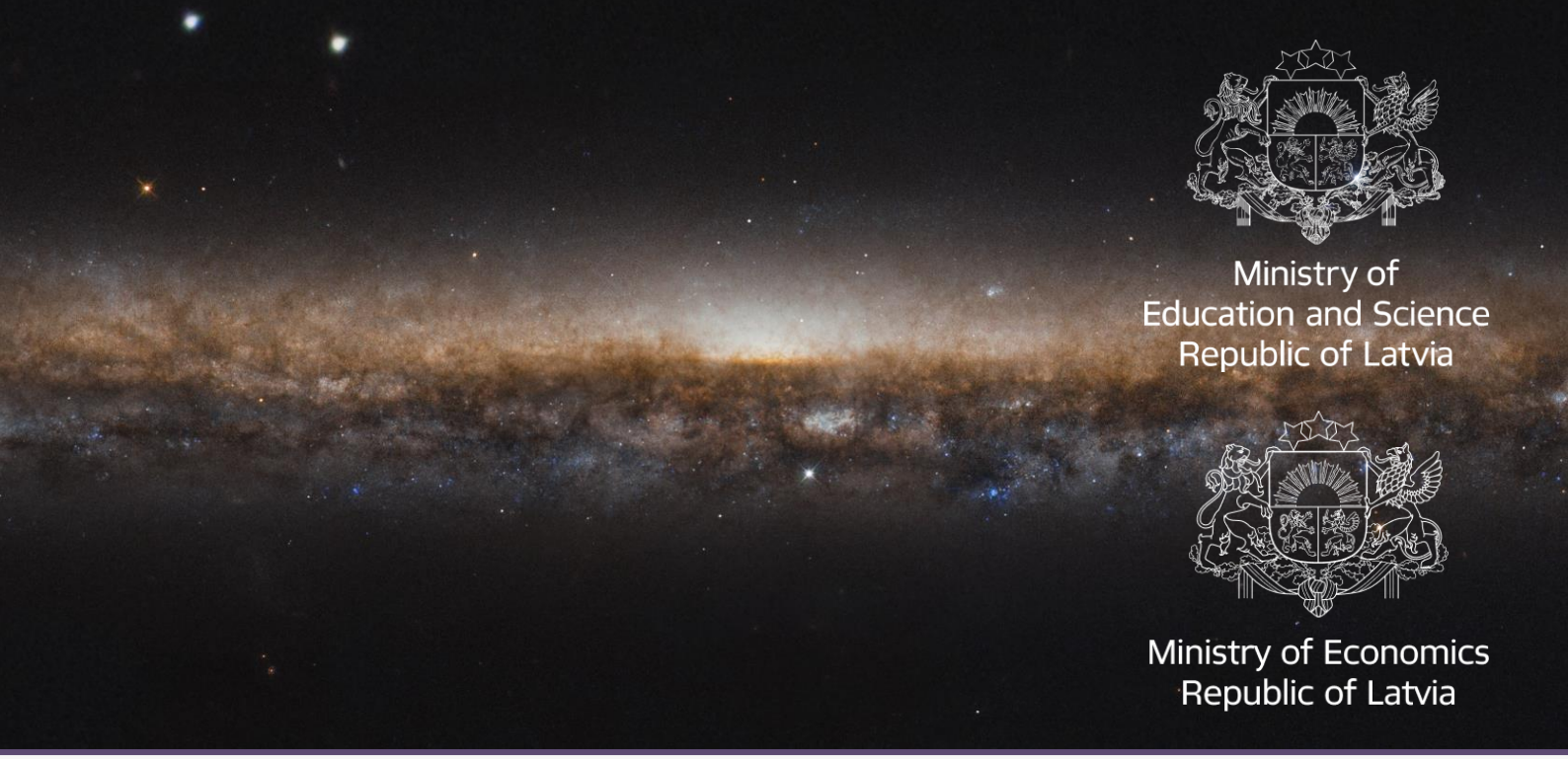


Ministry of
Education and Science
Republic of Latvia

Ministry of Economics
Republic of Latvia

The Space Strategy of Latvia 2021-2027

2020

The Space Strategy for Latvia 2021-2027 is an operational document that was collectively developed by the Ministry of Education and Science and the Ministry of Economics of the Republic of Latvia. The Strategy has been reviewed and adapted by the Latvian Space Policy Working Group, and its aim is to structure and coordinate the space policy related matters in Latvia as well as to demonstrate the willingness of the stakeholders to work together for the development of the space sector.

The Strategy was designed in 2020 following Latvia's accession as an associate member of the European Space Agency, and it establishes a focused framework for the cooperation of Latvia with the European Space Agency.

The strategy contributes to the achievement of the objectives, priorities and actions defined in the Latvian National Development Plan 2021-2027, the National Industrial Policy Guidelines 2021-2027 and the Science, Technological Development and Innovation Guidelines 2021-2027.

List of Abbreviations

ESA BIC	European Space Agency Business Incubation Centre
COPUOS	Committee on the Peaceful Uses of Outer Space of UN
EC	European Commission
ECS	European Cooperating State
ECSS	The European Cooperation for Space Standardization
EDA	European Defence Agency
EGNOS	European Geostationary Navigation Overlay Service
EO	Earth Observation
ESA	European Space Agency
ESERO	European Space Education Resource Office
ESOC	European Space Operations Centre
ESRIN	ESA Centre for Earth Observation
ESTEC	European Space Research and Technology Centre
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUSPA	European Union Agency for the Space Programme
EVN	European Very Long Baseline Radio Interferometry Network
GNSS	Global Navigation Satellite System
GOVSATCOM	Governmental Satellite Communications
GSA	European GNSS Agency
IAC	International Astronautical Congress
ICT	Information and communications technology
ILT	International LOFAR Telescope network
INSPIRE	INfrastructure for SPatial InfoRmation in Europe (directive)
IPR	Intellectual Property Rights
JIVE	Joint Institute for VLBI, a European Research Infrastructure Consortium
KPI	Key Performance Indicator
LIAA	Investment and Development Agency of Latvia
LOFAR ERIC	LOFAR European Research Infrastructure Consortium (LOFAR ERIC)
LSI	Large System Integrators
PECS	Plan for European Cooperating States
SatCen	European Union Satellite Centre
SSA	ESA's Space Situational Awareness Programme
STEM	Science, technology, engineering, and mathematics
VC	Venture capital
VIRAC	Ventspils International Radio Astronomy Centre
VLBI	Very-long-baseline interferometry

Table of contents

Executive Summary

Latvia, as a country of 2 million inhabitants located in the innovative Northern part of Europe, sees its potential in the new space economy lying in finding and filling niches open to innovation, as well as building on the historical heritage of space technologies and competences initially developed in the second half of the 20th century.

Since 2015, Latvia has been making notable investments in space-related industries, particularly through various ESA and other international projects. This includes the development of cutting-edge research and technology (upstream: instruments, electronics, materials, astronomy catalogues; downstream: space communication and tracking hardware) with a view to improving the local industry's technical capabilities and facilitating its integration into the European and global markets, while maximising socio-economic benefits such as the creation and preservation of highly skilled labour in these sectors.

The educational dimension has the pivotal role in the development of the expertise required for geospatial data processing and operations. Further promotion of downstream solutions (i.e. telecommunications, Earth Observation, navigation, and space situational awareness) would support sectorial policies, Latvian public administration services and sustainable business models, and above all, would benefit the country's citizens.

Latvia is successfully developing an increasing presence in the international space sector. This has been facilitated by its associate membership of ESA, as well as its participation in EUMETSAT, JIVE, ILT, and EU space programmes.

These memberships, in particular that of ESA, are used as a platform for innovation and development of various technologies, and enhance the national support for the local space research and business community, as well as offer local players invaluable access to highly specialised facilities and knowledge.

The Space Strategy of Latvia 2021-2027 sets out to deliver the following results[1]:

1. Sufficient numbers of Latvian-educated and suitably skilled new workers are available for employment in the Latvian space sector

2. Latvia's overall return from the ESA's programmes meets the targets – the minimum cumulative return coefficient of 0.95 at the end of 2027

3. At least 10 new companies benefit from the ESA engagement

4. At least 5 (15 if ESA BIC established) new start-up and spin-off companies benefit from the ESA engagement

5. At least 5 commercial space contracts won by Latvian entities outside the ESA and EU programmes

6. Latvian companies have products in the supply chain of the Large System Integrators

7. The number of above the threshold evaluated project proposals through the EU Horizon Europe programme in space-related activities are doubled(from years 2021 to 2027)

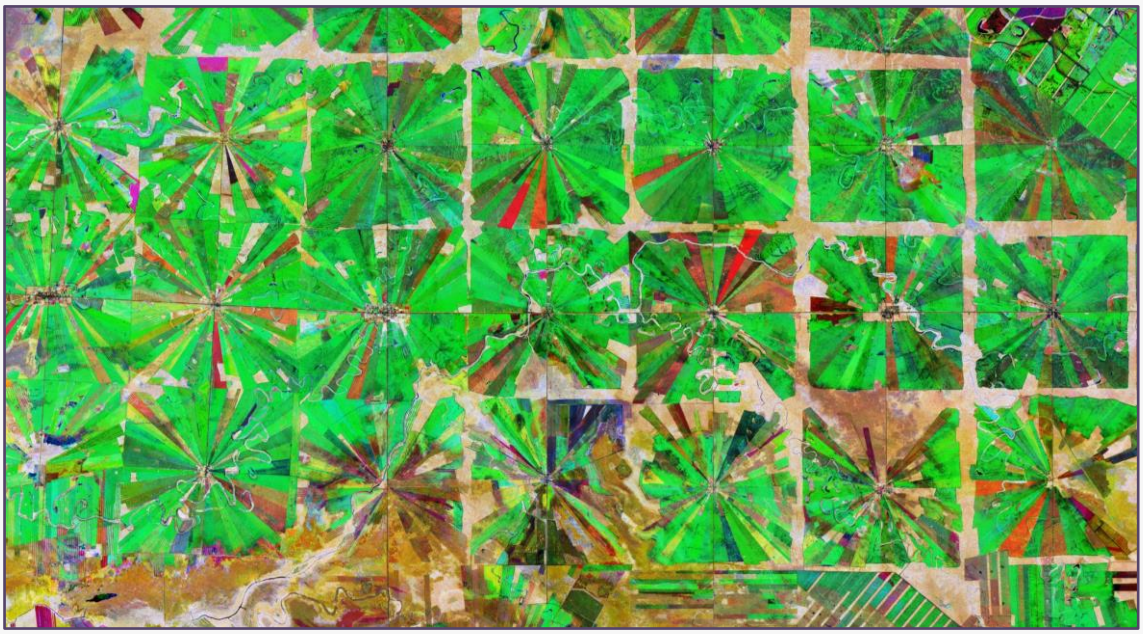
8. Latvian researchers are included in the core science team of at least one ESA science mission, or are key authors the production of at least three published research papers based on the data from the ESA spacecraft or missions.

9. At least five new sustainable Earth Observation or navigation services (applications) that are based on advanced data analytics capabilities of space data are developed and integrated in the public or private sector

10. At least five Latvian companies operating in non-space markets have integrated space-based capabilities into their commercial service portfolio (e.g., civil/geotechnical engineering, consulting engineering, mining services, transport services, infrastructure providers, forestry, agriculture, energy, financial services, etc.).

[1] The scope of the strategy focuses on education (skills), scientific and industrial aspects of Latvian space sector development and does not include other broader dimensions

1. Latvia's and global space activities in a changing world



Context of the Strategy - Global trends

The global space economy reached EUR 309 billion in 2017, having grown on average by 6.7% between 2005 and 2017. In the global space economy, satellite services represent the largest sector (around 37%), closely followed by ground equipment. After satellite telecommunications, Earth Observation is the biggest user of satellite manufacturing and launch services, and remains a key driver for the space industry in general. The most recent economic upswing happened in 2010-2014, providing an average growth of 6.2% — a value that surpassed the growth of the overall global economy, which grew at 4.4% over the same period[2].

- The main current trends affecting the space economy include:
- An increasing public interest and investment in space activities worldwide;
- An unprecedented level of private investment in space ventures, linked to a higher attractiveness and expected profitability and a growing venture capital (VC) market;
- An ever-increasing number of actors;
- The continued growth of space industry revenues;

[2] OECD The Space Economy in Figures, 2019

- Further development of commercial activities worldwide, including ones based on small satellites and the development of commercial activities in new fields, e.g. micro-launchers and space flight;
- A traditional space industry, still generating the main share of revenues, but facing more competitive and uncertain markets;
- Further development of the NewSpace worldwide;
- Further integration of space into the society and economy leading to more value creation and more socio-economic benefits[3].

NewSpace[4]

Space is one of the central enablers of digital economy. In recent years, a new operating model, the "NewSpace" economic model, has emerged alongside the traditional, institutionally led, space industry. The NewSpace economy refers to commercialisation of the space sector, in particular, to businesses using small satellites to deploy systems which offer commercial services and utilise space data and applications. The NewSpace economy enables easier and cheaper access to space than ever before. The traditional space industry and the NewSpace economy complement one another and constitute a market-oriented continuum for work in the space sector, which was formerly only publicly funded at national level. The shrinking of satellite sizes associated with NewSpace is creating opportunities for new market entrants. Spacecraft development has historically been dominated by Large System Integrators such as Airbus and Thales Alenia. Components for small satellites, however, are mostly produced by small enterprises founded in the last 10 years.

Satellite Telecommunication Constellations

There are presently four commercial constellations in development seeking to provide broadband communications and internet service to consumers and enterprises in every corner of the world. SpaceX has launched over 600 satellites, with plans for thousands more. Amazon has announced that it is working on a "Kuiper" constellation of over 3,000 satellites, and has announced plans to invest in excess of EUR 10 billion in its deployment. This level of commercial investment in space is unprecedented, and it underscores that a very large and vibrant commercial space economy is rapidly emerging. While the space portion of the global telecommunications market is today small, under 5%, the sheer size of global extraordinary growth in this space business segment[5]

[3] ESA Intermediate Report on the Space Economy 2019
[4] NewSpace: a global trend encompassing an emerging investment philosophy and a series of technological advancements leading to the development of a private space industry largely driven by commercial motivations.
[5] Start-Up Space Update on Investment in Commercial Space Ventures 2020 - Bryce Space and Technology

Earth Observation

The Earth Observation (EO) market has grown consistently over the last decade. In 2017, the global market reached EUR 4.1 billion for EO data and value-added services and EUR 3.9 billion for satellite manufacturing. The downstream EO sector is now growing at about 6% per annum globally and at about 12% within Europe. Information Products and Big Data solutions will drive this growth in the short-term.[6]

Global Navigation Satellite Service

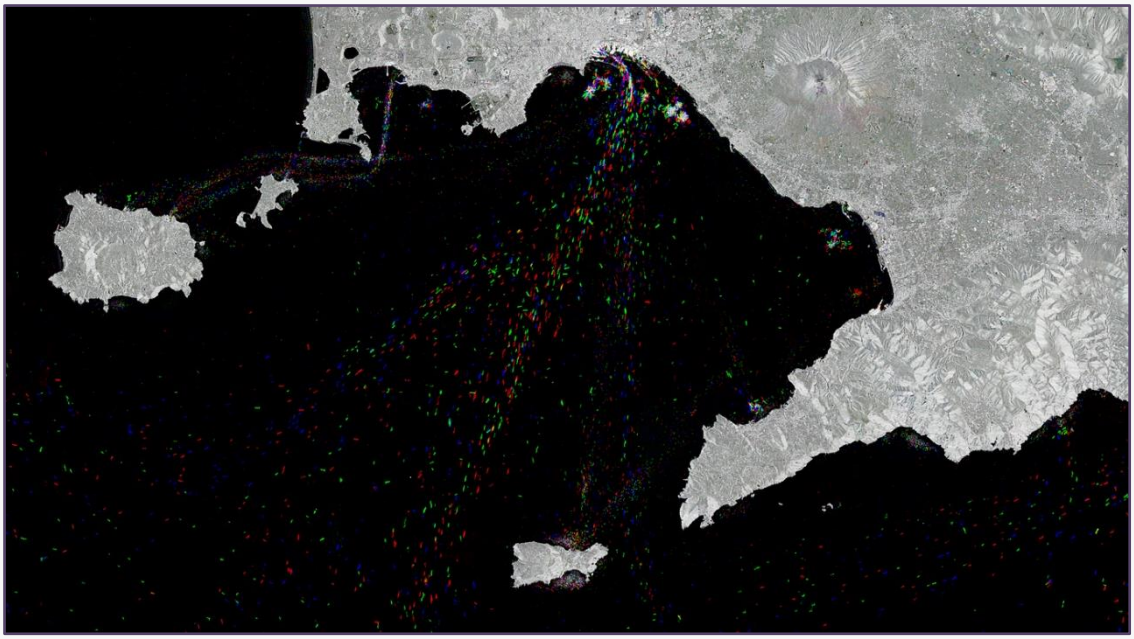
Estimates for the Global Navigation Satellite Service (GNSS) downstream market revenues from both devices and services are projected to grow from EUR 150 billion in 2019 to EUR 325 billion in 2029. The growth is mainly due to the revenues from mass market and mid-end devices and from augmentation services. Low-end receivers will record a growth of 16% per year between 2019 and 2029, while revenues from augmentation services are set to grow steadily from EUR 23 billion to nearly EUR 65 billion in 10 years.

The services relying on GNSS technology to create added-value for users represent the biggest revenue stream for the GNSS market. In 2029, added-value service revenues will account for EUR 166 billion, more than half of the total global GNSS revenues.

Stewardship of Space

The proliferation of large constellations of satellites has raised concern that satellite collisions and resulting fragmentation could create a space debris problem that could close space as a resource for future generations. This has given rise to a global effort to improve Space Situational Awareness (SSA), which monitors space weather and near-Earth objects, and tracks debris. While budgets for SSA remain small (under EUR 100 million at ESA), they are rapidly growing globally, and this new field is not yet dominated by any European nation.

[6] Creating Value for Europe, European Space Agency (2019)



Context of the Strategy - European collaborative space programmes

ESA and the EU have set out to invest EUR 52 billion combined in their space programmes between 2021 and 2027. In 2020, the ESA's budget was EUR 5.18 billion (income from the EU not taken into account) and the Euro-volume of annual EU space programmes are EUR 2.28 billion (EUR 16 billion in total for 2021-2027).

The global uptake of Galileo and Copernicus is a priority of the EU under its Space Strategy.

European Space Agency

ESA (European Space Agency) remains the primary tool and partner for Latvia in supporting innovative companies and researchers in the development of leading technologies for commercial use in the global space market. This collaboration also secures the local talent with valuable research and business linkages with other space organisations, building a collaborative platform where high-reliability and performance technologies are developed to serve both the space sector and other markets that could benefit from these technologies but are not necessarily operating in the space industry.

It is important to highlight that ESA carries out an industrial policy – known as the "GeoReturn". It is a fundamental pillar enshrined in the ESA convention. In other words, ESA undertakes to award industrial contracts to the member states or associate states in a ratio equalling the relative financial contributions which they make. As a simplified illustration, if Latvia contributes 10% of the funding of an Earth Observation programme, then ESA aims to award about 10% of the value of the contracts for this programme to the Latvian industry. This is a major incentive for smaller European countries to be a

member of ESA, as the benefit back to the country is directly related to the investment in ESA with a high level of certainty. The GeoReturn principle ensures all member nations have opportunities in developing expertise in high-tech sectors.

In the last ESA Council at Ministerial Level (called Space19+) committed the biggest ever budget with total subscriptions amounting to EUR 14.4 billion – substantially increasing funding allocation for ESA's basic science and technology programme.

EU Space Programme

The European Commission proposed a total budget allocation of EUR 16 billion to finance space and a budget of EUR 100 billion (Horizon Europe) to invest in EU research and be allocated to Galileo and EGNOS, the EU's global and regional satellite navigation systems, EUR 5.8 billion would be allocated to Copernicus, the EU's Earth Observation programme, and EUR 500 million would be earmarked for security, such as the Space and Situational Awareness (SSA) programme and the new Governmental Satellite Communication initiative (GOVSATCOM) to support border protection, civil protection and humanitarian interventions, for instance.

The main aims of the new EU Space Programme are to secure the EU's leadership in space activities, foster innovative industries, safeguard autonomous access to space and simplify its governance. The EU Space Programme would upgrade the European GNSS Agency (GSA) by expanding its tasks and transforming it into the new EU Agency for the Space Programme (EUSPA).

Galileo: Galileo is the global satellite navigation system of the European Union (GNSS). Galileo offers exact information on position and time. This programme is under civilian control and its data may be used for a wide scale of applications. It is autonomous, but at the same time interoperable with existing satellite navigation systems. Galileo will consist of 30 satellites and an on-ground infrastructure.

Copernicus: The operational Copernicus programme is the largest provider of Earth Observation data in the world today, and is projected to generate at least EUR 56 billion-worth of socio-economic benefits in the period 2019-2035[7]. Currently, there are eight Copernicus satellites, called Sentinels, orbiting the Earth and several more are planned to be launched in the future. Moreover, Copernicus processes and delivers information through its six Copernicus Services[8]. The Copernicus programme offers its data and information on a full, free and open basis.

Copernicus is envisaged to play an important role in implementing the key EU directives for example: EU Marine and Water Strategy Directive, EU Water Framework Directive, INSPIRE Directive, EU Nitrates Directive, Ambient air Quality Directive, Cleaner Air for Europe Directive, Habitats Directive, Fauna Flora Habitat directive, and the Floods Directive. It is therefore of high importance to develop and

[7] PwC, Copernicus ex-ante benefits assessment, 2017

[8] Copernicus Land Monitoring Service, Copernicus Marine Service, Copernicus Air Monitoring Service, Copernicus Climate Change Service, Copernicus Emergency Management Service and Copernicus Security Service.

exploit competences and services addressing these if Latvia is to keep pace in such an emerging market. Opportunities also exist in the area for international and inter-governmental cooperation on such tools and services, such as remote sensing, data processing, satellite communication, etc.

2. Participation in international space programmes

Cooperation with ESA

After the initial cooperation agreement on 23 July 2009, Latvia signed the European Cooperating State (ECS) agreement with ESA on 15 March 2013. This agreement came into force once the Plan for European Cooperating States (PECS) Charter was signed on 30 January 2015, which had a duration of 5 years.

Within the PECS framework, Latvian entities[9] have had an opportunity to submit their ideas to six calls for Outline Proposals under PECS in Latvia. The total sum of the Latvian commitments was EUR 8,5 million, and altogether 51 contracts have been awarded to 16 Latvian entities under the six PECS calls[10]. On 27 July 2020, Latvia became an Associate Member of ESA for the duration of seven years.

[9] Legal Entity is any legal person or public entity or group of persons and/or bodies which offers on the market, respectively, the delivery of supplies, products or services and which satisfies the eligibility criteria specified in Article 18 of the ESA Procurement Regulations (ESA/REG/001, rev. 5) and therefore is eligible to submit proposals to ESA. In case of universities, faculties can be considered as separate entities.

[10] List of contracts awarded, Ministry of Education and Science of the Republic of Latvia (in Latvian)

EUMETSAT

A Cooperating State of EUMETSAT since 2004, Latvia joined the organisation as a Member State in May 2009. The contact point for EUMETSAT in Latvia is State-owned limited liability company "Latvian Environment, Geology and Meteorology Centre" (www.meteo.lv). The Latvian contribution to EUMETSAT annually amounts to EUR 0.503 million.

JIVE un ILT

On 25 November 2016, Latvia becomes the full member of Joint Institute for VLBI, a European Research Infrastructure Consortium (JIVE). The main partners from Latvia are the Ministry of Education and Science, and Ventspils International Radio Astronomy Centre (VIRAC) at Ventspils University of Applied Sciences. JIVE is a central body of the European Very Long Baseline Radio Interferometry Network (EVN). JIVE has developed unique expertise in space science, near-field VLBI, geodetic VLBI. The EC has viewed JIVE as a valued ingredient of the European Research Infrastructure landscape in the area of radio astronomy. On 2 October 2019, Latvia became a member of the International LOFAR Telescope (ILT) network. LOFAR is a generic Wide Area Sensor Network that is used for astronomical observations at radio-frequencies below 250 MHz, as well as geophysical research and studies in precision agriculture. It is envisaged that by 2023 ILT infrastructure is set up as LOFAR European Research Infrastructure Consortium (LOFAR ERIC).

Science

The early development of Latvian space science has been influenced by the USSR's space exploration policy, as well as military research policy. Latvian scientists have participated in approximately a

hundred world-level importance space programmes since 1950s, mainly, taking an active and important part in the space programmes, including manufacturing the first satellite telescope and range finder and producing thermal isolation materials for rockets. Since regaining the independence, space science is performed mainly by the University of Latvia, Riga Technical University, Latvian State Institute of Wood Chemistry, Institute of Environmental Solutions, Institute of Electronics and Computer Science and Ventspils International Radio Astronomy Centre.

The key competences in the space science have been assessed through the analysis of successful ESA PECS and Horizon 2020 bids made by Latvian entities. They show that high-level research is carried out in such fields as radio astronomy, planetary small bodies (asteroids, comets, meteors) detection, orbit determination and physical properties, electronics and telecommunications, satellite technologies, remote sensing, climate change tipping point indicators, data processing, high performance computing, low density thermal insulation materials, structural safety assessments and composite structures, algorithms for EO applications, remote sensing data-based solution and others.

Space Industry

Since joining ESA in the ECS capacity in 2015, Latvian companies have developed dozens of scientific instruments, electronics components, materials and EO solutions. Space activities can significantly help Latvia develop its 'value chain' through knowledge-intensive and innovative products. Such space activities undertaken in Latvia can be considered as capabilities that are yet to be fully exploited in the space sector. Therefore, they should be strategically developed further. In the area of electronic components, there is wide expertise in the development and supply of integrated circuits. Latvia also has a rich heritage in the field of satellite laser and radio ranging. These skillsets, together with the

leading Latvian technology in event timing devices, thermal management and infrastructure, could be exploited within the relevant ESA programmes.

A significant expertise is being deployed in the development of instruments for radiation detection and measurements for developing scientific payloads in space. Fiber optic gyroscopes is another space capability which exists in Latvia. This technology is offered by very few companies worldwide and is potentially of great interest to ESA programmes.

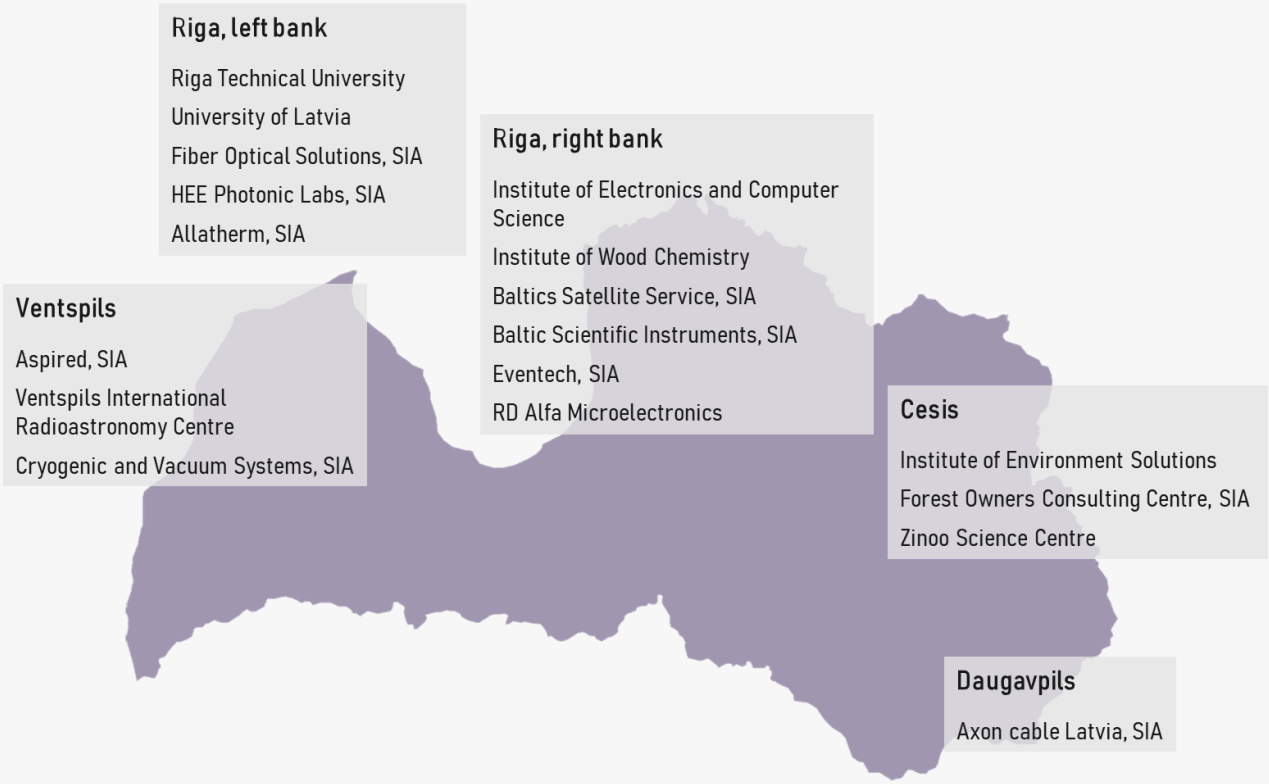
The key existing industry competences[11] in Latvia can be summarised as:

- Rad-Hard electrical and electronic space components and sensors
- Insulation materials for launchers
- Earth Observation applications and services
- Space-related ICT downstream solutions
- Event timing devices
- Satellite and space debris laser and radio ranging
- Radiation detection technology
- Fibre optic gyroscopes
- Space resource utilisation capacity building
- Thermal engineering solutions
- Thermal vacuum testing solutions, systems and services
- Cryogenic refrigeration and vacuum systems design and development
- Electric propulsion systems design and development.

Space industry in Latvia is represented mainly by a number of companies such as the Baltic Satellite Service Ltd, Baltic Scientific Instruments Ltd, Eventech Ltd, RD Alfa Microelectronics, Axon Cable Latvia Ltd, Cryogenic and Vacuum Systems Ltd, Fiber Optical Solutions Ltd, Allatherm Ltd, HEE Photonic Labs Ltd and Forest Owners Consulting Centre Ltd.

[11] Developed taking into account the following criteria: funded ESA PECS project, funded Horizon 2020 project, involved in space supply chains

Attēls 1 Landscape of Latvian space actors

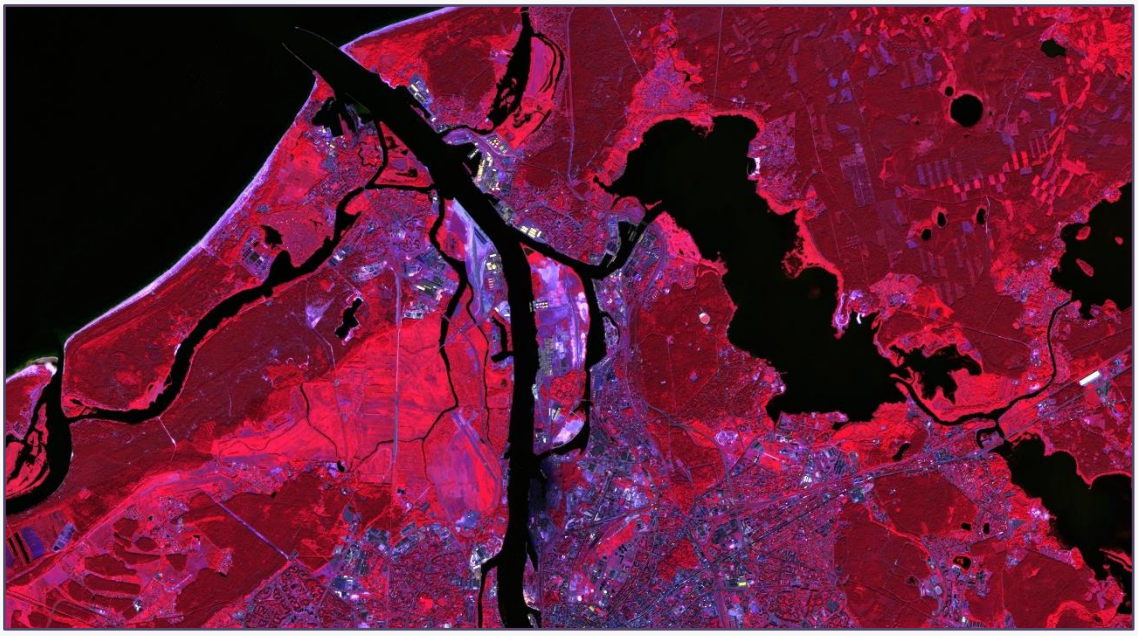


Cooperation with Large System Integrators[12]

A great achievement of the national industry is the establishment of a stable relationship with other European space industries, on a complementarity basis. A number of companies have already developed a stable relationship with Large System Integrators (LSIs), which can provide opportunities for participating in their value and supply chains, leading to a more stable and secure workload as well as involvement in exciting and demanding space development challenges.

The areas in which the Latvian entities have established cooperation with the LSI include the cryogenic insulation of launchers, new integrated circuits, Xenon Refuelling Compressors and Event Timing devices.

[12] Large System Integrators (LSIs) in the space industry specialise in bringing together component subsystems into a whole and ensure that those subsystems function together. The list of space-related LSIs in Europe includes: Airbus Defence and Space SAS, Airbus Defence and Space GmbH, Airbus Defence and Space Ltd, Arianegroup FR, Arianegroup GmbH, Thales Alenia Space France SAS, Thales Alenia Space Italia Spa, and OHB System AG.



Downstream applications

From satellite communication and navigation to Earth imagery, satellite technology improves our daily life in numerous different ways and will play an ever increasingly important role in the operation of government.

Recognising this, good capabilities in Latvia can already be found in the area of EO and remote sensing as satellite data-based solutions in different sectors, development of algorithms for EO applications, satellite imagery analysis etc. Such developments can be used to address regional (e.g. Baltic), European and global common issues and assist in fulfilling a number of EU directives. As such, this is an area where international cooperation, at least on a regional level, could be highly beneficial.

From an end-user's perspective, Latvian public services are already using EO data in several fields to varying degrees and intensity. However, there is a gap in understanding between service-providers and end-users due to the lack of awareness of the specific needs of the relevant user communities and, on the other side, the benefits of the existing space-based services. This asymmetry could eventually generate a mismatch between user demands and the supply from the space sector and is something to be addressed if Latvia is to gain the full benefit of the potential of EO applications and where a strong governmental push to lead by example (e.g. by an early take-up of new satellite data-based services) could give significant advantages.

Moreover, considering that EO data and information delivered by the European Commission through its Copernicus programme is open and free to use and is financed by the European tax payers, this is a cost-efficient and essential opportunity for Latvia to use to develop its value and supply chains.

Climate Change

For supranational institutions, such as the European Commission and the European Parliament, and international organisations, such as ESA or United Nations, climate change is among top priorities, which is reflected in their current and future funding initiatives[13][14][15]. This includes a target of 20% of the EU budget to be climate-related[16]. While climate change is a significant challenge, it is also presents a significant opportunity to Latvia to apply its. downstream and upstream skillsets, integrated across multiple sectors in society, research and industry to find and apply innovative solutions.

[13] https://climate.esa.int/en/
[14] https://ec.europa.eu/clima/index_en
[15] https://www.un.org/en/sections/issues-depth/climate-change
[16] https://ec.europa.eu/clima/policies/budget_en

3. Space governance

In Latvia, the space governance model is based on shared coordination among several ministries and connected public agencies, recognising the diverse nature of space and its potential role for a number of policies for sustainable growth and innovation.

In 2020, under the supervision of the Ministry of Education and Science, a Virtual Latvian Space office was established. It consists of several government professionals to support Latvian entities to secure funding from ESA and EU programmes to develop strategic space technologies.

The functions of the Virtual Latvian Space office are:

- to coordinate the Latvian delegation in ESA;
- to administer the participation in ESA optional programmes and to provide comprehensive support to Latvian entities related to the ESA procurement system;
- to work on operational measures concerning the implementation of this strategy, especially the Latvian Requested Party Activities of ESA;
- to facilitate international collaboration and to promote the Latvian space industry worldwide.
- In April 2020, the Latvian Space Policy Working Group was established under the supervision of the Ministry of Education and Science and the Ministry of Economics. It consists of 14 members (representatives of ministries, a cluster representing the private sector and scientific institutions). The main task of the working group is the coordination and governance of space-related programmes and activities at a national and international level. Decisions of the Latvian Space Policy Working Group are recommendatory, and the

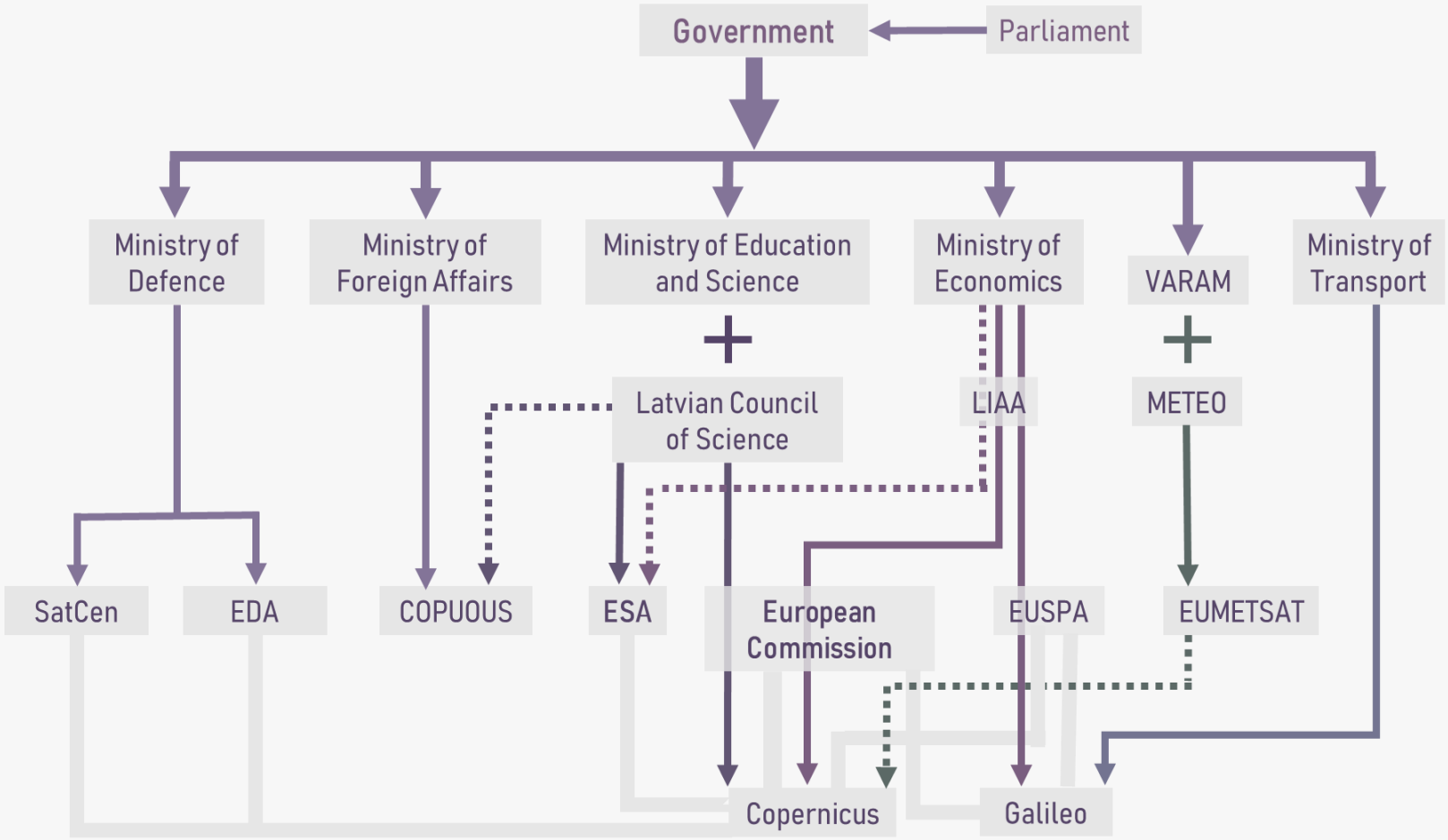
group aims to fulfil an advisory function to the relevant ministries. The Minister of Education and Science and the Minister of Economics of the Republic of Latvia will both co-chair the group.

- The functions of the Space Policy Working Group are:
- to promote and coordinate the cooperation among Latvia and ESA, including setting up a national delegation to the ESA committees and sub-groups, and advising on possible investment directions for the ESA programmes
- to support the uptake of the EU space programmes, i.e. Copernicus, EGNOS and Galileo, and ensure all applications related to the above technologies are effectively implemented in the management of public administration and economic activity in Latvia
- to promote and coordinate the participation of research institutions and companies in ESA, the EUSPA, EUMETSAT, the EU Horizon Europe and other space programmes and institutions
- to provide recommendations to the Cabinet of Ministers on Latvia's involvement in international organisation structures related to space
- to promote the inclusion of appropriate space activities in the smart specialisation strategy and synergies with the investment directions of the Structural Funds.

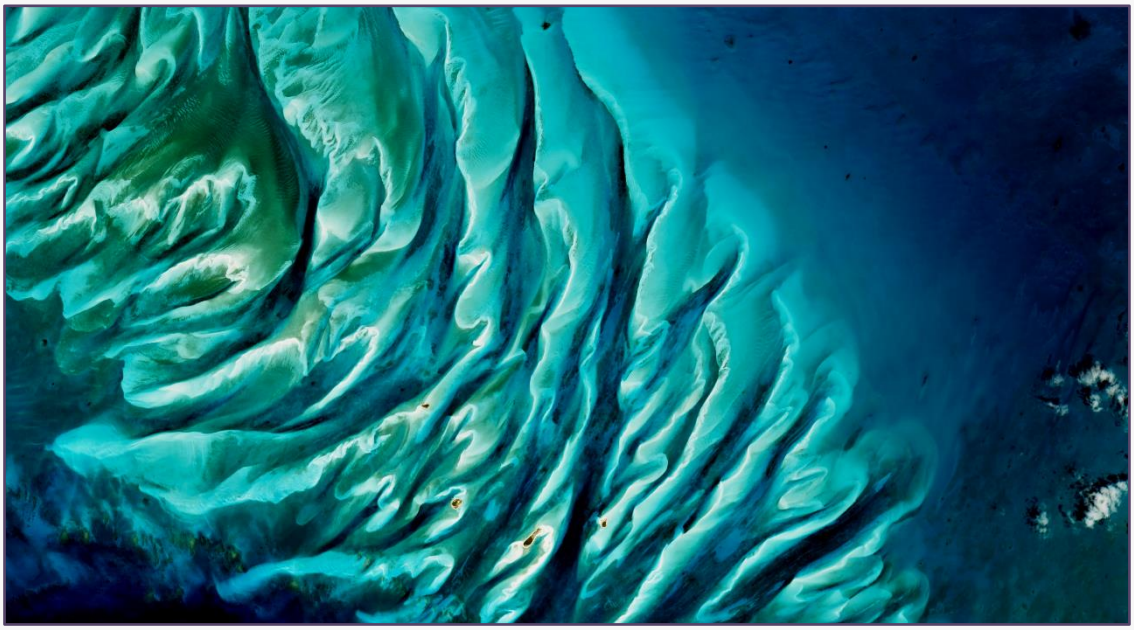
The Ministry of Education and Science is primarily in charge of cooperation with ESA, the Copernicus programme, JIVE, ILT and partly involved in EUSPA coordination. The Ministry of Economics supports the national space industry in terms of innovation and start-up development. The potential relevance of space technology and applications for agriculture, energy, transport, telecommunications, environment, security and defence, etc., is a key factor for many other ministries to be involved in the Latvian space sector coordination.

Effective inter-ministerial collaboration is a pre-requisite for successful implementation of the strategy.

Space governance model in Latvia



4. Visions, goals and activities



Education and skills development

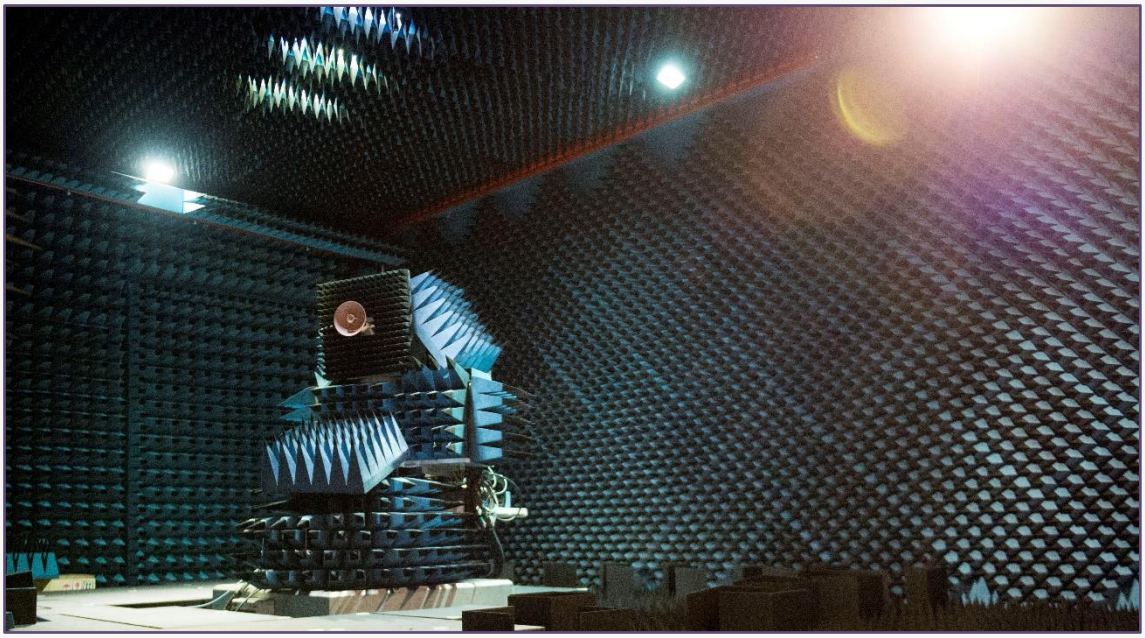
Vision: Latvian higher education institutions ensure the development of an adequate base of expertise and skills in graduates to be able to serve the needs of the space sector in Latvia.

Status and potential: A knowledge-based society requires well-trained scientists and technical experts, which makes it even more important to stimulate the enthusiasm of young people for science and technology at an early stage.

Latvia generally has excellent scientific training, but the students lack space application opportunities. Hands-on experience is the best method to build on the inspirational factor, which is naturally provided by space themes. Basic conditions for Science, Technology, Engineering, and Mathematics (STEM) training are an appropriate educational system, activities with real-world applications, and desirable careers, of which the space sector can make positive contributions due to its multi-disciplinary nature.

To use the human potential effectively, support measures and attractive training opportunities are necessary to lead young people to the space science and engineering. There is a need to develop initiatives, facilities and networks for the purpose of raising interest in research, innovation and technology with space as the stimulus. The challenge is to support increased cross-linking and cooperation between organisations and networks that are engaged in attracting young talent to careers in STEM from different perspectives.

Activities	Goals by 2027
EDUCATION. Universities in collaboration with local industrial partners and active space-related non-profits develop hands-on training activities, higher-education courses and lifelong learning programmes to respond to the national space industry need by studying the imbalance between labour demand and supply in space companies. **TRAINEESHIPS.** The Ministry of Education and Science in collaboration with ESA create practical training opportunities and a system for doctoral and master students at ESA technological centres (ESTEC, ESRIN, ESOC, etc.). **TRAINING.** The Ministry of Education and Science in collaboration with ESA organise relevant training courses for various space disciplines in Latvia, delivered by ESA experts (e.g. engineering, standardisation, EO/semote sensing, space communications, Space Situational Awareness, climate science, etc.). **ESERO.** All parties involved in the implementation of the Latvian Space Strategy actively participate in the European Space Education Resource Office (ESERO) activities to inspire students to engage with space and STEM subjects. **AWARENESS.** All parties involved introduce activities that promote the awareness of companies, scientific representatives and the public about cooperation with ESA, as well as Latvia's potential and experience in the development of space and related technologies, the importance of these technologies and their possible applications.	Sufficient new young employees available to the Latvian space sector that already possess expertise in the fields of interest for the space sector. Such persons having gained a high-quality education in Latvia in the areas of space environment, space engineering, satellite telecommunications, satellite navigation and EO/remote sensing and being aware of the relevant standards (e.g. ECSS). (KPI 1)



Entering in the space supply chain and international impact

Vision: Latvian businesses and research organisations collaborate with the key players in the global space industry to deliver world-class space activities in close cooperation with ESA, with the goal to develop recurring products and services that have great export potential.

Status and potential: Companies in the space sector are faced with high costs of qualification of technologies and processes, as well as long investment cycles, which create barriers to entry into the industry. Both the financial and the technological risks in the space sector are considered to be significant. To overcome these challenges, Latvia should capitalise on the expansion of specific actions in the areas of research and development and help encourage and nurture start-ups. Cooperation, between the industry and research, should be expanded as it is considered to be beneficial to all. Concentration of expertise, a strong focus on specialisation are desirable. Assistance is needed to industry to obtain ready access to component testing and qualification laboratories and equipment, in Latvia or conveniently nearby. Facilities can be shared among companies, institutes, government entities, or with cooperating laboratories in neighbouring nations.

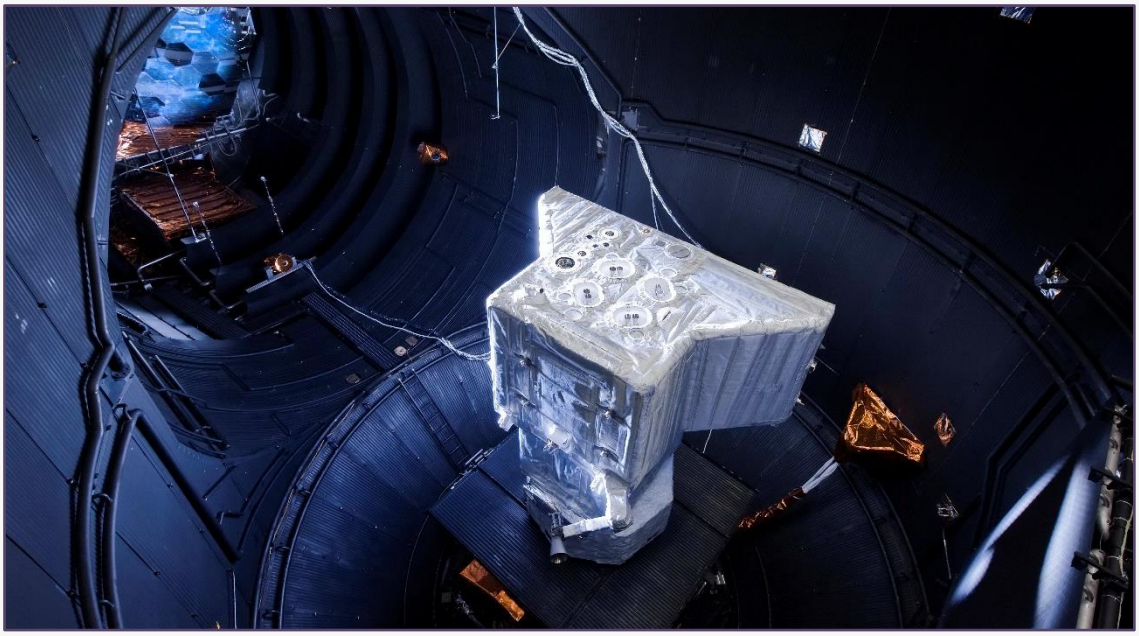
Latvia will seek to increase the number of equipment, instruments, sensors, and components manufactured in Latvia to become flight qualified and gain space flight heritage. The focus shall be on development of recurring products. Furthermore, the international network and visibility of Latvian space industry should be further developed and promoted with a specific view to enabling international co-operations and facilitating international customers for Latvian products and services. The legal and regulatory environment for space activities should be modern and favourable. Another important task is to penetrate commercial space markets and facilitate successful technology transfer to the non-space economy.

Activities	Goals by 2027
MARKETING. All ministries, agencies, enterprises and research organisations involved in the Latvian space sector collaborate to market the country's achievements and potential and promote its visibility internationally.	Latvia is represented by competent individuals in the most important international bodies and expert groups and the space activities of the EU (space programme + research programme) and the ESA, JIVE, ILT. The Space Policy Working Group coordinates the opinions of Latvia.
TRADE EVENTS. The Ministry of Economics and LIAA provide support to Latvian companies to participate at international space-related events (e.g. IAC, Toulouse Space Show) focusing on the local community's integration in the global space supply chains.	Latvian companies and research organisations participate in several ESA optional programmes and Latvia's overall return from the ESA's programmes meets the targets of a minimum cumulative return coefficient of 0.95 at the end of 2027. (KPI 2)
START-UPS. The Ministry of Economics and Ministry of Education and Science create favourable conditions for foundation of new start-ups in the space sector, especially considering creating an ESA Business Incubation Centre in Latvia.	Fifteen new space sector companies including start-ups have been established or reoriented in Latvia and benefit from the ESA engagement. (KPI 3 and 4)
ONLINE DIRECTORY. The Ministry of Education and Science in collaboration with the Latvian Science Council develop the online directory space.sciencelatvia.lv to promote the Latvian space industry capabilities to the global space market.	The needs for amendments to national legislation have been analysed from the viewpoint of business support for the space sector by 2022.
ENABLING. The Ministry of Economics and LIAA provide support instruments and measures to innovative space companies. LIAA identifies and facilitates the international opportunities to utilise Latvian space solutions and space data and facilitates investments in Latvia.	Latvian entities have commercial space contracts won outside ESA and EU programmes and have products in the supply chain of the Large Scale Integrators. (KPI 5 and 6)

LEGISLATION. The responsible authorities review Latvia's regulatory framework for licensing the use of radiofrequency spectrum for satellite communication purposes. The laws, regulations and policies will be analysed and amendments suggested so as to create an environment that encourages the development of the space sector, including the private use of satellite spectrum, while safeguarding the interests of Latvia.

ESA PROGRAMMES. The Ministry of Education and Science and the Latvian Space Policy Working Group actively analyse the success of Latvian industry in participation in ESA's programmes and activities. Together with ESA, experts explore possibilities for increased support in terms of training, organisation of events and advice with a view to achieve a successful integration of Latvia in ESA to ensure further development of sustainable and competitive industrial capabilities, and their integration in the space supply chain.

SUPPORT. Ministry of Economics and Ministry of Education and Science collaborating with all parties involved in the implementation of this Strategy create a support framework for the Latvian industry in all matters related to ESA, in particular the ESA's procurement, and building up the industrial capacity in the field of space activities.



Scientific and engineering research

Vision: Research organisations and universities operating in Latvia participate in the leading space projects and generate the world-class knowledge in space and related science disciplines.

Status and potential: The space industry supports fundamental scientific research through the availability of direct measurements in space. In addition to the expertise created through the exploration of the universe and the Earth, satellite-based space science drives research, science and industry to technological excellence and innovation.

Today, about 10 Latvian research institutions are significantly involved in international development and research activities in this high-technology field. The space environment (vacuum, high reliability with minimal energy consumption) puts the highest demands on engineering and thus remains a challenging research area. Therefore, the space science also furthers the education and training of future experts. Moreover, space and related topics stimulate the fascination for science, technology and mathematics amongst students.

Activities	Goals by 2027
EU SPACE PROGRAMME. All ministries, agencies, enterprises and research organisations working together to actively influence the success of the Latvian participants in the EU space programme in a way of new projects, innovations and new business opportunities in Latvia. **NETWORKS.** The Ministry of Education and Science and the Latvian Science Council will strengthen the participation in international space and related research partnerships and networks (e.g. the European VLBI network (EVN), JIVE, ILT). **SSA.** The Ministry of Education and Science and the Latvian Science Council support research organisations to participate in Space Situational Awareness related projects or initiatives at the European level.	Latvian companies and research organisations - Horizon Europe participants - double the number of above the threshold evaluated project proposals in space topics in the cluster "Digital industry and space" in comparison to Horizon 2020 (KPI 7) Latvian researchers are included in the core science team of ESA science mission, or are key authors of published research papers based on ESA missions or data from ESA spacecrafts (KPI 8)

Governmental services

Vision: In response to the country's social, economic, and environmental needs, satellite-based services and applications developed and built in Latvia are increasingly integrated within the public sector at local and national level.

Status and potential: Space technology and its applications in the public sector provide valuable contributions to meeting the social needs of our time with a toolbox of innovative technologies, mainly through information on security, emergency and disaster management and resilience, search and rescue, land use and other delivered both independently and jointly by Copernicus (Earth Observation) and Galileo (navigation). Copernicus and Galileo data and information can be used free of charge, but some of this information (e.g. information provided by the Copernicus Emergency Management Service and Copernicus Security Service or Galileo Public Regulated Service are restricted to authorised governmental users).

These services are of enormous economic and security-related strategic interest and should increase the safety of citizens, facilitate decision-making in certain policy areas (such as land use, forestry, energy, land and marine environment management and protection and safety and defence, green economy, etc.) and improve methods and procedures when integrated with other technologies.

Moreover, through the EU Space Programme (i.e. Galileo, Copernicus and EGNOS) and ESA programmes, services could be developed in the areas of navigation (fleet management, transport, agriculture, tourism, search and rescue), climate and climate change forecasts, atmosphere monitoring, marine environment, land cover and land use, security and emergency, etc.

Activities	Goals by 2027
SERVICES. All ministries, agencies and public service organisations (where appropriate) foresee the use of Earth Observation-based services in the respective legislative acts and integrate them in the public sector based on added-value and competitiveness. **AWARENESS.** All responsible ministries raise awareness of the potential of space applications in the public sector for various governmental areas through the provision of training for junior and senior level specialists and key decision-makers. **COOPERATION.** All ministries, agencies and public service organisations involved shall assess the need to set up collaboration with other Baltic states and Finland in the areas of common interest, e.g. - forestry monitoring, inland water and water quality monitoring, snow and ice monitoring, etc. **EU REGULATIONS.** All ministries, agencies and public service organisations involved analyse the need of satellite-based services in implementation of the EU regulations (e.g. water quality, land use, etc.)	Sustainable Earth Observation and navigation services that are based on advanced data analytics capabilities are developed and recruited by Latvian industry in the public sector for various governmental areas. (KPI 9.1) Latvian companies operating in non-space markets have integrated space-based capabilities into their commercial service portfolio (e.g. civil/geotechnical engineering, consulting engineering, mining services, transport services, infrastructure providers, and financial services). (KPI 9.2)

5. Funding

Implementation of this strategy will be mainly funded from the following sources:

Latvia's annual contributions to the ESA programmes of EUR 3 million

Through participation in the EU Horizon Europe programmes

Through relevant national support programmes based upon EU Structural Funds programmes for research, innovation and start-ups.

Through the allocated national budget of the involved ministries.

This strategy will be updated every two years to ensure that the information and measures to be taken are up to date and to ensure that the Latvian contributions to ESA keep pace with the development of Latvian industry. The next update is coming until 2023.

Minister for Education and Science	**Minister for Economics**
Ilga Šuplinska	**Jānis Vitenbergs**

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Annex I Performance measurement of strategy implementation

The Space Policy working group will review performance of the Space Strategy of Latvia 2021-2027 in achieving its results against related Key Performance Indicators (KPIs).

The Space Policy working group will provide a report to the Minister for Education and science and to the Minister for Economics every two years, reporting on the performance of the strategy and recommending changes to the strategy, including suggested new KPIs for improved measurement.

Result 1: Sufficient numbers of Latvian-educated and suitably skilled new workers are available for employment in the Latvian Space Sector.

KPIs:

1. The number of PhD and Master's students with space-related theses - at least 10 PhD theses and 50 MSc theses defended until 2027

2. The number of Young Graduate trainees and International Research fellows at ESA – at least 5 Young Graduate trainees and International Research fellows at ESA until 2027

3. The number of space-related modules (courses) offered by Latvian universities – at least 5 new or improved space-related modules (courses) offered by Latvian universities until 2027

4. The number of trainee placements in Latvian Space companies – at least 7 until 2027.

Result 2: Latvia's overall return from the ESA's programmes meets the targets - a minimum cumulative return coefficient of 0.95 at the end of 2027.

KPI:

The ratio between the share of Latvia in the weighted value of contracts in ESA programmes, and its share in the contribution paid to the ESA meets the return coefficient of 0.95 at the end of 2027.

Result 3: At least 10 new companies benefit from the ESA engagement

KPI:

The number of Latvian companies or research institutions, which won a contract in any ESA programme, but had not won any contract during the PECS programme – at least 10 until 2027.

Result 4: At least 5 (15 if ESA BIC established) new start-up or spin-off companies benefit from the ESA engagement.

KPI:

The number start-up or spin-off companies benefit from the ESA engagement, in terms of contracts won, loans or technical support that impact their product development and IPR – at least 5 (15 if ESA BIC established) until 2027.

Result 5: At least 5 commercial space contracts won by Latvian entities outside the ESA and EU programmes.

KPI:

The number of commercial space contracts won by Latvian entities outside the ESA and EU programmes – at least 5 until 2027

Result 6: Latvian companies have products in the supply chain of the Large System Integrators.

KPI:

The number of Latvian companies which have products in the supply chain of the Large System Integrators – at least 7 until 2027.

Result 7: The number of above the threshold evaluated project proposals through the EU Horizon Europe programmes in space-related activities are doubled (from years 2021 to 2027).

KPI:

1. The number of project proposals evaluated above the threshold through the EU Horizon Europe programme in space-related activities (from years 2021 to 2027) – at least 40.

2. The number of project proposals financed through Seal of Excellence or equal national scheme (from years 2021 to 2027) – at least 12.

Result 8: Latvian researchers are included in the core science team of at least one ESA science mission, and are key authors of at least three published research papers based on ESA missions or data from ESA spacecrafts.

KPI:

1. The number of Latvian researchers included in the core science team of ESA science mission – at least 1 until 2027.

2. The number published research papers by Latvian researcher based on the data from the ESA spacecraft's – at least 3 until 2027.

Result 9: At least five new sustainable Earth Observation or navigation services (applications) that are based on advanced data analytics capabilities of space data are developed and integrated into the public or private sector and at least five Latvian companies operating in non-space markets have integrated space-based capabilities into their commercial service portfolio (e.g. civil/geotechnical engineering, consulting engineering, mining services, transport services, infrastructure providers, financial services).

KPI:

1. The number of Earth Observation or navigation services (applications) that are based on advanced data analytics capabilities of space data developed and integrated in the public or private sector – at least 5 until 2027.

2. The number of Latvian companies operating in non-space markets integrated space-based capabilities into their commercial service portfolio (e.g. civil/geotechnical engineering, consulting engineering, mining services, transport services, infrastructure providers, and financial services) – at least 5 until 2027.

Annex II Information about the images used in the Strategy

Sources:

- Image galleries of the European Space Agency (www.esa.int/ESA_Multimedia/Images and www.esa.int/Applications/Observing_the_Earth)
- "Image of the Day" gallery on the European Commission's Copernicus programme website (copernicus.eu; Image of the day) and Sentinel Hub.

Credit:

- Title page: A galaxy on edge (2020) ESA/Hubble & NASA, R. de Jong; CC BY 4.0; Acknowledgement: Judy Schmidt (Geckzilla)
- Executive Summary: Spirals are in this season (2020) ESA/Hubble & NASA, A. Riess et al.; CC BY 4.0; Acknowledgement: Mahdi Zamani
- Context of the Strategy - Global trends: Deforestation in Bolivia (2020) contains modified Copernicus Sentinel data (2019), processed by ESA, CC BY-SA 3.0 IGO http://www.esa.int/ESA_Multimedia/Terms_and_Conditions
- Context of the Strategy - European collaborative space programmes: Bay of Naples, Italy (2020) contains modified Copernicus Sentinel data (2017-19), processed by ESA, CC BY-SA 3.0 IGO http://www.esa.int/ESA_Multimedia/Terms_and_Conditions
- Participation in international space programmes: Weser river estuary and Bremerhaven port, Germany (2020) European Union, Copernicus Sentinel-2 imagery
- Science: The Anti-Atlas Mountains (2020) European Union, Copernicus Sentinel-2 imagery
- Space Industry: Ariane 5 liftoff (2020) John Kraus
- Downstream applications: Rīga, Latvija (2018) Copernicus Sentinel-2 imagery, contains modified Copernicus Sentinel-2 data, processed by Angelina Bekasova using Sentinel Hub
- Climate Change: Phytoplankton bloom in the Barents Sea (2020) European Union, Copernicus Sentinel-3 imagery
- Space governance: Liftoff for Cheops (2019) ESA - S. Corvaja
- Education and skills development: Tarpum Bay, Bahamas (2020) European Union, Copernicus Sentinel-2 imagery
- Entering in the space supply chain and international impact: Copernicus Sentinel-6 on display (2019) ESA - S. Corvaja
- Scientific and engineering research: Bepi before space (2020) ESA–A. Le Floch
- Governmental services: Tulips bloom (2020) European Union, Copernicus Sentinel-2 imagery
- Funding: Solar Orbiter liftoff (2020) ESA - S. Corvaja

Images have been modified (cut).