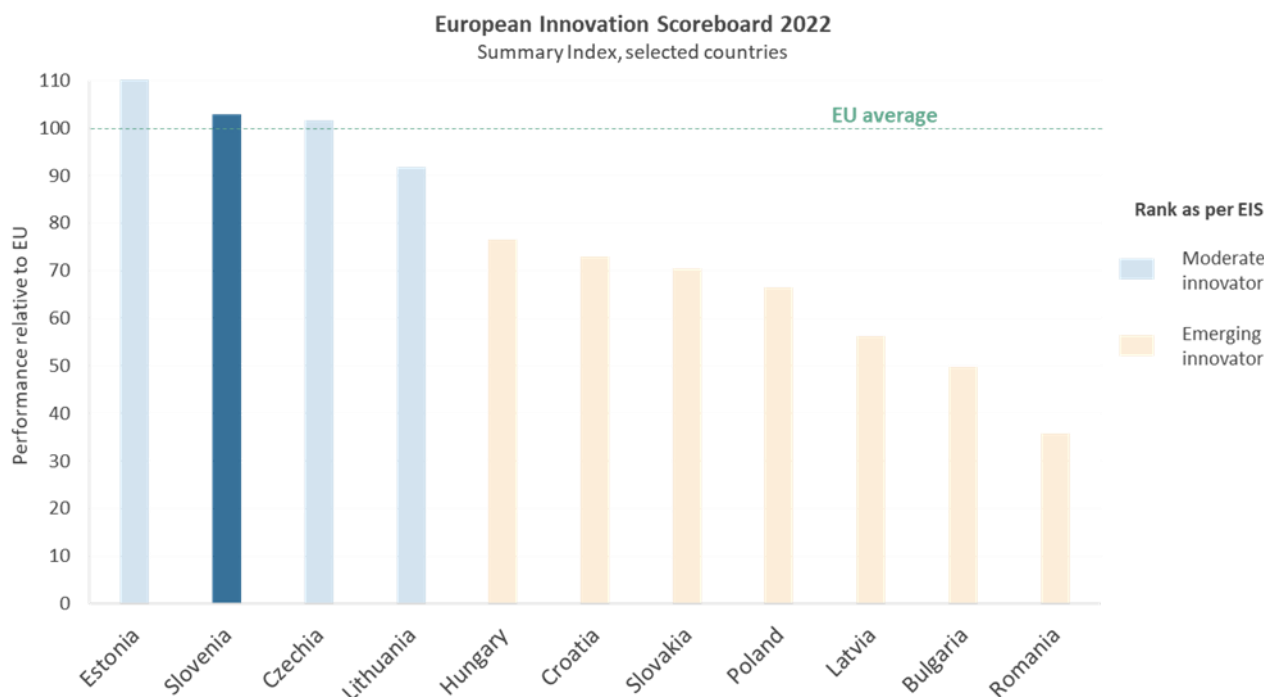


Figure 7: Overview of the state of innovation in Europe, a comparison of Central and Eastern European countries with the EU average performance

Funding mechanisms

We will work towards the more coordinated and effective integration of existing public support mechanisms aimed at linking science, innovation, technological development and the economy. Concrete support will be provided to relevant industry actors by establishing and building on existing schemes to facilitate the proposal stages. We will provide access to relevant information for companies wishing to access international funding opportunities and, more importantly, establish and maintain networks to connect with foreign players.

We will also seek to **provide business support and seed funding to emerging start-ups** using existing frameworks, such as the Slovene Enterprise Fund and the SID Bank. We aim to foster the emergence of business-minded cohorts of technical graduates and the establishment of an appropriate educational ecosystem that will provide them with the necessary tools to ensure entrepreneurial literacy, thus increasing their chances of successfully running commercial activities.

In the medium-term, when the space start-up ecosystem is more mature and consolidated,

further actions to continue its expansion will be evaluated, such as the establishment of innovation initiatives, including dedicated incubators and accelerators, or the use of existing international frameworks within ESA.

Long-term aspirations

Our ambition is to transform Slovenia into a **space start-up hub**, using national and international innovation instruments and mechanisms. We will reinforce our position in the international space industry to attract ever-increasing local and foreign entrepreneurial investment and to **become a leading regional hot-spot for space innovation**.

Key information

- Focus on the establishing and boosting **entrepreneurship support schemes** and mechanisms
- Foster the emergence of **business-literate graduates** from technical and engineering courses
- Improve the **maturity of the Slovenian space start-up** ecosystem

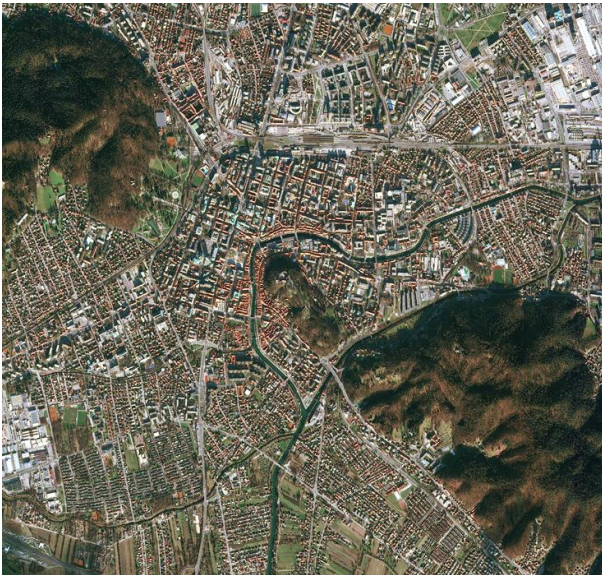


Figure 8: Ljubljana, Slovenia from space: Copernicus Sentinel-2 satellite image

Start-ups leverage space data to investigate a variety of urban management features, including unlocking efficiencies through synergetic services integrating EO and navigation data.

Next steps

Slovenia is confident in the potential and in the capabilities that our space sector has to offer. This strategy aims to **ignite and accelerate further activities across the entire space value chain**, and to support established and emerging Slovenian stakeholders. Slovenia, further propelled by the establishment of the **Slovenian Space Office** to further stimulate the growth of the space sector, will follow the path set by other ESA Member States in encouraging various public authorities to take a proactive approach in supporting the development of space products and services. The Slovenian Space Office will foster inter-ministerial coordination, now implemented within the Inter-ministerial Working Group, in order to align the activities at the national level.

As encapsulated in the five strategic pillars, we are focused on expanding our national activities in various domains, with the development of space technologies, participation in research and exploration efforts, and the expansion of space applications leading the programmatic push. This is complemented by initiatives to support efforts in education, creativity and entrepreneurship, thus strengthening our ecosystem as a whole and helping to create the necessary conditions for sustainable growth in the sector.

Slovenia has come a long way in the space sector. From being one of the youngest EU Member States to broach this industry, we now have three active satellites in orbit, with more to follow, as well as key infrastructure to support human missions to the Moon and beyond, and an innovative and fast-growing downstream industry for space applications. Furthermore, our industry has developed highly innovative solutions using diverse technologies such as additive manufacturing and AI processing. Building on these successes, Slovenia will now strive to expand its role on the international stage.

We will continue to develop the sector at the national level by identifying the key actions to be taken to achieve the strategy's goals and vision, through the closer integration and coordination of key national stakeholders.

Slovenia will comply with its international obligations and international space law based on the principle of using space for peaceful purposes.

The first important step is to become a full member of ESA. This will consolidate our position as a growing contributor in the international space arena, and will enable the further expansion of contacts between Slovenian space actors and international private and public actors. Slovenian industry and academic institutions continue to demonstrate their technical capabilities, well-deserved position and flight heritage. Ambitious and enterprising Slovenia will endeavour to proactively support its space sector, fostering its development and the uptake of its downstream services.

This strategy sets out the overarching direction of Slovenia's space ecosystem for the period 2023–2030. However, we will periodically review and update our approach to maximise the impact and relevance of the strategy. Specifically, Slovenia will not only assess the progress made and implement the lessons learned, but also adapt our approach to national and international trends. This recurring process will ensure that Slovenia remains abreast of the state of the space industry and is able to strengthen its role in Europe, including planning its contributions to the next ESA Ministerial Council at the end of 2025.

Slovenia is fully committed to supporting the growth and acceleration of its space sector, striving for a green, digital, creative and sustainable future.



List of abbreviations

Acronym	Description
AI	Artificial intelligence
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
CDAS	Copernicus Space Component Data Access
CNES	Centre national d'études spatiales (the French Space Agency)
DLR	Deutsches Zentrum für Luft- und Raumfahrt (the German Space Agency)
EOA	European Defence Agency
EIS	European Innovation Scoreboard
EO	Earth observation
ESA	European Space Agency
(ESA ARTES) BASS	Programme of Advanced Research in Telecommunications Systems (ARTES) – Space Solutions and Business Applications
(ESA) E3P	European Exploration Envelope Programme
(ESA) GSTP	General Support Technology Programme
(ESA) PRODEX	Programme de Développement d'Expériences scientifiques
ESERO	European Space Education Resource Office
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUSPA	European Union Agency for the Space Programme
GDP	Gross Domestic Product
GEO	Geosynchronous Equatorial Orbit
HPC	High Performance Computing
IRIS ²	Infrastructure for Resilience, Interconnectivity and Security by Satellite
LEO	Low Earth Orbit
ML	Machine Learning
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
OECD	Organisation for Economic Co-operation and Development
RR	Research and Development
RRI	Research, Development and Innovation
RF	Radio Frequency
RPA	Requesting Party Activity
RTO	Research and Technology Organisation
SatCen	EU Satellite Centre
SME	Small and Medium Enterprises
STEM	Science, Technology, Engineering, Mathematics
STM	Space Traffic Management
UN COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNOOSA	United Nations Office for Outer Space Affairs

