

space economy

SPACE BENEFITS

FOR EARTH

2025



CM25 Edition

EUROPEAN SPACE EXCELLENCE AS AN ENGINE OF EUROPE’S PROSPERITY, RESILIENCE AND INDEPENDENCE

In 2024, Europe's public expenditure in space accounted for just 0.07% of Europe's Gross Domestic Product (GDP) ^[1] yet this brings exceptional economic and societal benefits.

Space supports critical infrastructures and brings resilience to sectors such as transport, energy, food supply and public safety ^[2].

With funding equivalent to €15 per citizen from ESA Member States annually (compared to nearly €220 per citizen in the United States), the European Space Agency (ESA) plays a key role in driving European space capabilities. Space assets developed through ESA programmes grow Europe's space economy, support high-value-added jobs, foster innovation and critical skills. This secures Europe's strategic autonomy and safeguards its competitiveness in an increasingly complex economic and geopolitical context.

The €16.9 billion of subscriptions pledged at the ESA Ministerial Council in 2022 ^[3] are leading to industrial contracts and revenues to the European space industry, generating an estimated €22 billion of GDP and €6 billion of tax revenues ^[4]. These investments also support nearly 33 000 jobs per year primarily in high productivity sectors, including scientific research and development and manufacturing.

ESA programmes accelerate European innovation and lay the foundations for the commercialisation of space. In line with ESA's Strategy 2040, the Agency is committed to strengthening European industrial capacity and competitiveness by facilitating cost-effective and scalable production of cutting-edge space technologies. This approach enables new commercial markets to emerge and unlocks broader economic growth. Through strategic public-private partnerships, streamlined funding processes, and by promoting technology transfer, ESA strengthens and grows the thriving European space sector. This boosts startups and Small and Medium-sized Enterprises (SME) and attracts private investment.

Table of contents

Technology	4
Science	6
Exploration	8
Earth Observation	10
Navigation	13
Connectivity & Secure Communications	16
Commercialisation, Industry and Competitiveness	18
Space Transportation	20
Space Operations	22
Space Safety	24
References	26

An ESA production
October 2025

ISSN 0250-1589
ISBN 978-92-9221-162-2
Copyright © 2025 European Space Agency

TECHNOLOGY



IMPACT ON EUROPE'S INNOVATION AND RESEARCH

Advancing innovation and sustainability through next-generation space technologies

ESA's Technology, Engineering and Quality directorate drives new ideas, their adaptation and implementation, bridging research and industry. It stimulates multi-disciplinary research, incentivises investment in innovation, and supports the establishment of and access to state-of-the-art R&D infrastructures.

- Working on the development of flexible and miniaturised space electronics through coordinated funding from several ESA technology development activities (TDE, GSTP, ARTES), the French space agency CNES and the European Commission, French company NanoXplore grew its workforce from five to more than 150 staff over ten years (from 2014 to 2024), upskilling an entire space team^[5].
- Through an ESA Discovery funding of €175 000 supporting research on additive manufacturing, Italian University of Tor Vergata developed skills and experience which allowed them to further secure a €1 million funding in a non-space supply chain for further development of the process^[6].

As outlined in ESA Technology 2040^[7], Europe must ensure that its space companies are leaders in innovation and sustainability. ESA's Technology directorate leads the development of cutting-edge technologies that support a circular and sustainable space economy.

These include reusable launch systems, in-orbit servicing capabilities for satellite recycling and refurbishment, and the use of demisable materials designed to reduce space debris.

- Led by British SME, Kayser Space, a project funded through ESA Discovery worked towards developing renewable nutrient sources in space to reduce the food that needs to be transported for long-duration exploration missions. The activity involved British companies Cellular Agriculture and Campden BRI, both active in the food industry and successfully entering the space sector for the first time. The project led to intellectual property (patent filed), follow-on funding of nearly €1.8 million from UK research funds and invaluable research towards terrestrial systems for sustainable food production^[8].



Large Space Simulator



IMPACT ON EUROPE'S STRATEGIC AUTONOMY

Securing Europe's technological sovereignty and security of supply

ESA Technology activities include the assessment and monitoring of critical dependencies to reduce reliance on non-European suppliers and technologies. They enable the European space industry to mature key technologies and products to the performance and competitiveness levels required for future market demands.

- In the era of digital engineering, Model-Based Systems Engineering is one of ESA's technology priorities. It is supporting an estimated benefit for Europe's space industry of €2.6 billion between 2023 and 2032, generated from both time and cost savings related to information management^[9].
- ESA-funded technology activity (through ESA's Technology Development Element programme)

enabled the development of the first European shaped mesh reflector antenna, optimising satellite-based communications and observations. Led by German company Large Space Structures (LSS) and its Danish subcontractor, TICRA, the AMPER activity filled a technological gap for Europe whilst strengthening the supply chain^[10].



Bepi Colombo Laser Altimeter

The remarkable value of technology transfer

Space technologies fall into many categories: materials; hardware and software; automation and robotics; electronics, sensors and optics; communications; power and energy devices. ESA's Technology Transfer activities play a vital role, allowing the commercial use of space technologies for non-space applications, leading to innovative products which often improve everyday life.

- Thanks to research funded by ESA, Swiss company CSEM explored space-grade medical technologies for use in everyday healthcare. This led to ELAINE, a revolutionary technology to achieve accurate foetal monitoring at home. The research represents a paradigm shift in prenatal care and targets the €190 billion telehealth market^[11].

SCIENCE

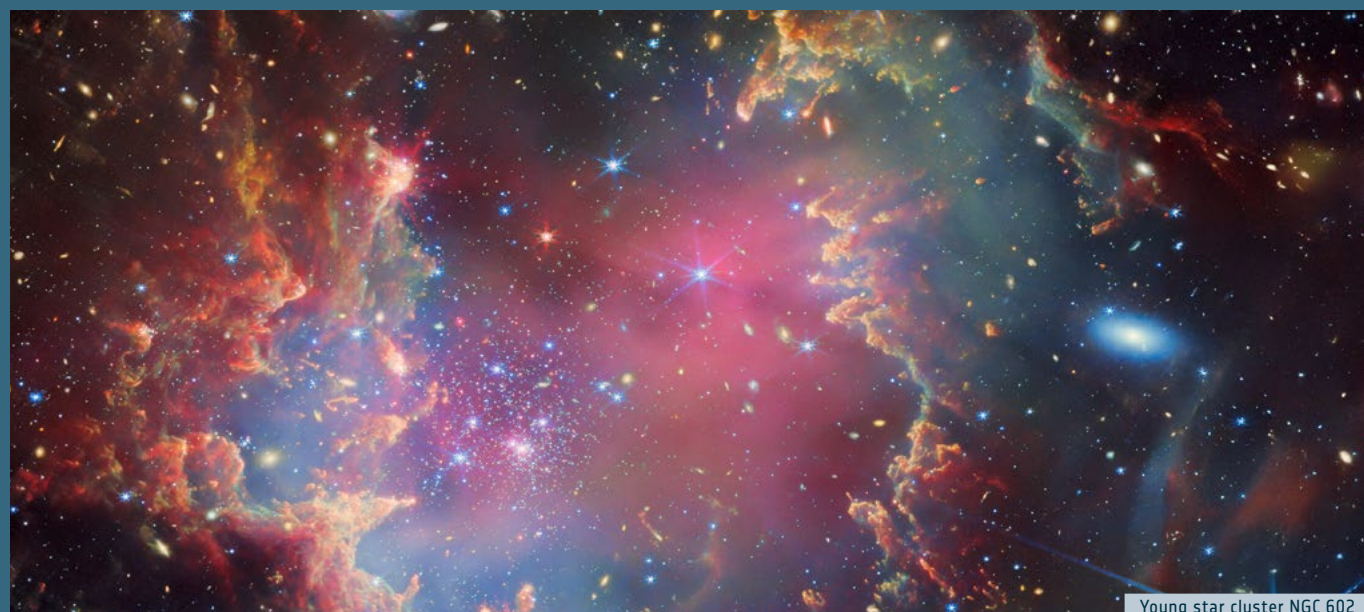


IMPACT ON EUROPE'S
INNOVATION AND RESEARCH

Empowering Europe's scientific and innovation leadership

At the heart of Europe's presence in space lies a unique and enduring commitment to scientific investigation and discovery. ESA's Science programme stands as the cornerstone of this commitment. It is built around a vision of European excellence and leadership, putting Europe's scientists and engineers at the forefront of global innovation. Through world-class space missions in astrophysics, cosmology, planetary science, heliophysics, and fundamental physics, the programme addresses some of the most profound questions of our time. It seeks to understand the complex rules that govern our Universe, probes the formation and evolution of our Solar System, and ultimately, helps us understand our place in the cosmos. The Science Programme also plays a central role in fostering international partnerships and scientific cooperation. In close collaboration with leading global agencies and with the international research community, ESA ensures that Europe contributes to and shapes the world's most ambitious scientific endeavours.

- In 2024, ESA-led science missions enabled more than 3700 publications. Scientific research based on these missions has shown growth of more than 100% in the past ten years^[12].
- In addition, more than 1800 publications were produced in 2024 based on partner-led missions, of which 1000 from Hubble Space Telescope and more than 700 from James Webb Space Telescope. Remarkably, nearly 40% of the publications based on James Webb in 2024 were led, as first authors, by scientists in ESA Member States.
- Large-scale science missions can continue to deliver benefits over long periods. Gaia, the ambitious European mission launched in 2013 to chart a three-dimensional map of our Galaxy, has led to more than 13 500 publications by 2024.



Young star cluster NGC 602

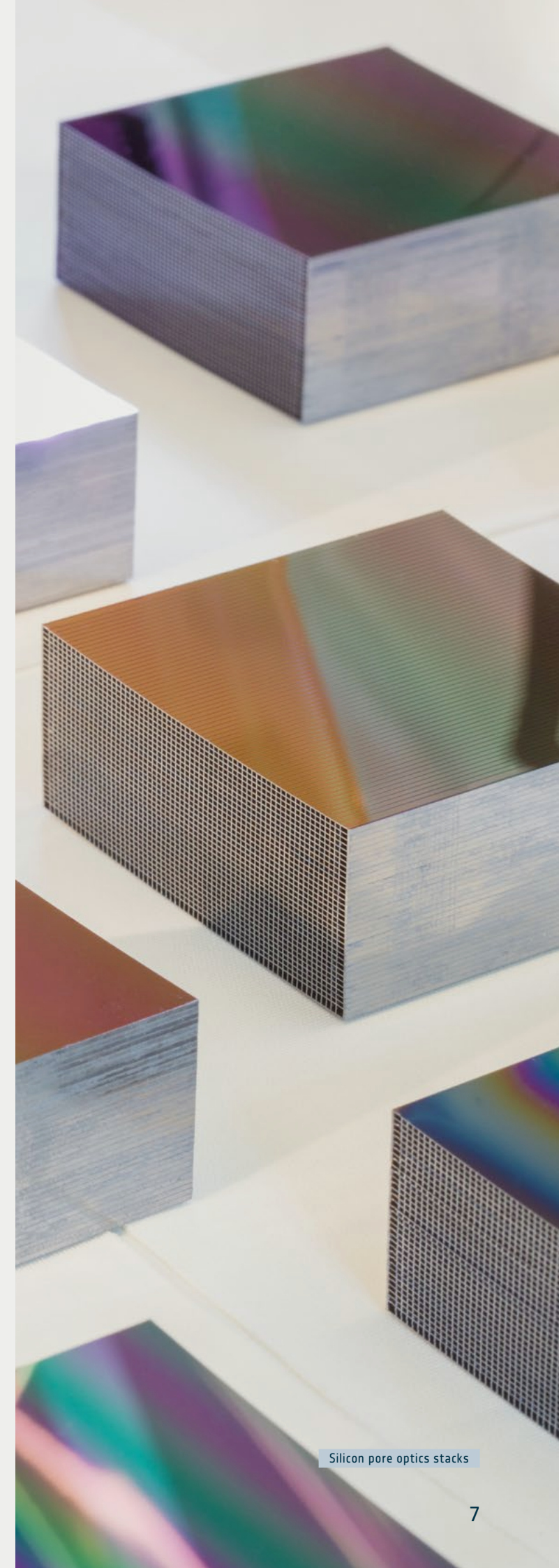


IMPACT ON EUROPE'S
STRATEGIC AUTONOMY

Turning scientific excellence into a strategic advantage

Space science is also a major driver of technological sovereignty, leading to the development of unique capabilities, strengthening Europe's supply chains and their strategic autonomy. ESA's space science missions power the development of advanced technologies which support new markets and applications on Earth, such as precision mapping, quantum tools, and medical devices.

- With technology development support from ESA, Dutch company Cosine, leveraged semiconductor manufacturing capabilities to deliver Silicon Pore Optics, the largest X-ray optics ever built. The technology gives Europe a key competitive advantage, securing Europe's leadership on a critical technology, and becoming a unique supplier on the international market^[13].
- Using a unique low-expansion material which is extremely stable, German company Jena-Optronik led the development of ASTRO XP, a state-of-the-art autonomous high-accuracy star tracker. The project, supported by ESA funding, enabled the development of a unique European solution which is highly competitive on the global market. This brought new capabilities to European industry and ensures Europe's access to a critical technology that is not dependent on other countries^[14].



Silicon pore optics stacks

EXPLORATION



IMPACT ON EUROPE'S STRATEGIC AUTONOMY

Leading Europe's human journey into the Solar system

Terrae Novae, ESA's Exploration Programme, delivers Europe's space exploration strategy. As outlined in ESA Explore2040^[15], strategic autonomy is set as a priority, allowing Europe to define its own exploration capabilities and partnerships.

- *Contracts signed in 2024 with The Exploration Company based in Germany, and Thales Alenia Space based in Italy for the development of a European cargo return service to low orbit were a key milestone^[16]. This enables ESA to continue its exploration endeavours and strengthens the independence of European industry in the future low orbit economy.*

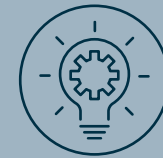


IMPACT ON EUROPE'S COMPETITIVENESS

Unlocking market opportunities from space exploration capabilities

ESA's space exploration programme also impacts Europe's competitiveness through commercialisation activities. The Business in Space Growth Network (BSGN) fosters Europe's competitiveness by actively supporting the emergence of new market opportunities, investigating space exploration commercial services, stimulating demand from terrestrial industries through the demonstration of use cases, and leveraging private investment.

- *The BSGN establishes collaboration with key industries, supporting innovative projects notably in biotech, agriculture, and advanced materials.*
- *As of 2025, nearly €80 million of non-ESA investments have been secured for the development of space exploration commercial services^[17].*



IMPACT ON EUROPE'S INNOVATION AND RESEARCH

Fuelling European innovation through scientific breakthrough

Space exploration contributes significantly to Europe's generation of research. Space is the ultimate laboratory. Its microgravity, extreme temperatures, and radiation exposure enable breakthroughs unobtainable on Earth – from revolutionary pharmaceuticals and materials to quantum physics and AI driven robotics. The very act of overcoming these challenges accelerates technologies with immediate terrestrial applications: miniaturised medical devices, disaster-resistant infrastructure, and sustainable closed-loop life-support systems^[18].

- *In 2024, ESA's SciSpacE supported nearly 140 research projects in physical and life sciences. These involved 1800 scientists from 38 countries and 41 industry researchers from 12 nations. More than 80% of participants came from Europe and Canada. These efforts led to nearly 160 scientific publications, including 70 peer-reviewed papers.*
- *ESA's Terrae Novae exploration missions also enable scientific firsts. In 2023, ESA's ExoMars Trace Gas Orbiter which arrived at Mars in October 2016, enabled the most detailed analysis of Martian atmospheric gases, resulting in the publication of more than 40 research papers^[19].*
- *Space exploration also inspires future European generations towards science and technology. In 2024, ESA space exploration educational activities reached 86 000 teachers and nearly two million students.*

Space exploration from the eyes of European citizens

A survey on the public perception of space exploration was conducted end of 2024^[20]. Results showed the inspirational value of European space exploration in supporting STEM-qualified workforce and public attitude towards science, research and global cooperation. Key findings included:

- *Europeans identify several benefits from space exploration, in particular the ability to improve scientific progress (88%) and develop useful technologies for life on Earth (84%).*
- *85% believe that sending astronauts from their country into space helps to motivate the younger generations to study science and technology and creates a positive view of technological cooperation between countries.*
- *Europeans prioritise Europe's capacity to send European astronauts into space (78%), and also to the ability to send cargo ships and return them to Earth without depending on other space powers (77%).*



Rehearsal at the LUNA facility



Sunlight from the International Space Station

EARTH OBSERVATION



IMPACT ON EUROPE'S
RESILIENCE AND
STRATEGIC AUTONOMY

Providing critical information for Europe by European means to benefit citizens and meet future challenges

ESA's Earth observation [EO] programmes enhance Europe's resilience by providing independent and reliable satellite data and assets that notably support climate monitoring, disaster management, sustainable agriculture, ecosystem protection, and security applications.

- *ESA's climate data support policymakers with global permafrost mapping and long-term monitoring, help predict coastline changes and assess risks like ground instability. By 2100, 21% of Arctic permafrost settlements may face erosion damage, 45% affected by sea level rise, and 77% may sit on unstable, crumbling and subsiding ground^[21]. Through projects like the Permafrost Climate Change Initiative, ESA enables informed climate adaptation and sustainable practices in vulnerable regions such as the Arctic.*
- *ESA's EO missions have revolutionised how Europe observes its water cycle, feeding powerful virtual models to anticipate droughts, design flood responses, and model future climate scenarios. In October 2024, Valencia's catastrophic floods underscored the critical role of Earth observation for rapid disaster response^[22]. ESA's satellites, notably Copernicus Sentinel-1 and Sentinel-2, mapped over 15 000 hectares of flooded land, affecting an estimated 190 000 people in Valencia province, effectively aiding emergency services in prioritising rescue and recovery efforts. The Copernicus Emergency Management Service and the International Charter 'Space and Major Disasters' provided rapid and detailed flood assessments, while data from ESA missions like SMOS and Third-Party Missions offered essential insights into soil moisture and damage.*
- *Earth observation also plays a crucial role in fighting wildfires^[23] by delivering real-time imagery and thermal data to track fire spread, assess risks, and support emergency response efforts. This capability was recently demonstrated in the case of the Iberian wildfires in August 2025 monitored by the Copernicus Sentinels, and for which the Copernicus Emergency Mapping Service was also activated.*

Copernicus strengthens Europe's strategic autonomy by reducing dependence on non-European geospatial data and boosts resilience in critical sectors like civil protection, climate monitoring, agriculture, and external action.

- *The public uptake of Copernicus Sentinel data^[24] made available nearly 150 million user-level data on the Copernicus Data Space Ecosystem by September 2025, with over 12.6 billion Sentinel products downloaded from ESA's data sites by March 2025. Registered users collectively downloaded nearly 770 PiB of data (1 PiB Pebibyte = 2^{50} bytes). To put this into perspective, the total volume of Earth observation data from the pre-Copernicus era was just below 6 PiB. Thematic domains of the data downloaded ranged from atmosphere, climate, land, emergency, and security, demonstrating the remarkable reach and strategic value of Copernicus.*
- *Examples of Copernicus ensuring Europe's resilience include nearly €40 million of annual benefits for monitoring the quality of inland waters in the Netherlands; over €30 million of annual savings in wind farm financing across Europe; and approximately €100 million of benefits per year supporting Finnish industry navigating the Baltic Sea in winter^[25].*



IMPACT ON EUROPE'S
INNOVATION AND RESEARCH

Pioneering R&D and paving the way towards groundbreaking scientific discoveries

The FutureEO programme constitutes the backbone of ESA Earth observation activities. The programme has a remarkable impact on Europe's research and innovation, acting as a pathfinder for breakthrough technologies and leading to groundbreaking scientific discoveries revolutionising our ability to study the Earth and addressing key societal needs. The programme paves the way from initial research and development to the implementation of large-scale operational missions, such as the Copernicus constellation and EUMETSAT's meteorological missions.

- *ESA's decade-long investment in advanced deployable reflector technology culminated in a first-of-its-kind large deployable antenna tailored for Earth observation missions. The successful European industrial partnership was awarded €125 million follow-on funding to mature and provide the technology for the Copernicus Expansion Mission CIMR, dedicated to monitoring global change, delivering critical insights for a sustainable Arctic and supporting climate action^[27].*
 - *ESA's Earth observation programmes provide free and unrestricted access to data products for the scientific community, fully supporting Open Science and encouraging users to collaborate and share best practices.*
 - *In 2024, nearly 4300 scientific publications were based on data from European EO missions, in particular Sentinels (excluding Sentinel 6), Heritage, Meteo, Earth Explorers and Earth Watch missions.*
- *Aeolus, ESA's fifth Earth Explorer mission, filled key gaps in global wind profile data, especially over the poles, oceans, and upper troposphere, reducing errors in Numerical Weather Prediction and improving forecasts. Its benefits are valued at up to €3.5 billion over its lifetime^[26].*





IMPACT ON EUROPE'S COMPETITIVENESS

Allowing European EO industry to thrive in the market

Accounting for nearly 15% of public investment in 2024, Earth observation is a cornerstone of global space activities. Driven by both civil and defence priorities, the EO market has followed a continuous growth trend in the past decade. ESA's Earth observation programmes support Europe's competitiveness by fostering innovation, leadership, and access to private capital.

- Funded through FutureEO, a new hybrid accelerometer, combining an electrostatic accelerometer with a novel quantum sensor, is allowing better measurements that will improve the resolution of future satellite gravity missions such as ESA's Next Generation Gravity Mission (NGGM). The €500 000 ESA funding for the French research centre Onera and the German Technical University of Munich to develop this state-of-the-art technology supported them in securing a role in a €17 million European Commission project^[28].
- In 2024, European EO companies overall captured over 60% of the global EO private funding. ESA's InCubed programme plays a pivotal role in supporting Europe's competitiveness in the EO market, and its access to capital. A prime example is OroraTech, a German startup which developed and launched a cutting-edge wildfire detection satellite network. InCubed's co-funding and technical support facilitated OroraTech's transition into upstream data acquisition, enhancing the performance of its wildfire monitoring services and contributing to its commercial success. In the past year, OroraTech has signed close to €100 million in commercial contracts and venture capital.



Copernicus Sentinel-5

NAVIGATION



IMPACT ON EUROPE'S RESILIENCE AND STRATEGIC AUTONOMY

Towards a secure and robust navigation and timing infrastructures

European Global Navigation Satellite System (GNSS) capabilities contribute directly to Europe's strategic autonomy, providing Europe and its citizens with sovereign access to high-precision PNT (Position, Navigation and Timing) services. PNT fuels our society, generates economic growth and is integral to our security and autonomy.

- Europe's Galileo, is the world's most precise GNSS system, delivering metre-level accuracy to more than five billion users. It is critical across numerous industries and applications such as safe flight operations and landing procedures in aviation or vessel navigation and port operations in maritime transport. It is also fundamental for modern infrastructure, enabling electrical grid synchronisation, financial transaction timestamping and logistics optimisation. As new applications emerge, so does the need for more sustainable, reliable, accurate and available satellite navigation.
- Today's evolving geopolitical landscape calls for a more resilient system as GNSS signals are increasingly subject to vulnerabilities such as interference and spoofing. Galileo operates in medium Earth orbit and is set to be reinforced with a complementary constellation of satellites in low Earth orbit (LEO). As part of the FutureNAV programme, ESA's Celeste mission will demonstrate LEO-PNT in orbit to evaluate how it can strengthen resilience, expand signal availability and diversity, and unlock new PNT service capabilities. The first two In-Orbit Demonstrator satellites will be qualified for launch by end of 2025 to perform key in-orbit experiments in the first half of 2026. LEO-PNT capabilities to be demonstrated by Celeste are expected to deliver nearly €15 billion in economic benefits for Europe between 2032 and 2050^[29].



Mega-constellation coverage



IMPACT ON EUROPE'S COMPETITIVENESS

Securing Europe's share in the fast-growing PNT sector

The satellite navigation market is the largest downstream space sector and is expanding rapidly. Europe already holds over 20% of the market and is positioned to capture an even greater share^[30]. Since its inception in 2017, ESA's Navigation Innovation and Support Programme (NAVISP) has been central to unlocking this potential. By fostering commercialisation, product development and reducing R&D risk, NAVISP has become a catalyst for commercial innovation in the PNT sector.

- The programme has implemented more than 350 projects, engaging over 300 companies (mostly SMEs) and research organisations across multiple domains. 56% of the companies are from the non-space sector^[31].

- Companies working with NAVISP have reported strong market impact: Over 70% have either commercialised their developments or plan to do so.
- 84% of participants indicated they were able to identify new business opportunities through partnerships and collaborations developed within the NAVISP programme.
- In the automotive sector for example, NAVISP has engaged a broad spectrum of actors across the entire value chain, from global manufacturers such as Volvo and Jaguar Land Rover to Tier-1 suppliers, chipset manufacturers, innovative SMEs, and agile startups. Projects span innovations in antenna design, resilient chipsets and receivers, and hybrid PNT solutions, enhancing system robustness and reliability.

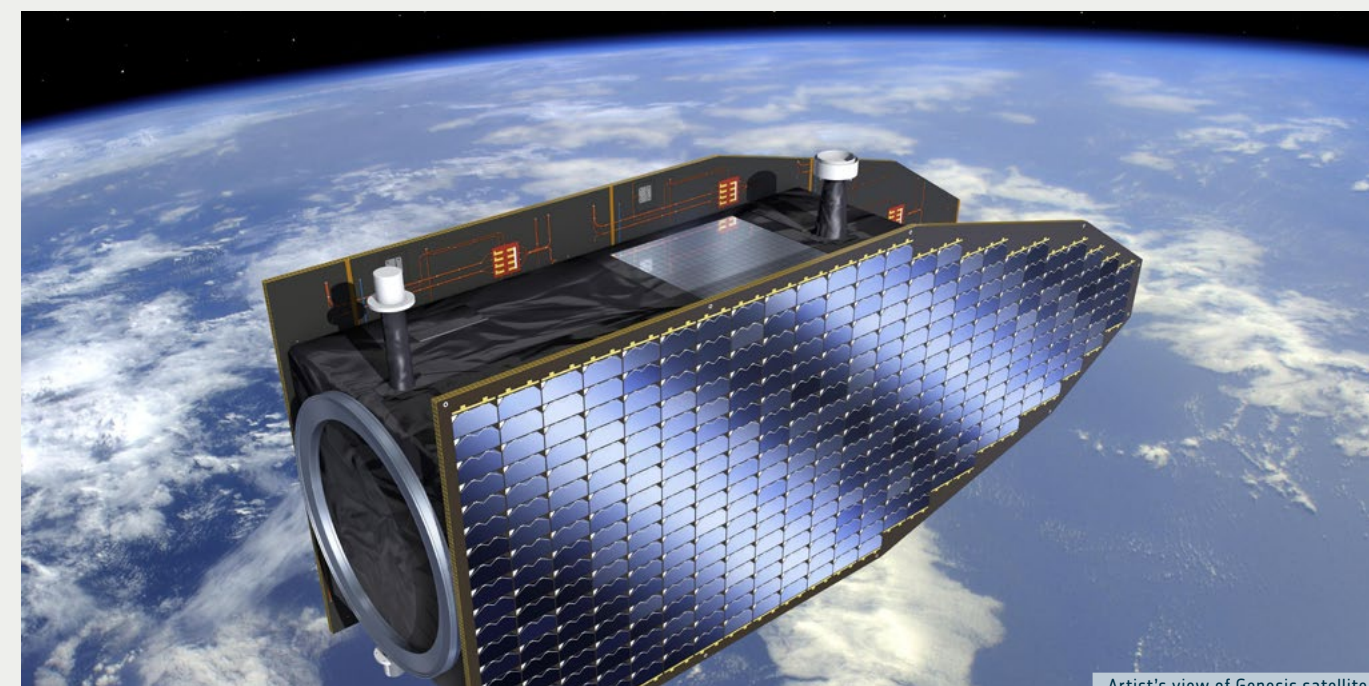


IMPACT ON EUROPE'S INNOVATION AND RESEARCH

Driving technologies with the potential to revolutionise the field of positioning, navigation and timing

Europe is a leader in today's satellite navigation technological landscape. To lay the foundation for tomorrow, ESA explores, matures and validates novel technologies and system concepts through various programmes, among them FutureNAV.

- ESA's Genesis, planned for launch in 2028, is a unique satellite mission designed to contribute to an ultra-precise terrestrial reference frame with 1 mm accuracy and 0.1 mm/year stability. An improved terrestrial frame will have immediate benefits on satellite-based navigation, impacting Galileo-enabled applications for transportation, construction, infrastructure, process control, surveying and mapping. This will benefit countless other fields like climate change research, environmental monitoring and precision geodetic applications. The Genesis Science Exploitation Team involves about 130 scientists and more than 60 scientific institutions worldwide.
- The OpSTAR study, kicked off in January 2025, aims to demonstrate the use of optical inter-satellite links to improve future satellite navigation PNT systems. It does this by providing precise time synchronisation and ranging between satellites, thereby enabling a multi-layer PNT system of systems. A concept definition study and technology predevelopment are being conducted involving 35 companies from across Europe, maintaining Europe at the forefront of innovation for future navigation concepts.



Artist's view of Genesis satellite

CONNECTIVITY & SECURE COMMUNICATIONS



IMPACT ON EUROPE'S COMPETITIVENESS

Securing the future of Europe's competitiveness in satellite-enabled telecommunication

ESA aims to sustainably strengthen Europe's satellite communications and increase competitiveness through activities in its Connectivity and Secure Communications directorate. The ARTES programme (Advanced Research in Telecommunications Systems) helps to transform investment in research and development into successful commercial products and services.

- Between 2020 and mid-2025, every €1 invested through ESA ARTES 4.0 and legacy projects supported the generation of nearly €7 in industrial revenues.
- This success is underpinned by strong private sector engagement: since 2020, ARTES-backed activities attracted over €700 million in co-funding from industry.

As satellite communications remains one of Europe's most valuable commercial space markets, accounting for nearly half of downstream revenues, ARTES ensures that European companies maintain technological leadership and can compete globally in a rapidly evolving domain.

- The HummingSat Partnership Project, supported by ESA since 2014, enabled Swiss company SWISSto12 to develop a new class of small, low-cost geostationary satellites. Lighter and ride-share compatible, these satellites boost industrial agility, strengthen the supply chain, and position SWISSto12 as a new European satellite prime, reinforcing Europe's competitiveness and autonomy in the satellite communications market^[32]. SWISSto12 have since announced contracts for five satellites with three different customers.



IMPACT ON EUROPE'S RESILIENCE

Addressing the needs of civil security and crisis management

Effective disaster management is crucial for protecting lives, infrastructure, and society from increasingly complex and frequent emergencies. ESA's Connectivity and Secure Communications directorate is advancing the integration of satellite technologies into Europe's communication networks to accelerate the deployment of 5G and 6G, while ensuring secure space-based systems for routine and crisis management.

- Through the Civil Security from Space (CSS) programme, ESA leverages cutting-edge optical and quantum communication technologies to enable fast, secure data exchange, supporting governments and civil security agencies in monitoring, mitigating, and responding to emergencies. These technologies enhance societal resilience and empower European industry to deliver critical tools for civil security and emergency response^[33].

ESA's Space Systems for Safety and Security (4S) strategic programme line aims to support European and national institutions and public bodies as well as public regulated sectors in building satellite communications tailored to their needs, while also maintaining Europe's position at the forefront of the global secure communications market.

- The EURIALO project is a 4S project that is developing a space-based, GNSS-independent aircraft surveillance system led by German company Spire Global. This innovative system will track aircraft using the principle of multilateration (MLAT), which determines an aircraft's position by analysing the arrival times of its radio frequency (RF) signals from a constellation of satellites. This project marks a significant and critical advancement in air traffic safety, security, and the sustainability of air travel^[34].



IMPACT ON EUROPE'S INNOVATION AND RESEARCH

By driving leading-edge technologies, Europe can stay competitive and secure

The Advanced Technology programme is part of ESA's ARTES 4.0 Core Competitiveness. It supports the long-term competitiveness of European and Canadian industry in the telecommunications market through preparatory development of satellite communications, and funding R&D activities addressing innovative technologies and techniques.

A few examples of how ARTES 4.0 has boosted Europe's innovation and research is as follows:

- Since 2020, over 3700 partnerships have been established and 92 patents filed as a result of ARTES 4.0 activities. These showcase the technological advancements and the creation of new intellectual property enabled through ESA partnerships with industry and academia.
- Developed by Belgian company ST Engineering iDirect, the Mx-DMA MRC allows real-time allocation of satellite capacity. This provides flexibility and scalability to network operators and unprecedented service agility. Funded under ARTES Core Competitiveness, the project led to the creation of valuable intellectual property with a fully patented technology and strengthened Belgium's role in satellite communications^[35].
- In July 2025, ESA partnered with the Centre for Doctoral Training in Future Open SecuRe NeTworks (CDT-FORT), an initiative led by British University of Surrey and Queen's University Belfast. In an increasingly interconnected world, the need for open, secure, and resilient communication systems has never been more critical. This Centre supports the development of skills across wireless communications, cybersecurity, networking and artificial intelligence, securing a critical expertise for the next generation of talents^[36].

COMMERCIALISATION, INDUSTRY AND COMPETITIVENESS



IMPACT ON EUROPE'S COMPETITIVENESS

Enabling space startups to attract talent and capital

ESA boosts European growth and competitiveness by positioning Europe as a commercial hub through its Directorate of Commercialisation, Industry and Competitiveness. ESA promotes and supports new and established companies, technologies from all space domains, and successful use cases in space and non-space industries. These commercialisation activities have a primary impact on Europe's competitiveness.

- Launched following ESA's Ministerial Council in 2022, ESA's Investor Network now has over 70 members. Members have collectively invested more than €1 billion in private capital in the European space sector between 2024 and 2025. By connecting space companies and investors, including banks and venture capital, ESA directly addresses one of the largest barriers to commercialisation: access to capital^[37].

- As part of ScaleUp INVEST, the ESA Marketplace provides financial support to help companies build customer base and strengthen market credibility. It engaged with more than 200 entities in 2025, enabling faster market entry and attracting investment. €16 million of co-funding was deployed to industry, combined with €17 million of funds from customers, leading to a total of €33 million awarded to industry. In addition, 40% of supported companies raised private capital after their ESA Marketplace contract totalling approximately €160 million^[38].
- ESA's Business Applications and Space Solutions (BASS) is geared towards supporting Europe's competitiveness through the exploitation of space technologies and data, accompanying their adoption and utilisation amongst a variety of users well beyond space. Since 2020, the programme has supported the delivery of competitive space-based solutions in many markets, implementing over 200 demonstrations, leading to more than 1000 partnerships created. The programme significantly supports companies improving their market position, with more than 60% of revenues generated on export markets^[39].



IMPACT ON EUROPE'S INNOVATION AND RESEARCH

Unlocking sustainable innovation through space-based solutions

Ranked second among European incubator networks and tenth globally by the Financial Times^[40], ESA Business Incubation Centres (ESA BICs) form the world's leading space-related business incubation network, with over 35 centres in 23 European countries, and more than 100 locations by 2025.

- Since its launch in 2005, ESA BICs have incubated nearly 2000 startups, which collectively generated more than €230 million in revenue and contributed to the creation of more than 5000 full-time jobs by 2023. Between 2020 and 2023, these startups raised nearly €1.3 billion in private investment and were granted close to 600 patents, reflecting their strong innovation and impact on the space sector^[41].

ESA's BASS programme provides funding opportunities for sustainable space-based integrated applications and solutions. The portfolio of BASS partners currently includes more than 50 private and public non-space actors, including corporate players from industries such as agriculture, forestry, energy and utilities, environment and wildlife, sport and tourism, transport and logistics, smart cities, or maritime.

- OWASIS, a company supported by BASS, has developed a commercially viable service combining Earth observation and satellite navigation data to deliver insights on real-time water availability. By offering cost-effective, scalable solutions for flood prediction and irrigation planning, OWASIS demonstrates how incubated companies can turn space technologies into market-ready services in the international landscape^[42].



SPACE TRANSPORTATION



IMPACT ON EUROPE'S
STRATEGIC AUTONOMY

Safeguarding Europe's independent access to space

The development and continued exploitation of space transportation services are essential capabilities for Europe to leverage space exploration, space science, and space applications for the wider benefits of Europe. As a critical enabler, ESA's Space Transportation activities ensure Europe's strategic autonomy in accessing and using space.



IMPACT ON EUROPE'S
COMPETITIVENESS

Supporting Europe's competitive position in a challenging market

ESA's Space Transportation activities support the development of Europe's launch, in-space and return-from space transportation capabilities in a challenging market environment. This safeguards Europe's competitive position in meeting institutional and commercial needs, in Europe and in key export markets.

→ In April 2022, Amazon signed a contract with Arianespace for 18 Ariane 6 launches to deploy several of the project Kuiper constellation satellites, representing the largest contract ever signed by the European launch service provider. The contract allowed Europe to capture a nearly 25% market share of launch order value in 2022^[43].



IMPACT ON EUROPE'S
INNOVATION AND RESEARCH

Fuelling innovation in European space transportation

Space transportation is part of an ecosystem of research, technology, industrial capability and services which need to respond to changing institutional and commercial mission requirements and financial models. ESA enables Europe's space transportation solutions and innovation in every part of this ecosystem.

→ The Ariane 5 and Vega programmes led to substantial advancements, driving new technological capabilities, advanced design and analysis capabilities, new manufacturing and software techniques, including new process developments. They led to the valuable development of Intellectual Property (at least 80 patents reported), more than 150 scientific publications, and internal spin-offs, exploiting the technologies developed within other business lines, both space and non-space (for example for tactical propulsion and aircraft components and parts)^[44]. These benefits will continue to accrue in Europe through the ongoing Ariane 6, Vega C and Vega E launch vehicle development programmes.

ESA's Future Launchers Preparatory Programme (FLPP) supports European industry in developing the technologies, systems, and partnerships needed for a modular, reusable and commercially viable space transportation ecosystem

→ One FLPP activity, the FIRST! campaign (Future Innovation Research in Space Transportation) identifies and de-risks breakthrough ideas for future space transportation. Over 70% of proposals to its first call came from startups, with nearly half of the top-ranked ideas led by them, highlighting its role in attracting new talent and boosting Europe's innovation and competitiveness in space^[45].



SPACE OPERATIONS



IMPACT ON EUROPE'S STRATEGIC AUTONOMY AND COMPETITIVENESS

Securing crucial capabilities for Europe to fly its missions while supporting the emergence of European market leaders

ESA's Operations directorate provides the mission operations infrastructure that is a key strategic asset for ESA and its Member States – and is unique in Europe. Europe's centre for satellite operations hosts the teams that control spacecraft and build ground systems. For over 50 years, it has been securing the independent capability to fly Europe's missions for planetary science, Earth observation, astronomy, fundamental physics, exploration and space safety, crucial to Europe's autonomy as a space power.

The investments made by ESA's Directorate of Operations have positively impacted the European space industrial ecosystem, enabling growth, supporting the creation of new capabilities, and leading to commercial successes.

- Cooperating with ESA, Spanish company GMV has become a world leader in satellite ground segment technology, powering nearly 1000 satellites including Galileo and OneWeb. Expanding across



Izaña-1 laser ranging station

Europe, the United States, Colombia and Malaysia, GMV is today amongst the largest European space employers.

- Founded in 2014, German company DiGOS gained international recognition through its partnership with ESA, securing its first ESA contract just four years later. By 2023, DiGOS developed advanced laser ranging stations for ESA, the Japan Aerospace Exploration Agency (JAXA), and the Galileo programme, driving innovation in satellite and space debris tracking. In 2024, DiGOS was honoured as one of ESA's 21 Rising Stars, highlighting its rapid growth and industry impact^[46].

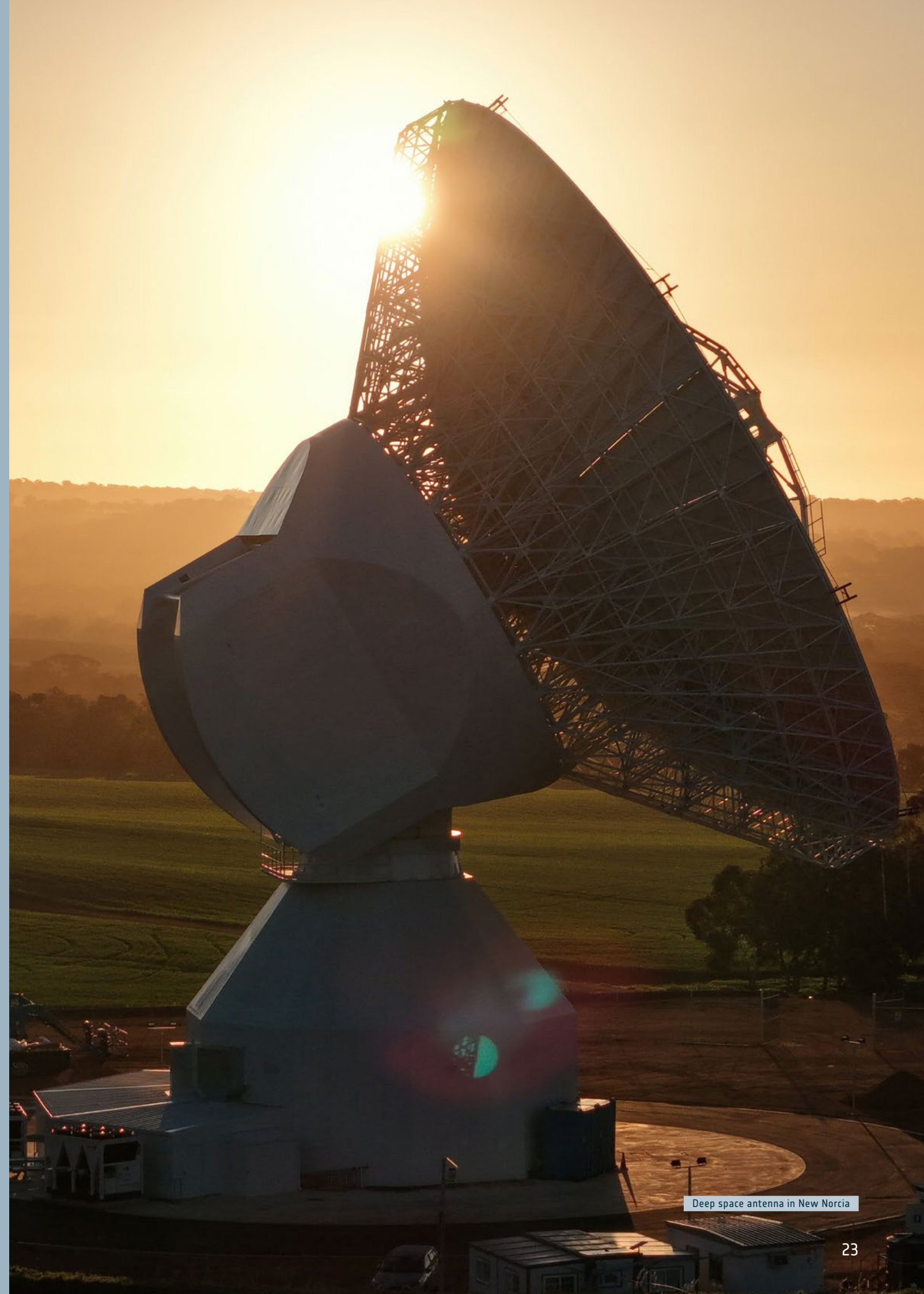


IMPACT ON EUROPE'S INNOVATION AND RESEARCH

Revolutionising space operations with cutting-edge technologies

Space operations at ESA pioneers the development of cutting-edge technologies using active intelligence technology for applications in ground systems engineering and operations. Current focus includes the adoption of artificial intelligence and optical communication to provide new world-leading capabilities in operations. This innovative approach improves efficiency, productivity, and service quality, while also enabling new industrial businesses and knowledge sharing between institutions, universities, and industry.

- On 7 July 2025, ESA marked an historic milestone by establishing its first optical communication link with a spacecraft in deep space^[47]. The link was made with NASA's Deep Space Optical Communications (DSOC) experiment aboard its Psyche mission, currently at a distance of 1.8 astronomical units, about 265 million km. The first successful demonstration of deep-space optical communication with a European ground segment marks a leap forward to bringing terrestrial internet like high-speed connectivity to our deep-space spacecraft.



Deep space antenna in New Norcia

SPACE SAFETY



IMPACT ON EUROPE'S
RESILIENCE AND
STRATEGIC AUTONOMY

Protecting our planet, humanity and assets in space

ESA's Space Safety programme protects people and infrastructure from hazards originating in space like debris, asteroids, and space weather events. ESA's Space Weather Service Network already connects over 50 expert centres, offering more than 300 products and tools, maintaining 95% service availability, and supporting more than 5000 registered users. This robust Research-to-Operations-to-Research (R2O2R) framework helps de-risk and industrialise new capabilities. Vigil, Europe's first deep-space operational space weather mission planned to launch in 2031, will be a strategic asset strengthening European autonomy and competitiveness in space safety by enabling early warning of extreme solar events.

Its timely development through integration, testing, and service deployment ensures European leadership in operational space weather capabilities. It bridges the gap between research and industry, and secures resilience for critical infrastructures that could be impacted by space weather events.

- Europe's critical infrastructures are highly vulnerable to space weather events. At the global level, available estimates suggest that a single extreme space weather event could cause an economic loss of more than \$2 trillion^[48]. Infrastructure disruptions and blackouts in turn affect public safety, causing additional considerable economic losses to industries and households as well as societal damages such as delays in emergency services.

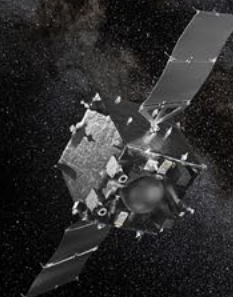


Vigil in deep space

ESA's Space Safety missions like FlyEye, NEOMIR and RAMSES, are progressively building independent capabilities for detection, tracking, and response, enhancing readiness in planetary defence.

Projects such as EcoSTAR and ESA Resilient In-Orbit Servicing (RISE) accelerate eco-design and pave the way for circular economy missions that refurbish and recycle, reducing lifecycle costs and environmental impact.

- All in-space infrastructures critical in providing vital data are exposed to space debris, posing a great risk for both the ground and space segments. The OECD estimated the global value of economic activity at risk to exceed \$190 billion^[49]. Since 2022, ESA has been advancing on two parallel tracks to drive increased global ambitions on space debris mitigation and remediation: ensuring Zero Debris ESA missions after 2030; and supporting community action through the Zero Debris Charter (counting 182 signatories from 33 countries as of September 2025) and the Zero Debris Technical Booklet.



Ramses mission to asteroid Apophis



IMPACT ON EUROPE'S
COMPETITIVENESS

Shortening technology gaps to unlock market opportunities

Space Safety activities support the European space industry to access future market opportunities.

- ESA activities to build greener satellites (EcoSTAR) and extend their life in space through in-orbit servicing (RISE) will drive global demand for European capabilities.
- ESA's space weather nanosatellite missions are projected to generate demand worth more than €2 billion in Europe for the provision of space weather data and services. These developments are positioning Europe at the forefront of a rapidly growing global market, expanding the portfolio of unique European capabilities^[50].
- ESA's Laser Tracking technologies are expected to establish the technical foundation for future laser-based SST tracking services. They will close the gap on the best tracking radars in the US, achieving on-par performances (in terms of the size of object tracked) or even better performances (such as about 10 times better accuracy)^[50]. ESA's Laser Tracking capabilities are foreseen to benefit 24 European satellite operators and nearly 490 European satellites with civil (including institutional and academia), military and commercial purposes.

REFERENCES

[1]ESA, ESA Report on the Space Economy, 2025.

[2]OECD, The Space Economy in Figures: Responding to Global Challenges, 2023.

[3]ESA, CM22 Subscriptions, Presentation for the Press Conference, 2022.

[4]Oxford Economics, ESA CM22 Economic Impact Report, 2025.

[5]Know.space, Case studies on the impacts of ESA early R&D activities, 2025. Miniaturisation of space electronics Full report and Infographics.

[6]Know.space, Case studies on the impacts of ESA early R&D activities, 2025. Hardware manufacturing beyond Earth Full report and Infographics.

[7]ESA, Technology 2040 - A vision for the European Space Agency, 2025.

[8]Know.space, Case studies on the impacts of ESA early R&D activities, 2025. Cultivating Meat in Space Full report and Infographics

[9]ESA, European Space Technology Harmonisation Dossier: Model-based for systems engineering, 2024.

[10]Know.space, Case studies on the impacts of ESA early R&D activities, 2025. Mitigating interferences Full report and Infographics.

[11]Know.space, Socio-economic benefits from ESA Technology Transfers, 2022. Electronic Foetal Monitoring System, Full report and Infographics.

[12]ESA, ESA Science Programme: Empowering Europe's Leadership in Cutting-Edge Scientific Research, 2025.

[13]Know.space, Case studies on the impacts of ESA Science Core Technology Programme (CTP), 2022. Silicon Pore Optics (SPO) Full report and Infographics.

[14]Know.space, Case studies on the impacts of ESA Science Core Technology Programme (CTP), 2022. Unrivalled High Accuracy Star Tracker Full report and Infographics.

[15]ESA, Explore 2040 - the European Exploration Strategy, 2024.

[16]ESA - ESA signs contracts for commercial space cargo return service, 22 May 2024.

[17]ESA, Business in Space Growth Network Reporting and Metrics, 2025.

[18]ESA, Human and Robotic Exploration - Groundbreaking Science Discoveries, 2025.

[19]Space Sciences Special Collections, ExoMars Trace Gas Orbiter: One Martian Year of Science, First published: June 2021; Last updated: June 2024.

[20]Harris Interactive, International survey about space exploration, 2025.

[21]Earth's Future, Pan- Arctic Assessment of Coastal Settlements and Infrastructure Vulnerable to Coastal Erosion, Sea- Level Rise, and Permafrost Thaw, 2024.

[22]ESA, Devastating floods in Spain witnessed by satellites, 2024.

[23]ESA, Iberian wildfires seen from space, 2025.

[24]Copernicus Data Space Ecosystem, Europe's eyes on Earth, 2025.

[25]EARSC, Sentinels Benefits Study, 2017-2024.

[26]London Economics, Value of ESA Earth Observation Missions: Aeolus case studies, 2022.

[27]Know.space, Case studies on the impacts of ESA Earth Observation early R&D activities, 2025. Large Deployable Reflector Full report and Infographics.

[28]Know.space, Case studies on the impacts of ESA Earth Observation early R&D activities, 2025. Improving climate modelling Full report and Infographics.

[29]London Economics, ESA LEO-PNT Impact Assessment, 2025.

[30]EUSPA, EO and GNSS Market Report, Issue 2, 2024.

[31]London Economics, ESA NAVISP Impact Assessment, 2025.

[32]London Economics, Impact Assessment of ARTES 4.0 programme, 2024. HummingSat ARTES Partnership Project.

[33]ESA, Civil Security and Crisis Response Enabled by Space Assets, 2025.

[34]London Economics, Impact Assessment of ARTES 4.0 programme, 2024. Real-time and Global Aircraft Tracking.

[35]London Economics, Impact Assessment of ARTES 4.0 programme, 2024. Real-time Satellite Capacity Allocation.

[36]University of Surrey, European Space Agency partners with CDT-FORT to drive the future of secure and resilient communication systems,2025.

[37]ESA, Boosting private investments in the European space sector, 2025.

[38]ESA, ESA Marketplace – ACCESS programme, 2025.

[39]ESA, ESA Business Applications and Space Solutions Success Stories: Harnessing the power of space technology, 2025.

[40]Financial Times, Europe’s Leading Start-up Hubs, Published 26 February 2025.

[41]ESA, ESA Business Incubation Centres (ESA BICs) - Empowering Space Start-ups, 2025.

[42]Deloitte, Case studies on the environmental and sustainability impacts of selected ESA activities, 2025.

[43]Novaspace, Space Market Monitoring, 2022.

[44]PwC, Socio-Economic Impact Assessment of Access to Space in Europe: an Ex-Post Analysis of the Ariane 5 and Vega Programmes, 2014.

[45]ESA Commercialisation Gateway, A First for the Future: ESA's Future Space Transportation Programme Celebrates Innovation, 2024.

[46]ESA, German laser ranging company receives ESA innovation award, 2024.

[47]ESA, Europe's first deep-space optical communication link, 2025.

[48]Lloyd’s, Risk of extreme space weather, 2025.

[49]OECD, Earth's Orbits at Risk: The Economics of Space Sustainability, 2022.

[50]PwC, Socio-economic impact assessment of ESA's ground systems engineering and operations activities and Space Safety programme, 2022.

Council Meeting at Ministerial Level

EUROPEAN SPACE AGENCY /// ELEVATING THE FUTURE OF EUROPE

Bremen, Germany, 26-27 November 2025

