

MEASURING THE SPACE ECONOMY IN FINLAND 2023

SPACE BUSINESS FORUM 22.11.2023

Finland 2025

The world's most attractive and agile space business environment which benefits all companies operating here



Finland is an attractive operating environment for the developers and adapters of the space sector. We have supportive legislation and a comprehensive field of easily approachable operators. Our companies base their operations on versatile expertise and are global leaders in producing and applying space solutions.

ICEVE offers timely and reliable radar satellite imaging for a variety of industries. Space Systems Finland supports is outcomers in designing and developing complex industrial applications such as vide processing applications, control systems and test automation solutions.

VISION

Prerequisites for entering the market

Measures

PILOT PROJECTS Business Finland increases the attractiveness of the sector by enabling and encouraging experimental pilot projects.

ENABLING The Ministry of Economic Affairs and Employment, the Ministry of Transport and Communications and Business Finland open opportunities provided by space to a larger group of enterprises.

Business Finland identifies and facilitates the international opportunities to utilise Finnish space solutions and space data and facilitates investments in Finland.

FINANCING The Ministry of Economic Affairs and Employment, Business Finland, Finnvera and Tesi facilitate patient financing for space infrastructure projects by attracting foreign financing and by developing public funding opportunities.

REFERENCES The authorities make acquisitions through which the enterprises in the space sector will receive their first reference. Business Finland will continue the financing of preparations for innovative public procurements.

LEGISLATION The authorities ensure that the national legislation supports business and does not unnecessarily limit it and that the permit processes related to space activities work smoothly (authorisation for space activities, export licences, radio licences).

The authorities involved, together with the security authorities, form a common opinion on ground station investments and implement the necessary amendments in legislation in consideration of national security.

Goals by 2025

The turnover of enterprises producing satellite technology (upstream) has grown 25-fold (current estimate EUR 20 million). The turnover of enterprises applying space technology and space data (downstream) has grown 10-fold (current estimate EUR 300 million).*

Utilisation of information and signals based on space activities is an everyday part of the business of Finnish companies irrespective of the sector. Fifty new space sector companies have been established here.

Finnish companies and research organisations are involved in designing, implementing and utilising the space infrastructure jointly determined by the public and commercial sector, as well as its validation and ground segment.

Finnish operators are leading and attractive partners in the best international projects of the sector.

Finnish companies in the space sector have gathered a total of MEUR 300 of capital from abroad. The Finnish operating environment of the space sector attracts the best experts to the country. Ten notable foreign space companies have established an operative unit in Finland.

The authorities make 1% worth of reference procurements out of their annual procurements. The procurement plan is published in advance annually. The authorities have adequate satellite capability in their use.



The needs for amendments to national legislation have been analysed from the viewpoint of national security by 2021.

The enterprises and research organisations operating in Finland resolve the challenges of sustainable growth by means of top-class space activities in close cooperation with the operators of the target market and the scientific community around the world.

VISION

International impact

Measures

SPACE ADMINISTRATION The Ministry of Economic Affairs and Employment updates the tasks and composition of the Finnish Space Committee and enhances its activities. In addition, the ministries foster the establishment of a centralised space administration.

INTERNATIONAL REPRESENTATION The Finnish Space Committee maps out the Finnish representatives in international bodies, expert groups and standardisation organisations and coordinates the nomination and activities of the representatives in the future.

MARKETING Ministries, agencies, enterprises and research organisations market Finnish space knowhow together and ascertain its visibility internationally, and actively and systematically promote the access of Finns to influential positions in international organisations.

INTERNATIONAL REGULATIONS The ministries involved participate in determining the international regulations in the EU, COPUOS and through other international cooperation, promoting especially the sustainable use of space, new business opportunities and security aspects.

ESA PROGRAMMES The Finnish ESA delegation, enterprises and research organisations are active in the creation and planning of ESA's new programmes and missions, utilising especially the small satellite/IOD type or other agile solutions that are quick and inexpensive to develop . The Ministry of Economic Affairs and Employment and Business Finland analyse the possibilities for additional funding for ESA's optional programmes.

EU SPACE PROGRAMME The Ministry of Economic Affairs and Employment and the Ministry of Transport and Communications will impact the development of the EU space programme in the direction of promoting sustainable use of space, new innovations and new business opportunities. The goal is also taken into account during the forthcoming EU Presidency of Finland.

IMPROVED COVERAGE The Ministry of Transport and Communications promotes the resolution of coverage problems concerning Finland and Arctic areas and better availability of remote sensing materials and data communications links.

Goals by 2025

The central operations of the space administration have been put together by 2020. The effectiveness and impacts of centralisation is assessed in 2023.

Finland is represented by the right parties in the most important international bodies and expert groups and especially in the space activities of the EU (space programme + research programme). A centralised space administration coordinates the opinions of Finland.

Finnish companies and research organisations participate actively in selected working groups of standardisation and industrial organisations (e.g. ISO, 3GPP, Eurospace, EAK, ECSS).

The accuracy of satellite navigation has been improved by 2022 to match the level of Central Europe, and more remote sensing data than today is available from the Arctic areas. The availability of data communications in Arctic areas based on satellites has been promoted through international cooperation.

Finnish companies and research organisations participate to a significant extent in the optional ESA programmes and new Finnish companies are involved. Finland's overall return from ESA's programmes meets the targets.

The space business employs more than 230,000 people in the EU area. One third of the world's satellites are manufactured in Europe.



Centre of excellence for research in sustainable space conducts research on central scientific matters from the viewpoint of sustainable utilisation and develop sustainable technologies with the aim of improving the international competitiveness of Finnish space expertise.

ISION

Research

Measures

JOINT PROJECTS Business Finland, research organisations and companies promote businessoriented joint projects between companies operating in the upstream and downstream sectors and research organisations in the fields of communication, navigation and remote sensing.

FUNDING Business Finland's offering includes funding for cooperation which promotes growth and improves expertise in space sector companies and research organisations. The Academy of Finland promotes high-quality, influential and responsible research in the space sector which is based on competition and supports the creation of cooperation networks in the high-quality projects it is financing.

SUSTAINABLE DEVELOPMENT Research organisations and funding agencies take the UN's goals for sustainable development into account in allocating research and funding.

COMPETENCE The Ministry of Economic Affairs and Employment, the Ministry of Transport and Communications and the Ministry of Education and Culture ensure that the ministries continue to cooperate to improve expertise base in Finland.

TRAINING To ensure an adequate expertise base, institutions of higher education will strongly focus on versatile education which serves the needs of the space sector.

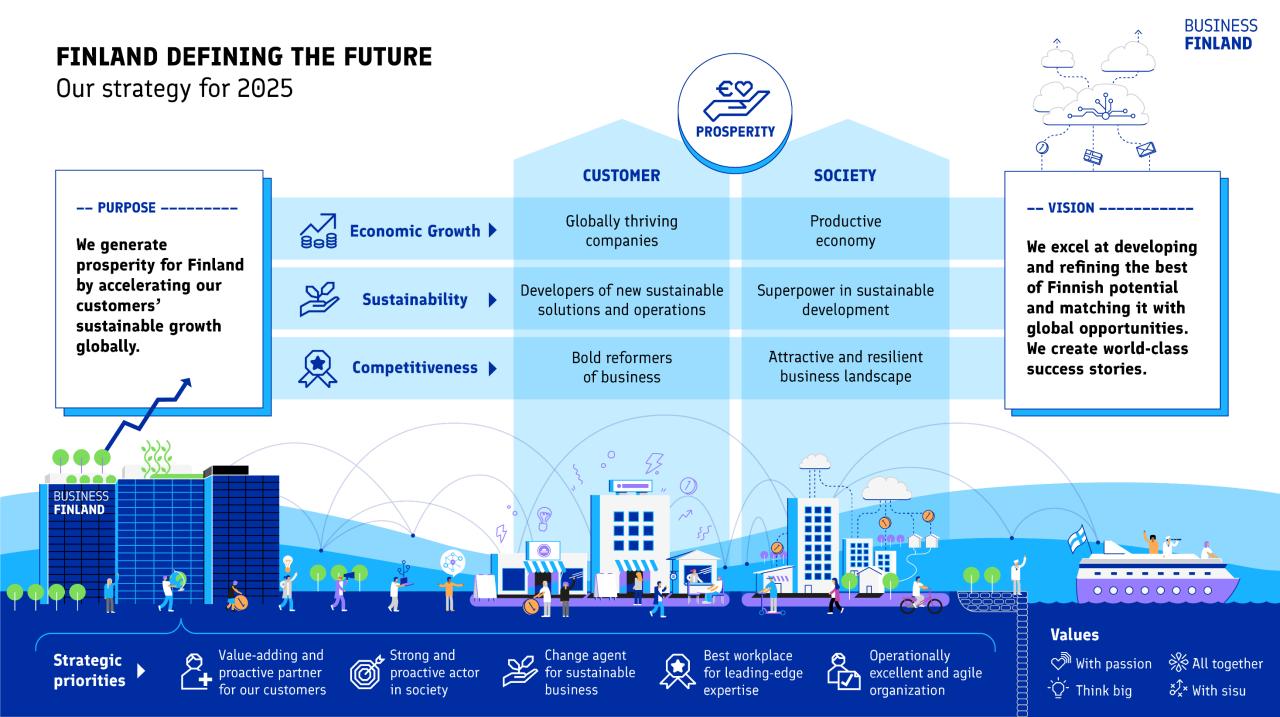
Goals by 2025

There are a larger number of high-quality joint projects ongoing between Finnish and foreign research organisations and enterprises.

Finnish companies and research organisations have a leading role in ESA and EU projects.

Finland is the home of leading applied research in the space sector, including in the areas of satellite navigation, remote sensing and data communications satellites, as well as the environment and climate change.

> The operators of the space sector have no lack of expertise which would hamper their operation.



FINNISH SPACE EXPERTISE ON THE MAP

A new global transition phase is currently taking place where the space industry players, roles, and ways of doing things are changing. The **New Space Economy** program helped to exploit the growth potential of international space business.

Business Finland's New Space Economy program (2018-2022) offered funding, networks and export services for developing international space related business.

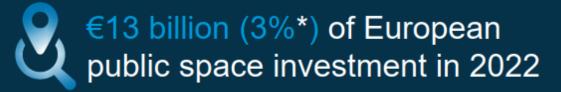
> Discover Finnish space know-how at <u>www.spacefinland.fi</u> <u>www.businessfinland.fi/en/space</u>



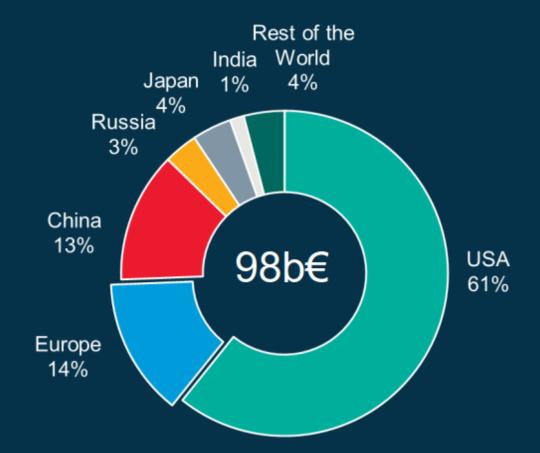
Public investment in space 2022



- €98 billion (7%) of global public space investment in 2022 (civil and military)
- Growth largely driven by defence space budgets
- Continuously underestimated
 Chinese and Russian space budgets due to lack of publicly available data



Public investment in space, 2022 (civil & military) (%)



* To be further consolidated for March 2024 IPC.

Source Euroconsult, Government Space Programs 2022, Press Release

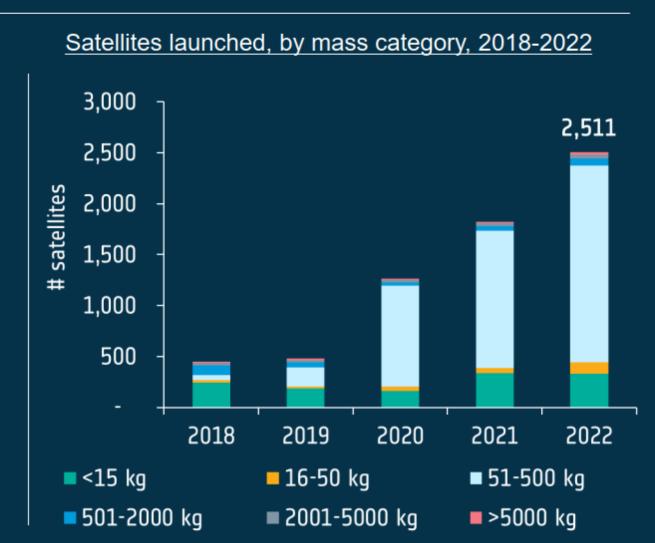
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Upstream overview 2022 Manufacturing & Launch

- 186 launches (28%) in 2022
- 2,511 satellites launched (36%) of which 95% of smallsats (<500kg) and 87% from commercial operators

With 6 launches, Europe captures 3% of the launch volume and 12% of the launch value

With 114 satellites launched, European prime manufacturers capture 5% of the manuf. volume and 19% of the manuf. value



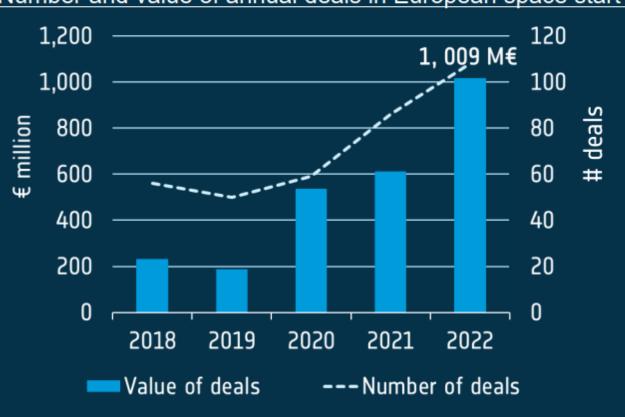
Sources Euroconsult, Market Monitoring Reports 2022; Euroconsult, Satellites to be Built and Launched 2022

Private investment in space 2022



- €8.8 billion (-28%) of global private space investment in 2022
- Decrease largely driven by the US (-33%)

Over €1 billion (64%) of private investment in European space ventures in 2022



Number and value of annual deals in European space start-ups

Source ESPI, Space Venture Europe 2022

Upstream overview 2022 Market Value



 €40.5 billion in 2022 (9%) of global upstream revenues in 2021

€8.3 billion (-4%) in 2022 of European upstream revenues in 2021

~ 20% of global upstream market value captured by the European industry

Global upstream revenues, by segment, 2018-2022 45 40.5 b€ 40 35 € billion 30 20 15 10 5 2018 2019 2020 2021 2022 Manufacturing Ground segment Launch

Sources Euroconsult, Market Monitoring Reports 2022; ASD-Eurospace, Facts and Figures annual release, The European space industry in 2022, 27th edition, 2023

→ THE EUROPEAN SPACE AGENCY

Downstream overview 2022

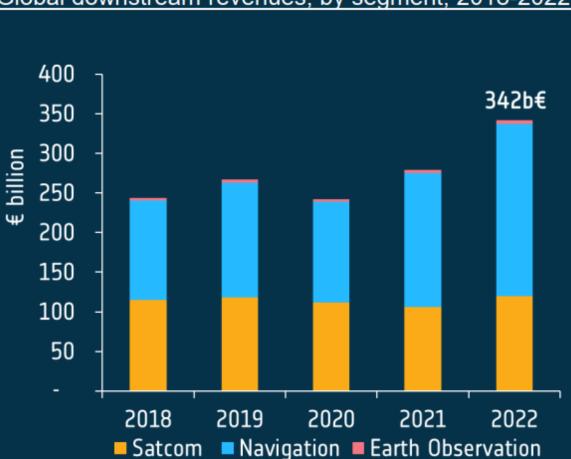


- €342 billion in 2022 (9%) of global downstream revenues in 2022
- 96% generated from commercial service revenues



€80 billion in 2022 (6%) of European downstream revenues

~ 23% of global downstream market value captured by European industry



Global downstream revenues, by segment, 2018-2022

Source Euroconsult, Space Economy Report 2022, Press Release

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- €104 billion (10%) of global institutional space investment
 - 51% expected to be dedicated to civil spending in 2023
- ~ €6 billion raised globally by private space ventures as of 30 September 2023
 - > 18% year-over-year decrease compared to 30 September 2022

- 158 launches, of which 2 by Arianespace, as of 30 September 2023
 - > 27% year-over-year increase globally compared to 30 September 2022
 - 74% of satellites launched are smallsats (<500kg)</p>

Sources Euroconsult, Government Space Programs, Digital Platform, 2023; Euroconsult, Market Monitoring Reports 2023

→ THE EUROPEAN SPACE AGENCY



- 406 satellite manufacturing orders as of 30 September 2023
 - ➢ 60% year-over-year increase compared to 30 September 2022
- €6.8 billion of manufacturing orders' value as of 30 September 2023
 - > 28% year-over-year increase compared to 30 September 2022

24% of the orders' value so far captured by European manufacturers

Source Euroconsult, Market Monitoring Reports 2023







European Space Tech lifting off

Dec 2022

What is Space Tech?

Upstream Space Tech

The segment encompasses companies operating in space or developing products for space: developing and/or operating satellites, launch vehicles, developing spacecraft payloads and components, innovative materials for use in space, etc.

Some of the most innovative areas in this segment include technologies that can enable long-term human presence in space: space resource exploration and in-situ resource utilization, space utilities (in-space datacenters, power grids, etc.) and space habitats, as well as space tourism.

The segment also includes companies where space is not their core business. For example, 3D printing, advanced materials tech companies that target space among a number of other industries or those that have participated in space projects, or biotech companies that have sent experiments to space with the goal of exploring the potential use of their technology in space.

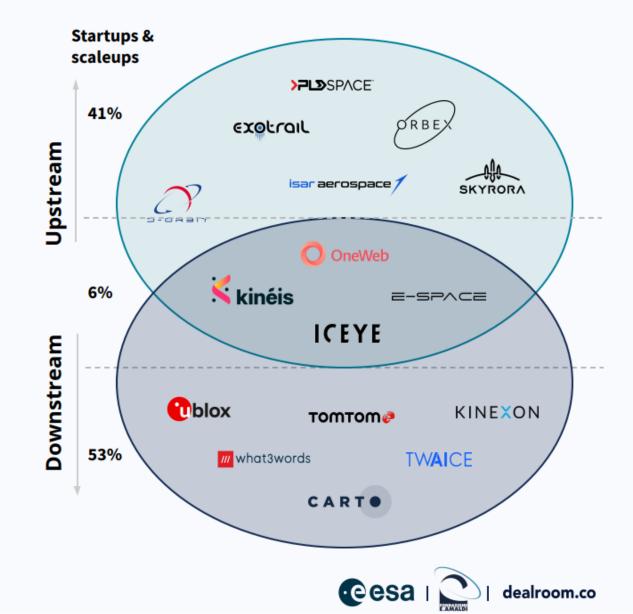
Downstream Space Tech

Downstream space sector encompasses technologies derived from space for use on Earth (e.g. materials and sensors originally developed for space but having found use in Earth-based applications) as well as technologies used in space with the main goal of serving Earth-based applications (mainly satellites: Earth observation, communication, navigation).

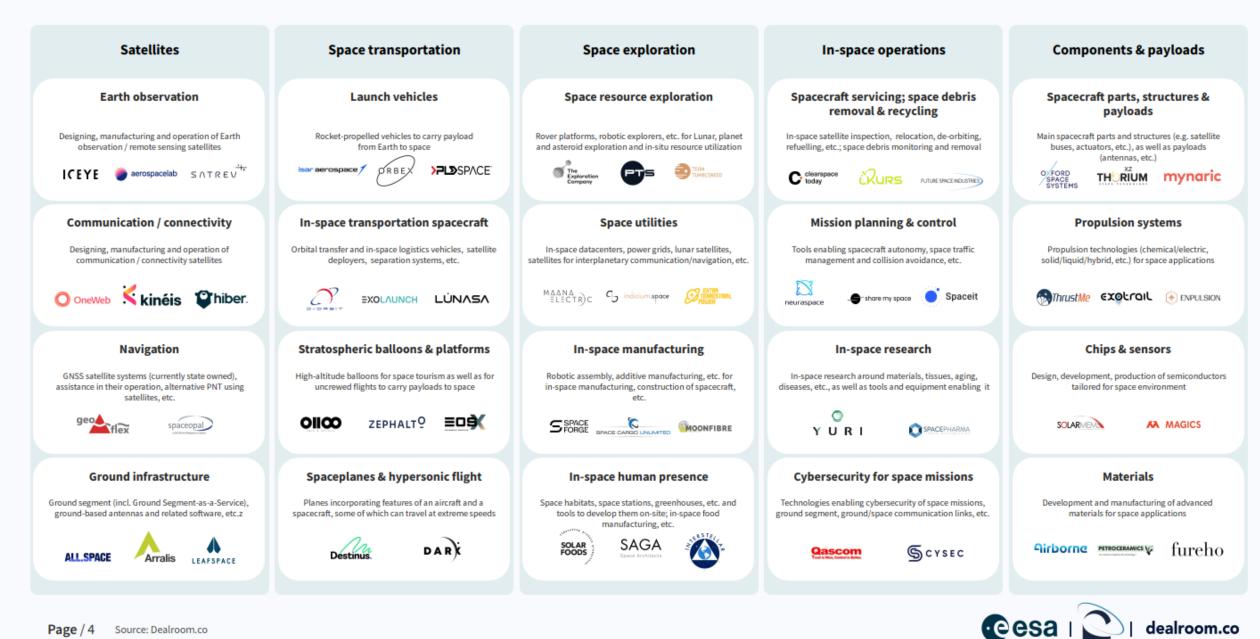
The segment also includes companies where space / space-derived tech is not their core tech. For example, companies that mention the use of satellite data among multiple other data sources.

Some companies belong to both Downstream and Upstream segments. For example, those operating their own satellites to deliver products / services on Earth (Earth observation satellite data for agritech, energy, etc.)

Some startups operate in both Upstream and Downstream sectors



European Space Tech overview - Upstream sector



Space Tech for Earth applications - the Downstream European Space Tech sector.

Agriculture & food Satellite communications for data transmission, Earth observation for monitoring of soil moisture & weather forecasts, satellite navigation for asset tracking, in-space research for studying plant growth & biology	Aviation Satellite services for air traffic management, airline operational communications & passenger in-flight connectivity, airport management & meteorology; urban air mobility; reduction of environmental impoct in aviation	Culture & entertainment Satellite technologies for content apps (e.g. location tracking in photo apps, earth observation data for content creation), gaming (e.g. enhancing AR/VR experiences), sports (acquiring 3D navigational data), etc.	Education Satellite connectivity enabling access to online education around the world, including rural areas and developing countries.	Energy Space-based data for mapping and measuring wind, wave, tidal and solar resources; satellite communications, navigation and Earth observation for the hydrocarbon and nuclear sectors; in-space research to study heat transfer processes.	Environment Satellite technologies to monitor the essential climate variables, support in ocean conservation and restoration of land and forests, to assist companies in monitoring their environmental footprint & ESG compliance.	Finance Satellite data for investment evaluation, risk assessment, event impact assessment, real-time asset/portfolio monitoring, carbon offsets auditing, etc.
Conce Co		Sekg	<pre>#AMBASAT @ Equilab</pre>	NERGIX PowerHarket	pando, Falconers TESSELO kanop	KOLO Occorr Image: Second Se
Health Satellite tech for telemedicine & digital monitoring devices and for enabling the concept of One Health; research in microgravity (tissue engineering, cancer research, etc.) for health technology improvements	Maritime Satellite technologies for maritime surveillance and safety/emergency response, transportation, all aspects of marine life and environment, aquatic-life monitoring, aquaculture & fisheries.	Materials, mining & manufacturing Satellite tech for site monitoring and connectivity at industrial plants and mining/construction sites; the use of advanced materials developed for space in Earth applications; in-space research leading to new achievements in industrial tech.	Mobility Satellite navigation and connectivity for mobility and logistics and freight systems (e.g. for smart traffic management, goods tracking and connecting infrastructures)	Security & safety Space-based services and satellite technologies for maritime surveillance, border control, disaster preparedness, emergency response, critical infrastructure management, secure communications, humanitarian operations, etc.	Smart cities Satellite connectivity for grid management (waste management, etc.), navigation for transport information & traffic modelling, Earth observation for ur an planning & urban agriculture, etc.	Tourism Satellite technologies for intelligent routing and smart guides, up-to-date maps and weather reports, high-resolution imagery for 3D views & digital panoramas for marketing, data on tourist flows.
think intelligent Essestation	AutoNaut bound-ublue		Sensolus			RevelTime triphood



UK, France, Germany and Finland are the key hubs for Upstream Space Tech in Europe.

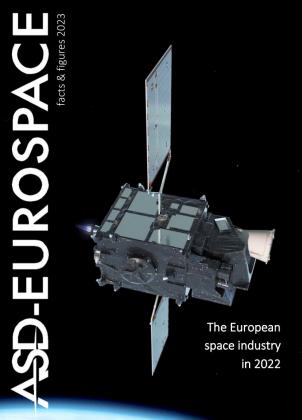
The UK boasts the most valuable Upstream space tech startup ecosystem. Its biggest player -OneWeb - with its €3.1B valuation, takes up nearly 60% of the entire ecosystem value.

Excluding OneWeb, UK runs 4th after France, Germany and Finland by the total amount raised in 2021-2022 YTD.

Among the biggest space tech ecosystems, UK and Finland have the highest % of VC funding going to Upstream Space Tech.

	Combined EV of privately owned Upstream space tech startups & scaleups	Amount invested in Upstream space tech; 2021-2022 YTD	Amount invested in Upstream space tech as % of all VC; 2021-2022 YTD
United Kingdom	OneWeb (€3.1B)	5.3B OneWeb (€1.9B)	€2.0B 3%
France	€1.7B	€181M	<1%
Germany	€995M	€170M	<1%
Finland	€885M	€170M	5%
Switzerland	€866M	€70M	<1%
Netherlands	€585M	€42M	<1%
Ireland	€471M	€15M	<1%
Spain	€383M	€80M	1%
Belgium	€284M	€42M	2%
Italy	€253M	€28M	<1%
Austria	€225M	€0M	0%
Poland	€172M	€31M	4%
Denmark	€94M	14M	<1%
Luxembourg	€88M	€13M	3%
Sweden	€78M	€12M	<1%
Portugal	€62M	€6M	<1%
Bulgaria	€60M	€10M	10%
Estonia	€48M	€8M	<1%
Norway	€13M	<€1M	<1%
Czech Republic	<€1M	€0M	0%

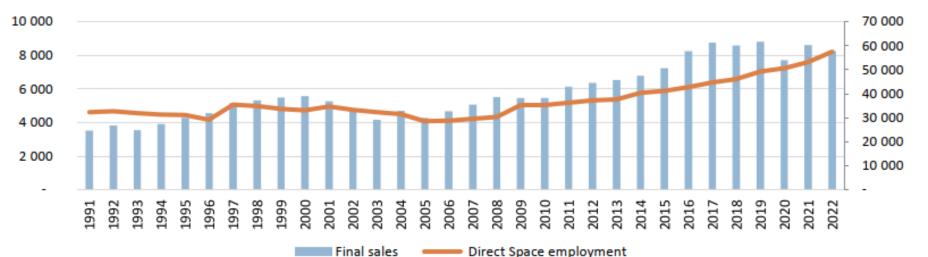




Final sales by main product segment (M€)

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(M€)	2020	2021	2022	Var.
Final sales (M€)	7725	8606	8257	-4,1%
Launcher systems	1316	1303	1214	-6,8%
Satellite applications systems	3529	3974	3657	-8,0%
Scientific systems	1130	1347	1403	4,2%
Ground systems and services	1567	1806	1750	-3,1%
Other & Unknown	184	175	232	32,3%

European space industry sales and employment (M€, right & FTE, left)



Industry employment distribution by country (FTE)

Country	2020	2021	2022	Level of confidence
Finland	280	501	472	10%

FINNISH NEW SPACE OFFERING

SMALL SATELLITES, SATELLITE SUBSYSTEMS AND COMPONENTS



SATELLITE DATA BASED SERVICES



SOFTWARE, SECURE CONNECTIVITY





SMALL SATELLITES, SATELLITE SUBSYSTEMS AND COMPONENTS

SMALL SATELLITES

ICEYE

SAR satellite constellation. SAR satellite data services

KUVA SPACE

Near real-time, high fidelity hyperspectral data services and analytics



Software-defined MEO and GEO satellites



NAUTICS Educational, sustainable and

innovative CubeSats & services.



Solution provider for plugand-produce automated fiber placement (AFP) systems.

+ Aeria

Design, production & testing of antennas.



Instrument development for space, radiation monitoring and space debris observation.

AURORA

Scalable solutions and services for small spacecraft movement and lifecycle control.

beyond gravity

High performance in space. Precise engineering on Earth.



Services for wireless, electronics, and mechanical design.



RF IC turnkey solutions. IP. and design services.



RF solutions. SAR components, embedded system solutions.



subsystems.



Electrolytic surface treatment



The most sensitive photodetector technology for space and satellite applications.



Microwave sensors and technology to detect, localize, and classify RF signals.



Software, testing services and Additive Manufacturing for space.

Isaware

SUBSYSTEMS, SENSORS AND COMPONENTS

Space Weather instruments for LEO and Deep Space missions.

KEYMET

Mechanical solutions for the aerospace industry.

mectalent°

Expert services for component and equipment manufacturing.

NORTHBASE

Ground Station as a Service (GSaaS)

OPTEON

Large scale optics manufacturing and testing.

Specim

SPECTRAL IMAGING A leading supplier in hyperspectral imaging.

VAISALA

Sensoring for satellite missions.

VALOe

Photovoltaic components for **New Space solutions**



portable LTE based satellite

SCHOTT glass made of ideas

Hermetic packaging for MEMS and optoelectronics based on Glass Micro Bonding technology.



State-of-the-art imaging sensors, small satellite platforms, communication HW and services for satellite imagery analytics.

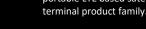
RILL

Atomic layer Deposition (ALD) tools for conformal metal oxide coating.

Ground support equipment and general tools for testing, hoisting, alignment etc









SATELLITE DATA-BASED SERVICES

AIRBUS

Satellite imagery and related services, combining radar and optical satellites. Open digital platform and marketplace for earth data, satellite navigation services.

ICEYE

SAR satellite constellation, SAR satellite data services

GISPO

Location intelligence solutions and data analytics.



GNSS signal reception or time synchronization.



Cloud-free mapping and analyzing platform for satellite images.

arbonaut

Mobile client for cloud-based geospatial information platform for project management.



Smartest Forest Solutions on the Planet.



Using climate, geo and process data for forest predictive inventories and forest management.



Location-based service development.

Isaware

data with local data sources.

Southern Finland separately.

GIM

and sensor fusion.

ILMATIETEEN LAITOS

Auroral monitoring with the all-sky cameras and

magnetic field alarm systems for Northern and

Mobile machines' localisation, mapping and

situational awareness with advanced algorithms

NSION

Space Weather instruments for LEO and Deep Space missions.

Data processing and analytics.

hold

Indufor Continuous Forest and Landscape Monitoring.

No-code tools for automating your needs from satellite imagery

Reaktor

Data analytics, machine learning systems.

S septentrio

Multi-frequency multi-constellation GPS/GNSS positioning technology.

SKYFØRA

Artificial intelligence, space data and ultralight instruments for high-performance weather forecasting.



geospatial APIs, scalable infrastructures for data sharing, and usage of satellite data

Sensor data fusion and data analytics with

artifical intelligence (AI) and machine learning (ML) algorithms.



VTT

SHIP Traffic Control utilizes satellite data for a coordinated, global approach to maritime traffic control, monitoring and decision support.



Next generation software for smart cities and the smart mobility applications utilizing satellite imagery data.

YIELD SYSTEMS

Development of machine learning solutions for agri-food value chain enhancement and video intelligence.

Situational awareness services combining SAR





SOFTWARE, SECURE CONNECTIVITY

SOFTWARE



Telematics solutions including tracking Dynamic spectrum access software and of vehicles usage, vehicle positioning services.

🖓 awake.ai

and employee/driver identification.

Optimisation platform for port bound cargo flow.

CG

Specialists in space security and ground control systems.



Fairspectrum

Software for satellites, instruments and ground segment.

ÎN STA

We safeguard our customers' future.



Advanced data analytics, data-based decision-making support.

MELUTA

Design, plan, and implement signal processing software, and algorithms for commercially available systems.

🛞 Netradar

Collect network performance data directly from mobile handsets.

Qt The Qt Company

Cross-platform software framework for the development of apps and devices.

Reaktor Software design & services. SILO

Trusted AI partner for AI-driven solutions & products.

Spatineo

High-level data analytics and data science services.



Satellite constellation design and optimization.

SECURE CONNECTIVITY

Bittium

Missing-Link

Software and systems engineering, Real-time local monitoring of wireless Secure connectivity: Secure wireless networks. communications, cyber security.

ekahau WIRELESS DESIGN

NOKIA

Ekahau designs and manufactures wireless location technology.

Secure communication networks

hld

Software solutions for privileged

access, secure file transfers, SSH key

management, quantum-safe & more.

Systems engineering, software development, data processing and cyber security protection for ground and space segment.

Magister

Simulation enabled R&D for optimized secure connectivity

POINTR an Augmented Reality based remote collaboration solution for industry and professionals.

OTHER SPACE-RELATED **SERVICES**

TESTING AND SPACE-RELATED SERVICES



The Accelerator Laboratory of the University of Jyväskylä's Physics Department hosts the Radiation Effects Facility (RADEF), one of only a few such radiation effects facilities in the world.

CoreHW

RF IC, mm-Wave, Analog, Mixed Signal, Digital, Antenna, Application, and System design. Development of GPS/GNSS receivers and other positioning technologies.

Mechanical Ground Support Equipment

TRAINING

A R C T I C **A S T R O** N A U T I C S

A fully functional satellite designed for schools, science centers and other space-related educational organizations.



Accurate predictions and inventories of forest resources based on sophisticated machine learning models.



EMC, simulation and mechanical testing services.



exafore

Material characterization.

Netradar Mobile Analytics

monitoring service for telecom

operators.

SOLAR FOODS

Use electricity to grow microbial biomass that can be used as edible protein.



Tailored antenna and radio frequency test solutions.



VR/XR Training technology provider.



Solutions for integrating communication technologies in space with terrestrial networks.

ESA BUSINESS INCUBATION CENTRE FINLAND

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255,4k € -174.5% 1-9	227,7k € -124.7% 8	102,7k € -7.2% 4	494,2k € -153.9% 5	266,6k € -51.5% 10
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	30-99	41,3k € 63.7% 1	3,4k € -17851.4% 8	3,6k € -424.4%





MEASURING THE SPACE ECONOMY IN FINLAND 2023



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