FULL REPORT

Bridging the Financing Gap in the European Space Sector

Alternative funding pathways in tightening markets

ESPI European Space Policy Institute

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TABLE OF CONTENTS

OBJECTIVE OF THE STUDY

The goal of the study is to provide a set of strategic recommendations addressing how **the European space sector and its participants can tackle the issue of access to finance** among European space companies in the context of shifting conditions on capital markets. Specifically, the study will aim to:

- Provide an overview of economic conditions and the risks that the sector is facing.
- Provide an overview of the public and private access to finance in Europe, as well as a reflection on how current economic conditions affect funding trends.
- Provide a primer into capital markets and their relevance to the space sector.
- Curate a list of relevant alternative financial institutions and mechanisms potentially applicable to the European space sector as sources of complementary or alternative funding.
- Provide recommendations to industry participants on how to further engage various investment communities beyond VC stakeholders and how to better support the ecosystem through alternative investment mechanisms.

SCOPE OF THE STUDY

The study investigates and analyses alternative investment mechanisms for the space sector, with a **primary focus on identifying innovative approaches that extend beyond traditional Venture Capital (VC) funding**.

The **content of the study is limited to the supply of capital, excluding demand side forces that would spur additional investment into the sector**. The study is intended to act as a baseline from which industry participants will be able to adapt and operationalize their strategies and develop specific lines of action in support of the European space sector.

To achieve this objective, the research team adopted a methodology that encompasses the following key steps:

- **Survey:** The 'European Space Investment Survey' by ESPI gathered insights on a range of topics related to investment in the sector. The survey attracted answers from 42 financial actors globally and laid out key areas of concern European actors may tackle to attract investors.
- **Workshop:** The ESPI workshop hosted at ESA HQ gathered over 40 participants to acquire insights on alternative finance mechanisms applicable to the European space sector. Experts from the public and private sectors contributed to the final delivery of recommendations.
- **Data compilation & analysis**: The study involves quantitative data analysis to assess the current status and trends in the European NewSpace sector, by examining investment figures, based on ESPI's in-house Space Venture database.
- **Expert interviews and event participation:** To gain firsthand perspectives from industry experts and key stakeholders, the research team conducted interviews with experts and participated in events which supported the study.
- **Case studies**: The research incorporates case studies of successful or proposed creative initiatives that utilized or are proposing to utilize alternative investment mechanisms or structures. These case studies shed light on the effectiveness and real-world applications of various funding models.

What is considered an Alternative Financial Mechanism? It denotes a set of structured methods for raising, managing, and deploying financial resources to fund various projects, initiatives, or activities beyond the use of venture capital.

1 ECONOMIC BACKDROP

1.1 Introduction

Creating a strategic roadmap for future space industry investment and growth requires a forward-thinking vision and an understanding not only through the nuanced lens of the space industry, but from broader perspectives of global macroeconomic, geopolitical, and financial industries.

Over the past two decades, global macroeconomic and financial transformations have significantly influenced the contemporary investment landscape in space. Dynamic changes in economic fundamentals, technology, and geopolitics have marked this period. The aftermath of the Great Financial Crisis has **reshaped financial markets, leading to the emergence of high-risk investment classes like private equity and venture capital**. Low interest rates, the pursuit of yield, and endless innovation have driven investors toward alternative assets, offering substantial returns, but also posing increased risks and regulatory challenges.

1.1.1 Economic Growth and Globalisation (1990-2008)

In the early 21st century, robust global economic growth was spearheaded by **globalisation and the expansion of international trade, facilitated by technological interconnectivity** and the emergence of the World Wide Web. The optimism of a conflict-free future, fuelled by globalisation and economic cohesion, led to macroeconomic stability. The shift to "offshoring" for lower prices resulted in intricate global supply chains, historic lows in goods and services prices, and increased quality of life in the West. However, this optimistic globalisation era, marked by complacency among political elites, central bankers, and economists, overlooked potential risks. The belief in a solved conflict scenario was tied to low inflation, high economic growth, and global financial stability, creating an era of economic euphoria.

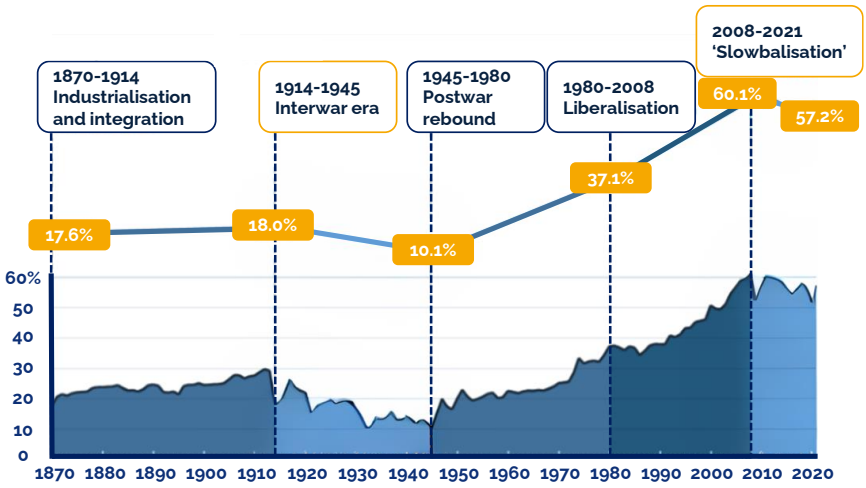


Figure 1: Trade openness index, 1870-2021 (Credit: PIIEI)

Amid this, **the space industry saw an increase in government-funded programmes across the programmatic spectrum**, the consolidation of established aerospace corporations, and a growing interest in commercial ventures (e.g., Teledesic, Globalstar) notably in satellite communications. Private sector investment gained momentum due to macroeconomic stability, leading to innovative satellite communication networks like Iridium. Despite financial challenges for some, such as Teledesic and ICO, the overall investment climate was positive. However, Central Bankers' disregard for an overheating economy was short-lived as the Great Financial Crisis unfolded.

1.1.2 Financial Crisis and Austerity (2008-2010)

The 2008 global financial crisis, triggered by Lehman Brothers' collapse and fuelled by high-risk credit practices, caused a severe credit crunch, housing market collapse, and numerous bank failures. Governments and central banks responded by implementing austerity measures to stabilise the financial system, aiming to prevent a deep recession. Austerity measures included reduced public services and increased taxes, contributing to economic uncertainty, and impacting investor confidence. **This crisis prompted caution in allocating capital to high-risk space projects, causing private financial markets to slow**.

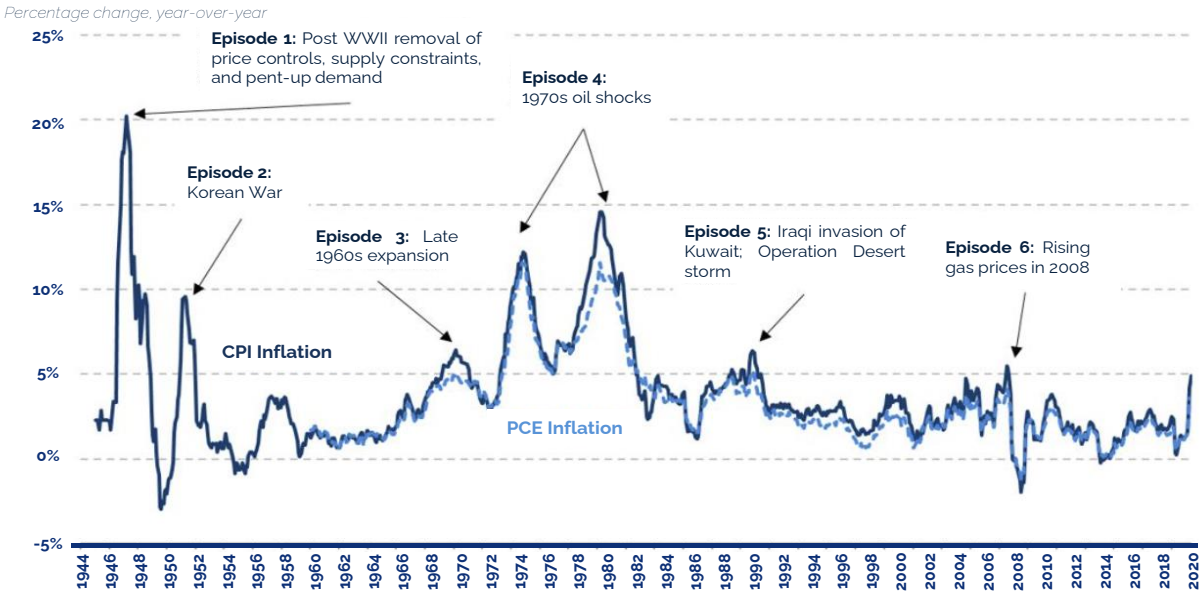


Figure 2: Six episodes of post-WWII inflation
(Credit: Federal Reserve Economic Data (FRED), Haver Analytics, CEA Calculations)

Despite challenges, the public sector prioritised investments in space-related projects, ensuring stability or even increases in funding. Established applications (satellite-based communication, navigation, and Earth Observation) remained a focus. To counter the risk of a deep depression, central banks, notably the U.S. Federal Reserve, adopted **quantitative easing (QE)**. This involved central banks purchasing existing financial assets, such as government bonds, in large quantities. This aimed to inject capital into the financial system and lower interest rates, to eventually encourage borrowing and investment. As central banks purchased these bonds in such large quantities, the demand for these bonds increased rapidly. As demand surged, bond prices rose, inversely impacting interest rates (which move in the opposite direction of bond prices). This influx of liquidity into the financial system and the resulting lower interest rates stimulated the economy and led to the successful avoidance of a global depression.

1.1.3 Low Interest Rates and Investments (2010-2019)

The rise of QE marked a transformative era in global financial markets, triggering unprecedented outcomes. **Low returns on traditional fixed-income investments, like bonds, due to low interest rates, prompted investors to seek higher returns in alternative, non-traditional investments**. This shift influenced traditional capital allocators, such as pension funds and endowments, to allocate more to higher-risk asset classes like private equity and venture capital, fostering their growth.

Private equity involves investing in late-stage private companies or taking public companies private with the aim of improving their operations and selling them at a profit. Low-interest rates

made it cheaper for private equity firms to borrow capital for acquisitions, leading to a surge in "leveraged buyouts", meaning that the companies were bought with debt at a low interest rate.

Venture capital funds financed the companies that were too early and too risky for private equity to invest in: startups and early-stage companies with high growth potential. Low interest rates fuelled the growth of venture capital by making it more attractive for investors to allocate capital to these high-risk, high-reward investments.

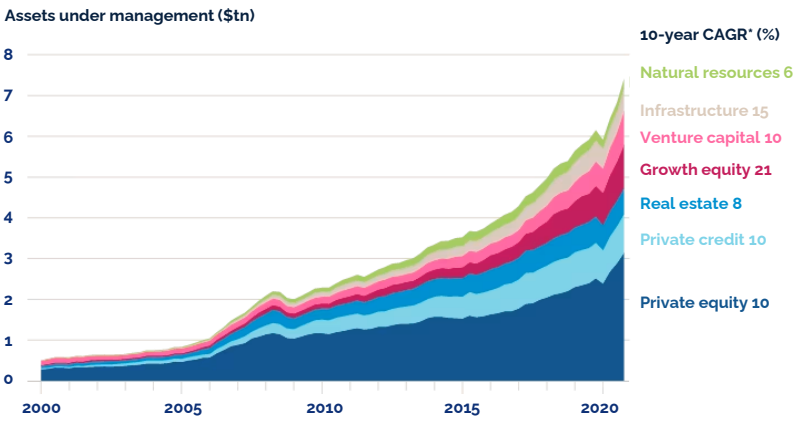


Figure 3: Growing power of private capital (Credit: Financial Times)

Investors saw venture capital as a means to participate in groundbreaking innovations and disruptive technologies, often with the hope of identifying the next industry giant that could corner the market and subsequently generate outsize returns. **This quest for innovation and market domination became a driving force behind the venture capital surge**.

The flight of capital to higher-risk industries had positive consequences, evident in a technological and innovation post-crisis boom. Sectors like technology, biotech, renewable energy, and the space industry thrived as low interest rates facilitated accessible funding. Two significant investment types in the space industry emerged: private equity, focusing on late-stage companies, and venture capital, financing startups with high growth potential. While low interest rates increased economic deal activity in the space sector, it also raised concerns about excessive leverage and reliance on cheap debt.

Unlike risks in the "public" markets, the global economic risk exposure to "private" markets which lay home to private equity and venture capital is less well known; **private equity and venture capital investments often lack the transparency and regulatory oversight associated with public markets**.

Most importantly, **macroeconomic risk and the impact of a failing private equity and venture capital market on global innovation and local economies are not well understood**. Governments and the private sector outsourcing innovation investment to private venture capital raise **concerns about the potential impact on urgently needed global innovation in high-tech areas if the venture capital industry slows**.

1.1.4 Space Economy Trends (2009-Present)

After the financial crisis, low interest rates facilitated large capital flows into high-risk, high-return industries; the Space industry was one such beneficiary. This period of emerging capital coincided with SpaceX's first Falcon9 launch (2010) and NASA's retirement of the Space Shuttle (2011). The Commercial Orbital Transportation Services (COTS) model, announced in 2006, aimed at expanding the delivery of cargo to the ISS by private companies, and represented a new way forward for a new cooperation between NASA and U.S. industry, and as such the eventual commercialisation of the Space industry.

The period also witnessed the rise of private space companies like SpaceX, Blue Origin, and Virgin Galactic, backed by substantial venture capital and family office investments. This era transformed the space industry from government-dominated to a dynamic, competitive sector, attracting private market allocations.[1] In Europe, a similar, albeit less prominent trend has emerged with some delay. Nevertheless, private capital enabled the emergence of some nascent champions in the satellite manufacturing and services sectors, notably also in countries outside the established industry epicentres, for example, ICEYE (Finland), NanoAvionics (Lithuania), and EnduroSat (Bulgaria). In the launch and space transportation segment, the activity of companies with private backing remains in established environments (Germany, France, Italy, Spain).

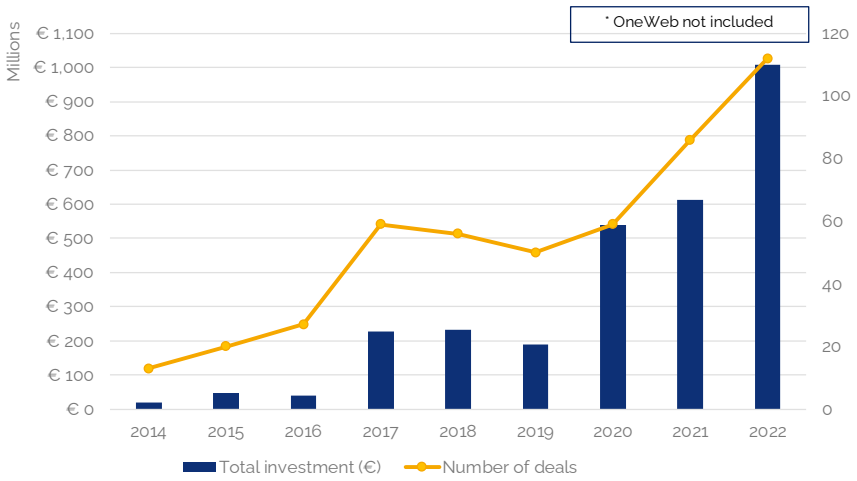


Figure 4: Investment value and number of deals in Europe since 2014

Private investment success narratives in the space industry are further complemented by increased government investments, notably in the U.S., acting as co-investors, "offramp" or "anchor" customers for commercial actors, exemplified by programmes like NASA's Artemis (e.g. Lunar Lander) and increasingly the U.S. Space Force (e.g. Starshield, BlueHalo). While civil expenditures have historically been higher than defence, the gap between the two is decreasing and is expected to reach parity by 2031 according to projections.[2]

1.1.5 Looking Ahead (2022-Onwards)

The past two decades have witnessed a remarkable transformation in the macroeconomic and financial landscape, which has directly influenced the investment landscape in the space industry. From the emergence of private space companies and reduced launch costs to the growing importance of space for Earth observation, internet connectivity, and geopolitical interests, numerous factors have converged to create a thriving space economy. However, it is inarguable **that the unique macroeconomic and geopolitical considerations that have preceded this point in time have now changed.**

The era of low interest rates that defined economic stability, and over a decade of economic growth in the financial private markets, is over. At the time of writing this report, inflation continues to dominate financial commentary. Central bankers, responding to a new wave of market exuberance, excessive leverage and financial bubbles that are reminiscent of a financial crisis, are raising interest rates in an attempt to stabilise the economy; liquidity management in the market is at the fore for investors once again.

[1] The authors note that most of global expenditure in space still relies on public budgets – yet the growing role of private investment is a relevant feature of this era.
[2] Euroconsult. 2022. "New record in Government Space Defense spendings driven by investments in Space Security and Early Warning." *Euroconsult* (Link).

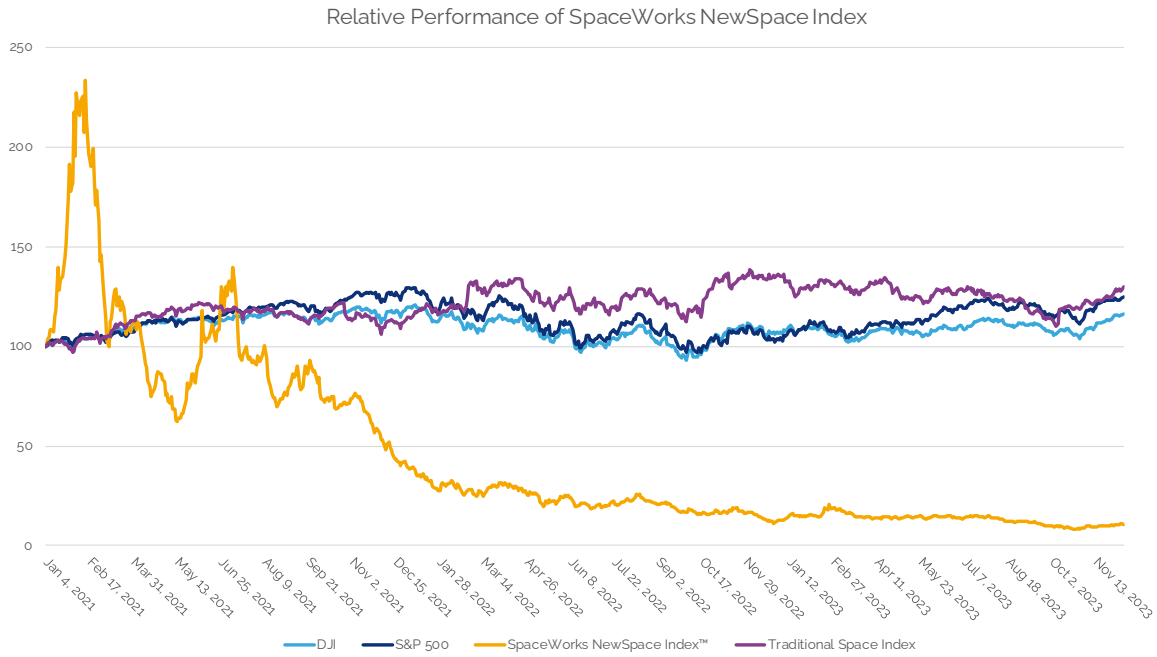


Figure 5: Relative performance of indexes based on day-to-day change in closing value (Credit: Space Works – New Space Index)

Increasing interest rates have prompted a shift of high-risk, high-reward capital to "safer" financial instruments amid fears of a global recession. As venture capital and private equity see capital outflows, investors are becoming more cautious about investments, particularly in high-tech industries like biotechnology, infrastructure innovation, and the space sector. **High asset price valuations, resulting from a decade of low interest rates, are now under reassessment. Space companies born in the NewSpace era are undergoing *market corrections (Figure 5)* with investors re-evaluating valuations based on revenue and commercial expectations**.

These changes in the wider venture capital and private equity landscape, beyond the space industry, are evidenced by insights from the **European Investment Fund's VC Survey 2023**, the **Boston Consulting Group's Global Asset Management Report 2023**, and the **State of European Tech Report 2023**.[3]

These reports collectively indicate that the **VC and private equity sectors are at a challenging juncture**, influenced by a confluence of macroeconomic conditions and market uncertainties. The EIF VC Survey 2023 reveals a downturn in market sentiment and activity in the European VC ecosystem, attributable to factors such as the economic fallout, geopolitical tensions, energy price shocks, and notably a period of high inflation and interest rates. This environment has led to difficulties in fundraising and exits, making access to equity finance more challenging for portfolio companies.

Moreover, the survey points out the **challenges in finding co-investors and the decrease in valuations of portfolio companies**. Other sources confirm this, citing that, as public markets have deteriorated, these investors have been quick to withdraw, focusing on stabilising their public portfolios. As public market conditions have worsened, investors in funds called limited partners, or LPs, have also pulled back, making it more difficult for VCs looking to close their own funding

[3] European Investment Fund. 2023. "EIF VC Survey 2023." *European Investment Fund* (Link);
Boston Consulting Group. 2023. "BCG Global Asset Management Report May 2023." *Boston Consulting Group* (Link);
Atomico, Orrick. 2023. "State of European Tech Report 2023.", *State of European Tech* (Link).

rounds. More than 50% of VCs surveyed have a negative outlook on raising over the next 12 months in light of high interest rates and economic uncertainty noting that VC fundraising "could be on track to drop to levels not seen since 2017."[4]

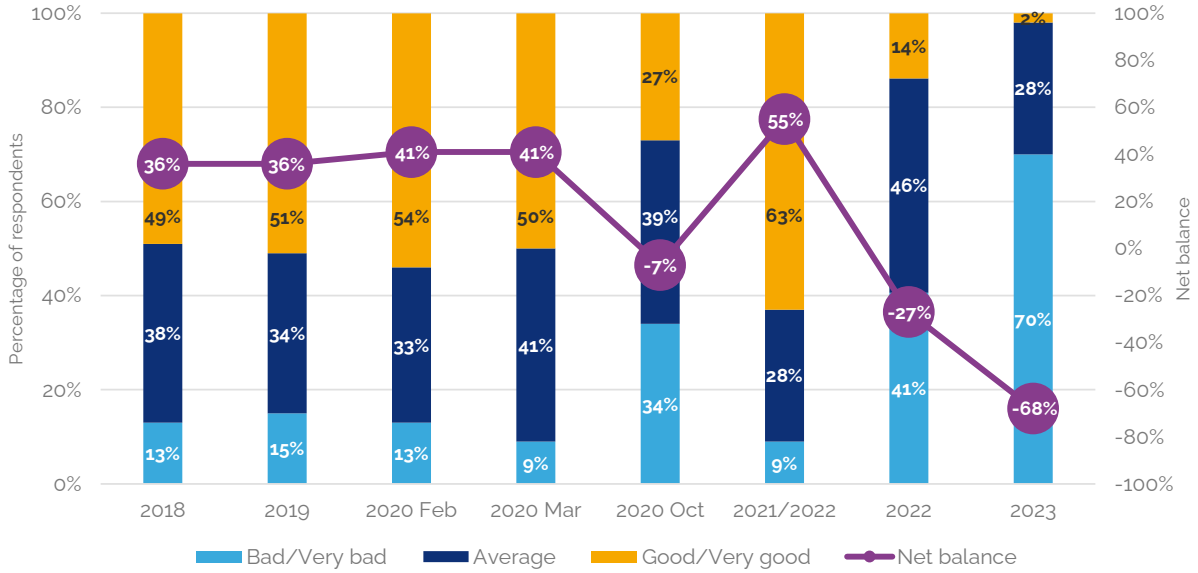


Figure 6: VCs perception of their current fundraising environment (Credit: EIB)

For the space industry, this highlights the need for novel approaches and partnerships, including through the involvement of public actors. Companies in the space sector might need to explore joint ventures or consolidation, thereby making their ventures more appealing to VCs who are increasingly cautious and seeking to mitigate risks. Additionally, the current environment may provide more realistic and grounded valuations, leading to more sustainable investment strategies for long-term growth in the space sector.

Similarly, the BCG Global Asset Management Report 2023 highlights a turning point for asset managers, driven by higher interest rates and the end of a long-standing bull market. These conditions have led to a **significant decrease in global assets under management and net flow rates**, underscoring the need for the industry to pivot towards more innovative and personalised products and services, and to **explore opportunities in high-growth private markets**. This pivot towards private markets and personalised investment products could mean a greater emphasis on direct private investments by family offices and pension funds, where there's a potential for tailored funding that aligns with the specific needs, timelines and ambitions of strategic space projects. Such capital might offer the patience and substantial funding injections that are essential for the growth of space ventures. For example, across 365 global pension funds, the allocation to private equity is

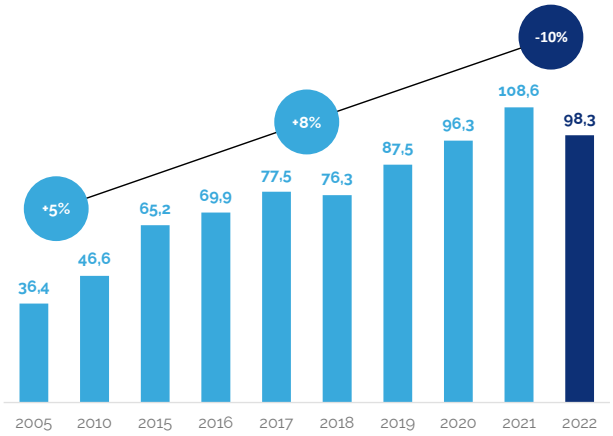


Figure 7: Global AUM in USD Trillion (Credit: BCG)

[4] J. Scott. 2023. "PitchBook analysts say 2023 VC funding is "pretty much shot," long-term recovery appears likely." *Betakit* (Link).

under target in 2023. An indicator reflecting the current environment is that in Q1 2023, 30 funds with a size greater than USD 100M were launched, compared to 450 during the same period in 2022.[5]

Echoing these sentiments, the State of European Tech Report 2023 paints a picture of a tech ecosystem that, while resilient, has **seen a decline in investment levels, with a noticeable slowdown in large investment rounds and the creation of new USD 1B+ companies**. Despite this, there are signs of stabilisation and growth in areas like AI and climate tech, indicating a shift in investor focus towards sectors with strong growth potential and **recognised strategic value through government backed prioritisation**. Faced with this new environment, **European states will have to rethink the way they have been engaging with innovation and, and by extent, the NewSpace sector**.

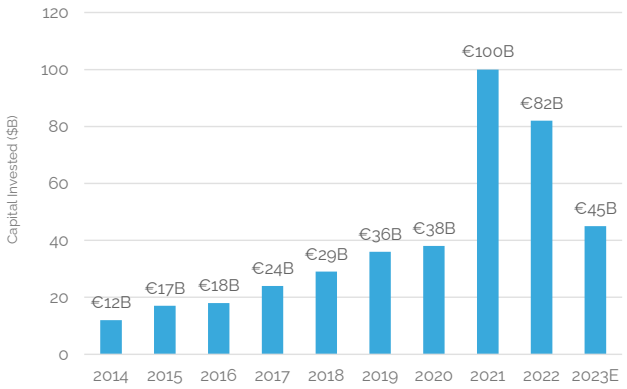


Figure 8: Total capital invested (Billion) in Europe, 2014 to 2023 (Credit: State of the European Tech)

However, their ability to operate may be hindered by the same macroeconomic conditions. A significant portion of European states could see increased constraints on their investment capacity due to the need of keeping their debt at sustainable levels. **Since the pandemic, the debt-to-GDP ratio of European countries has risen significantly**, which has forced states to consider how sustainable their public debt is to maintain. For the EU, countries have pledged to keep their public debt below 60% of their GDP, with an annual deficit below 3%. However, half of the MS are predicted to have debt ratios greater than 60% of GDP in 2024, with Belgium, Greece, Spain, France, Italy, and Portugal expected to exceed 100%.[6]

Whilst European Union fiscal rules were waived during the uncertainties of pandemic and post-Covid recovery, the **European Commission has only suspended these limits until 2024**.[7] Thus, the impact this may have on the national appetite to invest in high-risk, high-capital projects like the space sector may meet further challenges. In this context of re-establishing debt ceilings, the Recovery and Resilience Fund becomes an ever-timelier tool with EUR 33B in grants.

In conclusion, we are at a **macroeconomic, financial, and geopolitical crossroads**, whereby the future does not mirror the recent past. Assumptions about how our global economy functions and the strength of relative industries and nations no longer hold true; global supply chains are being redrawn, geopolitical tension remains heightened in the face of a war on the European continent, and political and economic risks have never been more complex or multidimensional.

As such, participants of the European space industry, especially public agencies, need to navigate an increasingly complex financial and economic environment to fulfil their mission in support of the sector, where the vision for the future of the industry is increasingly driven by investment managers who oversee increasingly prominent space companies. Understanding how financial markets, particularly private capital markets, work is crucial for European institutions and space ventures alike. This **understanding of the relationship between industry and various financing mechanisms** strengthens the European industrial base and policy pertinence, contributing to broader economic and technological advancements.

[5] D. Wilson, A. Sabatier, 2023. "Pension fund allocation to private equity under target." *S&P Global Market Intelligence* (Link)
[6] European Commission. 2023. "Debt Sustainability Monitor 2022." *European Commission* (Link).
[7] J. Allenbach-Amman. 2023. "EU Commission to police public deficits again in 2024." *Euractiv* (Link).

2 Access to Finance

In the present moment, our world finds itself at a juncture marked by substantial macroeconomic, financial, and geopolitical shifts. Assumptions that have traditionally governed the global economy, industry strengths, and international relations are undergoing a significant transformation. These developments necessitate a **thoughtful re-evaluation of the trajectory and pace of progress in the commercial and public space sector.** One critical aspect of this re-evaluation is the allocation of resources and access to finance, given the ever-growing importance of innovation. This report delves into the available financing options and how policies can stimulate further development.

2.1 Prescriptive vs Open Innovation Pipelines

European public institutions, in particular ESA and some national agencies in the space sector, have an **outsized ability to foster and steer European space industry innovation** through innovation policies. Industrial policy, which refers to government efforts to shape the economy by targeting specific industries, firms, or economic activities, usually comprises two sets of activities:

It is crucial to distinguish between these two sets of policies when establishing an understanding of the mechanisms and policies which create innovation outcomes. This is especially true in the space industry, which is driven by a complex set of evolving stakeholders. In turn, directed and open policies will impact these stakeholders in different ways, often with unknown or emergent second-order or higher-order effects on the ecosystem. **Directed and open innovation policies are two distinct ways through which innovation and development in an economy can be achieved**; however, these policies differ in their goals, strategies, and the level of government intervention required. For European institutions to effectively manage, and thus incentivise, their European space industry stakeholders, there must be an understanding of the two types of policies and their likely impacts.

2.1.1 Directed Innovation Policies

Directed policies have specific and targeted goals and objectives. These policies aim to **steer innovation towards specific sectors, technologies, or industries that are deemed strategically important for economic growth or societal enhancement**. Typically, the government identifies priority areas and allocates or shapes the allocation of resources toward those sectors or industries accordingly. Until recently, directed innovation policies were viewed as unfavourable tools by the public and private sectors, as they were seen as unnecessary government intervention that reduced or removed the "efficiency" of the private sector markets.

Recently, this view has drastically changed to see directed industrial policies viewed in a more favourable light. Changing economic challenges such as COVID-19, climate related emergencies, strategic national security interests, market failures, and global economic competition has increased the need for rapid innovation. This, in turn, has led to a re-evaluation of industrial policy

in contemporary economies, as can be seen with the USD 280B US CHIPS and Science Act and the USD 500B US Inflation Reduction Act.

These **top-down policies involve a high level of state intervention and planning;** the government or acting body actively selects and supports specific goals through blunt instruments such as subsidies, grants, or targeted regulations. Examples include funding for renewable energy projects, biotechnology research or defence and space technology. The U.S. government, for example, employs several direct innovation policies within the space industry to create a growing commercial sector, enhance national security, and promote all-economy growth. A strong example of directed innovation policy is **NASA's Artemis Programme**.

Analysing NASA's Artemis Programme as a Directed Innovation Policy

NASA's Artemis Programme is a directed innovation policy led by NASA, aimed at returning humans to the Moon and establishing a sustainable presence there. This initiative involves substantial government funding and partnerships with companies to develop crucial components like the Space Launch System (SLS), the Orion spacecraft, lunar landers, and lunar Gateway infrastructure. The Artemis programme embodies several key factors that characterise it as directed innovation policy:

1. **Specific Objectives:** The Artemis programme outlines clear and specific goals, including lunar exploration, establishing sustained lunar presence, and preparing for human missions to Mars. These objectives are top-down directives from NASA and the U.S. government, ensuring a shared understanding of the project's scope and purpose.
2. **Government-Led Initiative:** As a directed innovation policy, Artemis is primarily driven by the government, with NASA at the forefront. Substantial government funding and resources are allocated to achieve programme objectives, with NASA responsible for planning, execution, and oversight.
3. **Strategic Priorities:** The programme aligns with strategic priorities set by the U.S. government, focusing on advancing space exploration, maintaining national leadership in space endeavours, and promoting international collaboration. These priorities serve broader national interests, including security and defence objectives.
4. **Directed Investments for Platform Technologies:** Directed policies that include significant investment are typically employed to build a platform technology from which other, lower capital commitment technologies can be derived at a later stage.
5. **Partnerships with Industry:** The goal of directed policies is typically to spur industrial activity not just from a single stakeholder but amongst several of them, to create network-like effects.
6. **Regulatory Frameworks:** To facilitate economic growth, directed innovation policies often establish regulatory frameworks. The Artemis Programme operates within regulatory guidelines set by NASA and the U.S. government, promoting safe and compliant commercial activities in space. These frameworks reduce risks and incentivise economic investments.

In summary, NASA's Artemis programme is a robust example of a directed innovation policy. It encompasses targeted government investments, clearly defined objectives, and strategic priorities, guiding space exploration efforts. As a government-led initiative, it aims to advance space technology and exploration, serving both specific mission objectives and broader national interests.

As demonstrated by the US CHIPS Act and/or the "Made in China 2025" plan, a state-led industrial policy that seeks to make China dominant in global high-tech manufacturing, directed policies can and do lead to rapid advancements in specific sectors or technologies. Moreover, they can be used to create **strategic advantages for governments to gain increased competitiveness in strategic industries**. For example, South Korea's government support for the semiconductor industry has allowed companies like Samsung and SK Hynix to become global leaders in this field within a short timeframe.

However, there are clear drawbacks that must be understood through policy trade-off studies. Directed innovation policies are often a part of large programmes that are blunt, slow-moving tools. These policies are **less flexible than their open policy counterparts because they are tied to specific goals and priorities**. Changing priorities or technological developments may require adjustments to the policy, which can be slow and cumbersome.

Successful outcomes for directed policies require a clear, long-term vision that is unlikely to change and remain relevant over time. Further, there's a risk that the government, often deemed to be placed far from the fast-moving private markets, may misjudge which sectors or technologies will be most successful, leading to resources being allocated inefficiently. Additionally, **directed policies can distort market competition by favouring certain companies or industries, potentially stifling innovation in other areas.** For example, a strategic allocation by many governments to increase funding for electric vehicle infrastructure has increased the number of electric vehicles on the road, which in turn has stifled innovation and adoption of car-alternatives, such as public transport systems.[8] Directed innovation policies can have both positive and negative consequences, although they are fast becoming a tool of choice for many governments facing a myriad of contemporary challenges.

2.1.2 Open Innovation Policies

Open policies are more general and flexible than directed policies. **They focus on creating a favourable environment for innovation without specifying particular technologies**. More simply, the goal is to stimulate innovation across the entire economy and let market forces determine which innovations are most successful. Open innovation policy, often associated with laissez-faire or market-driven approaches, gained prominence in the 1980's when U.S. President Ronald Reagan led a push for "small government" economics, which went on to define a long-standing wave of market-driven capitalism and entrepreneurship.

Open innovation policy relies on the belief that 'markets' instead of governments are the most efficient allocators of resources, suggesting that letting supply and demand dynamics should guide innovation investments. This, in turn, allows for efficient allocation of capital and further encourages firms to respond rapidly to market signals. In non-economic parlance, this means that open innovation policies are driven by the fact that the private sector actors understand the needs of the markets better than the government because they are actively acting as buyers and sellers of goods and services, whereas the government is not. Open innovation policies have been shown to promote entrepreneurship and competition by allowing entrepreneurs and innovators to identify market opportunities and develop solutions without being told where to innovate. **This bottom-up approach creates the incentives that are extremely important to risk-taking and innovation-driven entrepreneurship.**

[8] M. Gupta. 2023. "Electric Vehicles Are Not the Solution. Sustainable Transit Is." *Chicago Policy Review*. (Link).

Unlike directed innovation policies, it is harder to "see", and hence measure, open policies because they are often more subtle and woven into the economy in more complex ways. They do not usually consist of large, heavily funded programmes, but rather the government creates many policies to instead promote an environment which is hospitable to increased innovation, R&D and economic growth across the economy or within a loosely defined perimeter. This is typically done through not just one, but several complementary policies and tools simultaneously.

Open Innovation Tools: Government Initiatives for Innovation and Growth

Investing in R&D: Governments can provide vital funding and incentives to spur R&D across various industries through wide-spectrum grant schemes such as Horizon Europe or ESA's General Support Technology Programme (GSTP). This fosters innovation and the development of groundbreaking products and processes.

Reducing Regulatory Barriers: Streamlining and simplifying regulatory processes can empower businesses to enter and compete effectively in diverse industries. This approach not only reduces compliance costs but also fuels innovation. The U.S. expedited commercial space activities by simplifying launch and re-entry licensing through the Federal Aviation Administration (FAA) and establishing a streamlined payload review process. These reforms enhance accessibility and efficiency for startups venturing into the space industry.

Supporting SMEs: Small and Medium-sized Enterprises (SMEs) serve as significant drivers of technological innovation. Governments that provide financial incentives, access to capital, and support services witness substantial GDP growth. The U.S. government has pioneered exemplary SME support programmes, including the **Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programmes.** These programmes offer competitive grants to SMEs for R&D aligned with agency missions, creating a "government-as-customer" revenue source, and fostering rapid commercialisation of space technologies.

Tax Incentives: Government tax incentives play a crucial role in shaping economic activities. Tax structures can be designed to promote growth in the space economy, an example is Zero G, Zero Tax (ZGZT) legislation from the 2000s. Favourable tax treatment for capital gains encourages private investment in high-risk space startups. Additionally, R&D tax credits incentivise space companies to invest in advancing space-related technologies. State-level tax incentives underscore the government's commitment to nurturing a dynamic and competitive commercial space industry.

Open innovation policies rely on a lighter touch of government intervention. They often involve creating a conducive ecosystem for innovation by investing in education, research infrastructure, intellectual property protection, and reducing regulatory barriers. Indeed, these policies are more adaptable to changing circumstances and a fast-paced economy. They allow for the **organic emergence of innovative ideas and technologies, which can evolve based on market demand** and generally lead to a more balanced and diversified innovation ecosystem. While the rewards may not be as concentrated, the risk of failure is also mitigated.

However, open innovation policies may lead to slower development in strategically important areas. For example, if there is insufficient government support for a commercial space economy in Europe, it is unlikely that the private sector will make the investment on behalf of the government, as innovation typically follows the direction of strong state-backed directional indicators. Crucially, open policies are fraught with the problem of being difficult to measure; **outcomes are often seen in third-order or higher effects of long-standing policies, and attribution to expensive or**

complex policies rarely exists, even if the impact is real. Naturally, market-driven, or capitalism-based innovation can sometimes exacerbate inequalities and naturally seeks to create a dominant, winner-takes-all ecosystem which may not align with equitable societal outcomes. For example, Silicon Valley's concentration of tech companies has contributed to regional economic disparities, and as venture capital moves into the domain of space and defence, private sector interests may diverge from those of the government that seeks to utilise the technologies it has helped to create.

As European institutions seek to understand and define their respective roles in growing a sustainable European space economy, they must acknowledge the role of both directed and open innovation policies to harness the strengths (and mitigate the weaknesses) of all stakeholders. The choice of use and the trade-offs between these policies depends wholly on the specific circumstances, goals, and economic priorities of the government or agencies that seek to utilise them, but most importantly, having a clear and distinct vision of the industry is key. **Balancing the need for strategic focus with the benefits of organic innovation is a complex, but achievable, challenge for policymakers**.

2.2 The European Public & Private Funding Landscape

Public funding continues to be a fundamental pillar in the space sector, underpinning its growth and innovation. In 2022, European and national public institutions notably increased their financial involvement not only through public programmes, but also with **direct deals for space ventures accounting for 16% of the total (mainly using debt financing**), a significant rise from the previous year. This increased public sector involvement reflects a strategic commitment to developing a strong space start-up ecosystem and highlights the critical role of public-private partnerships. More generally, the ratio of public space budgets to private investments (public funding accounting for the majority of space investment) globally, further emphasises the importance of public support in stimulating private investments and ensuring the sector's sustained growth and innovation.

Simultaneously, the significance of private capital in the space sector is rising, driven by a need to fund cutting-edge and disruptive technologies that don't find their place in established programmes. The **European space sector witnessed a 64% increase in investments in 2022**, with venture capital being a major contributor to this growth.[9] However, this reliance on private funding is not without challenges over the past years. Smaller deal sizes and a concentration of capital in a few companies are concerns that need to be addressed to maintain a healthy, diverse investment landscape. More generally, as capital markets are cooling down this has implications for the availability of VC and private equity funding in the years to come.[10]

2.2.1 Publicly Backed Funding

The report provides an overview of publicly backed funding sources that are tailored to the development of new ventures and their growth or that aim to spur innovation across various sectors. This overview will not include operational programmes that are aimed at developing or upgrading existing infrastructure, as those are largely handled by industry primes where the underlying liquidity dynamics, cost structures and trajectories are different and where access to traditional financing (through commercial banks) is more readily available.

[9] ESPI. 2023. "Space Venture Europe 2022." *ESPI* (Link).
[10] J. Scott. 2023. "PitchBook analysts say 2023 VC funding is "pretty much shot," long-term recovery appears likely." *Betakit* (Link).

Moreover, while this subchapter focuses on public actors, many activities (e.g., fund management on behalf of a public entity) might be undertaken by private fund managers. In contrast, some public actors also emerge in the section on private capital (e.g., Bpifrance), as they act in the same way (albeit with different underlying drivers), and through the same mechanisms, as private actors.

European Union

EU-level financing, especially in the post-Covid recovery, has **introduced new funding instruments and reinforced pre-existing ones**. Figure 9 provides an overview of the funding mechanisms of the EU which are relevant for the space sector. Specifically, the opportunities for the space industry are often found within more general funding programmes, **which aim to foster entrepreneurship and innovation**, as well as facilitate direct investments which can originate from the European Investment Bank (EIB).

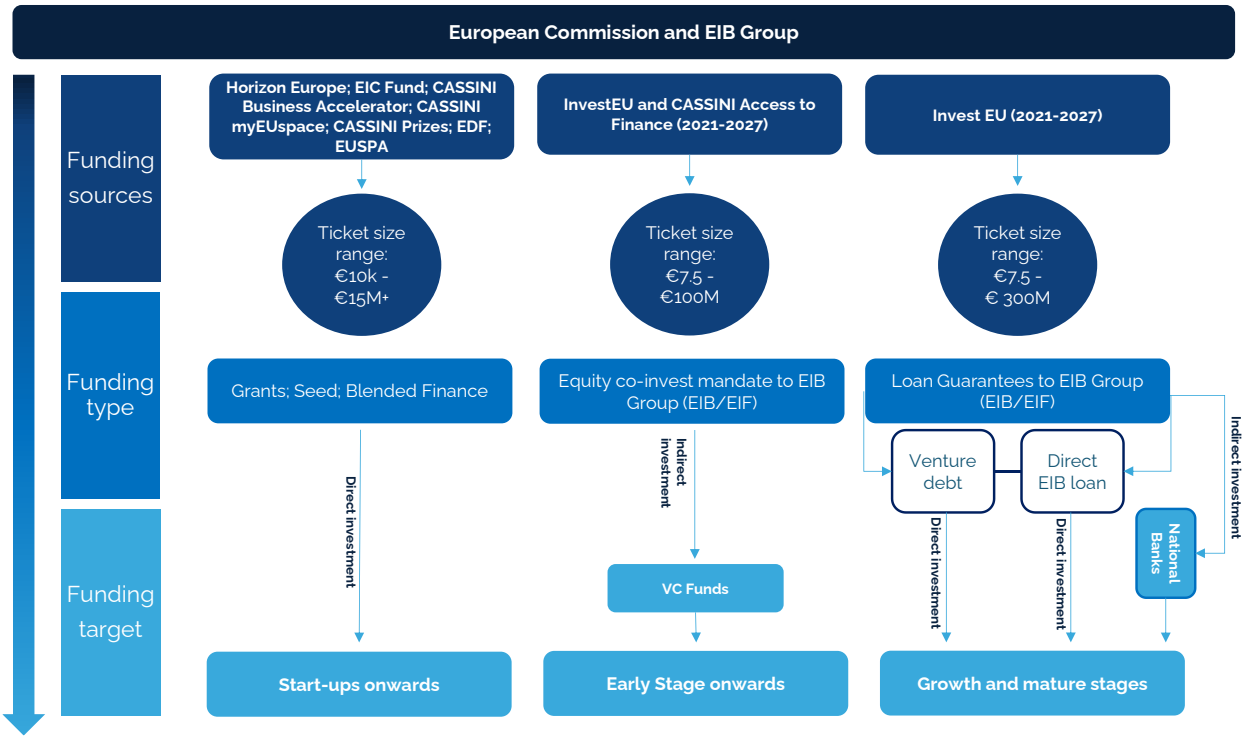


Figure 9: EU space investment mechanisms.

Horizon Europe and the European Innovation Council

With a budget of EUR 95.5B, Horizon Europe seeks to strengthen the impact of research and innovation, as well as disperse expert knowledge and technologies within the EU.[11] Under Pillar II (Global Challenges and European Industrial Competitiveness) of the Horizon Europe programme structure lies Cluster 2 with a focus on "Digital, Industry and Space" which **aims to facilitate an innovative and autonomous European space ecosystem**. Horizon Europe also seeks to enhance synergies among other EU programmes to foster **compatibility, coherence, and complementarity**.[12]

Specifically, within the Horizon Europe programme, the European Innovation Council (EIC) was launched in March 2021 and singles out projects relevant to space. Receiving a budget of EUR 10.1B to finance and scale up startups and SMEs, the initiative **aims to identify and support breakthrough**

[11] European Commission. N.d. "Horizon Europe." *European Commission* (Link).
[12] European Commission. 2021. "EU Research & Innovation programmeme 2021-27." *European Commission* (Link).

technologies and innovation through three main calls (EIC Pathfinder, EIC Transition, and EIC Accelerator). This specifically targets key strategic areas related to space, such as quantum technologies, innovative application of data from space infrastructures, and the development of space technologies.

EIC – Future Perspectives

Currently, the European Commission has acknowledged that the EIC Fund, whilst being operational since Autumn 2022 and supporting over 130 investments, will not be able to accommodate increasing demand from companies which require follow-on financing or larger investments. It is estimated that around 25% of companies which were awarded investment of over EUR 5M from the **EIC will require follow-up funding** of EUR 25-35M. This would be a pipeline of 20-30 companies requiring EUR 0.5-1B per year. This **highlights how a long-term funding analysis is crucial when ensuring public access to finance** for the space industry.

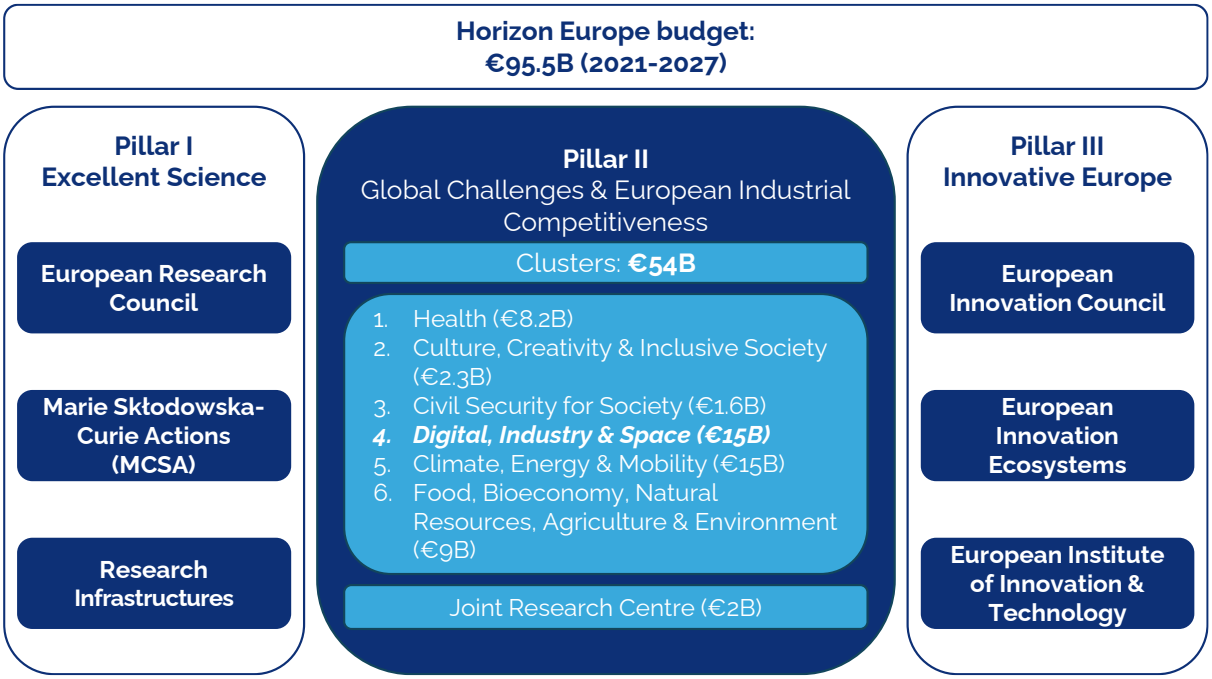


Figure 10: Horizon Europe funding structure (Credit: ESPI, European Commission, PNO)

InvestEU

InvestEU is a programme which leverages private and public funds to support investments into **sustainable infrastructure, research, innovation and digitisation, SMEs and midcaps, and social investment and skills**. It does so by provisioning an EU budget guarantee of over EUR 373B via the EIB and national development banks.[13] Previously, the landscape of **space sector support mechanisms was thought to be fragmented.**[14] Thus, InvestEU is designed to support European investment by helping to navigate different funding options and facilitate a more connected network of opportunity in the EU. In this way, InvestEU consists of three blocks (InvestEU fund,

[13] European Commission. N.d. "InvestEU." *European Union* (Link).
[14] EIB. 2019. "The future of the European space sector." *EIB* (Link).

InvestEU advisory hub, and InvestEU portal) that mobilise private and public investments, provide advisory support, and promote EU-wide investment opportunities.[15]

Competitive Space Start-ups for Innovation Initiative (CASSINI)

CASSINI was established to support entrepreneurs, start-ups, and SMEs **in the space industry**. Open to all areas of the EU Space Programme (i.e., upstream and downstream services), CASSINI supports the space sector under a EUR 600M (2021-2027) initiative.[16] It does so through several actions (e.g., hackathons, matchmaking, prizes, access to finance, and a business accelerator) and aims to **generate investments in space-related business activities**.

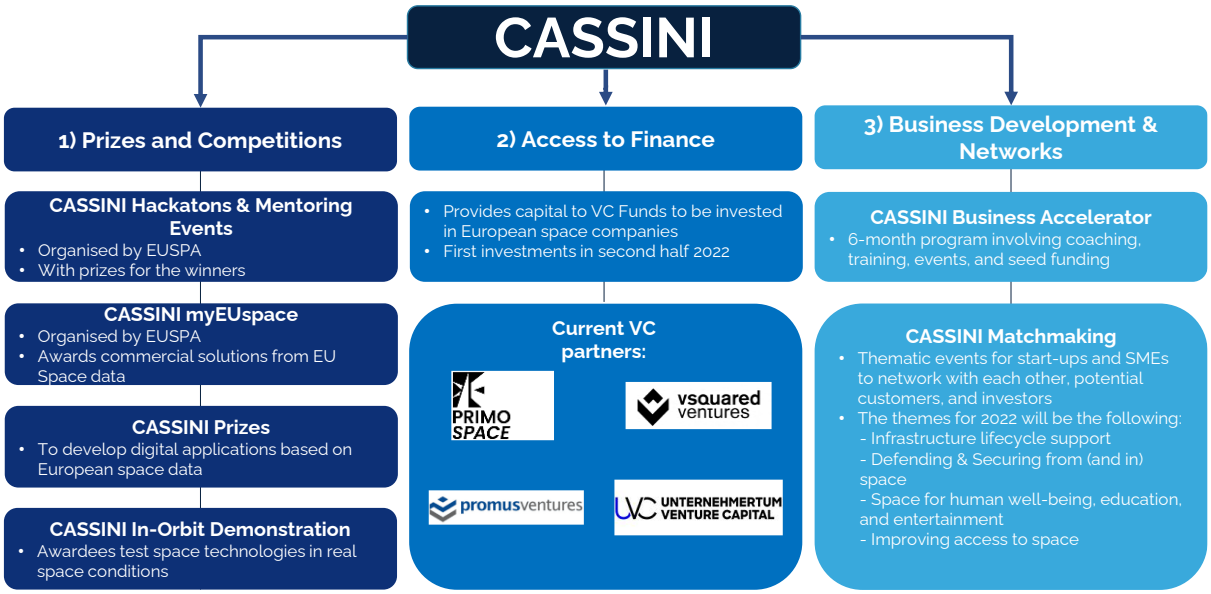


Figure 11: CASSINI funding structure

EIB and the Space Sector

The EIB, as the financing institution of the EU, also contributes to European objectives in the space sector. In fact, the EIB works closely with ESA to support the funding of several projects in space technology and infrastructure. For example, the "Joint Statement of the European Space Agency and the European Investment Bank" signed in June 2018 marked the beginning of increased investment in the European space sector to **encourage the global competitiveness of Europe**.[17] This is in line with projects such as the **Strategic European Security Initiative (SESI),** facilitating the financing of the space ecosystem.

EU Space-based Secure Connectivity System

The European Commission has proposed a plan for an EU space-based communication system to **protect critical infrastructure, ensure uninterrupted communications worldwide, and foster commercial high-speed services** to citizens and businesses across Europe. The main features of this system include cyber resilience and security, the integration of innovative technologies from both established space industry players and those from New Space, enhanced multi-orbital services, as well as the **reduction of non-European dependency**.[18]

[15] EIB. 2023. "Investment report on funding needs & gaps of selected segments of the upstream market." *EIB.*
[16] Cassini. N.d. "CASSINI Initiative." *EUSPA* (Link).
[17] EIB. 2018. "EIB and ESA to cooperate on increasing investments in the European Space Sector." *EIB* (Link).
[18] European Commission. N.d. "Space: EU initiatives for a satellite-based connectivity." *EC* (Link).

European Space Agency

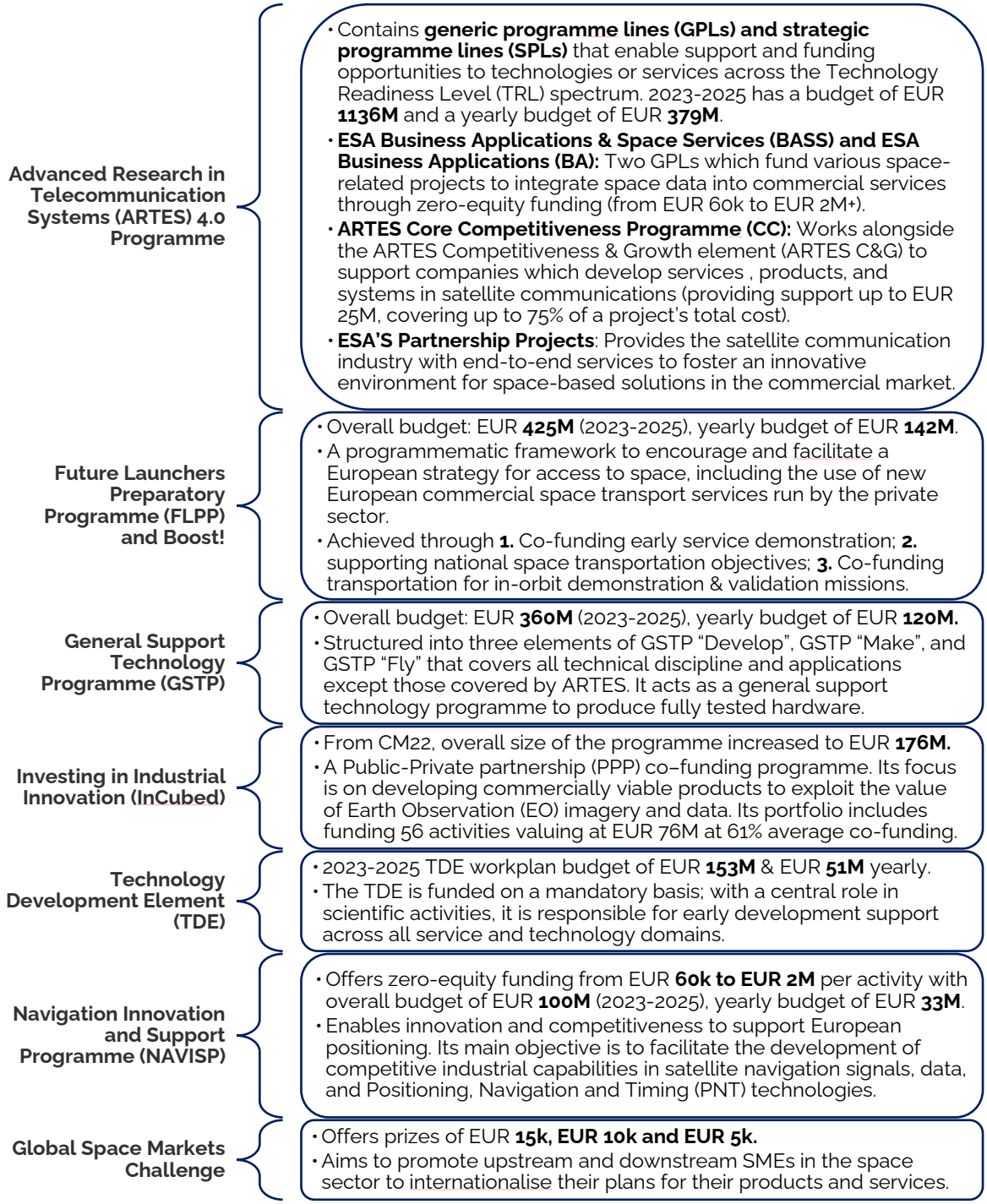


Figure 12: ESA financing programmes and organisational schemes.

The European Space Agency has had a long-standing, pivotal role in the growth of the European space industry, supporting investment through a range of programmes and initiatives. The ESA Council at Ministerial level in November 2022 allocated a budget of EUR 16.9B to supporting the

space ecosystem for 2023-2027, which represents a 17% increase compared to the 2019 allocation.[19] A representation of several key financing and organisational schemes are outlined in Figure 12.

Under the newly formed Directorate for Commercialisation Industry and Competitiveness (CIC), the strategic priorities of ESA are focused on fostering growth in the space sector, namely through several funding mechanisms and industrial initiatives. This recent reorientation has seen the emergence of the new ESA Commercialisation Gateway, as well as the directorate for Connectivity and Secured Communications (CSC) and CIC to operationalise commercial opportunities with ESA.[20]

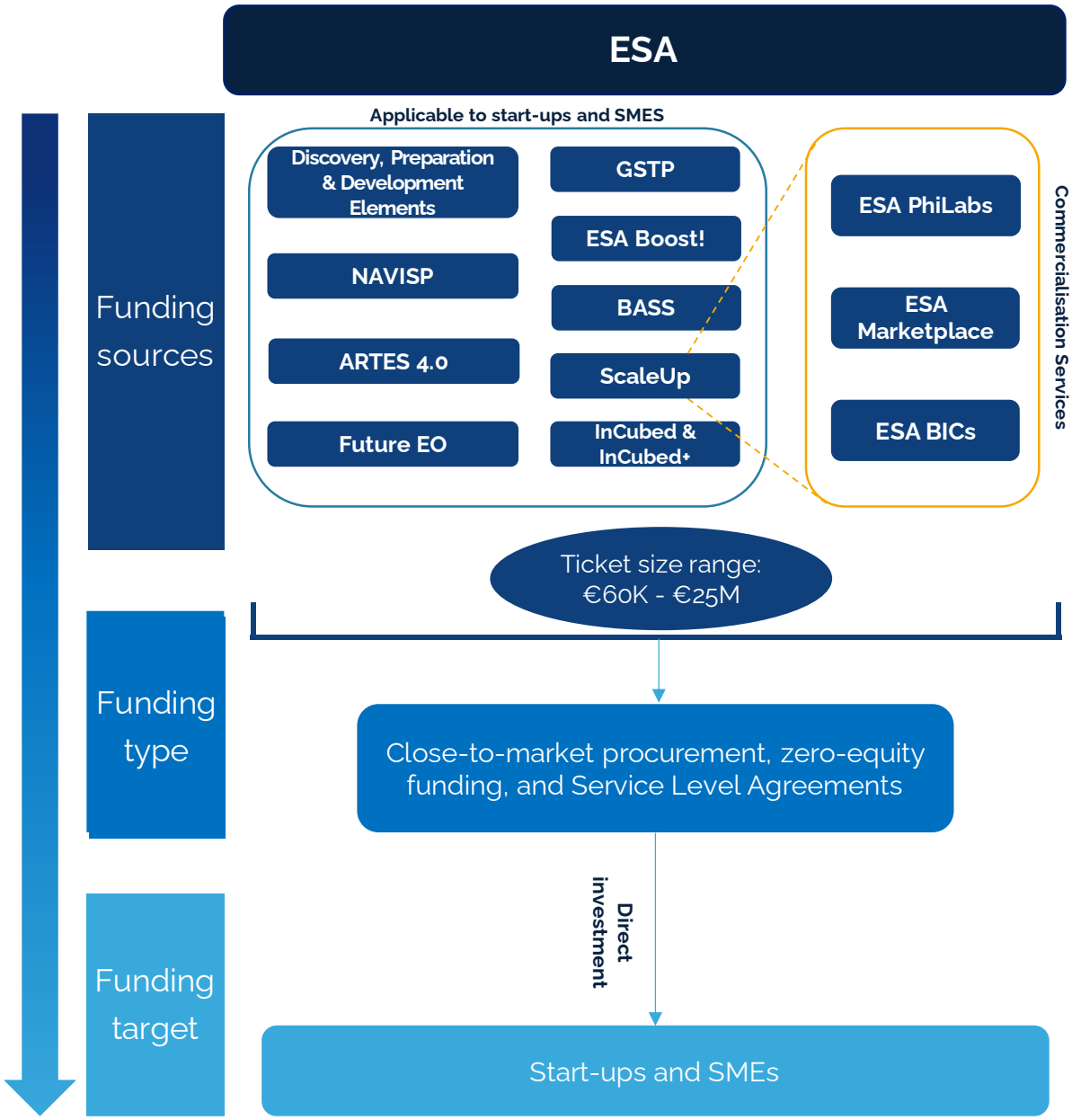


Figure 13: ESA funding ecosystem

[19] ESA. 2022. "Ministers back ESA's bold ambitions for space with record 17% rise." *ESA Newsroom* (Link).
[20] ESA. N.d. "ESA Commercialisation Gateway." *ESA* (Link).

The ScaleUp programme, which is accelerating space commercialisation as outlined in the ESA Agenda 2025, is the first ESA programme which will support end-to-end European entrepreneurs to scale up to the global space market.[21] In line with the aforementioned revamp of ESA directorates, the ScaleUp programme now includes the ESA Φ Lab (managing the innovation pipeline to accelerate EO) and the ESA Business Incubation Centres (ESA BICs) network.

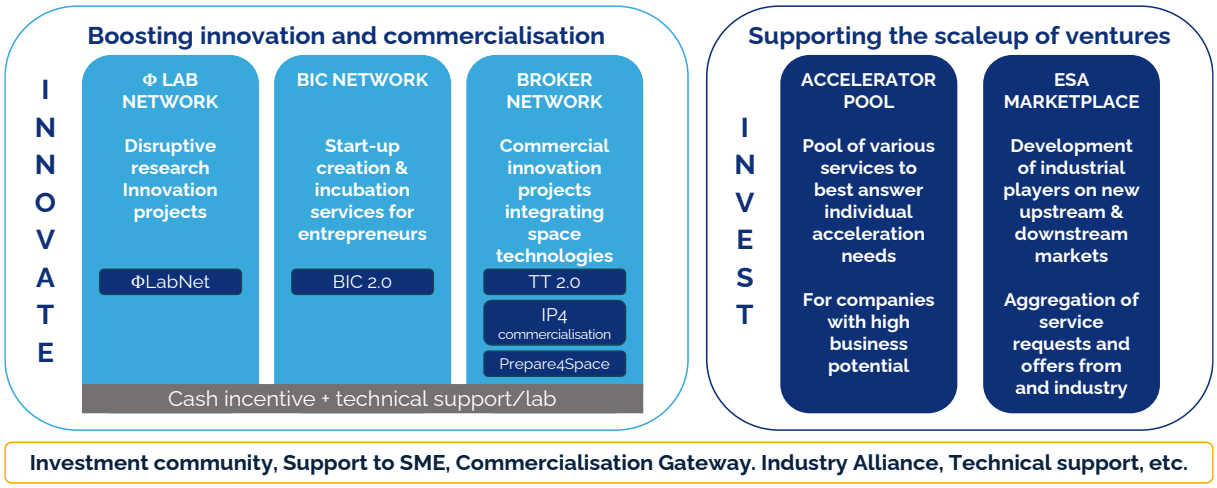


Figure 14: ScaleUp elements and components (Credit: ESA)

European States

National efforts to support the space ecosystem have been marked by the national recovery and resilience plans, thanks to the combined amount of EUR 723B in loans and grants available through the **Recovery and Resilience Facility (RRF)**. RRF is an opportunity for Member States (MS), especially those with a lack of budget flexibility, to invest in innovation and spur on new industrial strategy at the national level. This is especially notable in the context of securing European capabilities and near-shoring trends.[22] Some MS have used this opportunity to invest in space strategy in ways which would have otherwise not been accessible. RRF will play a key role in deploying capital into the space sector under grants, loans, project-based financing, and procurement. By 2022, of the 26 MS that had submitted their RRF plans, just under half made explicit mention to action related to space.[23] Whilst this included countries with a long-standing space tradition (e.g., France, Italy, Spain). it also came from newer space actors, like Poland and Portugal.

[21] ESA. N.d. "ScaleUP Programmeme." *ESA* (Link).
[22] DG for External Policies. 2021. "Post Covid-19 value chains." *European Parliament* (Link).
[23] V. Bacco & T. Walker. 2022. "Investing in Space: EU bets on the final frontier." *Logos* (Link).

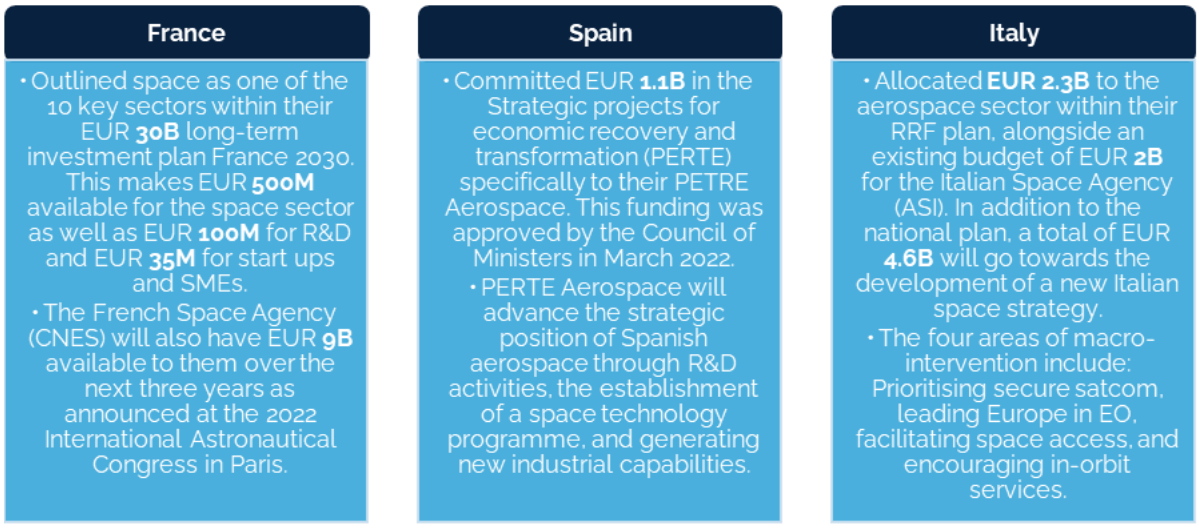


Figure 15: RRF usage in established European space ecosystems.

Poland is a country which arguably unlocked greater financial opportunities for their national space sector through RRF funding.[24] They harnessed the dual-use of space technologies and the benefits they can have on Poland's industrial and technological development potential. Specifically in Poland's Recovery and Resilience plan to the European Commission, **Reform A2.6** tackles the need for the expansion of national monitoring services, including the infrastructure for satellite data and the construction of a satellite system. [25] With this reform, they pledged an estimated EUR 150M, where EUR 41.8M goes towards a national satellite information system and EUR 108.2M was allocated towards a satellite earth observation system.[26] This exemplifies how at the national level, the space sector is increasingly being framed as a **multi-use industry, where investment can relate to not just a digital transition, but also an environmental or security strategy**.

In the case of **Portugal**, the space sector represents a commercial, rather than geostrategic, opportunity which has driven national investment. For example, Portugal has provided the space traffic management company, Neuraspace, with over EUR 3M in RRF funds (towards an approved value of over EUR 13M), with the specific associated measure to **mobilise the Portuguese agenda for business innovation**.[27] RRF funding is in addition to their national programme, Portugal 2020, which has been able to use EU funds to invest EUR 3.77M to LusoSpace, EUR 2.55M to Tekever, and EUR 2.67M on Active Space Technologies.[28] In fact, Portugal has just proposed the establishment of an investment fund within their draft 2024 budget that is intended to transition from the inflow of RRF funding. Starting in 2023 with a EUR 2B investment, it would be financed with funds from the 2023 expected budget surplus and whilst currently focused on structural investments, space-adjacent components could emerge.[29] Ultimately, whilst Portugal is a proponent for more permanent RRF funding, this shows how countries are beginning to look towards **more conventional national mechanisms to continue post-pandemic EU funds**.

[24] European Commission. N.d. "Poland's recovery and resilience plan." *European Commission* (Link).
[25] European Commission. N.d. "Poland's recovery and resilience plan." *European Commission* (Link).
[26] Ministry of Funding & Regional Policy. 2022. "National Plan Reconstruction & Resilience." *GOV PL* (Link).
[27] European Commission. N.d. "100 largest final recipients – Portugal." *European Commission* (Link).
[28] Portugal 2020. 2023. "Lists of Approved Operations." *GOV PT* (Link).
[29] Webber et al. 2023. "Ireland and Portugal to invest budget surpluses in new sovereign funds." *FT* (Link).

Public actors in Europe create predominantly open and mixed innovation policies

Public actor funding for the European space sector comprises a combination of both directed and open innovation funding. European space agencies and institutions tend to use a mixed approach that includes elements of both types of innovation policies to support the development of space-related technologies, missions, and commercial activities.

However, while **there is a hybrid of approaches, the dominant one that is used in Europe is open or mixed**, with a selection indicating the distinction in the table below.

Directed Innovation	Mixed	Open
Ariane Programme	**InCubed**	**General Support Technology Programme (GSTP)**
IRIS2	**Navigation Innovation and Support Programme (NAVISP)**	**Cassini**
LEO Cargo Return Service	**Advanced Research in Telecommunications Systems (ARTES)**	**Horizon Europe**
GALILEO		**BIC Network**
		InvestEU

Table 1: European and ESA innovation programmes

In this context, **additional research should seek to adequately assess the strength of the Directed Innovation programmes within the European space industry against the six core objectives of directed policy** identified above: (i) Specific Objectives, (ii) Government-led Initiative, (iii) Strategic Priorities, (iv) Directed Investments for Platform Technology, (v) Partnerships with Industry, and (vi) Regulatory Frameworks. This would then be able to identify the gaps between the core strategic goals of the European Space sector against the existing directed financing towards these goals.

2.2.2 Private Actors

This section data is based on **ESPI's proprietary Space Investment Database**. The period of the analysis is between Q1 2019 up until Q3 2023 and only considers European start-ups, thereby excluding OneWeb from the analysis.

Since 2019, European space startups have been raising more capital than the previous year, with 2022 being an exceptionally strong year where the **companies raised a record of over EUR 1B, up 69% compared to 2021**. Nevertheless, it seems that in 2023 the trend will not be repeated. Up until Q3 of 2023 the European NewSpace sector already raised approximately EUR 645M. Even though it surpasses the levels of 2019 (EUR 154M), 2020 (EUR 328M), and 2021 (EUR 431M), it was not able to raise as much as in the previous year (EUR 750M), representing a decrease of around 15%.

This also **reflects a wider trend in VC funding for technology companies in Europe, where the drop is even higher** - companies are on track to raise approximately EUR 42B in 2023, down from EUR 76B in 2022 and less than half the EUR 92B plus raised in 2021.[30]

[30] Atomico, Orrick, State of European Tech 23, November 2023, online: State of European Tech

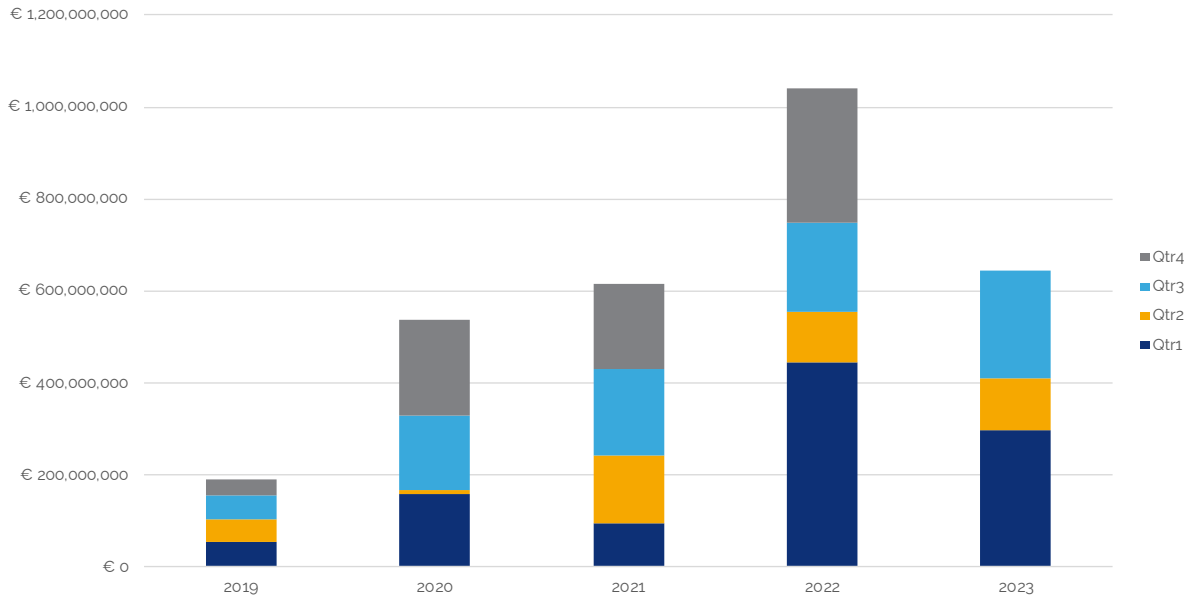


Figure 16: Investment value in the European Space Sector since 2019

Venture capital has been the largest source of private financing for the development of the European New Space ecosystem, comprising approx. 76% of the total funding since 2019. VC trends are therefore deeply connected to the funding trends in the European space sector. When comparing investment between Q1-Q3 of 2022 and 2023, VC saw a similar decrease of approx. 18%. At the same time, mainly since 2022, **debt financing has taken a secondary but key role in supplementing the financing needs** of European space companies.

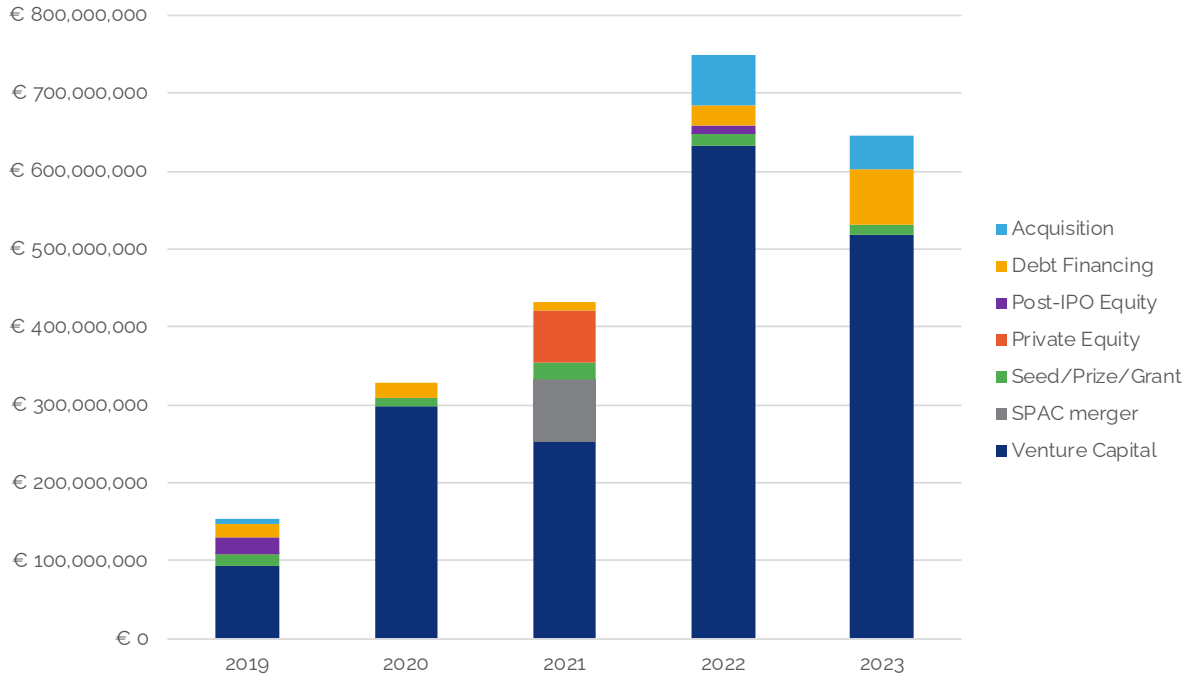


Figure 17: Investment value by deal category between Q1 and Q3 of each year between 2019-2023

Albeit a sizeable decrease, one could dismiss this as a product of comparison with an exceptionally strong previous year, particularly Q1. However, when putting this trend into the larger perspective of the financial markets, it **opens the possibility of hinting at the beginning of a capital winter for**

the European New Space sector, in line with trends in the wider technology and VC landscape.[31] Indeed, preliminary data from 2023 (including Q4), points to a slowdown in investment in line with Q1-Q3 data, and a **substantial decrease in activity (deal count), which appears to return to pre-2021 numbers.**

Graduation Rates

A graduation rate represents the ability for startups to scaleup by moving from one funding round to the next. In this table are the European space startups median deal time between different funding rounds in the 2019-2023 period.

In Figure 18, we can see that to date only **30% of the companies which raised a seed round managed to progress into a Series A**. Importantly, here we only consider data from the **2019-2021 period**, given that companies which raised a seed round afterwards are still within the median deal time of 18 months to graduate. Regarding **scaling from Series A to C**, the data only pertains to the **2019-2020 period**, for the same reasons as in the previous case. Within these two cohorts, the graduation rate is similar to one another, at a **50% rate**.

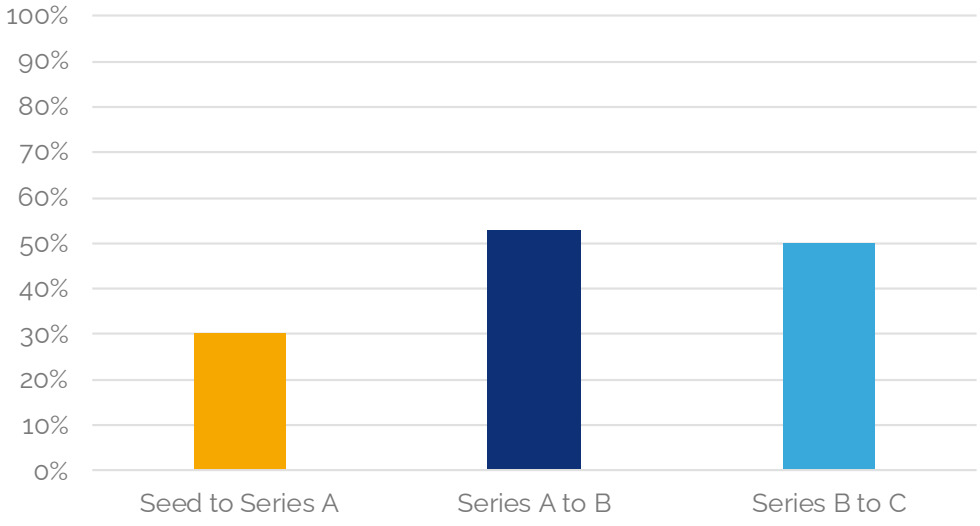


Figure 18: Graduation rates of European space startups.

Time to Graduate	
Seed -> Series A	18 months
Series A -> Series B	20 months
Series B -> Series C	23 months

Table 2: Time European space startups need to graduate between different funding rounds over 2019-2023

The graph below (Figure 19) represents graduation rates by year. Interestingly, even though funding into the European space sector increased especially after 2019 (as observed in figure 16), the graduation rates decreased since then. While 54% of the companies which raised a Seed round in 2019 managed to proceed to raise a Series A, by 2021 only 33% had managed to do so. Similarly, while approx. 70% of the companies that

[31] European Investment Fund, "EIF VC Survey 2023", 2023, European Investment Fund (Link); Atomico, Orrick, "State of European Tech Report 2023", 2023, State of European Tech (Link)

raised a Series A in 2019 managed to move on to a Series B, only just about 40% had managed to do so in 2020.

There are two likely explanations for an increasing failure rate between Seed and Series A rounds. Firstly, after 2019 the share of VC in the investment scene in Europe greatly increased as a percentage of the investment capital in the space industry. The mechanism of venture capital investing operates such that capital is deployed to a higher number of startups with a very high failure expectation, given that 1% of a VC portfolio can generate 99% of the returns of its fund. Therefore, as venture capital has moved into the industry, more companies have been funded with an overall higher failure rate. Secondly, since 2019, the European New Space sector saw the entry of new generalist VC funds which lacked sector-specific knowledge that is required to invest in and operationally assist space companies to grow. As such, **while eager venture capital may have come into the sector, there is a likelihood that it was not allocated efficiently to have a net positive impact on the size of the growing space ecosystem**.

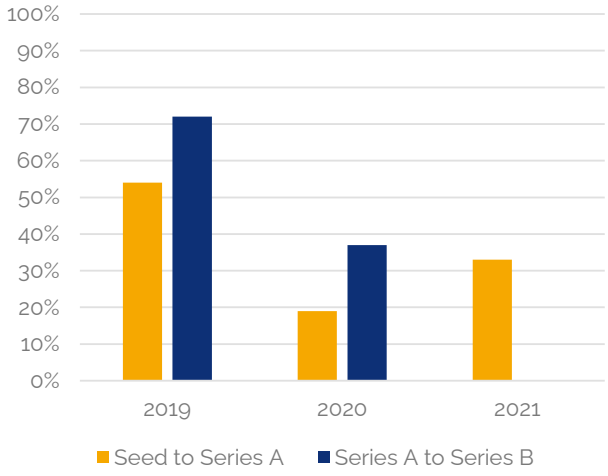


Figure 19: Graduation rates by year.

Towards a Venture Capital Funding Gap?

Considering these signals for the present and future financing environment, it is important to have an understanding, even if with certain limitations, of what are the capital needs of the European New Space sector. Considering both the macroeconomic environment and the funding dynamics analysed above, it would be sensible to **lay out a scenario where VC is not as available as before and understand the future capital needs of the sector**.

There are two scenarios for funding gaps, in the context of a slowdown of global venture capital, which will be explored below. The analysis is based on the VC raised in Seed, Series A and Series B stages between 2019-2022 to establish a baseline of capital needs for the foreseeable future.

The first scenario (Scenario A) is more pessimistic, where we would assume a decrease of 80% in VC funding to the European New Space sector. This hypothesis is based on the dynamics of the total capital invested in the European Tech ecosystem, which saw "overheating" activity in the 2021-2022 period but would otherwise be in a sustained growth trajectory.[32]

If we apply the same rationale to the European space sector, considering that the macroeconomic conditions which enabled it are no longer there, we can also identify a clear point of departure from the previous funding status quo from 2019 onwards. A return to levels of funding close to those of 2019 would represent an 80% decrease in VC funding. In turn, considering a scenario where a European space startup raised its funding round in Q1 2023, this would mean a funding gap of

[32] Atomico, Orrick, 2023. "State of European Tech Report 2023", *State of European Tech* (Link)

approx. EUR 74M for Seed stage, EUR 90M for Series A, and EUR 102M for Series B in H2 2024, leaving a **total gap of EUR 266M in the early-stage fundraising market**.[33]

In the **second scenario (Scenario B) we assume VC funding decreases by 60%**. This is based on various reports which point out a decrease of around 60% in 2023 compared with the peak in 2021.[34] Therefore, this scenario reflects what is already happening in the broader private markets, and which could affect specifically the European space sector fundraising environment. As such, the **funding gap would be smaller but still significant, totalling around EUR 200M**, with Seed stages lacking EUR 55M, Series A EUR 67M and Series B EUR 77M.

Funding Gap	Seed	Series A	Series B
Scenario A	EUR 74M	EUR 90M	EUR 102M
Scenario B	EUR 55M	EUR 67M	EUR 77M

Table 3: Funding gap analysis of Scenarios A and B

The natural question which arises for both the public and private sector is **which entity or asset class can fill in the funding gap?** It is also worth to consider that not all companies are meant to survive and that startup failures are an integral part of the innovation ecosystem. Another point to consider is that the lack of funding does not necessarily mean that these startups will die, but it will likely decrease their ability to scale-up.

Indeed, such dynamics were already present in the European New Space ecosystem, with various startups raising several Seed and Series A rounds (this dynamic is much less prevalent in Series B rounds) instead of moving on to the next round. Moreover, the macroeconomic environment is also making this a more prevalent trend in the U.S. with "graduation rates" from Seed to Series A facing a steep decline in 2021.[35]

Who is investing?

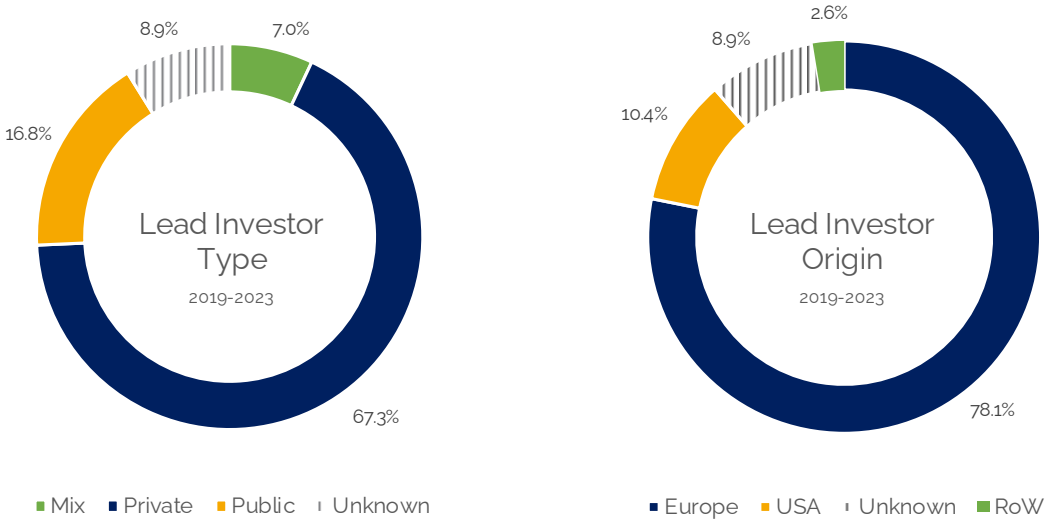


Figure 20: Lead investor type and lead investor origin in Europe between 2019-Q3 2023

Since 2019, approx. 234 different lead investors (the ones who commit the most capital in a funding round), led 347 deals in the European New Space sector, driving a total volume of almost EUR 3B

[33] Median deal time for VC seed rounds is 18 months, which places the capital need in early H2 2024, while for Series A and B is 20 months and 23 months, respectively, placing the capital needs later in H2 2024.
[34] Pitchbook. 2023. "Global Private Market Fundraising Report." *Pitchbook* (Link); Carta, State of Private Markets: Q3 2023 (Link); Seraphim Space Index Q3 2023 (Link).
[35] Peter Walker, US start-ups getting stuck at Seed, 7 November 2022, LinkedIn.

in investments. **Most of the investment volume was led by the private sector**, representing 67,3%, while public sector led 16,8%, mixed lead investors (co-owned by public and private actors) led 7%. The share of investment volume with an undisclosed lead investor was 8.9%.

Regarding the origin of lead investors, **most investments (78%) were led by European investors** and 13% by non-European. USA-based lead investors account for 10.4% of the investment volume, thus dominating the origin of lead non-European investors. The share of investments led by foreign entities, in particular from the U.S., has risen over the years. Whereas in 2019 investment led by American investors amounted to EUR 19M, in 2022 it reached EUR 165M. **Despite the near nine-fold increase, the aforementioned macroeconomic conditions are also affecting foreign investment.** Accordingly, in Q3 2023, this figure is sitting at approx. EUR 42M, well below the levels present in Q3 2022, which had already reached approx. EUR 158M.

Interestingly, if we analyse the lead investor origin by funding round, the foreign share of investment decreases as we go into later investment rounds. Accordingly, while in Pre-Seed foreign investors led roughly 27% of the investment volume, in Series B their share decreased to approx. 18%, almost a 10% reduction. Foreign lead investors led very few Series C or D investment rounds. Regarding acquisitions, foreign investors led approx. 19% of the transaction value.

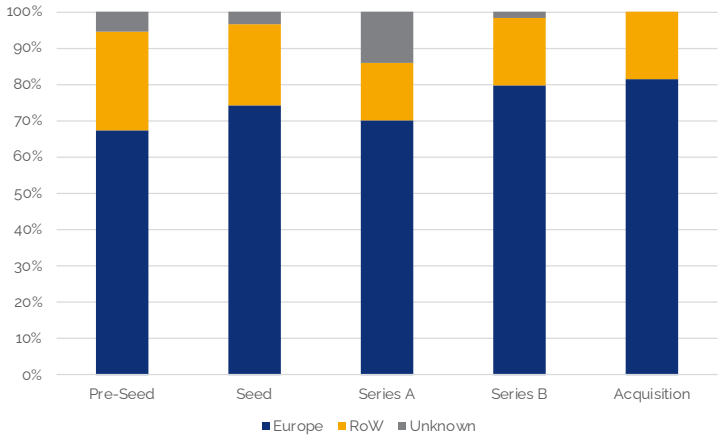


Figure 21: Lead investor region by round of funding between 2019-Q3 2023

Who led more volume?

It is also interesting to note that from the 234 different lead investors, only 15 are responsible for leading almost half (47%) of the capital volume raised by the European new space sector. Seraphim Capital and HV Capital were the lead investors that brought the largest amount of capital into the sector, each representing 7.1% of the total (each approx. EUR 212M).

Among the public sector lead investors, it was BPI France that oversaw 4.1% of the deal values into the space sector, the largest of its category. **Of the top 15 lead investors, four are public, one is mixed and the remaining ten are private.** Additionally, three of the top 15 lead investors are of foreign origin (Invema Group, Lakestar and True Ventures), and all from the U.S.

Among the ten private lead investors, there are seven venture capital firms, one private equity firm and two industrial actors. Among the VC firms, only one is dedicated to space (Seraphim Capital), while the others are generalists or invest in deeptech at large. Between the four public lead investors, two are development banks and two are development agencies. The only lead investor belonging to the public/private mix is an industry player.

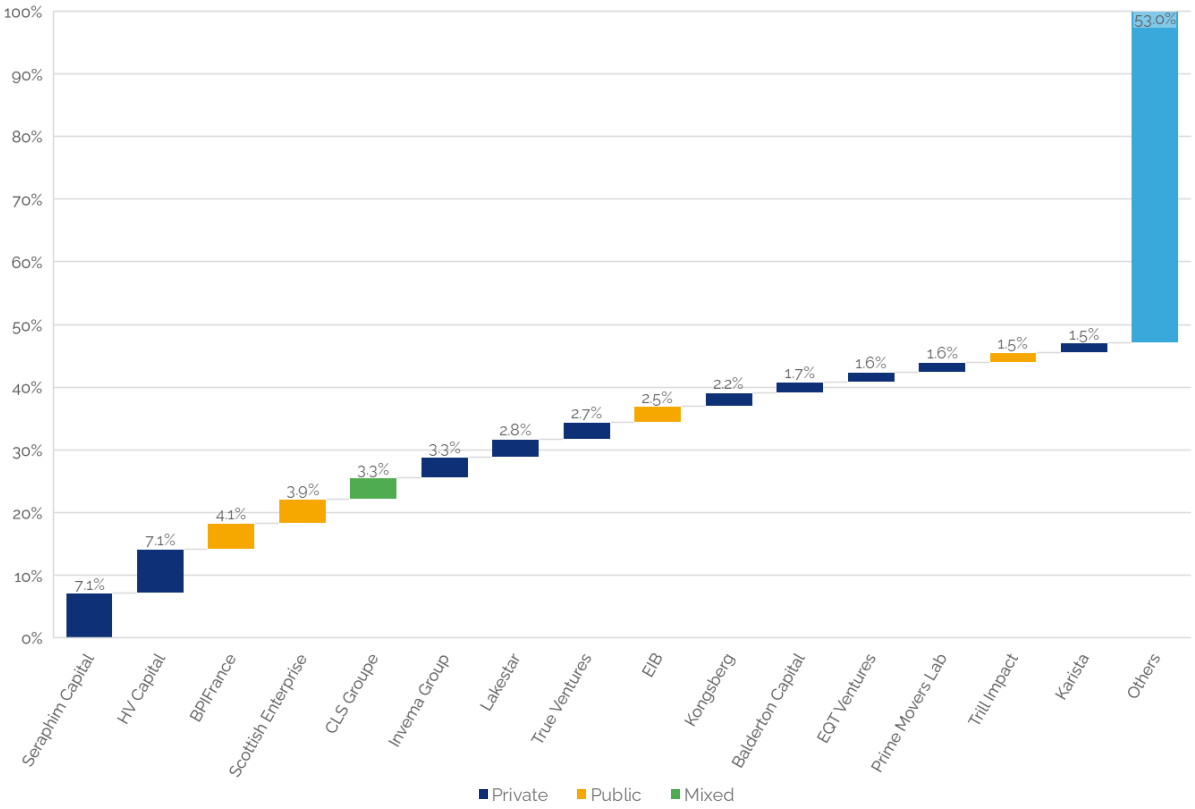


Figure 22: Top 15 lead investors 2019-Q3 2023

Ghost Impactors: Participating Investors

Although lead investors are important for the funding rounds to materialise, it is also interesting to take note of who participates in a large number of deals without leading them. These investors do not make as many headlines but are a significant part of investment activity in the European New Space ecosystem. The list is limited to investment in Europe between 2019 and 2023.

Investor	# Deals	Investor	# Deals
EZMC	5	SFC	5
inveready	5	vsquared ventures	5
DIETER VON HOLTZBRINCK VENTURES	4	High-Tech Gründerfonds	4
SRIW GROUP	3	hoshaq	3
DMNES	3	PLUGANDPLAY	5
AIRBUS VENTURES	3	Gresham House VENTURES	2
APEIRON INVESTMENT GROUP	2	AA SONS	2
BROOK CAPITAL	2	**Angel Investors** • Andreas Kupke • Ingo Baumann • Clemens Kaiser	3

Who led more volume across the space sector?

Even though a lead investor can be active in the space sector, its activity can be circumscribed. A glaring example can be found in the top 15 lead investors by volume presented in Figure 22, where almost half of which (7), have led all the funding into just one company. It is therefore important to identify which lead investors distribute value *across* the European NewSpace sector. To that end, the data was filtered in Figure 23 only includes investors that led investments in more than one deal and in more than one company. Accordingly, from the original 234 lead investors, only 36 fit this definition, and they have led approx. EUR 1.2B, or almost 40% of the total raised since 2019.

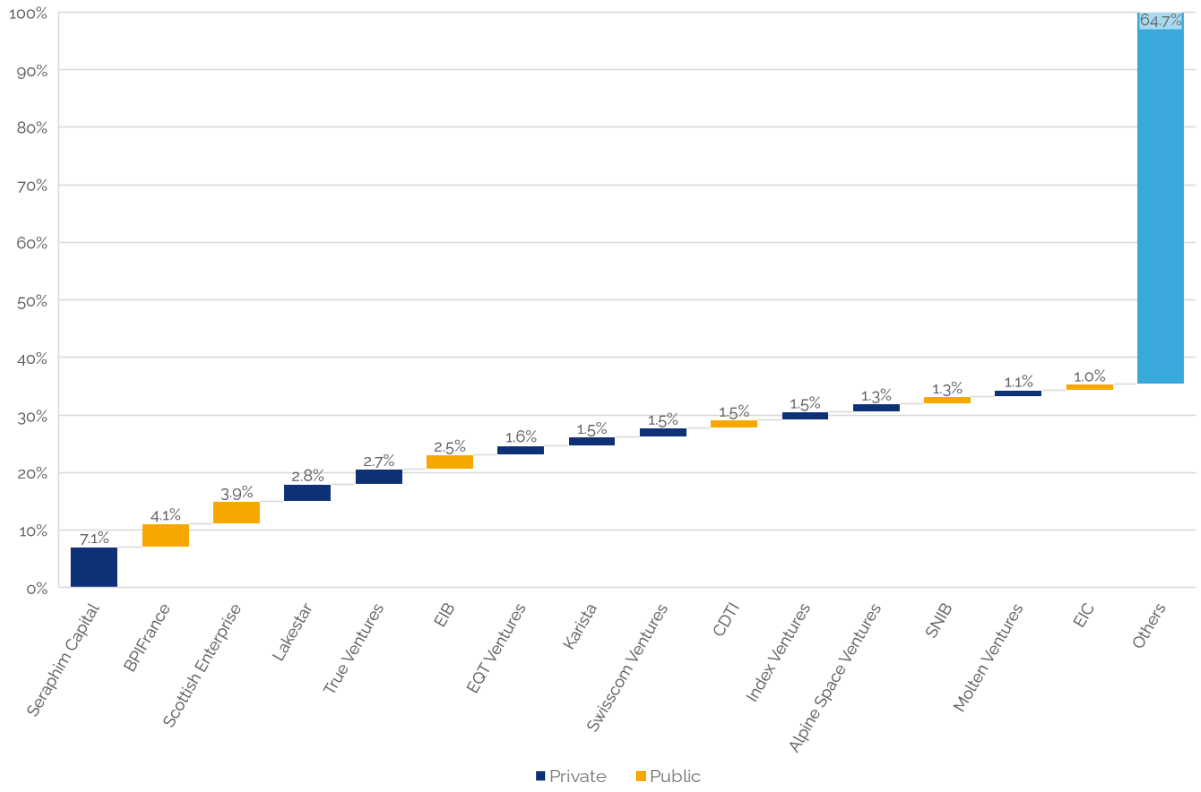


Figure 23: Top 15 lead investors adjusted 2019-Q3 2023

The share of capital volume led by the adjusted top 15 lead investors amounts to approx. 35% of the total raised by the European New Space sector, considerably less (12%) than in Figure 22. **Seraphim Capital maintains its overall leadership**, while **BPIFrance** sustains its leadership among public actors.

Within the adjusted top 15 lead investors, six are public sector (two more than in Figure 22), with the remaining nine being private sector, Similarly to Figure 22, there are still three lead investors that are of foreign origin, all of which are from the U.S., with Index Ventures taking Invema Group's spot in the top 15.

Of the nine private lead investors, all are VC firms, and only one is fully dedicated to space (Seraphim Capital), while another (Karista) has the space sector as an important component of its investment portfolio. Notably, there are no PE firms. Among the public lead investors, three are development banks and three are development agencies.

How does public support impact private investments?

How does the public investor help private funding materialise? Some tentative answers are provided by ESPI's database. Mixed consortiums are defined as deals where public and private investors participate in the funding round. Funding rounds with a mixed consortium account for around 1/3 of the volume raised since 2019, totalling approx. EUR 1B.

The mere presence of a public investor in a deal alongside private investors does not necessarily mean that the private investor would not otherwise have participated in the deal. Nevertheless, it is still safe to acknowledge that it will, at the very least, either lower the financial risk and/or the financial burden upon other participating investors, thus contributing, even if indirectly, to persuade them to join the investment round.

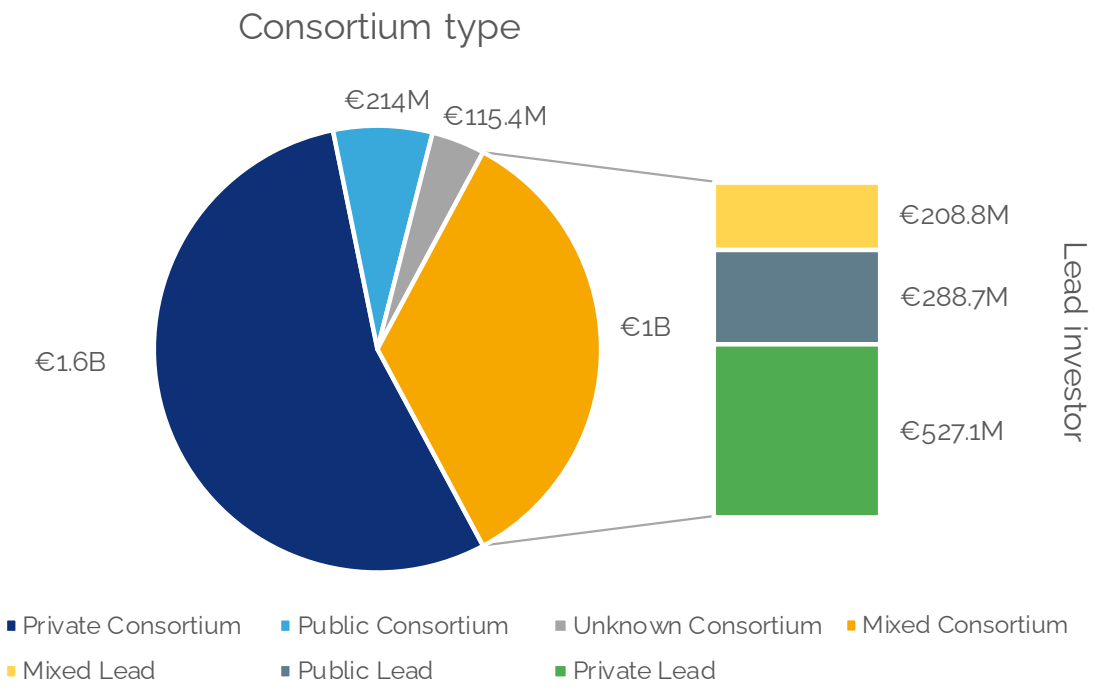


Figure 24: Consortium type and mix lead investor 2019-Q3 2023

Moreover, within the mixed consortium cohort, the data is divided into the corresponding proportion of lead investors. The lead investor, as the investor that makes the largest investment in a funding round, is a major catalyst for other investors to join the funding round. This can be used to mitigate the caveat presented above. Within the mixed consortiums, public lead investors led 28.2% of the investment volume (approx. EUR 289M), meaning that the public sector had a direct impact on the assembly of both public and private capital to make these investment rounds a reality.

In summary, since 2019, **public investors indirectly helped unlock around EUR 1B in investments with private investors by participating in their funding rounds**. Moreover, they **directly** contributed to raising **EUR 289M by leading funding rounds with private investors**.

Which funding rounds do different categories of lead investors pursue?

As expected, VC is the main investor category with more than 50% of funding in rounds from Pre-Seed to Series D. Its share of funding, sitting above 85%, is particularly pronounced in Pre-Seed and Seed financing rounds. Notably, in Pre-Seed there is an important share of around 7% led by Angel investors.

Between Series A and B, the share of VC led investment drops to 70% and 53%, respectively, to then regain its dominance leading 85% of the investment in Series C and being the only type of lead investor in Series D.

Private equity firms are the only type of lead investor in convertible notes, while in Series A they assume an important role, leading almost 20% of the funding, and in Series B they take a less pronounced, even if still important role, at approx. 6%. Conversely, Industry investors drove more funds into Series B (18%) and significantly less in Series A (4%), and they are the only type of lead investor in acquisitions.

Importantly, public institutions led an impressive 60% of the debt financing into the space sector, followed by development banks (48%) and commercial banks (2%). Public institutions also played a smaller but sized role in Series B rounds, leading 9% of the investment. Besides their important role in debt financing, development banks activity is concentrated in Series B investment rounds, with a share of 13%, as well as a similar share of 15% in Series C rounds.

Even though, as pointed out above, **venture capital firms are deeply ingrained in the European NewSpace sector, contributing to an overwhelming majority of the funding, the macroeconomic environment and the data collected by ESPI indicate that the sector should start searching for new sources of financing**. In the next chapter, the report will delve into different types of investment mechanisms and how they are implemented in- and outside of Europe. It is however important to keep in mind the current profile of European investors, how it can affect the pursuit of new policies and in turn how will the new policies alter this composition.

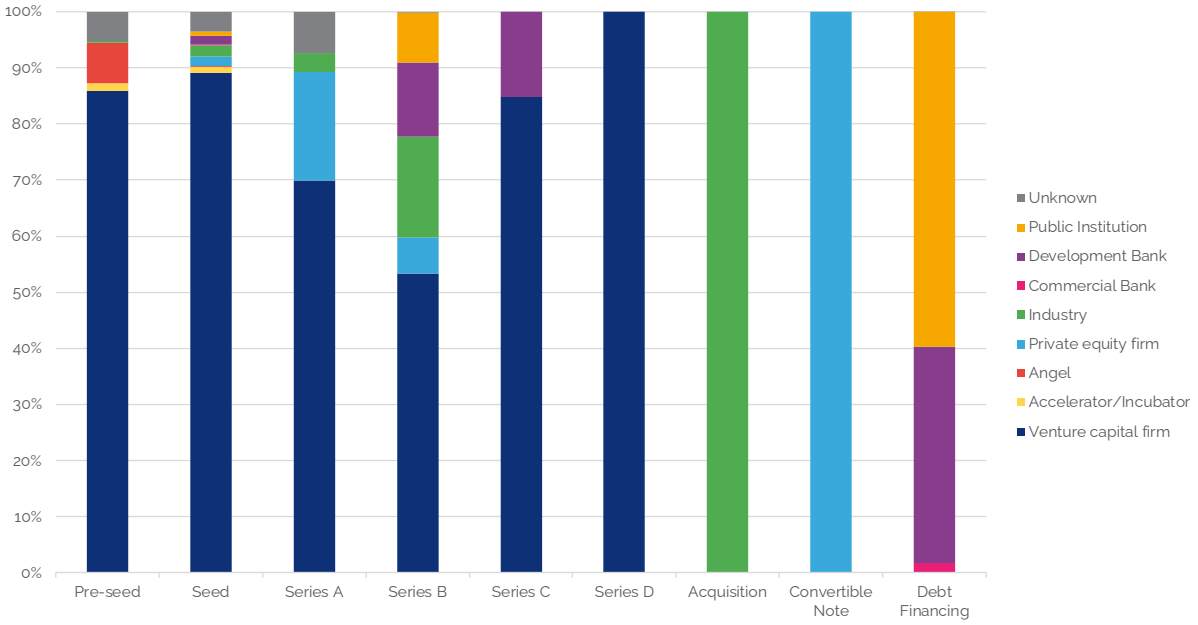


Figure 25: Category of lead investor by round of funding between 2019-Q3 2023

3 Capital Markets & Space Industry Funding

Bridging the gaps between public and private sectors is critical, yet notoriously difficult, notably for the finance industry. However, **the last fifteen years have demonstrated that the intersection of novel and often high-risk financing structures with the space industry has created a dynamic transformation**. Therefore, if actors of the European space sector wish to cement their respective positions as key enablers of a similarly dynamic and emergent innovation ecosystem in Europe, they too must pursue even bigger efforts in bridging the gap between public and private financial markets. This starts with having a **solid understanding of the purpose, goals, and priorities of the financial markets**; once the incentive models for investment managers is known, these incentives can be aligned more closely with those who wish to establish and grow the ecosystem. While understanding these incentives is complex and requires nuance, this chapter gives a sense of the types of topics which may influence the **investment manager** who, ultimately, will decide whether to pursue an investment in the space sector.

3.1 The Importance of Capital Markets

Global financial equity markets alone constitute a USD 100T market.[36] Thus, it is inarguable that they play a dominant role in shaping economies and industries, which control most aspects of our lives. As such, understanding how they operate and what makes capital move into (or out of) an industry is vital for understanding how that industry may be shaped in the future. This section addresses reasons why individuals, businesses, and institutions choose to invest their money.

These actors will use an investment fund to manage their capital because wealth, and as such power, is measured on a relative basis. If Company A becomes bigger than Company B, Company B's value, and as such their ability to grow in the future, diminishes. Thus, **increasing capital alone is not enough, but one must do so more effectively than others; for even having a healthy return on investment on your capital may result in a loss of market power** if your competitor has an even higher return on investment. As such, to simply "multiply money" is not enough, rather investors must multiply money more than their peers. Thus, in finance there is a set of peers which are used to create a financial "benchmark" to measure the extent to which returns from a business or investment fund are positioned competitively. They help investors gauge whether their investments are performing better than alternative options.

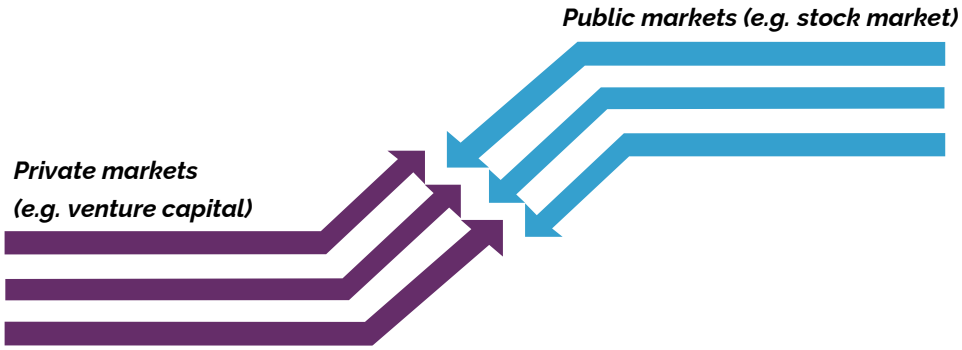
For example, if an investment in a space startup generated a return of 3%, one might be inclined to think of this as a successful investment. However, in reality and in a high interest rate environment, you may be able to invest your money into risk-free bonds which generate a 5% return. Using a set of alternative investments as a benchmark although the space startup returned 3%, it is 2% less than what other investment funds may have generated. This space investment would, in the eyes of an investor, have lost money relative to peers. The overwhelming goal of any investment vehicle, fund, or manager, is to generate a return that is above the benchmark. For example, if you are a venture capitalist, your fund should return more than the average of your peers. Likewise with private equity investors, bond investors and so forth.

In summary, understanding that investors or businesses will do anything within their (legal) powers to generate a higher return relative to their peers, the dynamics around investor incentives and financial capital growth become much clearer.

[36] Boston Consulting Group, 2021. "The $100 Trillion Machine: Global Asset Management 2021." *BCG* (Link).

3.2 Comparing Public and Private Financial Markets

Financial markets serve as the primary platforms where investments transactions occur, and these markets are broadly categorised into two main types:



Understanding these two distinct types of financial markets is crucial to understanding both the different types of investors that may be interested in the space sector, but also the expected trajectory of space startups by investors in these markets.

	Public Markets	Private Markets
Accessibility	Open to the general public	Limited to accredited investors and institutions
Transparency	Highly transparent and regulated	Less transparent and less regulated
Liquidity	More liquid	More illiquid
Reporting Requirements	Strict reporting and disclosure requirements	Limited reporting requirements
Investment Horizon	Shorter investment horizons	Longer investment horizons
Types of Assets	Stocks, bonds, commodities, ETFs, mutual funds	Private equity, venture capital, real estate

Table 4: Public financial and private financial markets

3.3 Public Financial Markets

Public financial markets offer wide accessibility to a range of investors and are characterised by a high degree of transparency and regulation. These markets include stock markets, such as the New York Stock Exchange (NYSE) and Euronext, and bonds and commodities markets. Investors can purchase shares or equity in these companies, allowing them to participate in the company's growth and, in some cases, receive dividends.

While the benefits for a company being floated on a stock market through a process called an **Initial Public Listing (IPO)** mostly include being able to sell shares to raise more money for expansion or growth, the downsides for being a publicly listed company are numerous. The IPO process is expensive and complex, due to high fees from investment bankers and specialised lawyers. Further, being a company whose shares can be bought and sold openly by the general public brings with it

intense protection for potential shareholders, by way of stringent regulatory requirements enforced by organisations such as the U.S. Securities and Exchange Commission.

Notably for the space industry, **companies that are floated on public exchanges are "marked to market" daily**, meaning that through calculating the demand and availability of shares, their share price is re-calculated, causing the company to either make or lose money. In reality, this occurs far more frequently. A company's share price can change in nano-second timeframes, often as a reaction to new information being released about the company. For this reason, **companies that are floated on public exchanges tend to be very stable and mature companies that have slow but positive growth**. On the other hand, companies that are undergoing high growth and are participating in R&D are at risk of having a volatile share price, and as such are more prone to inducing heavy losses or even facing insolvency. For this reason, it is difficult for companies that are producing novel space technologies or undertaking disruptive R&D activities to become publicly listed companies until they have steady revenue. For example, a single launch failure for a publicly listed space launch company could cause catastrophic damage to its financing, as was seen with space startup Astra in February 2022 when its share price fell 26% after failing to reach orbit and has suffered ever since with delisting looming the founders are now looking to take the company back into private hands.[37]

A Note on Special Purpose Acquisition Companies (SPACs)

SPAC mergers in the space industry have resulted in high-profile setbacks leading to increased scrutiny and scepticism. Investors and stakeholders may become more cautious, demanding more rigorous due diligence and financial transparency from space companies seeking to go public through SPACs. Consequently, a shift in how space industry startups approach funding and expansion is observed, potentially slowing down the pace of new ventures and innovations in this sector.

Delisting Notices on the New York Stock Exchange

SatixFy, an Israeli satellite communications equipment maker, is facing a potential delisting from the NYSE American stock exchange due to a significant drop in its share price. This decline followed its merger with a SPAC, Endurance Acquisition Corp. As of now, SatixFy's market capitalisation has fallen below USD 50M, and its shares are trading at around 40 cents, a drastic decrease from the start of 2023.

The company's troubles highlight the broader challenges faced by young space companies that opt for SPAC mergers, a quicker alternative to traditional initial public offerings. These **mergers often lack the intensive due diligence of traditional IPOs, leading to missed revenue targets and underperforming shares**. SatixFy's revenue for 2022 was only USD 10.6M, significantly below its forecast of USD 40M, mainly due to supply chain issues and management changes. For the nine months up to September 30, 2023, it reported USD 8.9M in revenue, a 31% year-over-year increase, but also a net loss of USD 28.1M, primarily due to higher R&D costs.

To avoid delisting, SatixFy must submit a plan to the NYSE American stock exchange by December 30th that demonstrates its ability to meet trading requirements by May 30th, 2025. The company is now focusing on its satellite communications systems and in-house developed

[37] M. Sheetz. 2022. "Astra stock drops 26% after NASA mission fails mid-launch." *CNBC* (Link)., J. Foust, 2023. "*Astra founders offer to take company private*", SpaceNews (Link)

chipsets, aiming to demonstrate higher valuation potential through new customer acquisitions and orders.

Other NewSpace companies with a stock price at around USD 1 (as of 22 February 2024):

Company	Share Price
Virgin Galactic Holdings Inc	1.76 USD
Globalstar Inc	1.62 USD
BlackSky Technology Inc	1.44 USD
Satellogic	1.50 USD
Terran Orbital Corporation	0.96 USD
Sidus Space	3.97* USD

Table 5: Stock price of selected NewSpace companies

When a company does not meet listing requirements, the listing exchange issues a warning of noncompliance. If noncompliance continues, the exchange delists the company's stock. The reasons for delisting include violating regulations and failing to meet minimum financial standards. Financial standards include the ability to maintain a minimum share price, financial ratios, and sales levels. To avoid being delisted, some companies will undergo a reverse split of their stock shares. This has the effect of combining several shares into one and multiplying the share price. For example, if a company executes a 1-for-10 reverse split, it could raise its share price from 50 cents to five dollars per share, where it would no longer be at risk of delisting.

*On the 18th of December 2023 after having traded below 1 USD for the year Sidus Space conducted a 1:100 reverse stock split to push the price above NYSEs minimum bid price.

3.4 Private Financial Markets

Unlike public markets, private markets in finance refer to financial markets where investments are made in assets and securities that are not publicly traded on open exchanges. Instead, these investments involve transactions directly between buyers and sellers or through private investment funds. Private markets encompass a wide range of asset classes, including private equity, venture capital, real estate, and private debt. **Investments in private markets have the potential to deliver higher returns compared to publicly traded assets**. This is because private market investments often involve early-stage companies, projects with significant growth potential, and investors can buy shares in what could eventually be a large company at an early stage, often on proprietary deal flow, for a much lower price.

For this reason, private market investments typically have longer investment horizons. Unlike companies which are floated on exchanges whose investors could buy and sell its shares many times a day, investors are willing to commit their capital for an extended period, perhaps up to a decade or longer, allowing them to ride out market volatility and economic cycles.

Private market investments are less susceptible to short-term market fluctuations and sentiment-driven volatility, offering a degree of stability and insulation from the daily ups and downs of public markets. This is a remarkably attractive proposition for the Management Team of a high-risk technology company, such as those found in the emerging space economy, as it allows them to focus on long term R&D instead of regular communication to short-term shareholders.

Venture capital and private equity firms typically operate as investment funds structured as limited partnerships. The investors in a VC fund are known as **Limited Partners (LPs)**. These LPs pool the capital that the funds deploy for investments. The fund managers that are responsible for making investment decisions and managing the fund are known as **General Partners (GPs).**

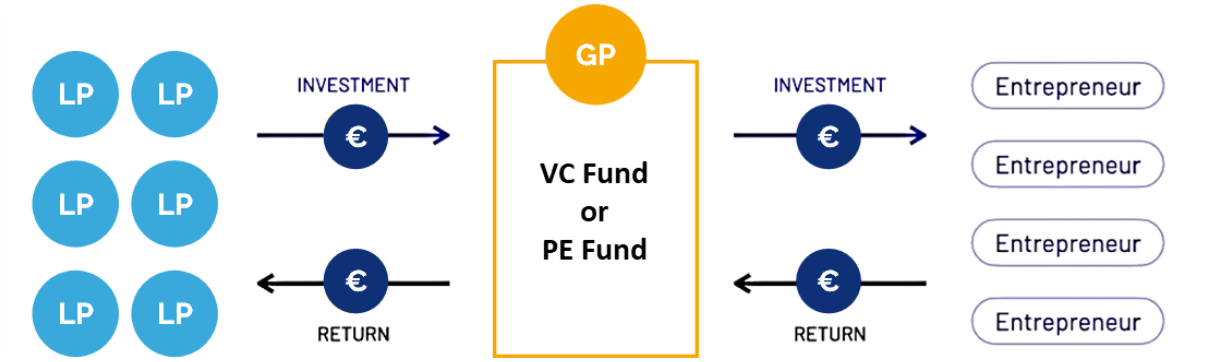


Figure 26: VC/PE Fund structure.

Further, private markets allow investors to create their own investment strategies. Investors can choose funds or assets that align with their specific risk tolerance, goals, and preferences. For example, there are now several space-specific funds in the private markets that allow investors to add exposure to financial gains derived from the long-term development of the commercial space industry. Over the last ten years, investors have poured USD 283.9B of private equity into space-related companies.[38] In this context, **there are two primary asset classes within private markets that are of most interest to the emerging space industry:**

3.4.1 Venture Capital

Venture capital funding for global space technology companies has reached USD 6.2B across 112 deals up until 2022 and is playing a critical role in changing the operational and business model of space industry companies.[39] **Venture capital (VC) is a form of private equity investment that plays a crucial role in financing and supporting early-stage and high-growth companies across multiple domains, specifically by investing in software and hardware startups.** This specialised form of funding is essential for nurturing innovative startups and emerging businesses that have the potential to disrupt industries and achieve substantial growth. To properly engage with VCs in the space sector, it is vital to understand how these funds are structured, and subsequently what incentivises fund managers to deploy (or not deploy) capital into the European space ecosystem.

[38] Space Capital, 2023. "Investment Dashboard, December 2023," *Space Capital* (Link)
[39] P. Mathur. 2022. "Space tech aims for the stars with VC's continued funding." *Pitchbook* (Link).

VC Fund Structure

LPs In VC are usually a mix of institutional investors, such as pension funds and endowments, family offices, as well as high-net-worth individuals. LPs pool the capital that the VC firm deploys for investments. VC funds have a finite lifespan, typically around 6-10 years, during which investments are made and portfolio companies are expected to grow and produce an "exit".

An exit occurs when an investor sells part or all of their ownership, and exit events usually entail the startup being bought through a merger, acquisition, or entering the public markets through an IPO. After the fund's investment period, whereby it deploys all the capital it has raised, it enters a period, where fund managers focus on helping the startups to grow and eventually exit, thus generating returns for the fund. The returns for the fund consist of revenue generated from exiting the startups, typically minus a 20% fee above an agreed upon rate, which the VC fund keeps and distributes to its GPs as compensation for performance.

Investors

Venture capital funds typically attract **three types of investors**, including:

Institutional Investors: These include pension funds, university endowments, foundations, and insurance companies. They allocate a portion of their capital to venture capitalists as part of their broader investment strategies. Institutional investors often write large cheques for funds; however, they have very strict requirements around which funds they can invest into. For example, most institutional LPs are not allowed to invest into first-time VC funds or first-time fund managers; having a proven track record for the manager and the fund is typically mandatory.

Further, most institutional investors have stringent rules around what constitutes a permissible investment. A leading problem with the European space investment ecosystem is that many European institutional investors have much higher ESG requirements around their allowed investments, and most are not allowed to invest in funds that may be defence related or defence-adjacent, affecting the space industry.[40] Consequently, a significant difference in the contribution of institutional investors such as pension funds to VCs in Europe arises as compared to the US. European VCs receive up to 18% of capital from pension funds amounting to USD 2.5 billion since 2014, compared to the US with 65%[41]. **This gap is not compensated by other investors in Europe.**

High-Net-Worth Individuals (HNWs): Wealthy individuals with significant disposable income often invest in VC funds or directly in startups. In the United States, HNWs are the primary source of VC fund financing for first-time funds and first-time managers. HNWs in the U.S. are often risk-seeking and are seeking to rapidly multiply their net worth through high-risk investing. In Europe, however, family offices which deploy the capital of HNWs are famously risk-averse. Instead of optimising their portfolio for high reward, they are optimising their portfolio for low-risk and wealth preservation. As such, the European VC landscape lacks a critical investor to generate an early-stage investing ecosystem sized to the size of its economy.[42]

Corporate Investors: Some corporations invest in venture capital funds to gain exposure to innovative startups that align with their strategic interests. They may also participate directly in venture investments through corporate venture arms. One such example is of Airbus Ventures,

[40] BPM. 2023. "North American institutional investors lag behind Europe and Asia in ESG investments." *BPM* (Link); B. Wolf. 2022. "ESG gap widens: EU rules become more prescriptive as US proposals wait in the wings.", *Thomson Reuters* (Link)
[41] Atomico. 2019. "VCs and LPs, Report." *Atomico.* (Link)
[42] Forbers Insights. 2014. "Europeans best at preserving wealth – study." *Reuters* (Link); G. Rachman. 2023. "Europe has fallen behind America and the gap is growing," *Financial Times* (Link)

which allows Airbus to own shares of early-stage innovation which it may end up using as a customer, or indeed acquiring and integrating into its business.

Investment Targets

VC primarily targets companies that are operating in technology-driven sectors, such as software, biotech, artificial intelligence, fintech, and clean energy. These areas offer opportunities for disruptive innovation and high growth. Over the last two decades, however, the most promising returns have been generated by investing in software-only entities, as **software companies require low levels of investment and can scale rapidly to huge addressable markets**.

On the other hand, hardware-based space companies exhibit the opposite characteristics: they require large, intensive capital; scaling production and manufacturing is slow and difficult, and **the space industry in most applications has a small number of addressable customers**.

VCs invest in startups at various stages of their growth, with each stage requiring a higher capital commitment as the company matures and reaches certain revenue, customer or product milestones.

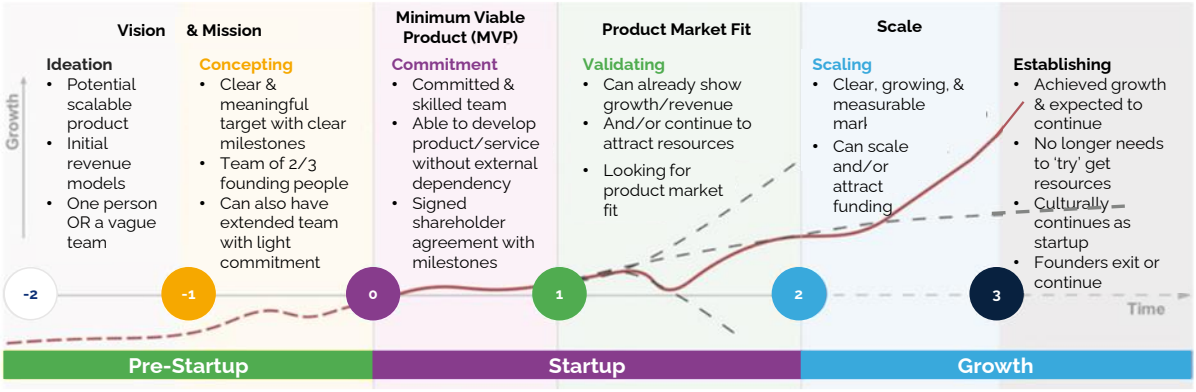


Figure 27: Timeline of investment & targets at different stages of startup growth (Credit: NewCo Factory)

One of the largest problems associated with investing in the space industry is that, unlike the software and other B2B startups, **there are very few ways for an early space company to meaningfully show that it is achieving growth milestones**; there are very few customers to commit to buying space products or services, it takes a long time to build and test novel developments, and validating whether the product is a good fit for the market is often not possible until after the product has entered the market. In short, **the space industry suffers from being a "build it and they will come" industry**, which is the worst combination of high-risk with low-reward.

Venture Capital Returns

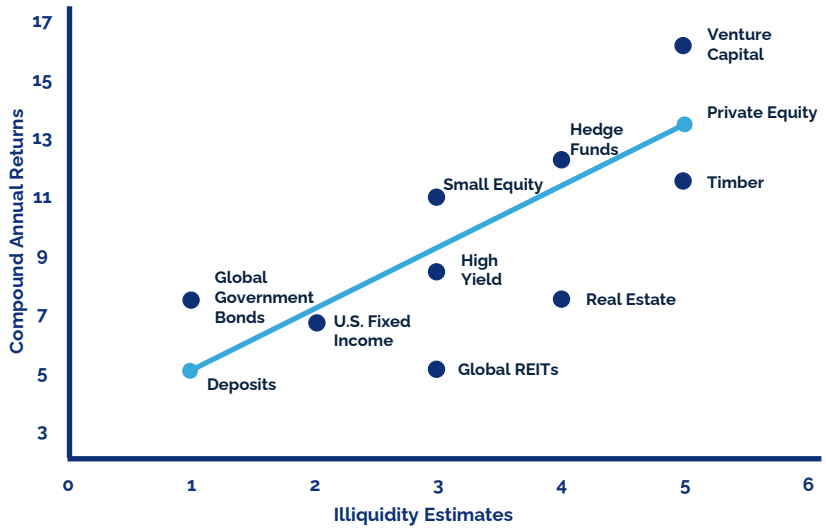


Figure 28: Comparison of the compound annual returns from different investments by illiquidity estimates (Credit; Raholavidal)

Venture capital investments are inherently risky, but they offer the potential for substantial returns. The returns for VC investments can vary widely, but some successful VC-backed companies have achieved exceptional results. Although VC funds seem to have a long lifecycle (6-10 years), in reality this means that a company has to grow very quickly to generate material returns for investors. For a typical software startup, it may take several years for portfolio companies to reach maturity or experience successful exits. For a hardware-based space startup, these timelines in reality are extended well beyond the lifecycle of a fund. For example, SpaceX was founded 22 years ago and has still not reached sustainable profitability or generated a typical VC exit.

Although there are significant structural challenges associated with venture capital allocation in the space industry, the last decade has shown a strong LP appetite for exposure to emerging space technologies. In this context ESA's Investor Forum is a good step in the right direction for increasing investor confidence in the sector, offering **fertile ground for a comprehensive Investor Relations Strategy** activity necessary to sustain trust and appetite.

3.4.2 Private Equity

Private equity (PE) is a form of investing in private companies or taking public companies off the stock exchanges in the public markets back into the private markets. PE firms typically acquire, invest in, and actively manage these companies with the aim of enhancing their performance and, ultimately, generating substantial returns for investors.

Fund Type

Similar to VC funds, PE funds' LPs are its investors, and the General Partners (GPs) are the investment managers who manage the fund. Like VC funds, PE funds have a finite lifespan, typically around ten years, during which investments are made and portfolio companies are improved before eventually exiting. One of the big structural differences between a VC and a PE fund, however, is its size.

A PE fund tends to be significantly bigger than a VC fund, as the companies it invests in are later stage, more mature, and as such have a higher valuation. Therefore, PE funds rely more heavily on institutional investors (pension funds, insurance companies and endowments) than VC funds, as these investors can write much bigger cheques to invest in the fund.

PE Investments

PE firms typically focus on investing in established companies with an operational track record and revenue. These companies may be looking for capital to invest in growing the company further, operational improvements, or strategic changes to the organisation. PE firms invest across a wide range of industries, including manufacturing, technology, healthcare, consumer goods, and financial services. **Unlike with VC, private equity has a much broader scope of the types of deals it underwrites; PE is much more comfortable with hardware and asset-heavy engineering or production than venture capital**. Crucially, PE investors generate returns by seeking companies with the potential for operational improvements, cost efficiencies, and growth opportunities. They will invest in these companies, and then make them more capital efficient before selling them again at a higher price.

In addition to the capital that they have raised for the PE fund, investment managers will often increase its investment into a company by borrowing money at low interest rates from a debt provider, before later selling the company to generate a higher return. This is why PE deals are often also known as "leveraged buyouts" because of the excessive debt or "leverage" that the fund uses[43].

Investment Strategies

There are three core investment strategies that PE funds use that have been used before and are directly applicable in the space industry.

1. **Leveraged buyouts (LBOs)** involve acquiring a controlling or significant stake in a company using a combination of equity and debt financing as previously mentioned. PE firms, after acquiring the business, will work to improve their operations and financial performance, making them a more valuable investment to the next buyer.
2. **Growth equity investments** are where PE firms provide capital to companies with strong growth potential. These companies may be looking to expand into new markets, launch new products, or scale their operations. Typically, these are late-stage startups that aren't ready for an IPO or don't have an acquirer yet, and still need significant capital to grow.
3. **Distressed investments** involve PE firms acquiring struggling companies, often in financial distress, with the goal of turning them around. This can involve restructuring, refinancing, or strategic changes. PE firms buy the company for a much lower price than their current asset value, before restructuring them and selling them back into the market at a much higher price.

Returns

Private equity investments compared to venture capital investments can generate more stable but typically lower returns, as well as demonstrating a lower risk profile. However, PE investments are on average still significantly driven by a high-risk and high-return rationale when compared to buying shares in companies floated on stock exchanges.

These higher returns are largely due to the active management and value creation that PE managers generate when they restructure and optimise the portfolio companies, leading to a sales price that is multiples higher than its acquisition price. However, like VC investments, PE investments are less liquid than publicly traded stocks. This means that the investment has longer

[43] It is important to note, in an LBO deal, the debt is typically loaded onto the companies' books. As such, if cash flow is reduced and the economy of the company experiences a downturn, it may not be able to service the debt and will have to restructure, most likely wiping out all returns to the equity sponsor.

holding periods, typically ranging from five to ten years or more; while that money is in a PE fund, it is difficult for an LP to withdraw it.

	Venture Capital	Private Equity
Investment Stage	Early-stage startups with growth potential	Mature companies, including buyouts
Ownership Stake	Equity ownership	Either equity or control ownership
Risk Profile	High risk due to early-stage investments	Lower risk due to mature company investments
Exit Strategies	Often IPO or acquisition by strategic firm	Sale to other companies or IPO

Table 6: Comparison between VC and PE characteristics

Within the private financial markets, venture capital and private equity have played the largest role in transforming the contemporary space economy, often working in tandem to grow a new class of space companies that could potentially one day compete with the powerful American prime defence contractors. In Europe, meanwhile, these funds have exhibited structural difficulties in allocating similar percentages of capital to the space industry. These difficulties pertain to having a lower risk profile, the European space industry not having defined customers which can create robust milestones for startups, and heavy-handed fund oversight which prevents defence-related investments.

4 ALTERNATIVE MECHANISMS AND INVESTMENT VEHICLES

Building upon the previous chapters analysis, this chapter will explore different alternative mechanisms and investment vehicles. During its research, ESPI organised a survey and a workshop, which helped confirm the untapped potential of these mechanisms and establish overall guidance for the research that followed.

Survey Findings

The **ESPI survey**, which gathered insights from 42 respondents, sheds light on the investment dynamics in the European space sector and lays out key areas actors in the European space sector may tackle to attract alternative investors. The respondents primarily consisted of "VC+" actors, including angels, founders, and venture capitalists, along with alternative capital providers, providing a comprehensive perspective on the sector's financial landscape.

Key findings of the ESPI 2023 Survey on Alternative Finance Mechanisms:

- **Investment Potential of Alternative Finance**: A significant share of respondents from alternative finance had not previously invested in the space sector, pointing to the untapped potential.
- **Investment Focus**: VC+ investors were predominantly engaged in early-stage investments, highlighting their dominant role in Seed, Series A, and Series B funding rounds. In contrast, alternative investors demonstrated a focus on strategic and practical elements of investments.
- **Information Sources and ESG Criteria**: VC+ investors primarily relied on word of mouth and inbound pitches for information. Notably, there was a marked difference in the emphasis on ESG criteria between investor types, with alternative investors placing greater importance on these factors compared to VC+ investors.
- **Regulatory Landscape**: There was a notable difference in the understanding of U.S. and European regulatory landscapes between VC+ and alternative investors. VC+ investors exhibited a stronger grasp of these regulations.
- **Investment Concerns**: Both investor types shared concerns regarding liquidity, market size, and regulatory issues, but VC+ investors also emphasized follow-up funding as a key concern.

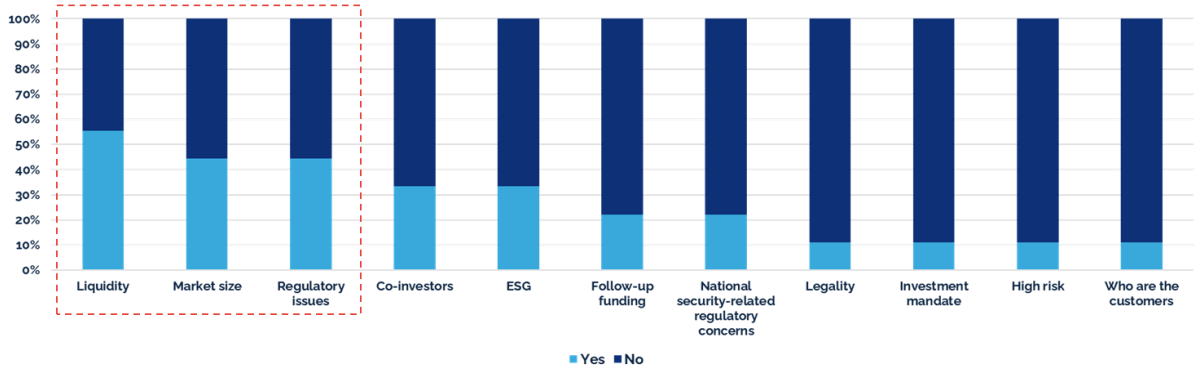


Figure 29: Concerns raised by investors in the alternative investor category.

The ESPI survey's insights are crucial in understanding the dynamics and challenges of non-VC investments in the European space sector. It highlights the significant role of alternative finance and the distinct motivations and concerns of different investor types. This understanding is vital for developing strategies to attract diverse investment sources and address the specific needs and concerns of various investor groups in the European space industry. Accordingly, throughout this chapter, insights from the Survey and resulting Workshop are highlighted.

Workshop Findings

The ESPI Alternative Finance Workshop took place on 24 November 2023 at ESA HQ in Paris, France. Organised by ESPI with support of the European Space Agency (ESA), the event gathered more than 40 participants, consisting of representatives of private asset management firms, commercial banks, venture capital funds, development banks, and European public financial institutions. The workshop analysed a key question within a changing macro-economic environment:

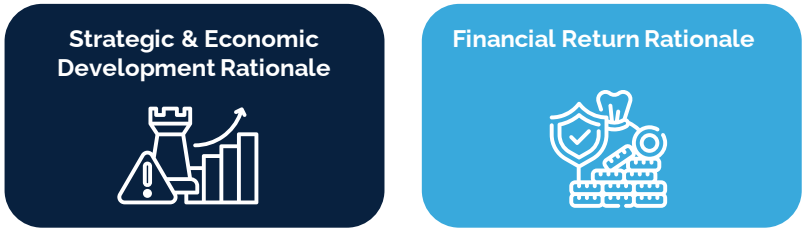
What alternative finance mechanisms can complement sources of capital currently supporting the European space sector?

Following five presentations and the ESPI survey results, the workshop was designed to stimulate a dynamic discussion between financial industry stakeholders, as well as support the delivery of recommendations to actors supporting the development of the European space industry. The following alternative finance instruments provided the highest validity for the European space sector to explore further:

- **Public Infrastructure Funds:** Public Infrastructure Funds (PIFs) backing Public-Private Partnerships (PPPs) for space sector projects were discussed as one of the most adequate financial mechanisms to attract institutional investors. Effective resource mutualisation and cost reduction of projects within properly structured PPPs were seen to attract significant capital. Ensuring alignment with public interests, compliance, and importantly long-term public support, primary investors in infrastructure projects such as long-term yield investors, namely pension funds, are potentially attracted by long-term stable revenue sources which in the space sector would primarily be driven by public sector contracts.
- **Venture Debt:** Venture debt in the space sector presents both opportunities and challenges. European financial institutions offer venture debt with equity conversion options (for example warrants). This form of debt is particularly useful for mid-sized, revenue-generating companies, enabling them to raise capital efficiently between funding rounds. These companies are currently at risk of falling under the radar of space-focused VCs or don't wish to offer the level of equity proposed.
- **Export Credit Agencies:** These institutions offer a path conducive to attracting foreign demand and revenue, providing financing (and insurance) to support exports and international business ventures. ECA involvement can have a positive impact on liquidity, especially relevant for up-front funding required for system development, and expanding the addressable market.
- **Development Bank Schemes:** The value of involving development banks (beyond their venture capital arms) is long-term, patient capital that is well-suited for capital-intensive industries like the upstream space sector. To make development banks matter, preferential financing must be considered a strategic priority of the political entity behind the development bank and in this context, the sector must showcase compliance with requirements set forth by the development bank (e.g. Multi-lateral Development Banks aligning their financial flows with the objectives of the Paris Agreement)
- **Asset-Backed Financing:** Asset-backed financing can be considered an option for capital infusion. Discussions unveiled challenges tied to the intricate regulatory landscape. The feasibility of asset-backed financing in the European space sector is uncertain, given the limited number of valuable easily transferrable assets. However, exploring alternatives like Sukuk Loans, which can back intangible assets such as spectrum rights from satellites in distress, presents a potential avenue, particularly during launch bottlenecks.

Methodology

Systematically examining the term 'financing mechanism', the concept denotes a set of **structured methods for raising, managing, and deploying financial resources to fund various projects, initiatives, or activities.** The following section examines the anatomy of financial mechanisms and instruments that could individually or in complement act as alternatives to VC. Various capital providers are analysed, from public institutions which invest to catalyse strategic and economic development, to privately led initiatives and institutions, driven by explicit fiduciary duties[44] to seek financial returns.



The goal of the section is to provide a deeper understanding of these mechanisms. Through this understanding of the financial resources available, ESPI believes, the European space sector can **deepen the financial markets** by supporting focused actions to maintain growth and mitigate the impacts of economic uncertainty and volatility.

Undertaking a structural analysis across multiple dimensions for specific financing mechanisms and instruments, this method provides guidance and understanding of their applications and suitability for various investment environments and projects. By examining factors such as the source and nature of funding, risk profiles of investments, return expectations, sectoral and geographic impacts, and regulatory considerations, investors and policymakers can make more informed decisions that align with strategic objectives. We provide a visual representation and summary of how selected **financial instruments compare to one another** across common dimensions:

Category	Metric	Definition	Scaling
Risk How many resources are committed and factored against the investment environment to achieve a desired impact?	**Potential Volume**	The amount of capital a financial mechanism can leverage towards a given project.	0 – Minimal 4 – Billions of euros in total investments
	Level of Regulation	The degree of regulatory oversight and compliance required within the financing environment.	0 – Unregulated 4 – Significant regulation
	Risk Profile	The level of uncertainty associated with the success of the venture following investment.	0 – Certain success 4 – High failure probability
	Time Horizon	The expected timeframe for an investor to see a return on their investment.	0 – Immediate 4 – Multi-decade payback period
	Sensitivity	The likelihood of the investment flow being affected by economic fluctuations.	0 – No correlation 4 – High correlation

[44] Fiduciary duty in private investment institutions refers to acting in the best interest of clients, with a high standard of care and loyalty, ensuring transparency, adhering to clients' goals, and complying with all legal and regulatory requirements.

Impact The level of benefit resulting from an investment into a project.	**Follow-on / Scaling Effect**	The level of tertiary funding rounds attracted due to initial investment.	0 – No/Adverse effect on follow-on funding 4 – Very likely to attract additional capital
	Sectorial Impact	Effect of investment on the broader industrial sector.	0 – Project-specific 4 – Multi-sector
	Geographic Impact	Extent of the investment's spillover across regions.	0 – Local 4 – Multiple countries

Table 7: Multi-dimensional criteria analysing alternative financial mechanisms.

The analysis serves as a broad comparison framework, not an absolute measurement and was developed based on a multitude of sources. In this context, **the framework should be considered of an evolutionary nature and as a rough indication prompting further reflection.** To better analyse the suitability and applicability of mechanisms, further targeted analysis and consultation is necessary.

	Financial Institution	Financial Instrument
	**Government Agencies**	Capital Release Guarantees
	Government Agencies	Asset Recycling
	Development Finance Institutions	Strategic Investment Funds; Direct Investments
	Export Credit Agencies	Export-Credit Financing
	Non-Profits (e.g. Foundations)	Philanthropic Venture investment
	**Family Offices**	
	Pension Funds	
	Various (e.g. DFIs, Commercial Banks)	Mezzanine Finance Instruments
	Various (e.g. Commercial Banks, Private Lenders)	Asset Backed Loans & Sukuk Loans

Table 8: Financial institutions and instruments.

4.1 Institutions and Financial Mechanisms with a Mixed Bias

To structure this section, we centre around the concept of fiduciary duty as it applies in private investment. Fiduciary duty does not directly transfer to public and publicly supported financial instruments due to the fundamentally different objectives, accountability structures, and broader mandates of public institutions. **Public financial instruments are often designed to achieve policy objectives, such as stimulating economic growth, managing inflation, or financing public projects. These objectives can sometimes necessitate actions that do not align with maximizing financial returns, which is a core tenant of fiduciary duty in the private sector.** Public financial

institutions, such as government treasuries or central banks, have mandates that are broader and more complex than those of private entities. Their primary responsibilities include macroeconomic stability, monetary policy, economic development, and, in some cases, social welfare objectives. **These goals often require balancing the interests of a broad constituency, including the public, rather than focusing on the financial interests of individual investors**.

4.1.1 Public Instruments

Government-led initiatives strategically allocate capital to spur economic growth via job creation and to yield improved societal returns. As detailed in *chapter 4*, we provide an up-to-date account of public mechanisms supporting the European space sector. This sets the benchmark for our examination of comparable, yet potentially complementary. initiatives in other contexts.

Capital Release Guarantees

Capital Release Guarantees are public financial instruments used to encourage lending to various SMEs including those in the space sector. By providing security to financial institutions, capital release guarantees help to stimulate additional capital for investment during or immediately following economic volatility. These guarantees manage risk, enhance liquidity, and provide stability for funds during economic downturns.

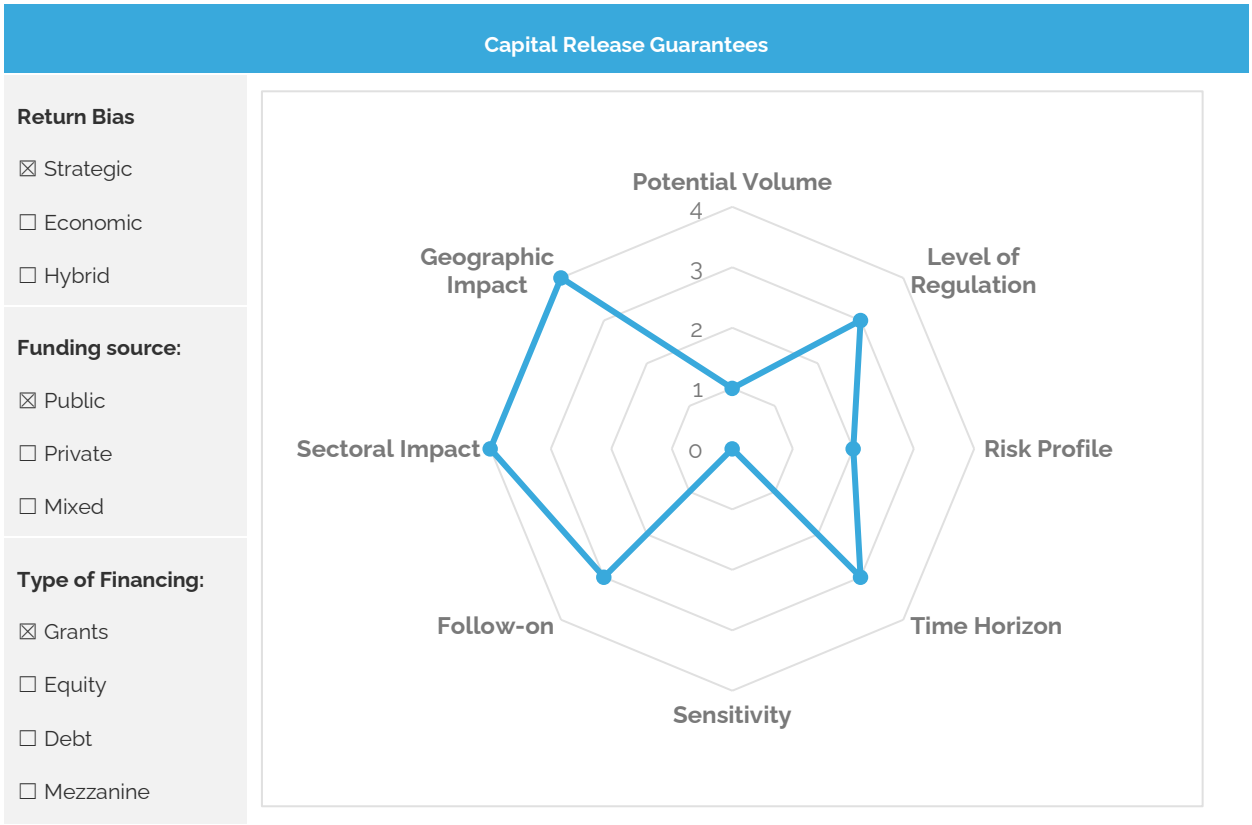


Figure 30: Multi-Dimensional analysis of capital release guarantees.

Key aspects of a capital release guarantee include:

- **Risk mitigation**: The guarantee is designed to mitigate financial risks for the intermediaries, encouraging them to make more funding available to the target enterprises.
- **Liquidity increases and stability support**: The guarantee provides an option for existing equity funds to receive additional liquidity. This liquidity can be crucial during economic downturns when funds might face challenges in raising capital from investors or attracting new LPs.
- **Support for various financial instruments:** The capital release guarantee can support different financial instruments, including equity and debt funds, as well as guarantee products. These instruments are designed to provide financing on more favourable terms to SMEs, mid-cap companies, and large corporates.
- **Flexible financing:** It allows for flexibility in providing financing, enabling intermediaries to support various types of enterprises, including those in special situations or those affected by unfavourable market conditions.

These guarantees are especially valuable in providing liquidity for funds and their LPs. They stand in as surrogates for LPs unable to fulfil financial commitments, aid funds in achieving targeted valuations, and bolster ventures in dire straits, thereby preserving business continuity.

In essence, **capital release guarantees offer a pathway for increased investment by addressing liquidity challenges and enabling financial institutions to support businesses more confidently**, playing a critical role in the economic health of the space industry.

The Pan-European Guarantee Fund's Role in Supporting EnduroSat

In July 2021, EnduroSat, a Bulgarian company specialising in nanosatellites, received a significant capital injection with a EUR 10M loan from the European Investment Bank (EIB), underpinned by the **Pan-European Guarantee Fund (EGF).** This funding aimed to mitigate financial difficulties caused by the COVID-19 pandemic and foster growth and innovation within the EU's space sector.

Objectives and Structure of the EGF

The EGF was established to support EU businesses grappling with the economic downturn of 2021 following the pandemic. **With a EUR 25B allocation, the EGF seeks to generate up to EUR 200 billion in economic activity**. It employs financial tools like risk-sharing guarantees and venture debt, constituting 75% and 25% of its financing, respectively.

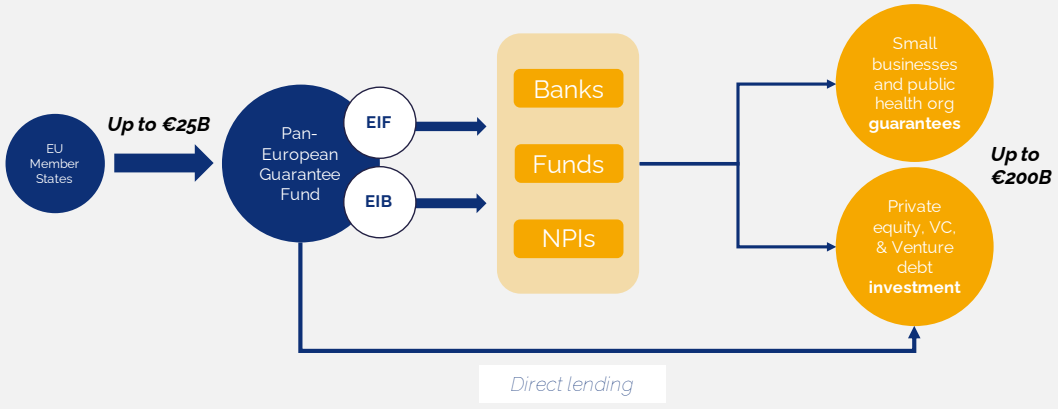


Figure 31: EGF capital source and allocation (Credit: NCP)

Method of Funding Disbursement

EGF channels its support through direct loans to businesses, aid to financial institutions, and backing for investment funds. The loans **impact on EnduroSat** is a prime example of how the EGF's Capital Release Guarantee can be pivotal for companies in the space industry, aiding them in weathering economic hardships and continuing their innovative pursuits.

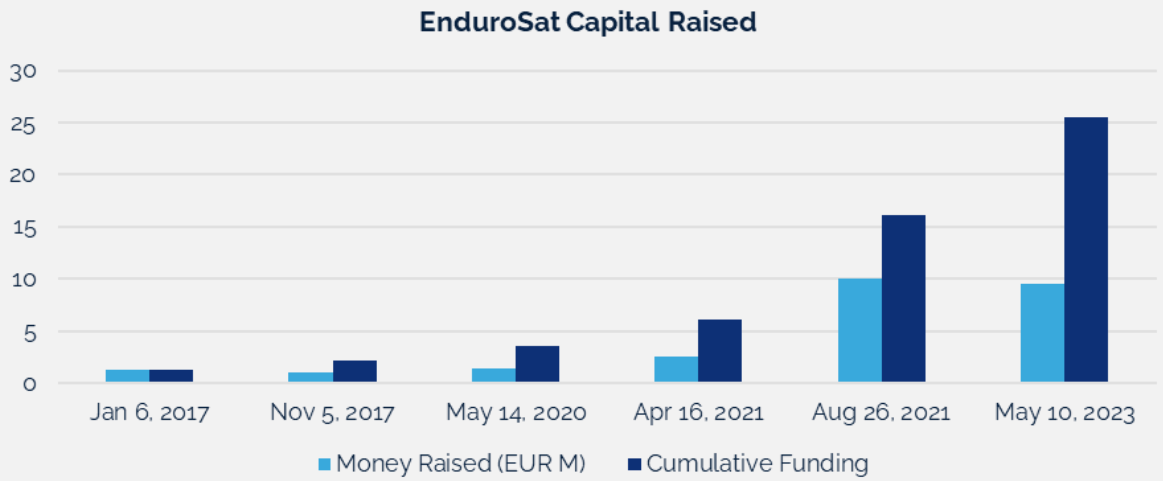


Figure 32: EnduroSat capital raised (Credit: Crunchbase, ESPI)

Asset Recycling

Asset recycling, traditionally used for infrastructure like toll roads or airports, can also fund space technology. Governments might privatise or lease out space assets (ground stations, launch facilities, satellites) to the private sector, generating government revenue. Startups, with limited time and resources, often cannot afford to develop their own infrastructure. **Leasing existing networks can save capital and accelerate development timelines, enhancing their funding prospects.**

The Alternative Finance Workshop revealed: Refinancing shared-use infrastructure, such as ground station networks, is seen as a viable way to back financing and yield returns.

Leasing underutilised real property has several benefits. First, leases may generate revenue the public actor can use to help reduce overhead expenses and defray the costs of maintaining and improving aging infrastructure. Second, leasing enables public actor to keep in their inventory facilities that although currently underutilised may be needed for future missions. Finally, SME's ability to raise subsequent funding is improved given the lower capital committed to building and maintaining own infrastructure.

Asset Recycling /Asset Leasing

Return Bias

☐ Strategic

☐ Economic

☒ Hybrid

Funding source:

☐ Public

☐ Private

☒ Mixed

Type of Financing:

☐ Grants

☐ Equity

☒ Debt[45]

☐ Mezzanine

Figure 33: Multi-dimensional analysis of asset recycling.

Lease Types:

- **Concessionaire Agreements:** Private businesses operate at agency facilities.
- **Non-reimbursable Agreements:** Mutually beneficial activities with no funds exchanged,
- **Reimbursable Agreements:** Third parties pay agencies for property use, with excess revenues typically going to the Treasury or Central Bank.
- **Enhanced Use Leases (EULs):** Agencies keep proceeds above costs.

To effectively utilise leasing agreements, agencies should:

- Hold comprehensive Inventory of property available for lease.
- Clear and effective guidance for identifying property.
- Market their properties for leasing.

NASA's Strategic Utilisation of Enhanced Use Leasing (EUL)

In-light of limiting resources and increasing mission needs, NASA has embraced EUL as an alternative to traditional funding for capital projects. This allows NASA to leverage its assets more effectively by accepting cash and in-kind contributions in exchange for leasing its real property.

From 2004 to 2006, NASA accrued financial benefits exceeding USD 1.3M through EUL transactions. Notably, this would not have been possible under standard leasing agreements, which typically require any surplus to be returned to the federal government.

[45] Lease payments are fixed payments for the use of an asset, no ownership transfer exists thus they most closely resemble debt.

Between 2017 and 2019, **NASA's net revenue from EUL activities increased to over USD 23M**, showcasing a substantial increase in leveraging assets for financial gain. NASA's advocacy for EUL is robust, as evidenced by a legislative proposal seeking to extend EUL authority until December 2024. The generated EUL income is strategically reinvested into the maintenance and enhancement of NASA's underutilised real property, ensuring the optimisation of assets for future mission success.[46]

Public-Private Institutions

Often for more complex or large-scale endeavours, **public and private funds are jointly utilised in mechanisms broadly denoted as Public Private Partnerships (PPPs)**. These mechanisms often balance requirements of achieving competitive financial returns sufficient to attract investors across the risk spectrum, as well as economic policy objectives. This dual return expectation is known as **the double-bottom line**. To execute, intermediate public financial institutions are established to allocate capital more efficiently than direct governmental interventions. These institutions, often under government oversight, follow specific mandates but benefit significantly from operational independence. This autonomy allows them to adhere to their long-term missions effectively.

4.1.2 Development Finance Institutions (DFIs)

DFIs are specialised financial institutions that provide long-term financing and support for development projects in various sectors, including the space industry. **To promote economic growth and technology advancement in emerging and developing economies, these institutions work to increase volume of investment into high-risk, capital-intensive sectors**. With a mandate to develop the space sector, an effective banking entity is one that actively contributes to the long-term plans set by space agencies in the region.

DFIs have broadly speaking 6 roles:

1. Providing counter-cyclical financing,
2. promoting innovation and structural transformation,
3. supporting infrastructure investment,
4. enhancing financial inclusion,
5. supporting the provision of public goods, particularly combatting climate change,
6. help fund urgent health needs.

Sustained investment is deemed key for avoiding interruptions to structural transformation. Thus, the first role assigns DFI as an additional instrument of counter-cyclical macroeconomic policy pertinent when economies slow down or decline,

DFIs are categorised into bilateral and multilateral institutions:

- **Bilateral DFIs**: Mainly funded by national governments, sometimes with contributions from international or private entities. These institutions typically support private sector projects through equity investments, long-term loans, and guarantees.
- **Multilateral DFIs (MLDFIs)**: Possess greater financing capabilities than bilateral DFIs and facilitate collaborative efforts among governments.

[46] US Government Publishing Office. 2019. "NASA enhanced use leasing extension Act of 2019, Report." *US Congress* (Link). NASA. 2007. "Enhanced Use Leasing Programme Needs Additional Controls Page: 11 of 16, Report." *UNT Digital Library* (Link)

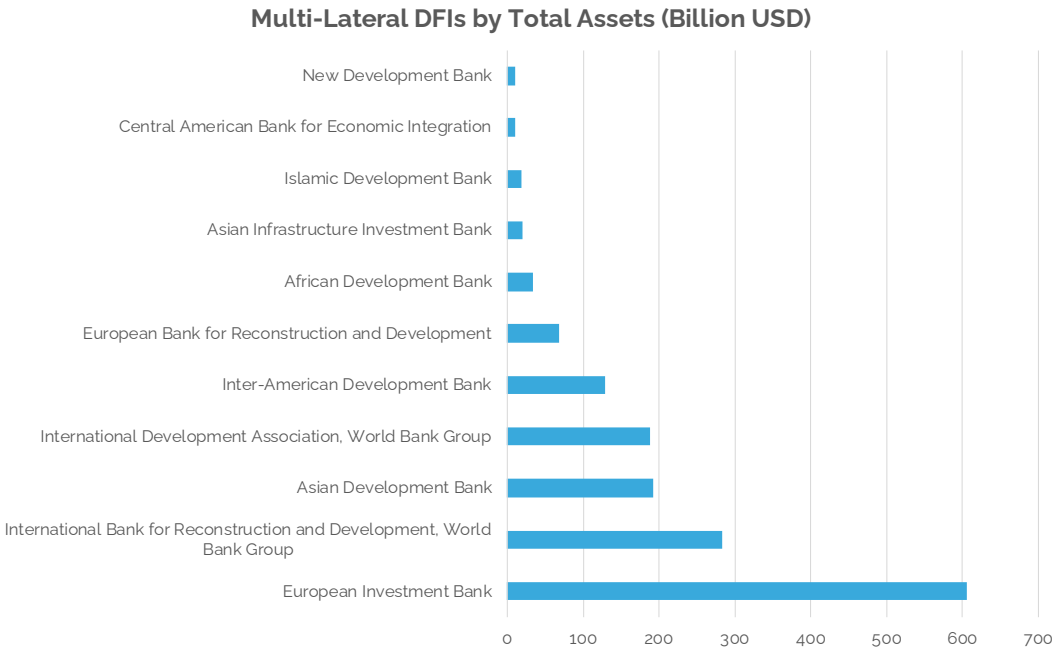


Figure 34: Multi-Lateral National Development Banks (Credit: Investopedia) [47]

The Role of Development Finance Institutions (DFIs) in Supporting the Space Industry

DFIs are increasingly recognising the importance of space technology and systems, not just as domains of advanced technological development and scientific exploration, but as vital tools for achieving development objectives. Numerous DFIs have actively supported space initiatives:

- **International Finance Corporation (IFC):** A World Bank Group member, the IFC invested USD 20M in Planet Labs in 2015. This U.S. startup deploys small satellites for purposes like disaster response, agriculture, and urban planning.
- **African Development Bank (AFDB):** In 2007, the AFDB backed the first pan-African satellite with a USD 50M loan, contributing to the total USD 380M project cost.
- **Asian Development Bank (ADB):** ADB collaborates with entities like JAXA, the U.S. Department of Defence, and ESA, using space technology for its projects. It also publishes a dedicated space sector report.
- **Nordic Investment Bank:** Approved a EUR 12M loan to the Swedish Space Corporation, highlighting the benefits of enhanced launch capabilities and educational advancements.
- **Development Bank of Wales:** Supported Space Forge with a GBP 250K equity investment through the 'Wales Technology Seed Fund.' Space Forge raised an additional GBP 600K from other sources.
- **BPIFrance:** As part of the 'Investing for the Future' initiative, this national investment bank focused on developing France's aerospace industry, including equipment for LEO constellations and valorisation of space sector data.

Some national DFIs opt for indirect investments in the space sector to mitigate risk. For example, KfW's subsidiary KfW Capital invested in the space sector through venture capital funds

[47] As of Dec. 31, 2018, except for the World Bank Group, which reflects Dec. 31, 2019 assets (exchange rates are as of April 15, 2020) Source: Investopedia. 2021. "Multilateral Development Bank (MDB Types And Examples." *Investopedia* (Link).

like HV Capital and UVC. UVC supported Isar Aerospace as an early-stage seed investor, with HV Capital later joining in the series B round and its extension.

Positioning of a National Development Bank (NDB) for increased space sector investment: NDBs in Europe have the potential to significantly augment investments in the space sector. They can either directly fund projects or utilise the EU's 'investment platforms,' which include special purpose vehicles (SPVs), contract-based co-financing arrangements, or risk-sharing agreements – most notably NDBs play a crucial role as implementing partners of the InvestEU programme, which provides a significant opportunity for accessing a wide range of financial instruments to support sustainable projects and initiatives. These platforms are instrumental in mobilising capital for investment projects, particularly for initiatives that span across national borders.

The Role of Special Purpose Vehicles (SPVs) in Risk Management: SPVs play a crucial role in these arrangements by facilitating risk-sharing agreements in conjunction with projects and lenders. This approach is especially effective for complex, cross-border initiatives where risk distribution is a key factor. For instance, a DFI like the EIB might assume the risk associated with an NDB's lending to a NewSpace project company. This risk assumption by the EIB would enable the NDB to provide loans more confidently to emerging space enterprises.

Commercial Banks as Final Loan Issuers: In the space sector financing ecosystem, commercial banks often play a pivotal role as they are typically closest to entrepreneurs and start-up ventures. Consequently, these banks usually emerge as the final issuers of loans.

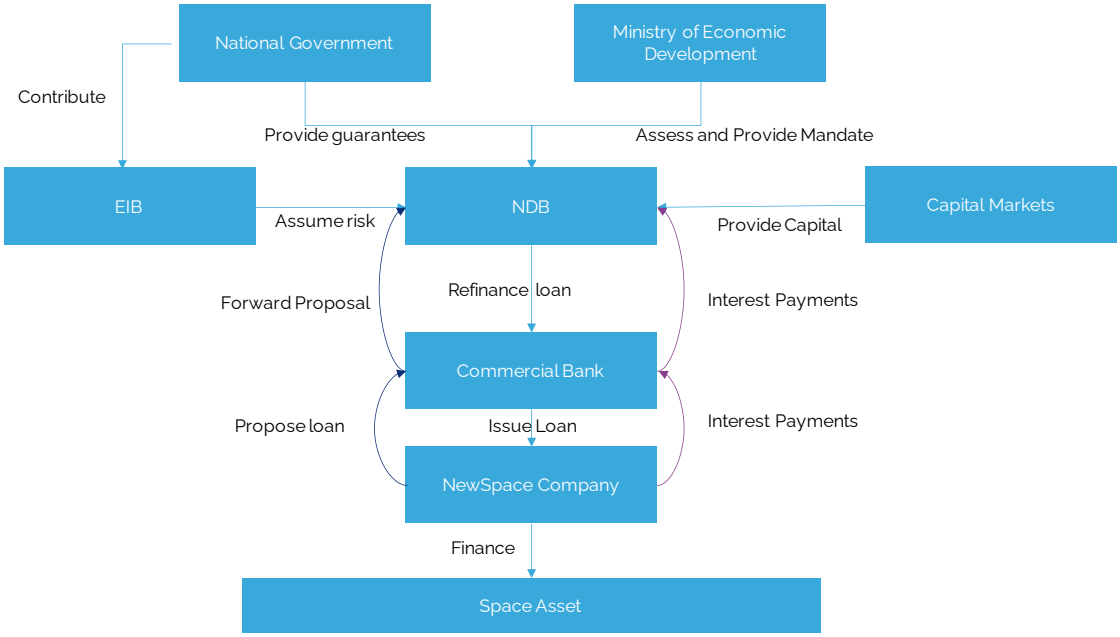


Figure 35: National development bank financing blueprint.

Their proximity to the entrepreneurial community positions them ideally to assess and manage the risks and potential of NewSpace ventures, thus acting as critical conduits of capital from DFIs and NDBs to these companies.

An Example of a Public-Private Investment Fund in Japan

In Japan, the approach to financing the space industry significantly differs from that in Europe, particularly in its reliance on public support. Traditionally, Japan's space industry has been heavily dependent on government backing, which, while providing stability, has often limited innovation and entry of new players. This is partly due to Japan's stringent budgetary allocation system and high dependability criteria. However, recent trends in Japan's NewSpace era show a shift towards embracing broader financial and social risks, with increasing involvement from both public and private sectors, including non-space companies like automotive and electronics manufacturers.[48]

Risk-Absorbing Funds as a Catalyst for Innovation

The **Innovation Network Corporation of Japan (INCJ)**, a public-private investment fund, has been instrumental in fostering a new space industry in Japan. Established in July 2009 and later restructured into INCJ, Ltd. in 2018, it was conceived as a temporary corporate entity with a focus on open innovation across various sectors. INCJ's unique composition, including the Government of Japan and major corporations like Mitsubishi Corporation and Toyota, reflects a diverse investment approach supervised by the Ministry of Economy, Trade and Industry (METI).

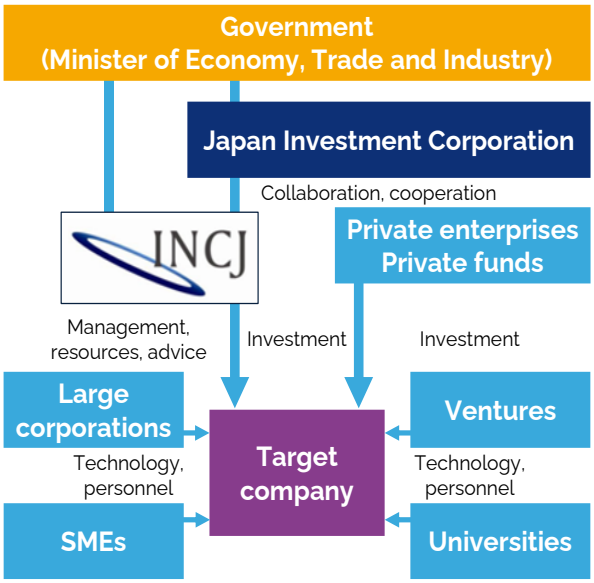


Figure 36: Investment vehicle structures of Japan's INCJ (Credit: INCJ).

INCJ's Investment Strategy and Criteria

INCJ operates under strict investment criteria, emphasising alignment with long-term social demands, potential for new value creation, and innovation. Its investment targets span various business stages and sectors, requiring a balance of impact, profitability, and feasibility. The fund's management involves obtaining approval from METI and the JIC Committee's decisions, ensuring objectivity and expertise.

INCJ's Role and Recent Trends in Investment

The INCJ has been significant in nurturing Japan's space industry through risk capital. However, post-organisational reform, there's been a noticeable gap in INCJ's space sector investments. For instance, the only substantial space-related investment after the reform was a JPY 4B Series B extension round for GITAI in May 2023. This decline is in stark contrast to INCJ's earlier active investment phase.

[48] INCJ. N.d. "INCJ About, Overview." *INCJ* (Link).

INCJ's Investments Include Notable Ventures Like:

Company	Investment Amount	Business Focus	Support Provided	Partners
ispace	JPY 3.5B	Lunar transport and exploration	Investment, management support, and dispatch of external directors	TBS Holdings, Shimizu Corporation, Konica Minolta, Dentsu, Suzuki
iQPS	JPY 850M	Development of the world's lightest small SAR satellite	Investment and management support	Mirai Creation Investment, Real Tech Fund, Mitsui Sumitomo Insurance VC, SMBC VC, MUFG Capital

Table 9: INCJ selected investments.

The Current Financing Gap and Shift in Focus

The recent decline in INCJ's investment activity, particularly in the space sector, highlights a financing gap. With the JIC Group's operation ceasing in March 2025, and no prominent entity filling the void left by INCJ, Japan's space industry is increasingly reliant on government subsidies like SBIR funds for innovation investments. **This shift marks a significant change from the large-scale, sector-crossing investments that INCJ previously facilitated, signalling a potential need for new financing mechanisms, or increased private sector involvement, to sustain the momentum in space development**. To that end, JAXA's **new investment initiative**, as reported by Nikkei, is a notable shift in Japan's space strategy. In a major financial commitment to its space agenda, Japan's cabinet has approved a bill to establish a **one trillion Yen (approximately USD 6.7B)** fund for JAXA. This change is supported by legislation currently being developed which will allow JAXA to freely invest in private businesses. This legislative backing is crucial as it provides a formal and robust framework for JAXA's investment activities.

4.1.3 Strategic Investment Funds (SIFs)

Strategic Investment Funds (SIFs) are instruments designed to bolster local economies by encouraging high private sector engagement through direct investments. These funds are characterised by their:

- Government sponsorship or capitalisation, either in full or in part.
- Pursuit of both financial and economic returns, aligning with development objectives.
- Goal to attract private capital by partnering in investments.
- Function as informed investors for their sponsors.
- Provision of long-term 'patient' capital, mainly in equity form, but also quasi-equity or debt.
- Establishment as investment funds or corporations.

SIFs differ from international, bilateral, or multilateral institutions, development finance institutions, pension funds, or fiscal funds. A **Sovereign Wealth Fund (SWF) typically follows commercial motives for international investments, but a domestically focused SWF aligning with the six traits above could also be classified as a SIF**. The European Fund for Strategic Investments (EFSI) exemplifies a regional SIF.

While SIFs prioritise attracting private investment, it should be noted that a higher investment multiplier could mean reduced control over policy objectives.

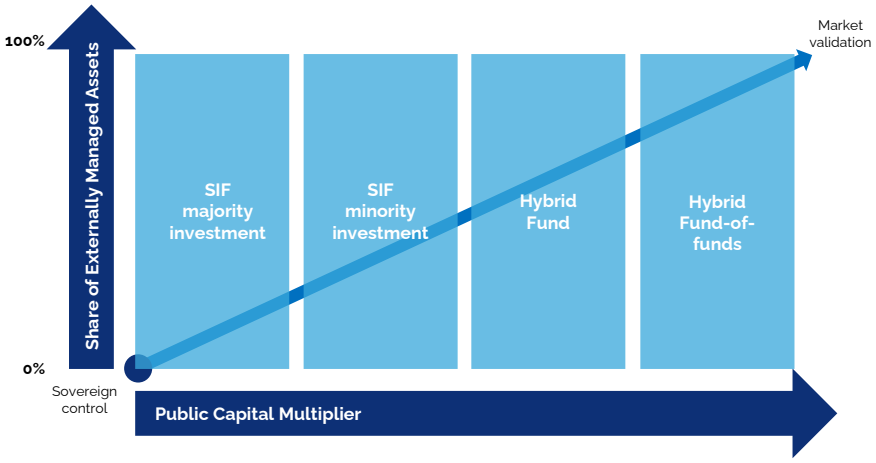


Figure 37: Strategic investment fund market multiplier. (Credit: World Bank).

The Luxembourg Future Fund (LFF)

The Luxembourg Future Fund (LFF) represents a strategic initiative to bolster Luxembourg's economy through innovation and diversification. The first phase, LFF1 (active investment period between 2015 and 2022), was a EUR 150 million fund established by the European Investment Fund (EIF) and the Société Nationale de Crédit et Investissement (SNCI), with contributions of EUR 120M and EUR 30M, respectively. Targeting the growth of strategic sectors like ICT and cleantech, LFF1 aimed to attract venture capital fund managers and innovative businesses to Luxembourg. This was accomplished through direct and indirect investments in venture capital funds and SMEs, fostering economic diversification and sustainable development. LFF1 comprised two sub-funds: **one focusing on investments in venture capital funds not yet established in Luxembourg** and another on **co-investments alongside venture capital funds and business angels in innovative technology SMEs.**

As of 2022, LFF1 concluded its active investment period, leading to the launch of Luxembourg Future Fund 2 (LFF2). LFF2, with up to EUR 200M from EIF and SNCI, aims to continue supporting innovative projects in Luxembourg, expanding its investment scope to include funds and businesses already established in the country and offering hybrid debt-equity investments targeting more mature companies. This shift marks an evolution from LFF1, aiming to further diversify Luxembourg's economy and develop strategic sectors.

LFF 2 further refines its investment strategy compared to its predecessor with a focus on both primary fund commitments and co-investments through SPVs. This approach aligns with the overarching goal of fostering innovation and economic diversification in Luxembourg, with a particular emphasis on the following aspects:

1. **Primary Fund Commitments:** LFF 2 will invest as a Limited Partner (LP) in venture capital and private equity funds, including hybrid debt-equity funds. These investments target funds that are either not yet established in Luxembourg or are already present and looking to expand their operations within the country. This approach aims to attract and integrate new fund managers into Luxembourg's investment ecosystem, as well as to support existing ones in their expansion efforts.
2. **Co-Investments through SPVs:** The co-investment strategy of LFF 2 involves using SPVs managed by institutional-type investment funds, which may include venture capital and private equity funds, family offices, etc. The underlying beneficiaries of these investments are typically innovative companies at various stages and across different sectors. These companies are either seeking to establish their offices in Luxembourg or are aiming to expand existing operations or presence in the country.

Common Challenges and Remedies for SIFs

The World Bank identifies common challenges for SIFs:

1. **Attracting Private Investment:** Essential to a SIFs attractiveness is credible investment potential, underscored by **sound governance**. This involves clear mandates, objectives, and a separation of roles between ownership, board oversight, and management. Transparency and strong audit systems enhance market credibility.
2. **Sourcing Projects:** Many markets struggle to develop investable projects into viable PPP transactions. SIFs should ideally **manage PPP project stages** up to financial closure, potentially taking equity in the project's special purpose vehicle.
3. **Balancing Objectives:** Achieving a double bottom line demands investing in projects that yield competitive financial returns to attract a broad investor base while fulfilling economic policy goals without displacing private sector investment.
4. **Securing Qualified Staff:** The success of SIFs is increasingly supported by access to highly skilled investment professionals both within the country and its diaspora.

European Fund for Southeast Europe (EFSE) as a Public-Private SIF

The **European Fund for Southeast Europe (EFSE)** stands as a prime example of a debt-based SIF, engaging in public-private partnerships (PPPs) to enhance the efficacy and reach of development finance. With EUR 1,243.8M in commitments, EFSE draws from an amalgamation of donor agency funds, international financial institution (IFI) contributions, and private investments. EFSE fills the financing gap in southeastern Europe by providing private debt and financing to partner lending institutions.

EFSE's PPP Framework

EFSE's PPP model leverages private institutional investments to augment public donor funds. **It acts as a conduit for donor coordination within its operational regions, effectively amplifying the impact of public capital through resource pooling**. This approach positions EFSE as:

- A catalyst for market enablement and facilitation.
- A bearer of risks to incentivise further investment.
- An innovator and incubator for novel financial products.

To finance investments, EFSE amalgamates diverse fund sources, each representing varying degrees of risk, into a unified financing stream. This ensures that within each country's investment portfolio, the integrity of the risk tranches, proportional to the pooled funds is maintained. Consequently, donors and stakeholders maintain their share relative to their initial contributions.

Investment Structure and Access to Finance

The investment framework of EFSE is tiered, with donor or public capital forming the first-loss tranche, IFIs populating the mezzanine tranche, and private investors constituting the senior tranche. This tiered structure enables EFSE to extend access to long-term finance at market conditions to qualified investors.[49]

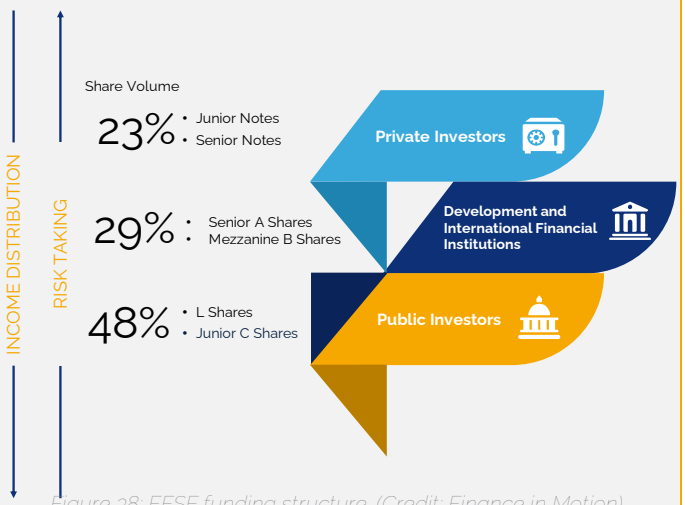


Figure 38: EFSE funding structure. (Credit: Finance in Motion)

[49] Finance In Motion. N.d. "How you can invest." *Finance in Motion* (Link).

Sovereign Wealth Funds (SWFs)

Sovereign Wealth Funds (SWFs) are state-owned investment vehicles, often funded by surpluses from commodities or foreign exchange earnings. These funds primarily aim to secure long-term returns, serving both economic stabilisation and intergenerational wealth preservation for the nation.

Governance and Investment Mandates of SWFs

SWFs operate under specific investment mandates. These guidelines outline how the funds should allocate assets and make investment decisions, influenced by factors such as the fund's objectives, risk tolerance, governance structure, and capital investment policies. It is important to note that **SWFs are not to be classified as public investors, as capital is allocated to selected private investment managers**.

Governance of Australia's Future Fund

In the context of Australia's Future Fund, the board delegates investment management to external, private sector financial institutions. These managers are chosen for their in-depth understanding of the fund's strategy and are tasked with fulfilling the specific mandate of each fund under their management.

The Australian Government has set forth distinct investment mandates for the Future Fund, guiding its operations and investment strategies. These mandates include:

Benchmark Return Target

- The long-term performance benchmark for the Fund is defined as an average return exceeding the Consumer Price Index (CPI) by 4% to 5% annually. This target ensures that the Fund not only maintains but also increases its value relative to inflation over the long term.

Restrictions on Listed Company Holdings

- Legislative constraints under **Sections 21 and 22 of the Future Fund Act** regulate the Fund's investments in listed companies. These include:
  - Prohibition from initiating takeover actions in accordance with the Corporations Act 2001.
  - Limitation on owning more than a 20% stake in any foreign publicly listed company.

These mandates are integral to the governance of the Future Fund, ensuring it operates within a defined framework that balances growth objectives with regulatory compliance.

Direct Investments

SIFs and SWFs may engage in direct investments, acquiring stakes in companies rather than through intermediaries or market instruments. This approach grants the fund greater control over their investments, allowing for alignment with broader economic or strategic objectives. The portion of funds dedicated to direct investments varies depending on each funds' unique strategy and mandate. All investments, including direct ones, must adhere to the fund's established mandates. **These mandates guide the fund in achieving its goals, managing risk, and selecting sectors, ensuring that even direct investments are in sync with the fund's overarching strategic aims.**

Strategic Investment Funds and Sovereign Wealth Fund Direct Investments

Return Bias

☐ Strategic

☐ Economic

☒ Hybrid

Funding source:

☐ Public

☐ Private

☒ Mixed

Type of Financing:

☐ Grants

☒ Equity

☒ Debt

☐ Mezzanine

Figure 39: Multi-dimensional analysis strategic investment fund direct investments.

Future Fund's Direct Investment in Rocket Lab

In November 2018, Rocket Lab, the prominent small rocket company, received a significant investment boost of USD 140M, led by Australia's Future Fund. This investment round included participation from both new and existing backers, notably Bessemer Venture Partners, Promus Ventures, Khosla Ventures, K1W1, Data Collective, Greenspring Associates, and, **for the first time, New Zealand's Accident Compensation Corporation.**

Allocation of Funds and Strategic Expansion

- A substantial portion of the investment, approximately one-sixth, was allocated for the expansion of Rocket Lab's launch facilities in New Zealand. This includes the development of second and third launchpads at the Mahia facility, highlighting its strategic importance as noted by Rocket Lab executive, Adam Spice.
- Around one-third of the funding is earmarked for research and development initiatives. The company plans to undertake three major R&D projects, signalling its commitment to continuous growth and technological innovation.

Patient Capital for Operational Resilience

Spice remarked that the funding would allow Rocket Lab to **"survive a pretty lengthy shutdown on the pad if we have an anomaly."**[50] This foresight proved beneficial in September 2023 when Rocket Lab faced a launch failure, interrupting its streak of 20 successful launches. Despite this setback, the Electron rocket maintains a 90% success rate over 41 missions, underscoring the importance of patient capital in providing stability and resilience in the face of industry challenges.

[50] CNBC. 2018. "Rocket Lab raises $140 million in 'dry powder' to fast-track business of small rockets." *CNBC* (Link).

4.1.4 Export Credit Agencies (ECAs)

ECAs are private or quasi-governmental institutions that act as an intermediary between national governments and exporters to issue export insurance solutions and guarantees for financing. The purpose of these banks is to support deals benefiting domestic enterprises. ECAs like the Export-Import Bank of the United States and COFACE in France play a pivotal role in supporting the space industry, particularly in financing endeavours that might not attract conventional debt or investment funding due to their risk profiles. **These agencies, bridging between government support and exporters, provide crucial export insurance solutions and guarantees.**

In the early 2010s, the Export-Import Bank of the United States was instrumental in funding significant projects like Iridium's USD 3B NEXT satellite constellation programme. The Bank's involvement was essential due to the project's weak financial fundamentals, which made it unattractive for mainstream funding sources. Similarly, COFACE in France has backed the deals for several satellite constellations, including O3b, GlobalStar, and Iridium, underlining the role of ECAs in sustaining innovative yet financially precarious space ventures.

U.S. Export Credit Agency Working Through USD 5B Pipeline of Space Financing

Published in Q3 2023, the Vice Chair of the Export-Import Bank of the United States (EXIM) Judith Pryor, announced that the institution is working on a USD 5B pipeline of space financing, with about USD 1.3 B are likely to come to fruition within a year and another USD 4 B a bit further down the line.

Export Credit Financing

To receive an export financing loan, the Ex-Im Bank's mandates a comprehensive collateral security package. This package encompasses a mortgage on the financed asset, lease assignments, receivables, stock pledges in the SPV, and various supplementary agreements. **These requirements ensure a secure financial base for the investments made. Furthermore, in cases of questionable creditworthiness, guarantees from related, creditworthy parties are sought, enhancing the security of the investment.**

Additionally, the Ex-Im Bank often collaborates with other countries' ECAs in co-financing arrangements. This strategy is particularly employed when a significant portion of the project's content is supplied by another country, such as France, facilitating shared financial responsibility and risk.

Export Credit Financing

Return Bias

☐ Strategic

☐ Economic

☒ Hybrid

Funding source:

☐ Public

☐ Private

☒ Mixed

Type of Financing:

☐ Grants

☐ Equity

☒ Debt

☐ Mezzanine

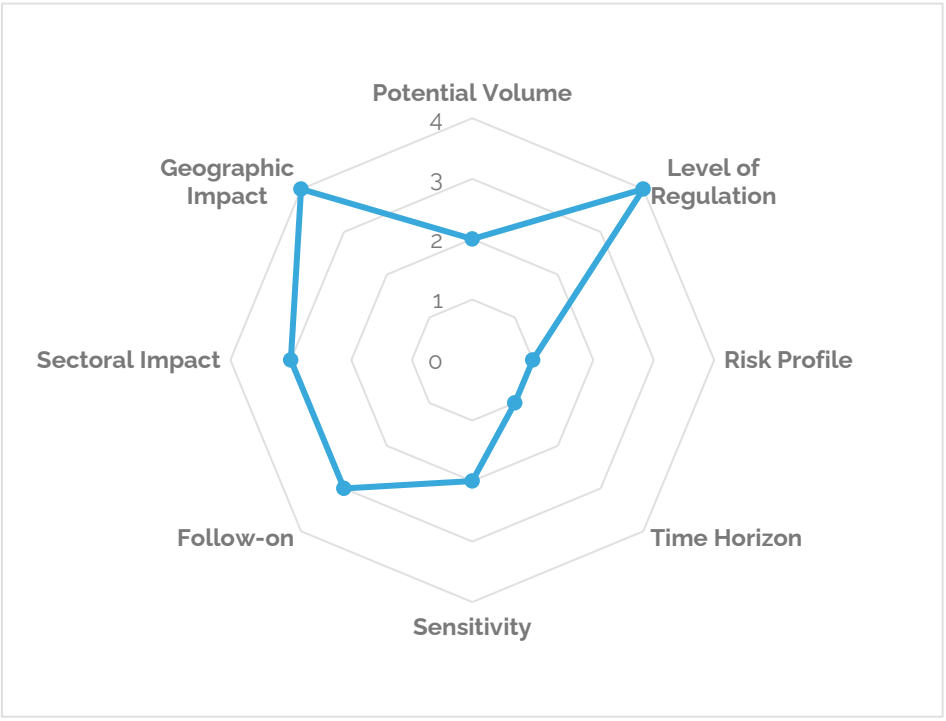


Figure 40: Multi-dimensional analysis export credit financing.

Boeing / Inmarsat ECA Loan

On May 12, 2011, the **Ex-Im Bank announced it was providing USD 700M as a long-term direct loan to finance the sale of satellites by Boeing Space and Intelligence Systems (US) to Inmarsat (UK).** The Bank's support helped Boeing Space and Intelligence Systems win the contract over competition backed by a foreign export credit agency.

The loan was made on the following terms:

- 8.5-year term, fixed-rate direct loan,
- availability period of four years,
- the loan related to the development of three satellites and launch insurance.

The current fixed rate ("CIRR") was 2.02% for direct Ex-Im Bank loans with a 5-to-8.5-year tenor and 2.63% for tenors of longer than 8.5 years. On top of this interest, the borrower pays fees and reimburses expenses incurred by Ex-Im Bank.

European Export Excellence

In Europe, the space industry's export market has been robust, as indicated by ASD-Eurospace's findings. Over the past decade, the spacecraft and launcher segments in Europe generated substantial export values, contributing positively to the European trade balance. However, imports, particularly from the U.S., have slightly offset this positive impact. Satellite systems and components (mostly for telecommunications systems) are the main segment for exports. Launcher systems are less prone to export dynamics due to limitations on international trade in launcher technology.

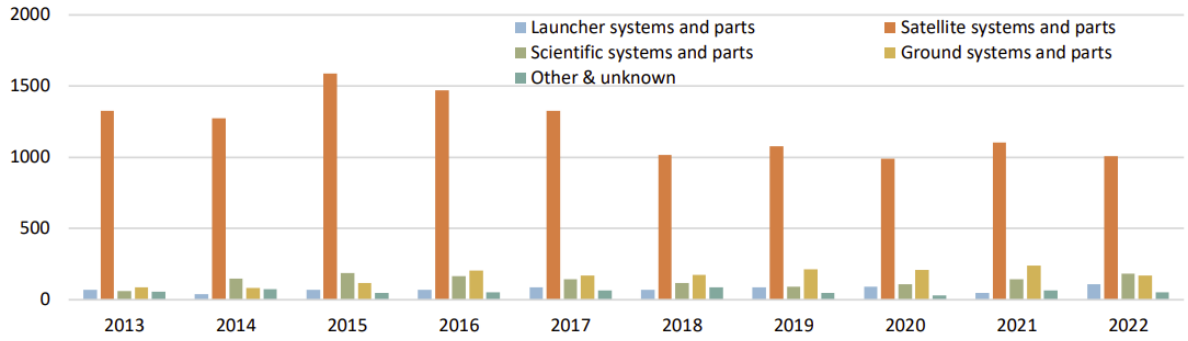


Figure 41: Export sales by system segment (M EUR, Credit: ASD-Eurospace). [51]

4.2 Private Institutions and Financial Mechanisms with an Economic Bias

In recent years, the landscape of space technology financing within the private sector has undergone a significant transformation, primarily owing to the proliferation of venture capital and private equity funding. This paradigm shift has introduced a fresh perspective on how space technology companies can secure the necessary resources to fuel their innovative endeavours. **While the allure of selling equity in these companies has become increasingly widespread, it is imperative to recognise that gaining access to these forms of capital remains a multi-faceted challenge, especially in the current economic environment**.

Private investment institutions refer to a legal and ethical obligation to act in the best financial interest of their clients or beneficiaries. **'Fiduciary duty' in private investment institutions is about acting in the best interest of clients**, with a high standard of care and loyalty, ensuring transparency, adhering to clients' goals, and complying with all legal and regulatory requirements. Private capital markets are usually fed through investments made by family offices, endowments and pension funds, as these sources are now becoming more careful in their strategies when it comes to venture capital and established private equity, bespoke offerings, including through direct investment in high-growth potential sectors might become more attractive.[52]

[51] ASD-Eurospace. 2023. "Facts & Figures - 27th Edition." *ASD-Eurospace.*
[52] D. Wilson & A. Sabatier. 2023. "Pension fund allocation to private equity under target in 2023." *S&P Global Market Intelligence* (Link); European Investment Fund. 2023. "EIF VC Survey 2023" *European Investment Fund* (Link); Boston Consulting Group. 2023. "BCG Global Asset Management Report May 2023." *Boston Consulting Group* (Link); Atomico, Orrick. 2023. "State of European Tech Report 2023." *State of European Tech* (Link); J. Scott. 2023. "PitchBook analysts say 2023 VC funding is "pretty much shot," long-term recovery appears likely." *Betakit* (Link); C. Morris, Venture capital's 2023 bloodbath, by the numbers, Fast Company (Link).

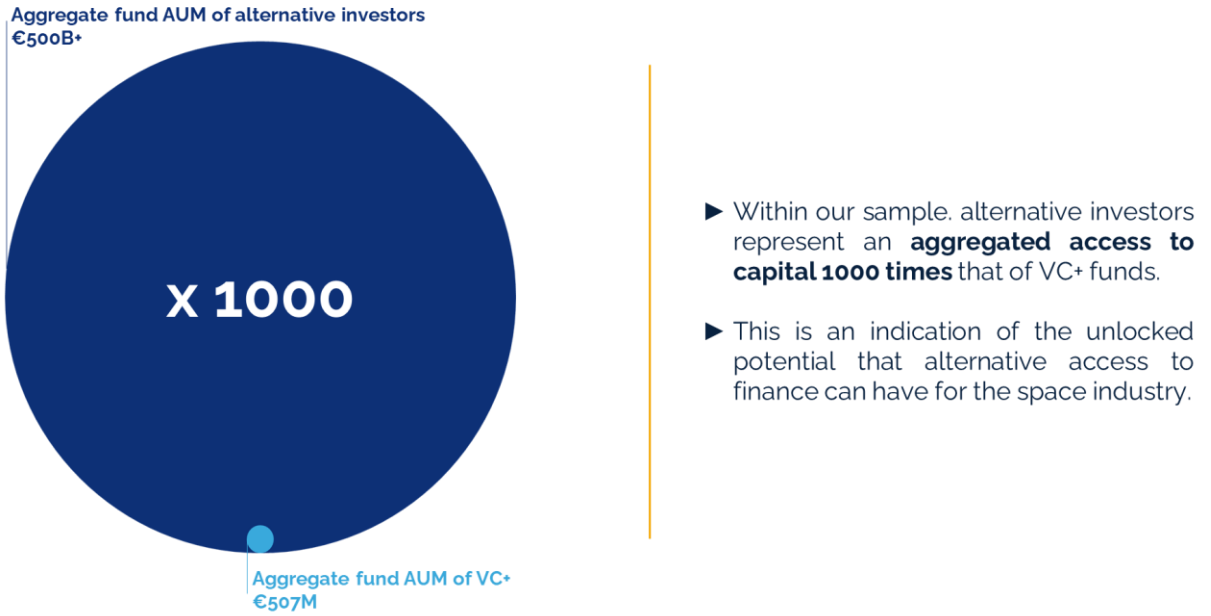


Figure 42: Comparison of financial firepower between the VC+ category and alternative investors, including family offices & pension funds (Source: ESPI Survey, 2023).

This shift toward customised investment strategies by family offices and pension funds presents a unique angle for consideration. **As these institutions diversify their portfolios to seek greater returns, the space sector emerges as a compelling capital destination also in views of the long-term nature of family office and pension fund investment, without hard exit timelines**.[53]

In this context, better understanding the family offices and pension fund environment should become a priority for anyone trying to create an environment conducive of increased or sustained investment in the European space sector.

4.2.1 Family Offices

Family Offices (FOs) in Europe, representing high-net-worth families, play a significant role in the private investment landscape, particularly in the NewSpace sector. As organisations focused on wealth growth and preservation, FOs are increasingly engaging in space technology investments.

Family Office Market Growth and Distribution[54]

- The global family offices industry, valued at USD 124.28B in 2023, is **projected to grow to USD 209.91B** by 2028.
- The **average assets managed by an FO stood at USD 917M in 2019**, with family net worth averaging USD 1.2B.
- European distribution: United Kingdom (25%), Switzerland (18%), Italy (9%), Germany (8%), Spain (6%), Belgium (5%), Monaco (5%), and the rest of Europe. **Notably, France is underrepresented despite its affluent families**.

[53] KirkPatrickBank, N.d. "How Family Offices Are Investing Directly in Businesses," *KirkPatrickBank* (Link); Rhodium Analytics. 2023. "How Direct Investments are Empowering Family Offices to Take Control." *Linkedin* (Link)
[54] Campden Wealth. 2022. "The European Family Office Report 2022." *Campden Wealth* (Link).

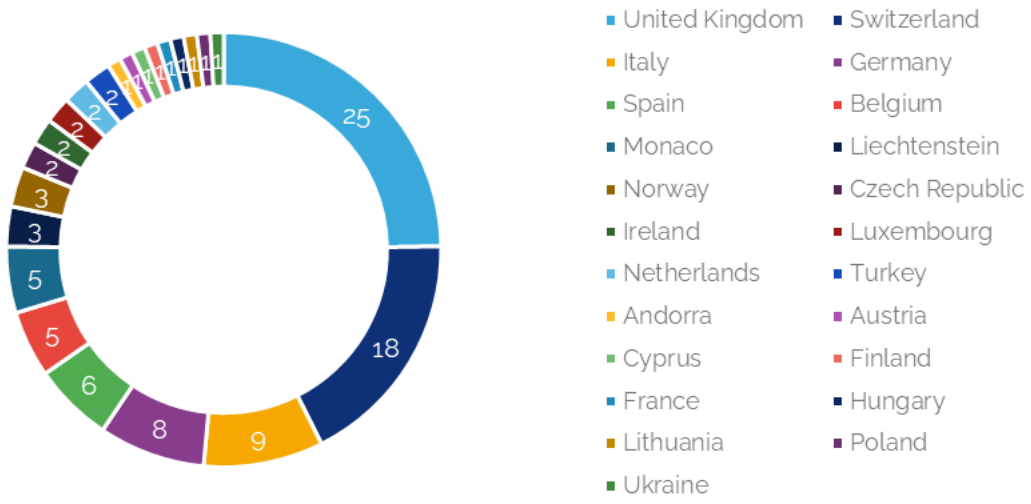


Figure 43: Family offices in Europe (Credit: Campden Wealth)

1. **The Decaux Family (France):**
   - Current Focus: Diverse, including technology and media.
   - Space Benefit: Could leverage space solutions for media, such as digital outdoor advertising, and invest in hybrid space/telecom solutions.
2. **The Moller-Maersk Family (Denmark):**
   - Current Focus: Transport infrastructure, shipping, logistics, energy, and renewables.
   - Space Benefit: As a user of satellite communication (Satcom) and IoT, they may invest in SatCom solutions for enhanced maritime connectivity.
3. **The Dassault Family (France):**
   - Current Focus: Aviation, aerospace, technology, real estate, software, biotech.
   - Space Benefit: Invested in space; potential to expand into space-based R&D for biotech.
4. **The Bosch Family (Germany):**
   - Current Focus: Electronics, automotive, future mobility, digital transformation.
   - Space Benefit: Potential to enrich offerings in automotive and other mobility sectors with space technology solutions.
5. **Klatten/Quandt Family Office (Germany):**
   - Current Focus: Automotive, pharmaceuticals, renewable energy.
   - Space Benefit: Space investments could align with their sustainability goals and renewable energy ventures.
6. **Porsche/Piech – Porsche SE Family Office (Germany):**
   - Current Focus: Mobility and industrial technology.
   - Space Benefit: Interest in diversifying portfolio; potential synergies between automotive and space technologies.
7. **The Wallenberg Family (Sweden):**
   - Current Focus: Finance, telecom, technology, healthcare, automotive.
   - Space Benefit: Further diversification into space could complement their financial, technological, and industrial investments.

Table 10: Family offices incentivized to (further) invest in space activities.

Attracting Family Office Investment

Family offices invest in private equity, venture capital, hedge funds, and real estate. Their risk appetite varies, with some focusing on lower-risk sectors like satellite communication and others engaging in high-risk ventures like space tourism. The space industry's potential for high returns is a key attraction as it synergises with the top verticals for FO-backed investments being **Software-as-a-Service (SaaS), FinTech, AI & Machine Learning, Technology Media and Telecom (TMT), and Mobile.**

Investment Drivers and Barriers

- **Drivers:** Technological advancements, portfolio diversification, global connectivity, and sustainability align with FOs' investment strategies.
- **Barriers:** High capital requirements and technical and regulatory complexities are challenges in space investments. FOs generally seek pre-IPO investments with a defined exit strategy.

The **Alternative Finance Workshop** revealed: The top three investment barriers perceived by alternative investors were:

- **Liquidity concerns,**
- **the size of the overall space sector,**
- **and regulatory concerns**.

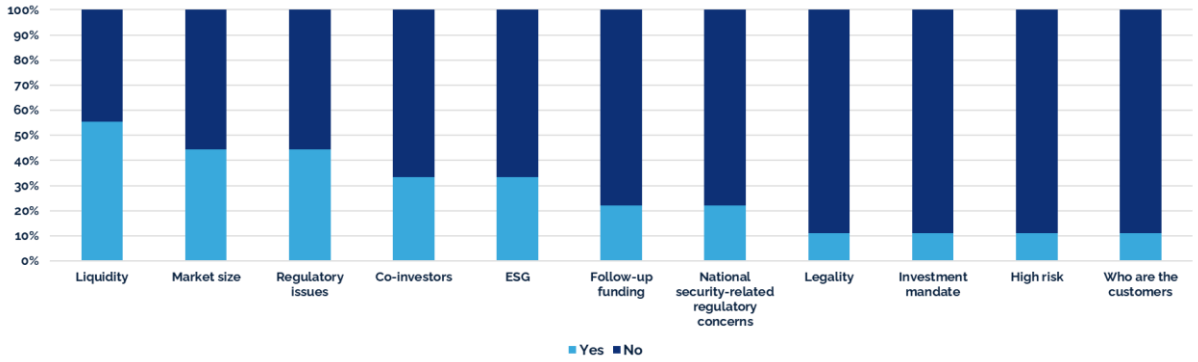


Figure 44: Perceived investment barriers by alternative investors.

4.2.2 Pension Funds

Pension funds are by far the largest financial institutions in terms of assets under management. **In the fourth quarter of 2022, the total assets of euro area pension funds saw a tremendous increase, reaching EUR 3,123B.** This marked a significant growth of EUR 156B from the third quarter of the same year. A key factor contributing to this increase was the transfer of assets from insurance corporations to newly established pension funds in France.

The composition of these assets highlights a preference for investment fund shares, which constituted the largest category at 40.8% of total assets. Debt securities followed as the second-largest holding at 27.0%, and equity represented 11.5% of the total assets. This distribution of investments showcases the strategic asset allocation of the pension funds in the euro area, balancing between risk and return through a diversified portfolio encompassing investment funds, debt securities, and equity.

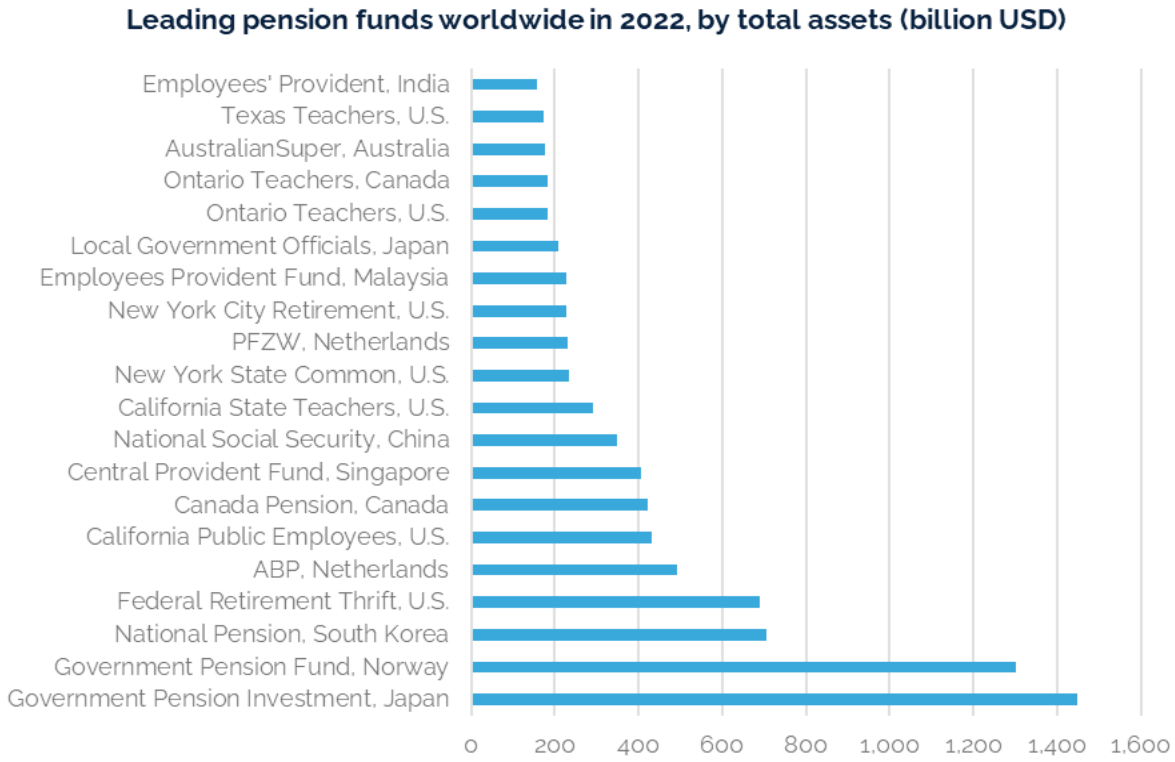


Figure 45: Leading pension funds globally (Credit: Statista)

4.2.3 Philanthropic Venture Investment and Catalytic Investing

Venture philanthropy combines elements of impact investment, venture capital finance, and business management to achieve philanthropic goals. This approach, first described by John D. Rockefeller III in 1969, represents **an imaginative and risk-taking strategy in philanthropy, typically undertaken by philanthropic organisations**.

A snapshot of the impact investing market size as of 2022 through a GIIN survey was USD 1.164T in assets under management (AUM). Geographically, the largest concentrations of impact investing organisations were the U.S. & Canada (50%) and Western, Northern, & Southern Europe (31%), allocating 37% and 55% of AUM respectively. Those in emerging markets are most frequently based in sub-Saharan Africa (6%), Latin America & Caribbean (3%), and Southeast Asia (2%).[55]

Strategy	2020	2018	2016	Growth (%)[56]	CAGR (%)
Impact/community investing	352	444	248	42	9
Positive/best-in-class screening	1384	1842	818	69	14
Sustainability-themed investing	1948	1018	276	605	63
Norms-based screening	4140	4679	6195	-33	-10
Corporate engagement and shareholder action	10504	9835	8385	25	6
Negative/exclusionary screening	15030	19771	15064	0	0
ESG integration	25195	17544	10353	143	25[57]

Table 11: Global growth of sustainable investing strategies 2016-2020. Value in Billion USD. (Credit: GIIN)

[55] Global Impact Investing Network 2022. "Sizing the Impact Investing Market," *GIIN* (Link).
[56] Growth in the period 2016 – 2020.
[57] GSI Alliance. 2020. "Global sustainable investment review 2020," *GSI Alliance* (Link).

> "Philanthropy has seen itself as the research and development arm of society".
>
> **Franklin Thomas, President (frm.), Ford Foundation**

Applying this to the European space sector, **venture philanthropy could involve investing in space-related ventures with a clear social or environmental impact, using methods and techniques from venture capital.** This could include providing funding, expertise, and other resources to support innovative space technologies and projects that have the potential to address significant challenges on Earth, such as **climate monitoring or disaster management**, while also fostering the development of the space industry in Europe.

One of the largest European philanthropic venture networks is **Impact Europe**. It refers to the crowding-in effect of philanthropically motivate capital as 'Catalytic capital' with several characteristics:[58]

Addressing Gaps: Catalytic capital specifically addresses gaps left by traditional capital in pursuit of impact for people and planet that otherwise could not be achieved. This includes reversing engineering solutions, de-risking investments, and ensuring both impact and long-term financial sustainability.

Intentional Approach: It is defined by its intentional approach rather than the specific financial instrument or asset class. Catalytic capital covers a full spectrum of financial instruments, from grants to debt, equity, and hybrid instruments. The key element is its focus on impact, tolerance for risk, and/or willingness to accept concessionary returns.

Risk Taking: Catalytic capital involves taking risks that many impact investors might avoid. It de-risks impact solutions and enables the development of new markets or under-served areas. This characteristic addresses the financial risk aversion prevalent among many impact investors.

Patience: It is patient in nature, aligning with the term "patient capital" well-known in the impact community. Unlike conventional investment strategies that prioritise immediate financial gains, catalytic capital acknowledges the importance of a more extended timeframe for addressing social and environmental challenges. This patient approach is vital for allowing time for experimentation, adaptation, and continuous evaluation.

Flexibility: Catalytic capital is designed to be flexible, versatile, and responsive to financial requirements and operational constraints of impact ventures. This flexibility is key to unlocking its true potential.

Concessionary Returns: It is characterised as concessionary, meaning it accepts financial returns lower than the risk-adjusted market rate. This feature is essential in blended finance mechanisms, where the catalytic capital portion mobilises resources from other funding sources with less flexibility in terms of returns.

A Call for More Philanthropic Investment Institutions

Impact Europe argues that **funds of funds play a crucial role in developing and enhancing impact investing markets**. They contribute by directing financial resources and fostering essential skills. However, they represent only one component of the broader impact ecosystem, with a need for diverse investors to support impact organisations at various stages. As Cyril Gouiffes from the EIF notes, while impact funds can drive innovation, they are not always the most appropriate or sufficient funding source for impact enterprises.[59] **Collaborative opportunities with other capital providers, policymakers, intermediaries, and corporations remain untapped**. Philanthropic institutions, for instance, could bolster the technical assistance offerings of impact funds of funds, enhancing their offerings, or build a network of pioneering funds of funds to leverage future investments.

[58] EVPA (Impact Europe), Catalytic Capital in Europe Whitepaper, 2023 (Link)
[59] Impact Europe. 2023. "To Fund a Fund." *Impact Europe* (Link).

4.2.4 Novel and Underutilised Financial Instruments

Beyond the potential sources of private financing, it is also important to understand private market instruments that can apply to space sector growth financing. In this context, instruments that appear somewhat novel or underutilised in financing the European space sector emerge: **Mezzanine Financing, Venture Debt, and Asset-Backed Financing, notably through Sukuk loans.**

While traditional sources of financing, such as equity investments and bank loans, have been the mainstay in the sector, these alternative financing tools have the potential to offer complementary options for the sector.

Mezzanine Financing and Venture Debt

In the space industry, **financial challenges often confront small and medium-sized enterprises (SMEs), particularly when they seek to balance growth with equity preservation**.

Mezzanine financing emerges as a strategic solution, particularly suitable for companies that have undergone multiple rounds of venture capital (VC) funding but are cautious about further equity dilution or those finding bank loans too risky or unaffordable.

Mezzanine Finance and Venture Debt Instruments

Return Bias

☐ Strategic

☐ Economic

☒ Hybrid

Funding source:

☐ Public

☐ Private

☒ Mixed

Type of Financing:

☐ Grants

☐ Equity

☐ Debt

☒ Mezzanine

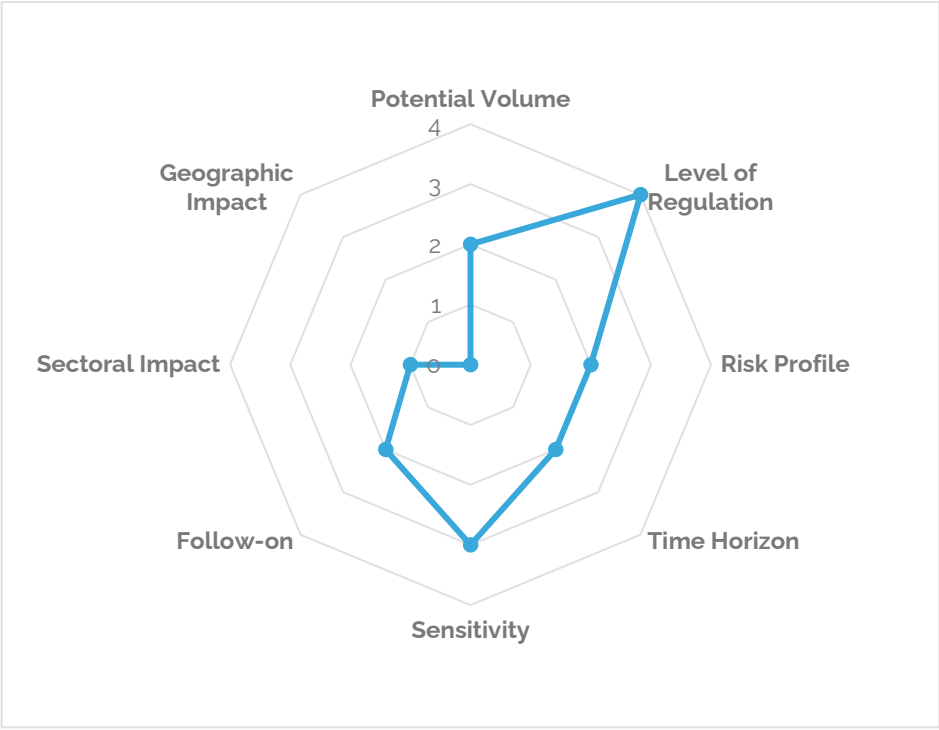


Figure 46: Multi-dimensional analysis of mezzanine finance and venture debt instruments

The key aspects of mezzanine financing in the space sector are:

- **Target companies**: Best suited for young, expanding New Space companies and larger firms exploring new, risky market opportunities.
- **Ownership and management**: Investors typically aim for no more than 5% ownership, with minimal involvement in management.

- **Flexibility in payment**: Offers the possibility to defer interest payments until loan maturity, easing financial pressure on SMEs.

This financing approach is especially beneficial for space sector companies at different growth stages and facing unique market challenges. Young New Space companies, already supported by VC funding, view mezzanine finance as a pathway to obtain necessary capital without substantial equity loss. Larger, established firms consider this option to fund innovative projects that might not guarantee immediate returns, such as Active Debris Removal or new propulsion technologies.

Venture debt is another crucial financial instrument in the space industry, primarily serving venture-backed companies that are yet to achieve positive cash flows or lack hard assets for collateral. The Key characteristics of Venture Debt are:

- **Utilisation**: Fills the funding gap for mid-sized companies in growth stages between equity rounds.
- **Advantages**: Less dilutive than equity financing and may include warrants for potential equity conversion.
- **Appeal to Lenders and Borrowers**: Lenders benefit from interest payments and equity upside, while borrowers gain essential growth capital with reduced equity dilution.

In regions like Europe, venture debt has become a significant tool for companies needing to sustain growth without substantial equity sacrifice. Lenders find value in this arrangement through potential equity gains while borrowing companies appreciate the non-dilutive nature of the capital.

The Alternative Finance Workshop revealed: NewSpace ventures, face challenges like undercapitalisation due to uncertain customer bases. With a shift towards a more cautious investment climate, venture debt offerings from the private sector have contracted, though they remain competitive against private debt in stable markets. Careful consideration is advised to ensure venture debt's role in supporting the financial continuum and follow-on investments.

Mezzanine Finance in India

Within India, commercialisation of the space sector is changing as the segment rapidly develops. **The regulatory framework for commercial space activities in India is in flux**, with the Department of Space overseeing entities like NewSpace India Ltd. (NSIL), InSpace, and the Indian Space Research Organisation (ISRO). NSIL is responsible for technology transfers from ISRO and managing its export and import operations. There is anticipation for legislation that could further open the space sector, especially in LEO and MEO orbits, to private involvement. ISRO's constrained budget has spurred discussions about privatisation and better monetisation of its assets to support its ventures and resolve existing friction with the private sector over satellite operations.

Amid this, **Compulsory Convertible Preference Shares (CCPS)**, a form of mezzanine financing instrument, are increasingly being utilised in India's burgeoning NewSpace sector. **Such instruments are appealing due to their hybrid nature, offering the protection of debt initially and the potential for equity participation later.** Local and western VCs with Indian partners are actively investing through convertible notes. This trend is supported by the policy that mandates SMEs in the space sector to be contracted by prime contractors, ensuring a connection to long-term government procurement contracts.

Asset-Backed Financing and Sukuk Loans

Asset-backed financing is a financing mechanism that leverages the inherent value of tangible and intangible real assets to secure funding. In the context of the European space sector, where capital-intensive projects and long-term investments are common, asset-backed financing offers a unique opportunity to unlock the value of physical assets, optimise capital allocation, and mitigate risks for both investors and space companies.

The Alternative Finance Workshop revealed: In general asset backed financing for the European space sector is uncertain, given the limited number of valuable easily transferrable assets. However, exploring alternatives like Sukuk loans, which can back intangible assets, such as spectrum rights from satellites in distress, presents a potential avenue, particularly during launch bottlenecks.

Within the realm of asset-backed financing, Sukuk loans, which are structured to comply with Islamic finance principles, have gained prominence as a niche but promising option for funding space ventures.

Asset-Backed Loan and Sukuk Financing

Return Bias

☐ Strategic

☒ Economic

☐ Hybrid

Funding source:

☐ Public

☒ Private

☐ Mixed

Type of Financing:

☐ Grants

☐ Equity

☒ Debt

☐ Mezzanine

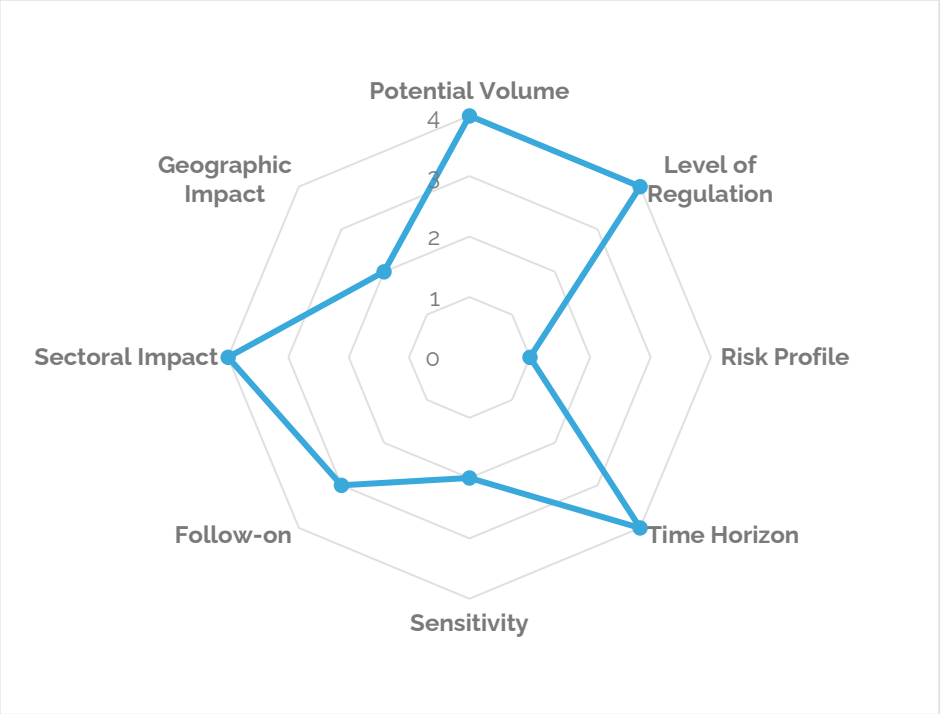


Figure 47: Multi-dimensional analysis of asset-backed financing

The rise of Islamic Finance in the space sector presents a unique financing landscape, particularly with the rising investments from the Gulf. For example, the government of the United Arab Emirates (UAE) is focusing on the space sector as a key area for the next 50 years. **This commitment is evident in the establishment of the National Space Fund (NSF), a USD 820M fund managed by the UAE Space Agency.** NSF aims to develop infrastructure and create an environment conducive to attracting startup companies, which also incentivises local or regional investors familiar with Sukuk.

Islamic Finance, particularly in infrastructure financing, plays a crucial role in the Gulf. In the UAE, the country's largest international and local banks use various sophisticated instruments like bonds,

Sukuks (Islamic bonds), loans, syndicated loans, Murabaha (Islamic loans), and direct equity investments. **Islamic banking, constituting approximately 80% of total Islamic financial assets globally, dominates the Islamic finance industry**.

Principles of Sukuks

Sukuk loans, adhering to Islamic finance principles, provide a Sharia-compliant financing mechanism for companies. These loans are based on key Islamic finance principles:

- **Prohibition of Interest (Riba):** Sukuk loans avoid interest payments, instead structuring contracts to create real sector exposure. For European space companies, this offers an alternative to traditional interest-based loans.
- **Profit and Loss-Sharing (Mudarabah/Musharakah):** Emphasising shared risk and rewards.
- **Prohibition of Uncertainty (Gharar) and Speculation (Maysir):** Ensuring all terms are transparent and known to all parties, aligning with the need for clarity in space investments.
- **Asset-Backing:** Each transaction is tied to a tangible or intangible asset. Transactions tied to purely financial assets are not permitted.

Stock Exchange	Sukuk Listings	Funds Raised
LSE	65+	USD 50b+
LuxSE	20+	USD 9b+
Euronext	100+	USD 75b+

Table 12: Sukuk listings in European stock exchanges

The pricing model of Sukuk loans, which does not require a credit assessment of the company, can enable European space companies to raise funds more cost-effectively than conventional bonds. This aspect of Sukuk loans makes them an attractive financing option for space sector investments, providing a cheaper and Sharia-compliant alternative to conventional funding methods.[60]

4.3 Coordinating Across Biases: Financing China's Commercial Space Ecosystem

Ultimately, it will not be one instrument or funding source that will on its own propel a sector ahead. It is inherently a **combination of strategic high-level priorities matched with appropriate funding, through the creation with additional double bottom line mechanisms and incentivising private markets** that can truly provide an ecosystem-wide shift. While **noting the socioeconomic and governance differences between the European and Chinese environments**, it is valuable to look at the dynamics that emerged in the evolution of the Chinese commercial space sector over the past five years, leading to its growth.

The Chinese space ecosystem's development is a fascinating study in coordinated multi-level funding and strategic guidance. This ecosystem's success stems from a unique blend of financial inputs and policy

[60] Although an increasing interest rate environment may seem to be competitively beneficial to Islamic banks, Islamic banks, or IIFSs, do not directly engage in interest-based instruments but are still exposed to interest rate risks indirectly. This exposure arises from the pricing mark-ups for deferred sale and lease-based transactions, which are influenced by market conditions and risk. Islamic banks often use benchmark rates like the London Interbank Offered Rate (LIBOR) to price their financial instruments. Therefore, changes in LIBOR can impact Islamic banks as it represents a significant portion of financial assets. This means that fluctuations in interest rates in conventional banks can affect the terms offered to depositors in Islamic banks, potentially leading to the migration of depositors to more attractive institutions. Hence, Islamic banks must closely monitor and manage interest rate risks.

directions from three key sources: **state (national government), provincial/regional governments, and private capital markets**.

- **State Capital:** The national government plays a pivotal role in setting the overall strategic direction and priorities for the space industry. This includes formulating policies, providing direct funding through various state-owned entities, and enabling a conducive regulatory environment. The national government's involvement is primarily geared towards ensuring that the space sector aligns with broader national objectives and security interests.
- **Provincial/Regional Capital:** Provincial and regional governments act as crucial intermediaries, translating national strategies into local initiatives. They provide substantial financial resources, often in the form of subsidies, tax incentives, infrastructure support, and direct investments. These governments tend to tailor their support to local strengths and capabilities, fostering specialised clusters of space industry activity within their jurisdictions.
- **Private Capital Markets:** Private investment has emerged as a dynamic component of the ecosystem, providing essential capital to startups and more established firms. These investments are often market-driven, focusing on innovation and commercial viability. Private capital not only injects financial resources but also brings market discipline, efficiency, and a focus on profitability to the space sector.

The coordination among these three sources is not just about funding but also involves policy alignment, strategic planning, and market regulation. The central government sets the overarching goals and policy frameworks, which are then adapted by provincial/regional governments to fit local contexts. Private capital, while independent, is influenced by these policies and often aligns with broader national goals.

For example, when **China's National Development and Reform Commission (NDRC)** added Satellite Internet (卫星互联网) to its list of New Infrastructures (新基建) in 2020, a great many commercial companies started advertising their abilities to build internet satellites, and sure enough, a great many provinces and cities were ready to support them with funding.[61]

The rapid growth in funding for China's commercial space industry, particularly since 2014, is a direct result of this coordinated approach. The total funds raised by Chinese commercial space companies since 2014 amount to approximately ¥47B, with a significant uptick since 2019. The below represents a rough estimate of the funding division across private, provincial, and national sources.

- **Private Capital:** The largest funding source, accounting for about 42% of the total. Private investors are attracted by the industry's potential for innovation and high returns.
- **City and Provincial Governments:** Contribute around 39% of the funding, often through indirect means like infrastructure, policy incentives, and financial support. They play a pivotal role in nurturing local space industry ecosystems.
- **National Government**: Comprises about 19% of the funding, mainly through direct investments and funding from state-owned enterprises and national institutions.

The figure for provincial & city governments is likely underestimated, as much of the financial contribution from these entities would not be cash, but rather free land, subsidiaries for employees hired by space companies in a given city or province, and other non-cash subsidies.

[61] Galaxy Space funding round from that time included Hefei, Anhui funding (Link); Commsat similarly announced a round of funding including Beijing Municipal Government (Link)

The combined support from these funding sources has led to a vibrant and competitive commercial launch sector in China, with numerous technological advancements. However, it has also resulted in some inefficiencies, such as an oversupply of certain types of companies and products.

The growth of the Chinese commercial space sector showcases a complex but effective coordination between different funding sources and government levels. **This multi-layered approach has fostered a substantial industrial base and a competitive commercial space industry**. As the sector continues to mature, it is likely that this *coordination* will evolve, potentially leading to a more market-driven approach while maintaining strategic national interests.

Case Study: Chang Guang Satellite Technology Limited (CGSTL)

CGSTL exemplifies how a company can leverage the full spectrum of available support. CGSTL, a spinoff from the Chinese Academy of Sciences' Changchun Institute of Optics and Precision Mechanics in 2014, enjoyed significant initial technology transfer, regulatory backing from local governments, and financial support from both governmental and private investors.

The government has actively passed policies in support of CGSTL. In 2015, the Provincial Government published the city's 13th Five-Year Plan, in which they noted plans to accelerate development of the Jilin-1 satellite constellation, and in December 2015 they published the "Jilin Province Satellite and Aerospace Information Industrial Development Plan, 2015-2025" (《吉林省卫星及航天信息产业发展规划（2015—2025年）》), which explicitly supported the Jilin Remote Sensing Satellite Constellation.

With funding that includes **¥25M from provincial and municipal talent funds and a massive ¥2.78B from a pre-IPO round** of which an undisclosed (estimated ~30%) came from provincial and city VCs. We therefore estimate that CGSTL has received some ¥1B in funding from provincial and city support, CGSTL has developed a formidable EO industrial base in Changchun, becoming a regional champion.

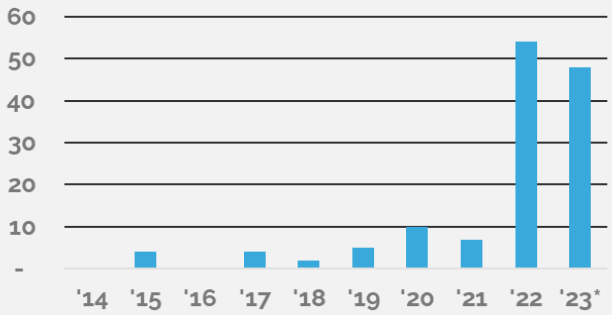


Figure 48: Number of satellites launched by CGSTL (Credit: CE, ESPI)

The support from sub-national governments extends beyond financing to **include policy-making and direct purchases**, which has propelled CGSTL to deploy a significant constellation and become a leading provider of remote sensing data in Asia. With that said, not all has been smooth sailing. In pre-IPO documents filed earlier this year, CGSTL revealed that they **had lost ¥1.2B over the 2019-H1 2022 period.** primarily due to massive CAPEX associated with building and launching 133 of their own satellites.[62] In the most recent year for which there were full financial results (2021), CGSTL saw revenues of ¥312M, a big improvement from the ¥104M of 2020, but still a small amount when considering how much money the company is spending on manufacturing.

CGSTL has seen very impressive technological progress, putting up one of the world's leading remote sensing constellations in just over five years, partly via leveraging all the support that the Chinese system has to offer. But at the same time, this has clearly led to some excess, with out-of-control spending getting far ahead of a relatively immature business model.

[62] CE, 2023. "Changguang Satellite has not made up for the loss gap, and the commercial aerospace burns money to raise 27 billion yuan in IPO." *CE* (Link).

5 RECOMMENDATIONS

The European space sector is navigating a crucial transition, marked by the evolving dynamics in capital markets. This transition, as detailed in the report, is **set against a backdrop of changing macroeconomic and geopolitical landscapes that challenge the traditional mix of public and private funding.**

Highlighting the reliance of emerging space companies on private investment, notably venture capital (VC) over the past decade, this financing source emerged as critical in driving innovation of early-stage ventures and their subsequent commercialisation and growth. However, the recent economic climate, characterised by **the end of low-interest rates and inflation**, is prompting a re-evaluation of investment strategies. There is a growing concern about the sustainability of venture capital in the space sector (and beyond), considering the increasing caution among investors, a cooling down of financial markets, and a shift towards safer assets.

Limitations do plague both VC and public funding initiatives. VC, while targeting high-growth, high-risk ventures, often **overlooks projects with longer development times or uncertain commercial viability,** a common scenario in space-related initiatives. We noted constrained deal sizes in VC and a concentration of capital in a few firms. This can limit funding opportunities for a broader range of projects. Established public funding, despite its stability, is subject to general government budget dynamics and policy priorities, which can change with political shifts, as we have observed with constrained spending after the COVID-19 pandemic's relief funds have increased the debt-to-GDP ratios of European economies, and a surge in defence allocation in the face of the Russian aggression.

Considering these limitations, the report underscores the importance for public institutions acting in the European space sector **to be prepared for an environment where now established sources of private funding might be less available**, without this necessarily being immediately obvious. In this context, we might see VC firms who continue to exist, managing a portfolio of investments, but halting to participate in new funding rounds amid struggles to generate returns.[63]

In this context, institutions should explore alternative financial structures and instruments that can complement VC and established public funding, namely mechanisms and instruments, including those led by public bodies, mixed-source approaches, and privately led initiatives. Among those, Strategic Investment Funds (SIFs) and a spectrum of Public-Private Partnership models are **crucial in spurring economic growth and attracting private capital.** European institutions should consider leveraging these mechanisms, which can provide longer-term 'patient' capital, given government sponsorship and procurement commitments.

Development Finance Institutions (DFIs) and Export Credit Agencies (ECAs) can play an even more significant role in supporting the space industry and leveraging European export strength. Space Agencies at national and European level as an example, can benefit from collaborating with DFIs and ECAs, which support private sector projects through equity investments, long-term loans, guarantees, and trade finance.

ESPI's strategic recommendations cover a wide spectrum of activities from increased community building, individualized investor relations, to translating technology milestones into investment pathways. Moreover, the sector is encouraged to engage strategic industrial investors and explore specific financial mechanisms to navigate the shifting investment landscape effectively.

When considering **how the public sector could more strategically encapsulate a wider set of**

[63] R. Browne, Rise of 'zombie' VCs haunts tech investors as plunging valuations hammer the industry, CNBC (Link)

investors and asset classes into Europe's growing NewSpace ecosystem, we can see that there are existing examples of large, public organisations which have already sought to do something similar, with early signs of success. One such example is the **U.S. Department of Defence's (DoD) Office of Strategic Capital (OSC)**.

The OSC was established in December 2022 with the aim of directing private sector funding towards critical technologies and supply chains important to the DoD. The office's initial task was to develop an investment plan for 14 technology areas deemed vital by the Pentagon. These areas include artificial intelligence, space, integrated networks, quantum science, biotechnology, and advanced materials. **This development can inspire the future evolution of investors relations management and strategic private capital flow facilitation aligned with European policy priorities and needs**.

This can be done via the **formation of a Strategic Advisory Body** with representatives from key national and European space and political institutions, as well as the wider investment and user ecosystem to evaluate strategic priorities and investment plans and ensure **the integration of priority technologies into future space programmes on one end and private (and mixed) investment pipelines on the other**.

5.1 Community Building, Investor Relations & Alignment across the Capital Market Spectrum

In the emerging European space industry, investments are heavily influenced by word-of-mouth and personal networks, as evidenced by the ESPI Survey. Therefore, cultivating robust investor relationships is essential for sustained expansion. While traditional channels retain their significance, **the reliance on word-of-mouth for early-stage capital investment underscores the pivotal role of community building, credibility, and effective communication in boosting capital allocation within the sector**.

ESA and national agencies and actors mandated with **industrial policy and sectorial development** hold a unique position within this ecosystem to play a prominent role in fostering a more interconnected network of investors across the full capital market spectrum **underpinned by institutional credibility**. Such a network can address existing market weaknesses, including:

- Establishing a **trusted investor deal flow** in the space ecosystem.
- Creating **opportunities for co-investment** in European space ventures.
- Expanding the capital market for **follow-on funding**.
- Providing **technical expertise for financial due diligence**.

Specifically, this recommendation supports the **evolution of a dedicated Investor Relations (IR) mandate** across four dimensions:

- Individualized **investor relations management** akin to that found on private capital markets, utilizing elements used by agencies in managing its relations with high-ranking political representatives.
- **Structured dialogues** between relevant **LPs, the Agencies, and public Financing institutions** in view of strategic priorities and investment opportunities
- Tapping into **new investment communities**, notably family offices as well as **Venture Philanthropy & Impact Investment** entities, along with a dedicated capacity-building effort.

Key Actions for Space Agencies

Integrate individualized investor relations in the agency's strategy: Embrace Investor Relations as a key part of the commercialisation strategy and increase individualized investor engagement.

Ingest high-level visits into IR: Incorporate elements of strategies used in managing relations with Member States into IR management.

Engage a broad investor audience: Reach out to a broader range of investors, including Fos, foundations, and National Development Banks. Start with interest probing and follow-up with capacity building, illuminating sector-specific opportunities and challenges.

Explore impact & catalytic investing: Engage in discussions and activities at events that focus on impactful investing and the intersection of finance and purpose.

Develop measurable KPIs: Establish key performance indicators to assess the effectiveness of IR efforts.

5.2 Continued Innovation around Novel Financial Mechanisms

This report highlights the relevance of continuous efforts towards internal capacity building on financial markets and private investment dynamics across European agencies. Commitment to ensuring the dialogue between the European space sector and capital markets is clearly understood and considered by actors in the broader finance industry sector. These efforts can provide the space sector with the diverse and robust financial support it needs to innovate, grow, and maintain Europe's competitive edge in the global space industry.

With the increased relevance of private investment in the sector, the knowledge of financial markets and their impact on the development of innovation across Europe should be **better understood throughout relevant agencies, both at executive level as well as across programmes notably among individuals managing contracts with parts of the industry reliant on private capital funding**. As such, ESPI commits to conduct further technical studies on financial mechanisms; initially focusing on Public-Private Partnerships (PPPs) and Public Infrastructure Funds (PIFs), Export Credit Agencies, and National Development Banks. As well as focus on the untapped bond markets through asset-backed lending and Sukuk loans. ESPI will strive to uncover investor constraints and address the alignment with ESG goals of various investor types, including family offices, pension funds, foundations, and corporates.

Key Actions for ESPI

Conduct further technical studies on financial mechanisms: ESPI commits to conduct further technical studies on financial mechanisms; initially focusing on Public-Private Partnerships (PPPs) and Public Infrastructure Funds (PIFs), Export Credit Agencies, and National Development Banks.

Facilitate community building actions: ESPI, seeing the value in bringing public agents active in the space sector together in the same room as financial market participants such as investors and credit institutions, will continue to host or co-host workshops and events to bridge gaps in understanding between these two groups.

ESPI will strive to uncover investor constraints: Further elaborating on the alignment between ESG goals of various investor types and the ability for space-based services to support as such.

5.3 Strategic Corporate Investors & Standardising Downstream Verticals

In the context of wider European industrial policy and competitiveness, **strategic corporate investors** should be engaged. Large European corporations (e.g. through their venture arm Siemens Energy Ventures, M Ventures Volvo Group Venture Capital, Maersk Growth, Porsche Venture) with close proximity to innovation through their VC arms, present significant opportunities for investment in the European space industry.

> *No matter the sector, there is opportunity in space for all. Space will be a key theatre of growth and innovation during this decade. Leaders should open a dialogue across the gulf between the space community and end users to further the development of the technologies and solutions that will matter most for businesses and the world.*
>
> **McKinsey & Company, 2023**

This **recommendation is founded on two primary premises**: (i) the innovation within the space sector can directly benefit these corporations by enhancing and informing their innovation processes, and (ii) the assets developed in the space sector, such as communication and earth observation satellites, can become invaluable resources for enhancing services and products in other sectors like automotive, agriculture, and energy. In this context **their investment choices might not be purely driven by ROI but also by industry relevant strategic considerations.**

To effectively implement this recommendation, **agencies should initiate an integrated outreach effort targeting potential corporate investors**. This outreach should focus on highlighting the mutual benefits of collaboration between these industrial giants and the space sector. Agencies can showcase the potential for technology transfer, co-development opportunities, and knowledge sharing that can significantly impact the downstream industries. Additionally, agencies should actively promote the concept of cross-sector synergy, illustrating how advancements in space technology can drive innovation in other fields.

Clarifying industry use cases could be more directly tackled (e.g. through the ESA Accelerators, ESA BASS, or EUSPA downstream activities). In this context (and beyond the scope of this study), a clear display (and commitment) of user needs for space services must be manifested to ensure potential customers see the value of space investments for their business, namely through cost reductions, economic growth, or ESG and wider societal benefit.

Relatedly, it is **recommended special effort is placed on conducting assessments of industry verticals and market opportunities within.**[64] As organic growth has begun to slow in many industries, leading corporations globally increase consolidation efforts and thus seek opportunities in tightening control over specific industry/market verticals. Engaging with industry champions and their supply-chain partners, these assessments not only have the potential to uncover space-enabled use cases for the business but can also provide a clearer picture of the expected return from investment activities.

Key Actions for Space Agencies

Initiate outreach to industrial investors: Start a dedicated outreach campaign to engage potential corporate investors.

[64] The recent study "*Assessment of Space-Enabled Applications in the Automotive Sector*" published by ESA, Einstein Industries Ventures, Porsche Consulting and Acitoflux serves as a good example that could be further expanded.

Consolidate engagement pathways: Establish an integrated process for interacting with corporates across different industry verticals. & set up specific entry points within agencies for each downstream industry vertical, serving as central hubs for communication and collaboration.

Conduct assessments: Conduct market vertical studies to identify and assess the impact and value of space services on business fundamentals and act as a guide for investment decisions.

5.4 Translating Development Scales into Investment Pathways

The space sector has gradually developed various scales which can be used to assess the maturity and readiness of various aspects of a project, technology, or service, for example:

- Technology Readiness Level (TRL):
- Manufacturing Readiness Level (MRL):
- Application Service Readiness Level (ASRL);

Each of these frameworks serves a different but sometimes overlapping purpose in the lifecycle of a product, service or technology, helping stakeholders make informed decisions about development and deployment. As in the pharmaceutical sector, where clinical trial stages through drug development serve a similar signalling function, such **scales serve as important tools in risk management, decision making, and communication among stakeholders but are focused on engineering communities**. They allow for a clear understanding of the status and potential challenges of a project or technology, aiding in the strategic planning of development, investment, and deployment. By offering a common language and standardized criteria, these readiness levels help in aligning expectations and ensuring that all parties involved have a consistent understanding of the maturity and capabilities of the technology or process in question.

However, translating TRL progression into a clear pathway to success in the space sector is not straightforward due to several challenges:

- **Market Uncertainty:** Unlike (e.g.) pharmaceuticals, where there is a better-defined market need for drugs under development, the commercial opportunities in space are less certain. Business models in the space sector can be speculative, with many ventures relying on markets that are emergent or unproven, such as space tourism or asteroid mining. Thus, a high TRL does not necessarily correlate with a clear market demand, making it a less definitive signal of success to investors.
- **Limited Precedents for Success:** The space industry has fewer examples of end-to-end commercialisation successes compared to the established track record of the pharmaceutical industry. With less historical data to rely on, investors may find it difficult to gauge the potential returns on investment, even when a space venture achieves a high TRL.
- **Intellectual Property (IP) Challenges:** The protection and monetisation of IP in the space sector are more complex than in pharmaceuticals. The collaborative nature of space projects, varying international IP laws, and space treaties create ambiguity around IP rights. This uncertainty can dilute the confidence of investors who might otherwise be encouraged by a project reaching a higher TRL.

Setting up a **group of technical experts from investment, engineering, standardisation, and Intellectual Property communities** could conceive relevant approaches, address challenges, and ultimately create a white paper for such a scheme, generating an impulse which would clarify the relevance and feasibility of such a framework.

Key Actions for Space Agencies

Compare existing frameworks: Study existing frameworks as a tool to gauge the maturity of space sector technologies, similar to clinical trial stages in the pharmaceutical industry and identify if other similar frameworks exist in other industries.

Form a multidisciplinary expert group: Establish a group comprising members from investment, engineering, standardization, and legal communities.

Develop a white paper: Aim for the creation of a white paper that clarifies the relevance and feasibility of using or developing such a framework for the space sector, providing guidance and confidence to investors.

5.5 Directed Innovation through a Space-Focused Fund

A multi-source directed technology fund is proposed as a potentially feasible vehicle to improve the directionality and impact of investment in the space sector. The European Investment Fund has the mandate and expertise to set up dedicated sector-specific as well as country-specific funds and through preliminary consultations and research seems best positioned to be at the core of such an activity if its relevance is proven.[65]

Recognising the **strategic significance of space capabilities for Europe's competitiveness, such a fund could focus on targeted critical space technologies, bringing together public and private investors**, including corporate investments, private capital markets, and existing public funds. This structure could take some inspiration from the presented INCJ model in Japan. Adopting a more directed innovation policy, as opposed to open innovation policy, with specific and targeted goals and objectives. Such policies aim to steer innovation towards specific sectors, technologies, or products and services that are deemed strategically important for economic growth or societal enhancement.

The specific **governance of such a fund remains a key question and would need to be investigated further**. Important questions such as defining accountability to a political body and with what mandate such a fund would operate and how would investment decisions incorporate the at-times opposing political and business priorities, remain to be tackled.

While space-focused funds (CASSINI) or funds with space among their impact areas (EIC Fund), already exist in Europe, and should be sustained, their investment rationale is broader and akin to an open/hybrid innovation tool as described in *Chapter 4.1*.

While such funds **can provide some direction when paired with initiatives like the Strategic Technologies for Europe Platform (STEP)**, which for example, recognizes robotics, cloud computing, and smart connectivity among target investment areas, this still doesn't meet the threshold of Directed Innovation Policy particular to the space sector.[66] A more specifically directed fund could potentially mobilize more resources and provide a better return in terms of developing capabilities recognized as strategic by political priorities of European Member States.

[65] EIF. N.d. "Country and sector-specific initiatives (Funds-of Funds and Guarantee Debt funds)," *EIF* (Link); Evaluation of EIB Group equity and quasi-equity support for small businesses and mid-caps, November 2022, EIB (Link) .
[66] Strategic Technologies for Europe Platform, European Commission (Link)

As a first step, a **rigorous assessment should be conducted, analysing the potential limitations of existing funds** with a broader investment rationale and **assess the feasibility and relevance of a directed fund**, involving relevant financial institutions as well as potential sources of private financing.[67]

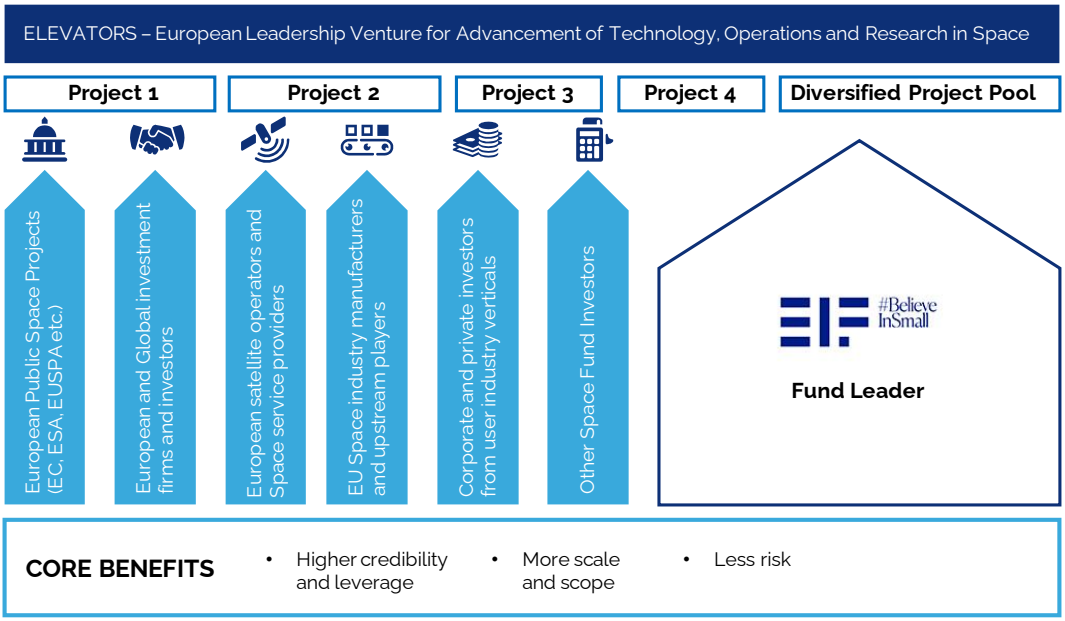


Figure 49: Joint Space Investment Fund structure.

Should feasible plans emerge, space agencies would play a key role in contributing to the establishment of this joint Space Investment Fund, with a respected European public investment institution, like the EIF, leading the fund's creation and management.

One recent example that could inform the development and the rationale behind such a fund is the **NATO Innovation Fund (complementary with the NATO DIANA Accelerator Programme) which recognized the market to support deep tech innovation is underfunded**. It markets itself as the source of patient capital to satisfy the needs and timelines of deep tech innovators and prides itself with unmatched diligence and validation, also in view of the market size spanning 23 participating countries.[68]

Furthermore, involving downstream industry players, contributing to the fund can shape its investment strategy, ensuring alignment with their specific needs, as well as de-risk private capital markets investment as it would indicate possible sources of future revenue should these corporates use the developed products and services to improve their own value propositions.

Naturally, clear guidelines and risk mitigation strategies should be established to manage differences in risk appetite among investors, as well as different exit strategies and potentially leveraged benefits. In this context effective technology transfer mechanisms for translating innovations into viable commercial products need careful design. In this context, a supervisory board consisting of co-investing entities from various industries and bodies would be key in providing oversight, alongside an advisory board (where ESA could play an important role) to assess

[67] The 2019 IDA Study "Assessment of the Utility of a Government Strategic Investment Fund for Space", while different in nature and context, can serve as an example in terms of methodology and approach.
[68] While the fund is hybrid rather than fully directed, the rationale behind fund development and setup affirms the findings of this study.

project viability, allowing only technically, regulatorily, and commercially assessed projects to be eligible for financing.

Key Actions for Public Actors in the European Space Sector

Assess relevance for a directed innovation fund in the sector: Consider limitations of existing funds with a broader investment rationale and assess the feasibility and relevance of a directed fund along with relevant financial institutions.

Contribute to potential fund establishment & management: Utilize respective expertise that best fit the fund's needs: Space Agencies would for example contribute to defining technological priorities in line with their programmes & provide technical due diligence and advisory processes.

Shape investment strategy: Involve downstream industry players in shaping the fund's investment strategy to align with their specific needs of the European business community across different industry segments.

DEVELOPMENTS SINCE WRITING THIS REPORT

In-keeping with the theme of alternative financing and investment mechanisms used in the European space sector, since pre-publication of the report in December 2023, ESPI has tracked an increasing amount of non-VC deals and developments. The following is a selection of such deals and developments:

The European Investment Bank strengthens its position as space infrastructure financier.

On the 18th of December 2023, the European Investment Bank (EIB) and the Walloon Region in Belgium have signed a Memorandum of Understanding (MoU) to enhance the region's space industry, particularly focusing on Earth observation and reusable launch vehicles. This partnership aims to support local government efforts in developing the space sector**, marking the EIB's first such agreement with a European Union region.** Wallonia has recently invested in projects to strengthen its space industry, with ambitions to become a European space sector leader.

With turnovers growing to over EUR 350 M over the last two decades, and Belgium's aerospace cluster Skywin, counting nearly 50 companies, research centres, and academies from the space sector as its members, the EIB continues to seek opportunities to support the space industry more broadly to boost Europe's competitiveness on the global stage.

The EIB has earmarked around 2.3 billion euros for projects in Belgium in 2022, **In this report we emphasise the positioning of Multi-lateral and National Development Banks for increased space sector investment and thus how these funds may be allocated**. We discuss how development banks either directly fund projects or utilise the EU's 'investment platforms,' which include special purpose vehicles (SPVs), contract-based co-financing arrangements, or risk-sharing agreements. These platforms are instrumental in mobilising capital for investment projects.

Recovery and Resilience Facility (RRF) funds continue to support the sector.

On the 26th of January 2024, the Spanish government allocated a €40.5 million loan to PLD Space for the development of the Miura 5 launcher, signifying a strategic move towards enhancing Spain's capabilities in the space industry. Scheduled for a maiden flight in 2025 and commercial operations beginning in 2026, the Centre for Technological Development and Innovation (CDTI)'s pre-commercial public purchasing instrument requires that the full amount be repaid via payment of royalties over the first 10 years of the commercial operation of Miura 5.

In this report we identified how the RRF with its €723B in loans and grants, is pivotal for Member States, especially those with limited budget flexibility, to invest in innovation within the space sector. **By 2022, nearly half of the Member States mentioned space-related actions in their RRF plans**, including both traditional space nations like France, Italy, and Spain, and newer actors such as Poland and Portugal.

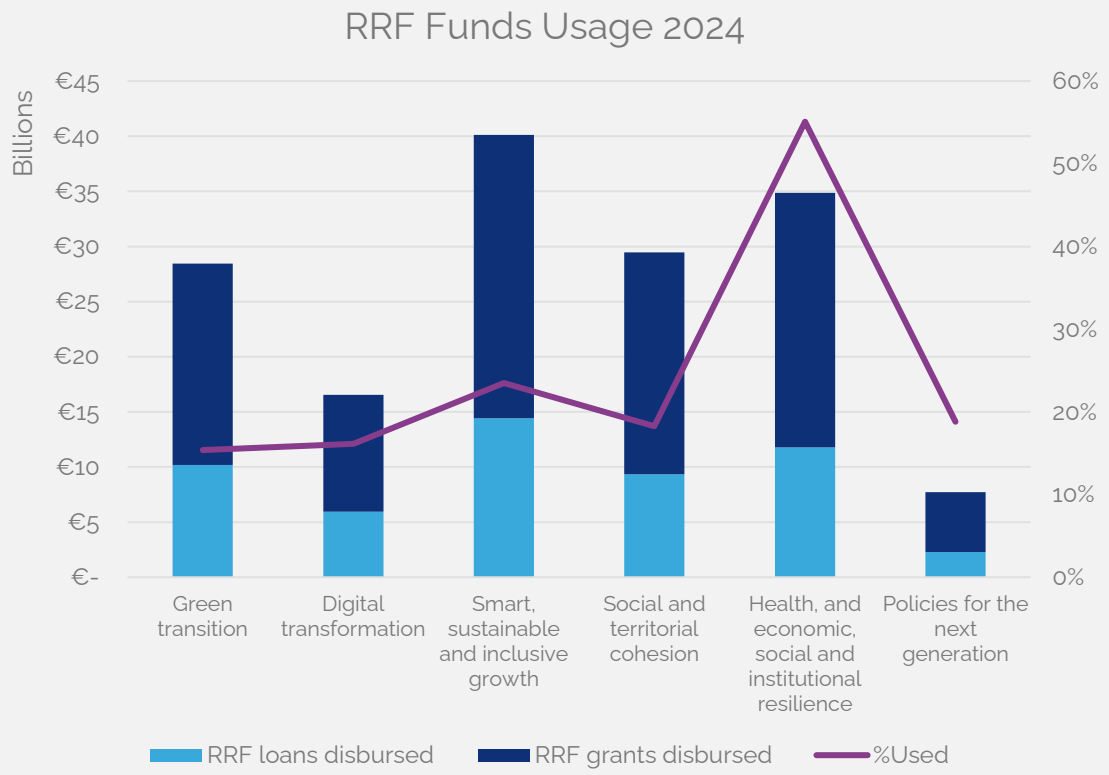


Figure 8: RRF fund disbursement. (Source: ESPI, EC)

With first deployment in 2021 and the final foreseen in 2027, total usage of RRF funding today amounts to 31%, broken down into 43% of grants deployed and 21% of loans. Health, and economic, social and institutional resilience used up 55% of the pillars allocated funding while all other segments barely break 20% in terms of allocated funds used.

Corporate Venture Capital (CVC) sees value in space applications.

On the 13th of February 2024 satellite connectivity startup Skylo Technologies raised USD 37 million equity round for its Series C with backers from 4 CVCs out of 6 participating investment firms. Skylo Technologies provides Internet of Things (IoT) connectivity to machines, sensors, and devices. Leveraging the cellular narrowband Internet of Things (NB-IoT) protocol for satellite communications, Skylo's network can be leveraged across sectors such as agriculture, logistics, railways, and disaster management and utilises Deutsche Telekom as prime partner.

In this report ESPI described how corporations' investment through in-house venture capital funds provide exposure to innovative startups that align with their strategic interests. Equity participation of early-stage innovations is typically intended to either be of service to the parent company directly or improve the bottom line by increasing customer value with eventual acquisition and integration into the core business.

The participation of CVCs in the space sector sends a strong and positive signal.

Venture Capital Firm	Owner
Samsung Catalyst Fund	Samsung Electronics
Next 47	Siemens
Intel Capital	Intel Corporation
BMW i Ventures	BMW Group

Table 13: Corporate venture capital firms participating in Skylo's series C

OneWeb Gen 2 constellation to utilise export credit agencies for efficient financing.

On the 16th of February 2024 Eutelsat announced a 30% reduction in the capital expenditure for the OneWeb Gen 2 network, from an estimated EUR 4 billion to EUR 2.8, attributing the reduction to phased investment and new technology utilization. Crucially, Eutelsat plans to finance two-thirds of this project through low-cost **export-credit financing from agencies in India, Britain, and France**, highlighting a resurfacing trend of ECAs supporting high-tech and space-related exports.

In this report, ESPI established the reinvigorated role of ECAs. The involvement of India's ECGC Ltd., Bpifrance in France, and UK Export Finance represents this trend in space sector financing.

- **ECGC Ltd.:** The support from ECGC Ltd. for satellite launches is a notable example of an ECA venturing into space sector financing. This diversification underscores ECGC's adaptability and willingness to back high-risk, high-reward projects, expanding the scope of export credit guarantees to include space-related exports.
- **Bpifrance and UK Export Finance:** Bpifrance owns 13.6% of Eutelsat Group equity while the UK government owns 10.9%, the ECA's involvement is indicative of a coordinated international effort to support the space industry.

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List of Workshop Participants	
Ahmed Aly	LSA, Space Business Development Manager
Andrea de Blasi	BCG, Managing Director
Andrey Gushchin	APG Asset Mgmt., Senior Portfolio Manager
Antoine Lebourgeois	Bryan, Garnier & Co., Equity Research Associate – Tech
Charles Galland	Eurospace, Policy Manager
Diarmaid Kehoe	EIB / EPEC, Advisor
Felix von Schubert	NewSpace Capital, Executive Chairman
Florian Marmuse	ESA, Strategy Coordinator for CIC
Gianluigi Baldesi	ESA, Head of Ventures and Financing Office
Heriberto Saldivar	ESA, Head, Foresight, Strategy and Coordination Dept.
H. Ludwig Moeller	ESPI, Director
Janusz Heitmann	DLR, Head - INNOSpace Masters
Jeremy Record	ESA, Contracts Officer
Jules Varma	ESA, Commercialisation Officer
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