ESPI

European Space Policy Institute

ESPI Yearbook 2023

SPACE ISSUES AND TRENDS

EXECUTIVE SUMMARY

Dear members of ESPI and readers in Europe and worldwide,

I am pleased to introduce to you this 2023 edition of the ESPI Yearbook. This long-established annual publication has gained a solid reputation over the years for being a reliable source of information and a useful tool for monitoring the development of the European space policy in a global context.

2023 was a ground-breaking year for the space sector globally and also for ESPI: In the frame of our 20th anniversary event in the Austrian Parliament in September 2023, we launched **ESPI 2040 Policy Vision "Space for Prosperity, Peace and Future Generations".**

Globally, 2023 was the Moon year. For Europe, 2023 was marked by the launcher crisis. With regard to (human) space exploration, space science and post-ISS, Europe's revived interest continues, but without much action. Europe's highlights were the launch of JUICE and Euclid. The war in Ukraine and the role of space for security and defence continued to be in the focus for Europe in 2023 – this was symbolized foremost with the release of the first ever EU Space Strategy for Security and Defence. Moreover, the EU legislative process concluded with the approval of the EU Secure Connectivity Programme "Infrastructure for Resilience, Interconnectivity and Security by Satellite" (IRIS^2) - and a European industry Consortium was formed to build the multi-orbital satellite constellation. Furthermore, 2023 saw a positive evolution of EU-UK relations: the UK rejoined Horizon Europe and Copernicus. Finally, 2023 saw some "rising stars" - nations/regions that were stepping up in space: India, the Gulf nations and Africa.

Trends in industry and innovation include developments in verticalization, the integration of space in other industry sectors such as maritime, automotive, and biotechnology. Moreover, there were numerous developments in in-orbit servicing, in particular in active debris removal, in-space refuelling, Docking & RPO, and Last Mile Delivery. 2023 also saw developments in space cybersecurity, including commercial space cyber security providers and quantum key distribution and post quantum cryptography. Furthermore, R&D for innovative key technologies received a boost in 2023, including space-based solar power, with progress in the U.S. and China but also remarkable progress in in Europe, as well as space nuclear propulsion, in which the U.S. is leading the emerging space nuclear propulsion market.

The Global Space Economy in 2022 is estimated at $385 billion (SIA) and $546 billion Space Foundation). The total governmental budget for space programmes in 2022 is estimated to be $101.8 billion by SIA/Bryce, $118.6 billion by the Space Foundation, and $103 billion by Novaspace. Thereof, the European space budget is estimated €13,853 million in 2022. With regard to Global Private Space Investment, private investment totalled €6 billion in 2023.

With regards to global launch activity 221 launches were conducted in 2023 (+19% compared to 2022), thereof 10 launch failures (which makes 4,8% of all launches) with 2889 satellites launched (+16% compared to 2022).

Sincerely,

H. Ludwig Moeller
Director of ESPI

“The ESPI Yearbook series offers a comprehensive overview of the space ecosystem, providing annual insights for policymakers and enriching research. It is an essential resource for understanding current trends and anticipating future dynamics of the sector.

Matija Renčelj
Research Manager
Concept & Editing

About the ESPI Yearbook

The Yearbook on Space Policy is an annual publication, which provides an overview of major developments and trends in space policy, industry, programmes, economy and overall worldwide activity over the year. The ESPI Yearbook does not aim to be comprehensive but rather to provide useful information, data and insights on a selection of topics expected to shape the future of the global and European space sector.

The Yearbook is structured in 4 chapters:

- **Policy & Programmes** outlines the developments of public, governmental and institutional affairs,
- **Industry & Innovation** gathers prominent announcements related to space industry evolutions worldwide and promising progress in technology development,
- **Global Space Economy** collects indicators relevant to the global space economy,
- **Launches & Satellites** explores ESPI databases related to launch site activities

ESPI Yearbooks at a glance

Past and present yearbooks can be found on the ESPI website.

Did you know?

ESPI has developed 5 areas of thematic focus:

- Green & Sustainable Societies
- Security & Defence
- Exploratrion & Science
- Space as an Asset
- Industry, Innovation, Finance, Workforce

These can be identified throughout the 2023 ESPI Yearbook by their associated symbols:

> At a global scale, 2023 saw a revived Moon race. For Europe, highlights are the launch of JUICE and the Euclid mission, while the year was foremost marked by the launcher crisis: further delay of Ariane 6, Ariane 5's last launch, and unavailability of Vega C after its launch failure. With lessons learned from the crisis, Europe works on a new launcher procurement process and progressed with spaceports, with the inauguration of Esrange and Andøya. Finally, 2023 saw an increased ambition to connect space, security and defence – at the European level with the release the EU Space Strategy for Security and Defence.

Lina Pohl
Research Fellow, Project Lead, Author, Policy & Programmes

European Space Summit
defining a roadmap towards ESA CM25

- Accelerators
- Future of European Launchers
- Competition for cargo transport vehicles to the ISS

Zeitenwende or a Revolution Postponed:
focus on launcher crisis but limited attention to (human) space exploration.

Exploration & Science

Revolution Space:
Europe's mission for space exploration - recommendations for ESA towards the space summit

Assessment of the High-Level Advisory Group (HLAG) on Human and Robotic Space Exploration for Europe mandated by ESA Council on (1) geopolitical, (2) economic and (3) societal relevance of human and robotic space exploration for Europe.

Recommendations to act:
- Visionary
- Differently
- Now

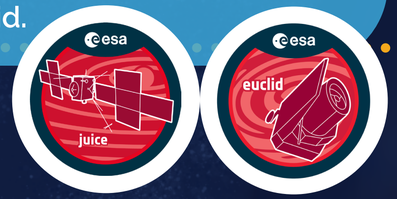
The HLAG called on ESA to prepare for the 2023 Space Summit:
- Transformation and Invigoration Plan of the European space ecosystem and processes including a quantification of the induced and catalytic economic impact.
- A scenario for independent and sustainable European human landing on the Moon in the 2030s.
- Proposals for new transformative European space flagship projects for the 2030s and beyond.

ESPI Yearbook 2023

Policy & Programmes

Europe's Continued Leadership in Space Science

ESA launched the JUICE mission to Jupiter and the deep space mission Euclid.



Global Moon Race

India

Successful Moon landing of **Chandrayaan-3**

Russia

Unsuccessful Moon landing of **Luna-25**

Japan

Launch of **SLIM**

Competition and Bloc Building

US' Artemis Accords vs. China's ILRS

Artemis Accords: 12 new signatories in 2023

- Angola
- Argentina
- Bulgaria
- Czech Republic
- Ecuador
- Germany
- Iceland
- India
- the Netherlands
- Nigeria
- Rwanda
- Spain

International Lunar Research Station Agreements signed in 2023

State Signatories

- Argentina
- Azerbaijan
- Belarus
- Brazil
- Egypt
- Pakistan
- Russia
- South Africa
- Venezuela

Non-state Signatories

- Asia-Pacific Space Coperation Organization
- ILOA (Hawaii)
- NanoSPACE AG (Switzerland)
- NARIT (Thailand)
- University Adriatic Aerospace Association (Croatia)
- University of Sharjah (UAE)
- PT Universal Satelit Indonesia

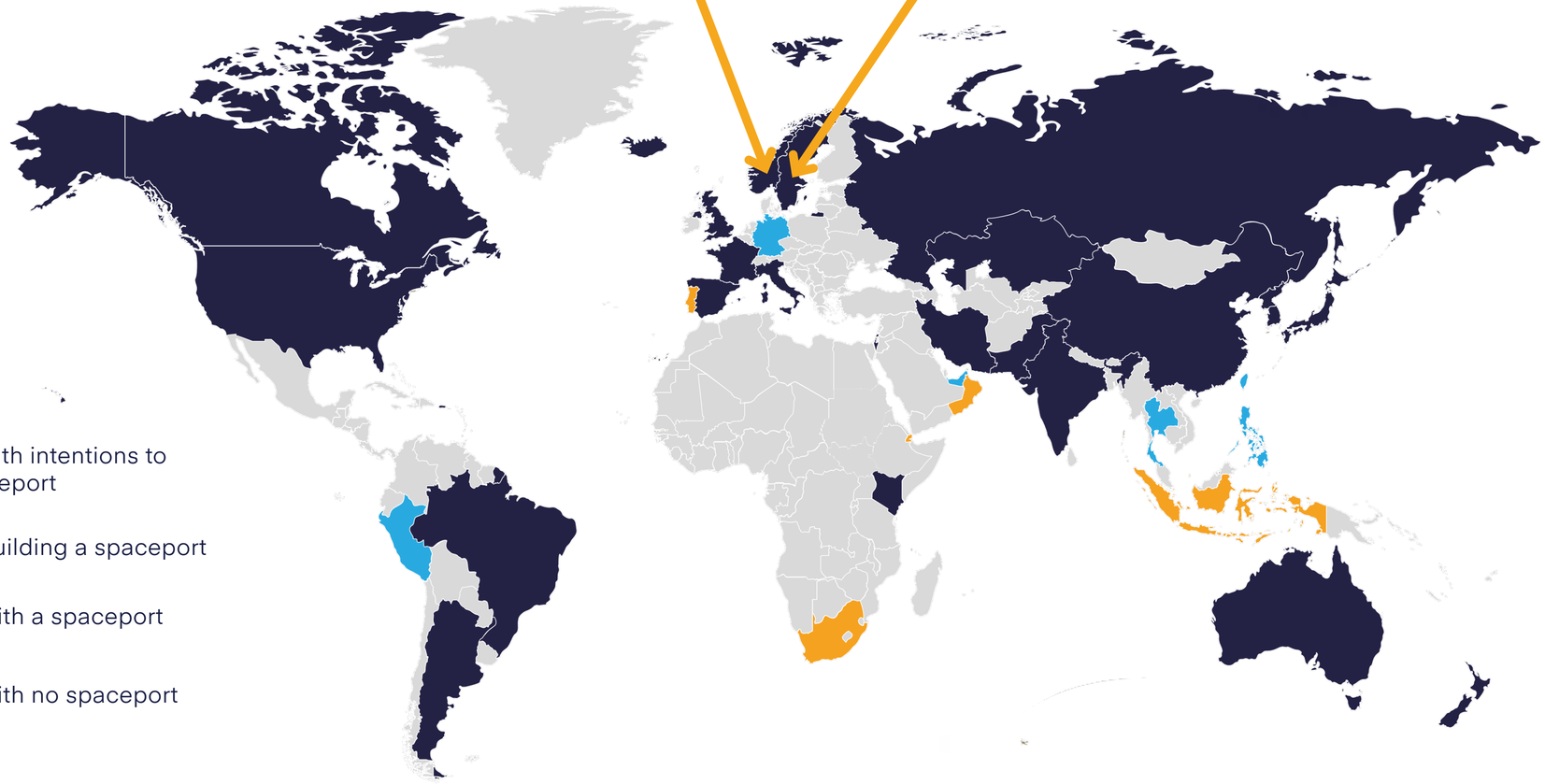
Launchers
European Launcher Crisis

The crisis persisted from the second half of 2023 until July 2024, and was marked by the absence of a European launcher.

- Last Ariane 5 launch
- Further delay of the inaugural launch of Ariane 6
- Unavailability of Vega C after launch failure at the end of 2022

In contrast to the launcher crisis,
2 new spaceports
were inaugurated:

Andøya Space Center (Norway)
and
Esrange Space Center (Sweden)



Space as an Asset

ESPI Yearbook 2023

POLICY & PROGRAMMES

Security & Defence:

The war in Ukraine and its implications for European security and defence and the role of space continued to be in the spotlight and focus for Europe in 2023.

In March 2023, the first ever EU Space Strategy for Security and Defence was released.

Security & Defence

5 Pillars of the EU Space Strategy for Security & Defence

Enhancing the understanding of space threats

Resilience and protection of space systems and services in the EU

- Potential EU Space Law encompassing safety, resilience and sustainability
- EU Space Information Sharing and Analysis Centre
- Continued development of resilience-enhancing technologies

Partnering for responsible behaviors in space

- Increasing EU-NATO cooperation
- Engagement with the UN Framework
- Strategic partnership with the US
- Space Security talks with third countries

Responding to space threats

Use of space for security and defence

EU Secure Connectivity Programme Iris² kicked off

IRIS²

- EU legislative process on IRIS² was finalised: EU approved IRIS²
- Consortium for IRIS² was formed
- ESA-EU Contribution Agreement was signed

Rising Star: India

Highlights

- India Space Policy 2023: restructuring of space governance & boosting commercialisation
- The Indian space economy is projected to grow to $600B (from $447B in 2020) by 2025 (Ernst & Young).

Exploration & Science

Exploration & Science

- Moon landing of Chandrayaan-3
- Solar mission Aditya-L1
- India signed the Artemis Accords
- Updates on India's Bharatiya Antariksha Station
- India to send astronaut to the moon by 2040

First Launches

- First successful landing of Reusable Launch Vehicle Autonomous Landing Mission
- First successful launch of India's SSLV rocket (after first launch failure in 2022)

Rising Star: Gulf Region

Policy Context

*2023 saw flourishing space **activities** and developments in the Gulf (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE).*

Space endeavours are considered as one of the key domains within a broader plan to invest into high-tech industries and thereby diversify their economies. Moreover, their multilateral approach to strategic partnerships is remarkable – covering various regions and countries, including the U.S., China, Japan, Europe and many more.

وكالة الإمارات للفضاء
UAE SPACE AGENCY

SSA
وكالة الفضاء السعودية
SAUDI SPACE AGENCY

NSSA
الهيئة الوطنية لعلوم الفضاء
National Space Science Agency

سلطنة عُمان
وزارة النقل والاتصالات وتقنية المعلومات
Sultanate of Oman
Ministry of Transport, Communications and Information Technology

Qatar Aeronautics and Space Agency
QASA

Exploration & Science

Highlights

- UAE adopted national space fund and announced to update national space law
- Saudi Arabia withdrew from the Moon Treaty
- Saudi Space Commission to transform into the Saudi Space Agency
- Bahrain's National Space Science Agency reviewing new national space strategy
- Oman plans to build the Middle East's first spaceport

Exploration & Science

- UAE Space Agency announced Mission "Max" ("Multiple Asteroid Exploration")
- Saudi astronauts Rayyanah Barnawi and Ali Al Qarni flew to ISS on Axiom Space 2 Mission. UAE's Astronaut Sultan Al Neyadi became the first Arab spacewalker.

Rising Star: Africa

A Flourishing Space Economy in Africa
Highlights from the African Space Industry Annual Report 2023

- African space economy projected to reach $22.6 billion by 2026.
- African countries budget for space activities estimated $425M (+15% compared to 2022)
- Over $4.7B were invested by African nations on 58 satellite projects in Africa (55 satellites manufactured by 15 countries across 4 regions)

Highlights

- African Union Commission inaugurated the African Space Agency
- Ghana approved a national space policy
- Senegal to establish the Senegalese Space Study Agency

Enhanced Cooperation with EU

- First ever EU-AU Space Dialogue took place

First African Satellites Launched

- Kenya (Taifa-1)
- Djibouti (Djibouti-1A)

> In 2023, the space industry transformed sectors like maritime, automotive, and energy. Key advancements included in-flight connectivity, satcom for cars, and space-enabled maritime safety, and progress in in-orbit servicing and space cybersecurity, setting a promising course for future space technology.

Irene Saiz Briones,
Author, Industry & Innovation

Summary

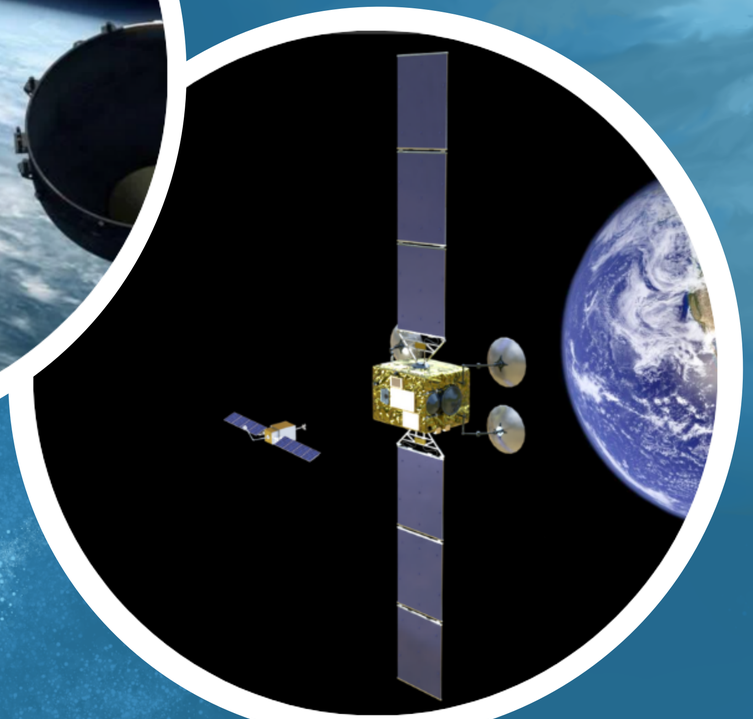
Regarding space industry, 2023 has also been quite vibrant with the advent of major initiatives that will have an impact on future public and new private initiatives.

Developments in the verticalisation of Space:
space in other industry sectors

In 2023, developments were visible mainly in the maritime, automotive and the biotechnology domains, but also in energy and terrestrial transport. In particular, 2023 saw developments in in-flight connectivity, satcom for automotive and space for maritime safety and sustainability.

Developments in In-Orbit Servicing

Including Active Debris Removal (ADR), in-space refulling, Docking & Rendezvous and Proximity Operations (RPO), On-orbit Servicing, Assembly, and Manufacturing (OSAM) and Last Mile Delivery.

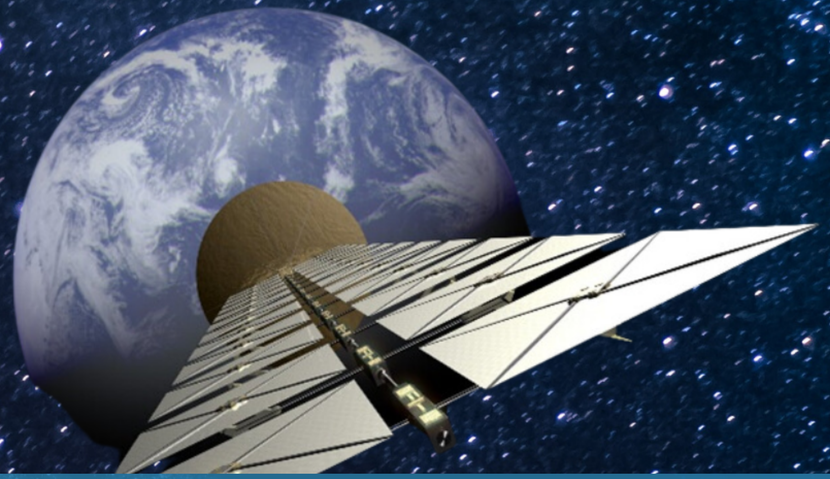


Developments in Space Cybersecurity

Including commercial space cyber security providers and quantum key distribution and post quantum cryptography.

Developments in Space-Based Solar Power

In Europe, ESA awarded concept studies for commercial-scale SBSP plants under SOLARIS, the UK allocated €5 million government funding for made in UK SBSP technologies and European companies such as Thales Alenia Space and DCUBED progressed in SBSP. Beyond Europe, especially the U.S. and China progressed on R&D in this technology.



Developments in Space Nuclear Propulsion

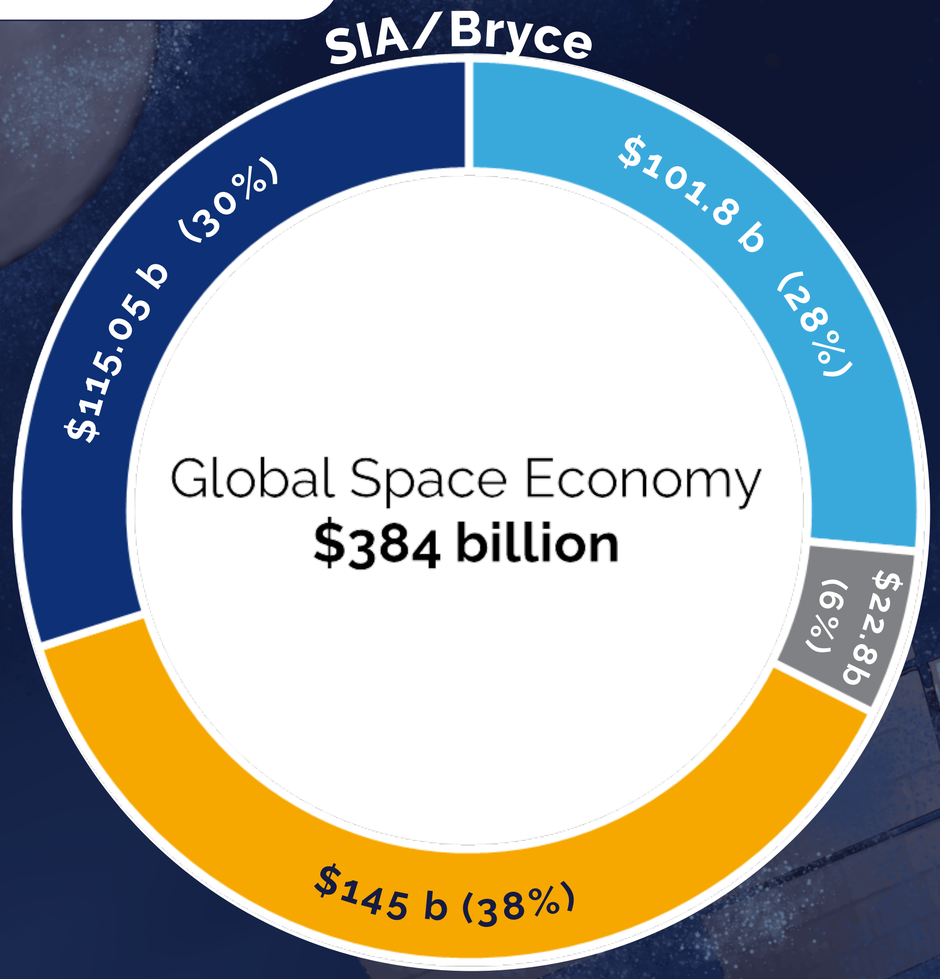
The U.S. is leading the emerging space nuclear propulsion market. NASA and DARPA announced a partnership to showcase a nuclear thermal rocket engine in space, a pivotal advancement for NASA's manned missions to Mars on the DRACO programme. In Europe, ESA is investigating in multiple studies innovative applications of nuclear propulsion for deep space exploration, and on national level, UK is pushing for this technology. Furthermore, Russia announced that the planned nuclear-powered space tug to remove space debris is scheduled to be ready by 2030.

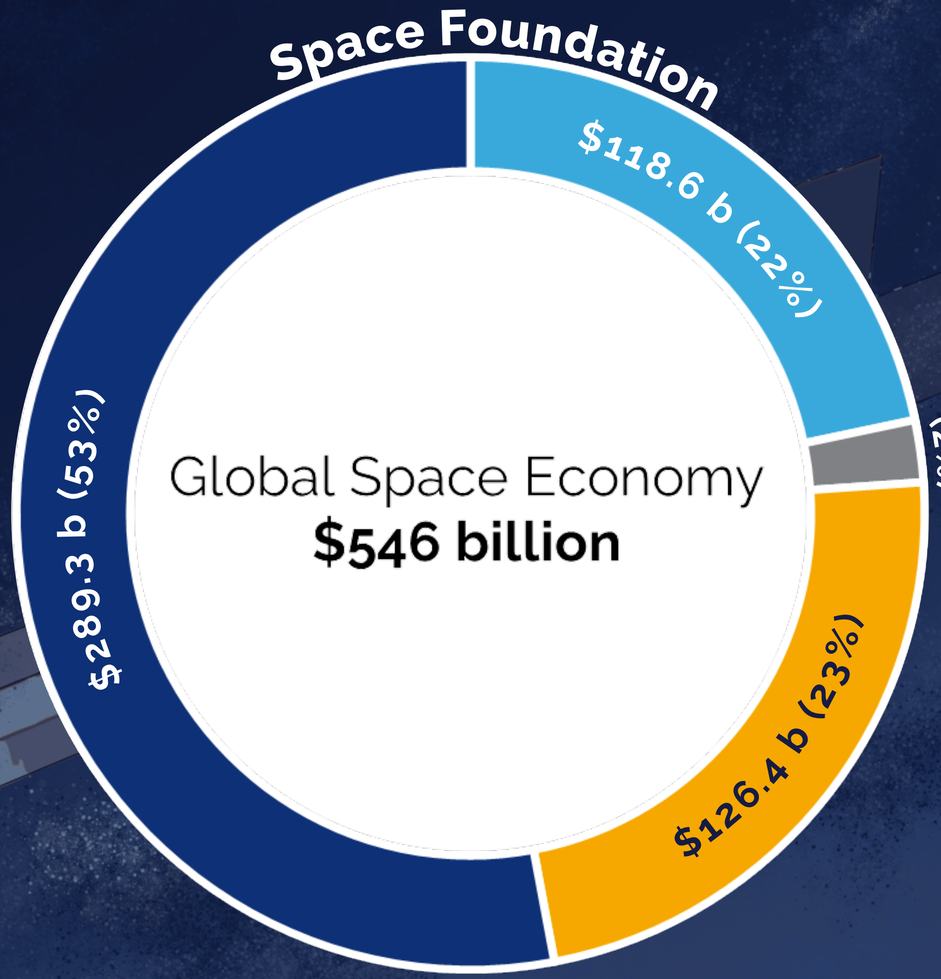
“Estimates on the Global Space Economy vary substantially, but comparing different sources we can say that in 2022, the global space economy settled between $384 billion and, if one includes PNT services, $546 billion, representing a 2% and 6.3% CAGR, respectively. Economic activity directly related to government spending represents around 25% of the total, and most sources indicate that they grew in 2022. Nevertheless, it is important to consider, on the one hand, effects of inflation in the space budgets and, on the other, that investment into space startups fell by 28%.

João Falcão Serra,
Author, Global Space Economy

Global Space Economy 2022

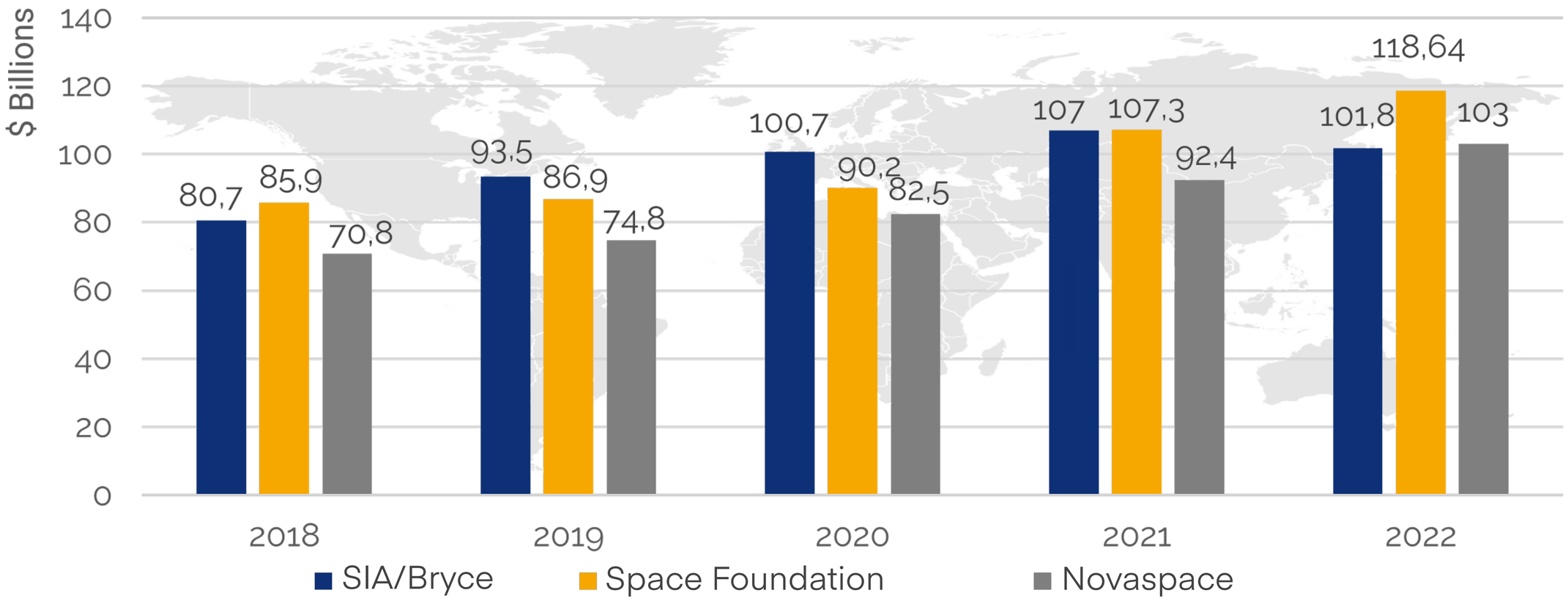
While the distribution remained the same in relative terms in 2022, There is a stark difference in the budget growth estimates between SIA and SF. SIA estimates a $5.2 billion (-5%) contraction in global space budgets as compared to an over $10 billion (+11%) increase by SF.





Government Space Budgets
Ground Stations and Equipment
Space Products and Services
Commercial Satellites and Launches

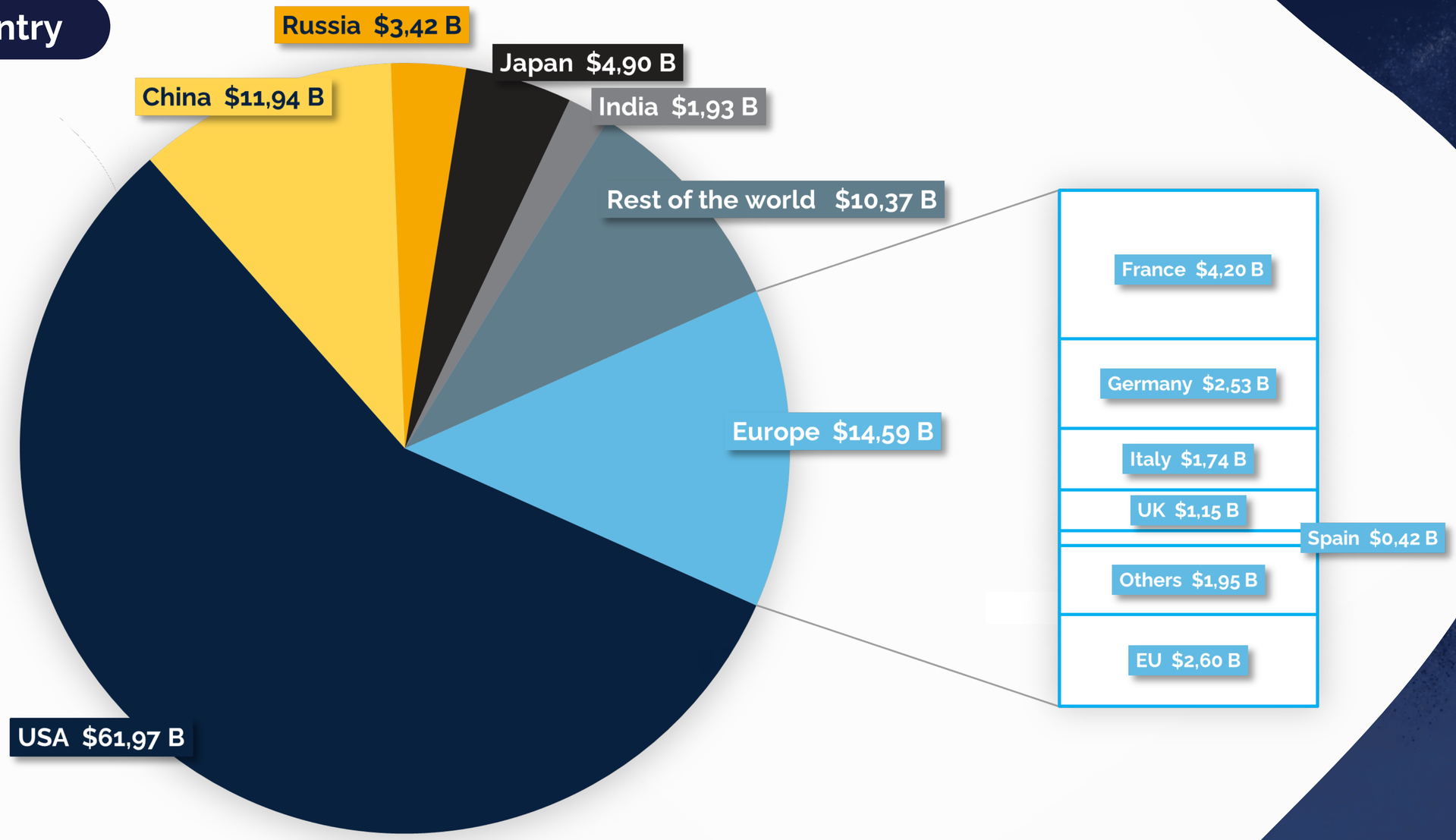
Evolution of Government Space Budgets



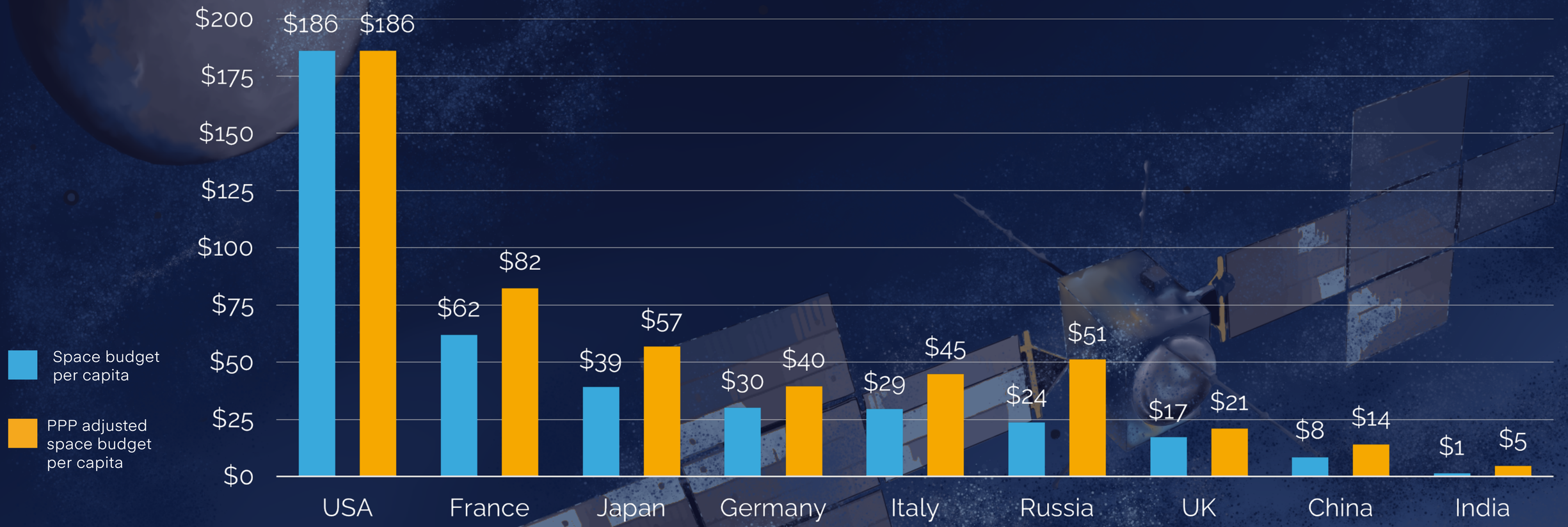
Estimates for Government Space Budgets are $101.8 billion by SIA/Bryce, $118.6 billion by the Space Foundation, and $103 billion by Novaspace.

Budgets per Country

Novaspace estimates that in 2022 the third largest nominal space budgets were from the U.S., followed by China, and Japan.

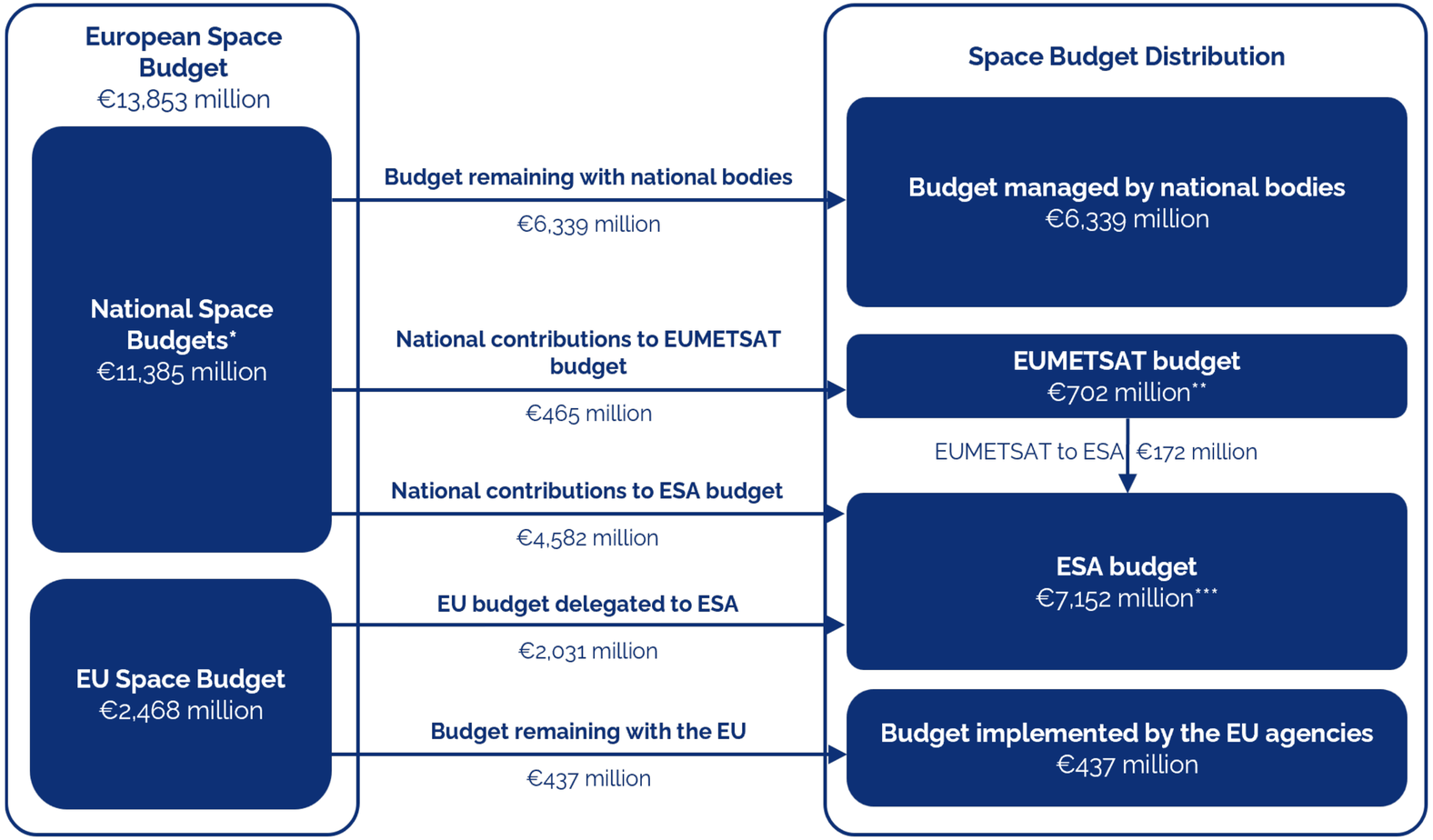


Adjusted Space Budgets per Capita, 2022



However, when looking at adjusted space budgets per capita the top three countries are U.S., France, and Japan.

Consolidated European Space Budget 2022



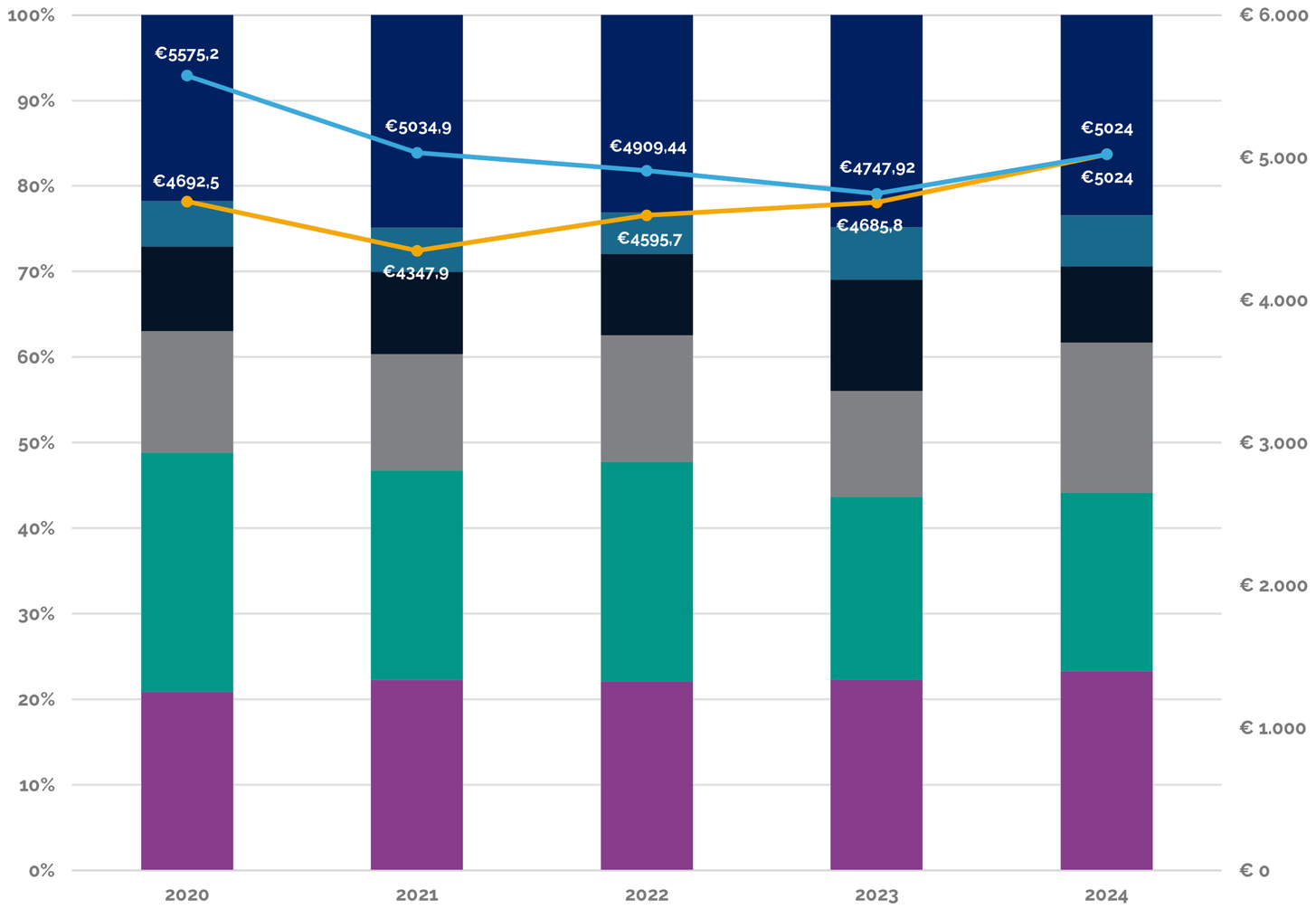
Space budgets in Europe include two main sources: National space budgets (€11.385 million in 2022) and European Union space budget (€2,468 million in 2022).

*National Space Budgets include all budgets of EU and ESA member states excluding Canada

**EUMETSAT budget includes €237 million from other sources including the contribution from Turkey

*** ESA Budget includes €367 million from other sources including the contribution from Canada

ESA Budget 2020-2024

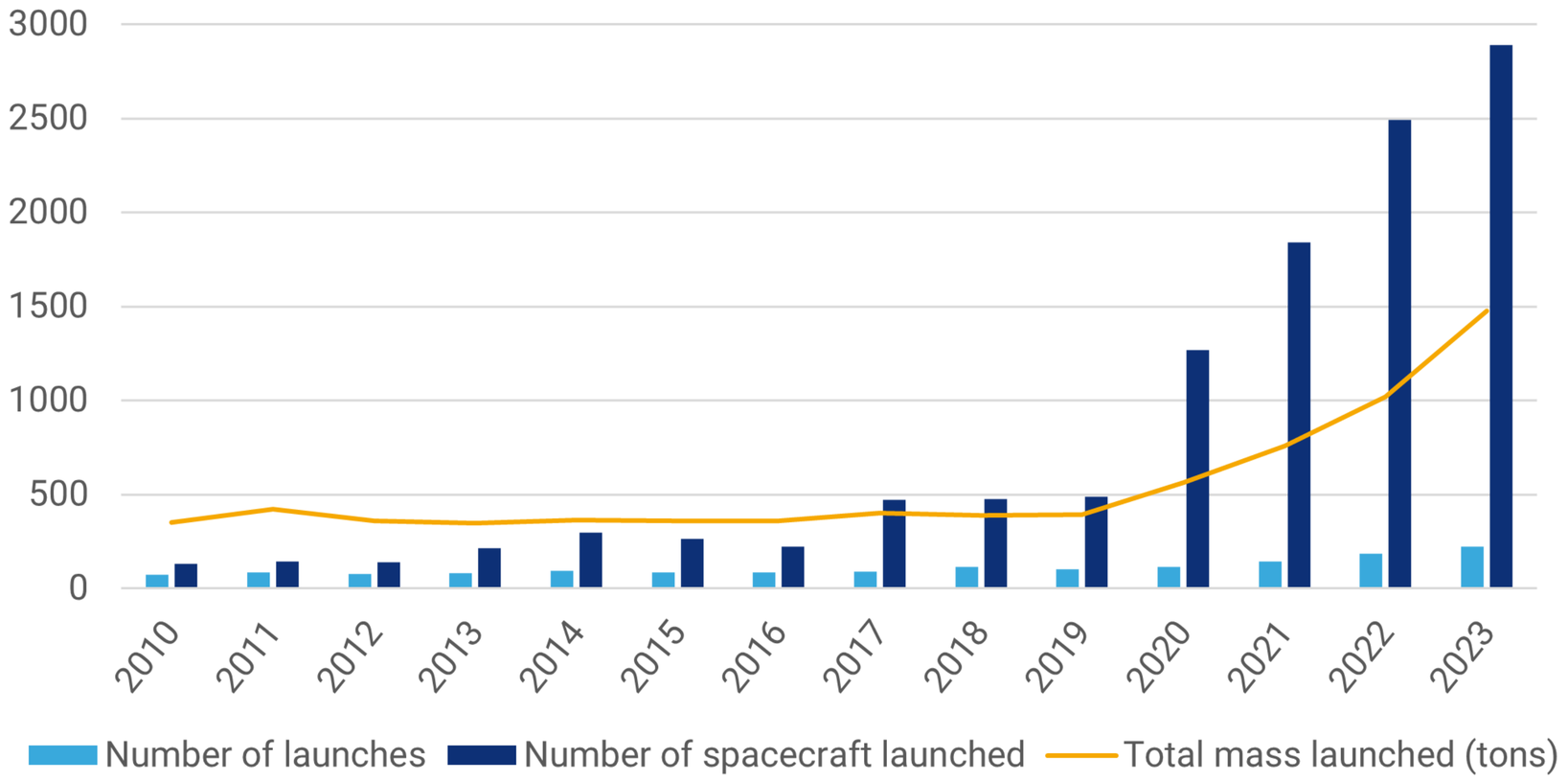


The ESA budget, when adjusted for inflation, has consistently fallen between 2020 and 2023.

> In 2023 global **launch** activity broke all records again, reaching new heights in terms of total mass, number of launches, and number of spacecraft launched. Early indicators already signal that this trend will continue and accelerate in 2024. The impressive growth is mainly driven by commercial US telecommunication satellites in LEO, namely the Starlink constellation by SpaceX.

Lars Petzold,
Author, Launches & Satellites

Global Space Activity Evolution



Evolution of launch activity over time (2010-2023)

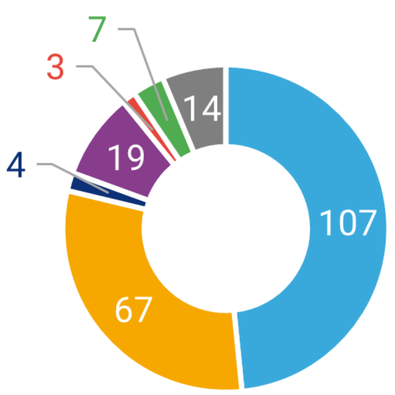
With **221 launches being carried out** worldwide, 2023 is a new landmark in terms of launches, 19% higher than the previous one set in 2022 with 185 launches. Confirming the trend started in 2020, a new record high of **2889 satellites were launched** in a single year (16% more than in 2022). While the number of launches and spacecraft launched still rises significantly, a relative slowdown compared to the growth rates in 2022 (+28% launches and +35% spacecraft) can be observed.

A large part of the activities in 2023 is caused by the launch of the Starlink connectivity constellation by SpaceX, and to a lesser extent OneWeb. As a result, the total mass launched also went up drastically, increasing from 1021 tonnes in 2022 to 1477 tonnes which translates to an increase of 45%. It is noteworthy that, as opposed to the relative slowdown in the growth of the number of launches and spacecraft, **the increase in mass is up almost 20 percentage points** compared to the growth between 2021 and 2022. This increase is largely attributed to SpaceX starting to launch its heavier Starlink V2 satellites. This deviates from previous years (2020-2022), where we observed the strongest rise in the number of spacecraft launched.

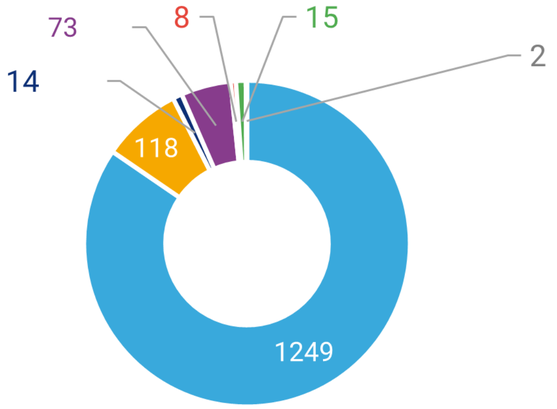
Launch Activity in 2023

In 2023, eleven countries (United States, China, France (for Europe), Russia, Japan, India, New Zealand, South Korea, Iran, North Korea and Israel) launched 2889 spacecraft belonging to 58 nations. Among these nations, Oman, the Vatican, Djibouti and Ireland had their first satellite launched, joining the more than 100 countries involved in outer space activities. These figures and the numbers also include failed launch attempts, which represent 4.5% of all launches carried out this year **(10 failures out of 221 launches)**. The United States keeps the top spot for number of launches (48%). It launched 107 times, an increase of 37% compared to its previous record of 2022. China came again in second place with 67 launches, representing 30% of all launches. The third traditional main launch country, Russia, lags behind with only 19 launches (8.6% of the total), a smaller number than what was performed in 2022 (21 launches). Compared to the previous years, the number of satellites that it put into orbit is lower than China's, likely due to the loss of OneWeb launches following the severing of ties between Arianespace and Russia after the start of the war in Ukraine. At the same time, the number of spacecrafts launched for commercial customers in China has seen a strong increase in recent years.

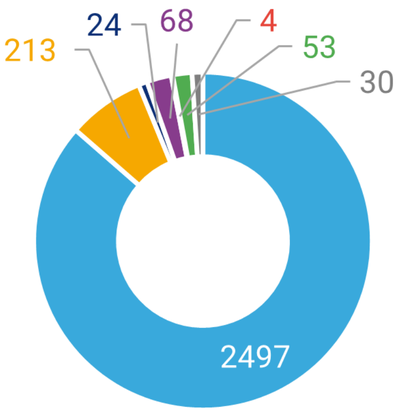
Number of launches per country in 2023



Mass launched (in tons) per country in 2023



Number of spacecraft launched per country in 2023



USA · China · Europe · Russia · Japan · India · Others

Launches: 221

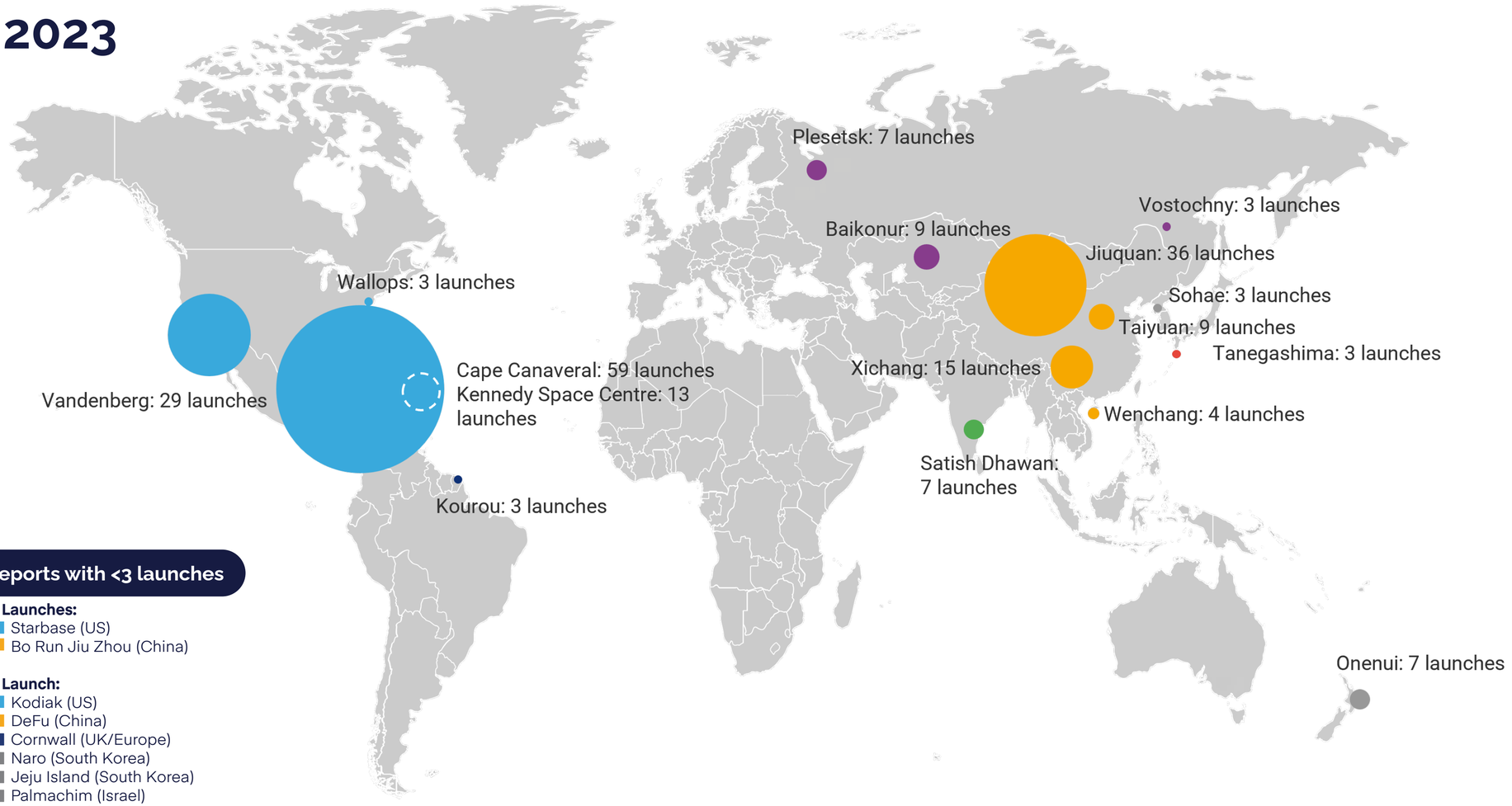
Mass launched: 1477 tons

Spacecraft: 2889

Number of launches, spacecraft and mass lauched in 2023 per launch country

Spaceport Activity in 2023

Cape Canaveral defends its position as the most active spaceport of the planet, after having regained it from the Jiuquan Satellite Launch Center in 2022. 59 launches were conducted from the Cape in 2023, followed by Jiuquan (36 launches) and the Vandenberg Space Force Base (29 launches). Vandenberg replaced the Kennedy Space Center (13 launches) as the third place, mainly due to launches related to Starlink. In terms of mass launched, Cape Canaveral is also the major spaceport, with 787 tons, that is, more than double the mass of the second (Vandenberg Space Force Base, with 323 tons) and more than fifteen times the mass launched from the first non-U.S. spaceport (Baikonur, 4th position with 50 tons). In total, **more mass was launched from Cape Canaveral than from all other spaceports combined** (53%).



Number of launches per spaceport in 2023

ESPI European Space Policy Institute

ESPI Yearbook 2023 Point of Contact

Lina Pohl,
Research Fellow seconded by DLR,
lina.pohl@espi.or.at

Contact and follow ESPI

office@espi.or.at
www.espi.or.at
Schwarzenbergplatz 16, 1010 Vienna, AT

Graphic Design by Julia Drössler, Comunications & Engagement Intern