

Innovate
UK

Circular Critical
Materials Supply
Chain Programme:

Private Investment Report



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Executive Summary

A wide range of critical minerals are required for the technologies and innovation required to decarbonise the transport, energy and industrial sectors and achieve the UK's Net Zero ambitions. An electric vehicle not only requires Cobalt, Lithium and Graphite for the battery but also Rare Earth Elements for the electric motor. These minerals and others have been identified as having high criticality for the UK in the recent Resilience for the Future: [The United Kingdom's Critical Minerals Strategy report](#).

The Circular Critical Materials Supply Chains programme (CLIMATES) supports the UK's Critical Minerals Strategy and aims to build and develop resilient supply chains to

address this strategically important area with a focus on rare earth elements. Utilised in electric vehicles, consumer electronics and wind turbines, permanent magnets made from rare earth elements, are crucial in the development of Net Zero innovations.

Central to the challenge of developing and scaling supply chains is the investment required to support organisations on their innovation and deployment journey. This report by Innovate UK details the overarching opportunities and challenges faced by private investors when navigating investment in the rare earth supply chain. It features insights on equity funding activity across both the global and national supply chains.

Through doing so, this report aims to create a cohesive picture of the investment landscape and identify key mechanisms for creating an attractive environment that will encourage private investors to actively engage with the UK's rare earth supply chain.

This report finds that collaboration rather than competition is crucial to accelerate private investment into the UK's rare earth supply chain. A connected ecosystem of corporates, startups, government, industry and academia is needed to provide a coordinated approach to the development of a stronger domestic supply chain here in the UK. It also highlights the importance of detailed and transparent market insights for those deploying private sector funding, as well as investor alignment across the value chain. In doing so, we hope to support the creation of a connected value chain that scales sustainably and leads to long-term growth.

There are a wide range of potential future use cases for this report, including identifying appropriate investors for companies looking to access external funding, highlighting the initiatives and activities that can be put in place to support investors, as well as communicating the market sentiment and business opportunities available. As a result of this, we encourage stakeholders interested in engaging with the report findings and the CLIMATES programme to get in touch.

We hope this report demonstrates the opportunities available and will encourage more investors to get involved in the sector. We also anticipate the market insights provided will be of value to founders that are navigating scaling in the sector and who may be looking to raise external funding.





Introduction

The **UK's Critical Minerals Strategy** was released in July 2022 and a **refresh** published in March 2023. The Strategy details the UK government's plans for developing secure and resilient critical mineral supply chains through accelerating the growth of the UK's capabilities, collaborating with international partners and enhancing overseas markets to make them more responsive, transparent and responsible.

Critical Minerals are a set of elements, materials or compounds which are of critical economic and technological importance. The Critical Minerals Strategy highlights 18 minerals of high criticality for the UK, assessed for their economic vulnerability and supply risk factors, with a further five added to a watchlist.

One group of elements identified as critical are rare earth elements (REEs); they are relatively abundant but are highlighted as economically valuable. Increasing demand for rare earth elements is being driven by the demand for high-performance magnets, used in a variety of consumer and industrial applications including mobile phones, laptops, electric vehicles and wind turbines. High-performance magnets and therefore rare earth elements are a part of the fabric of modern life.

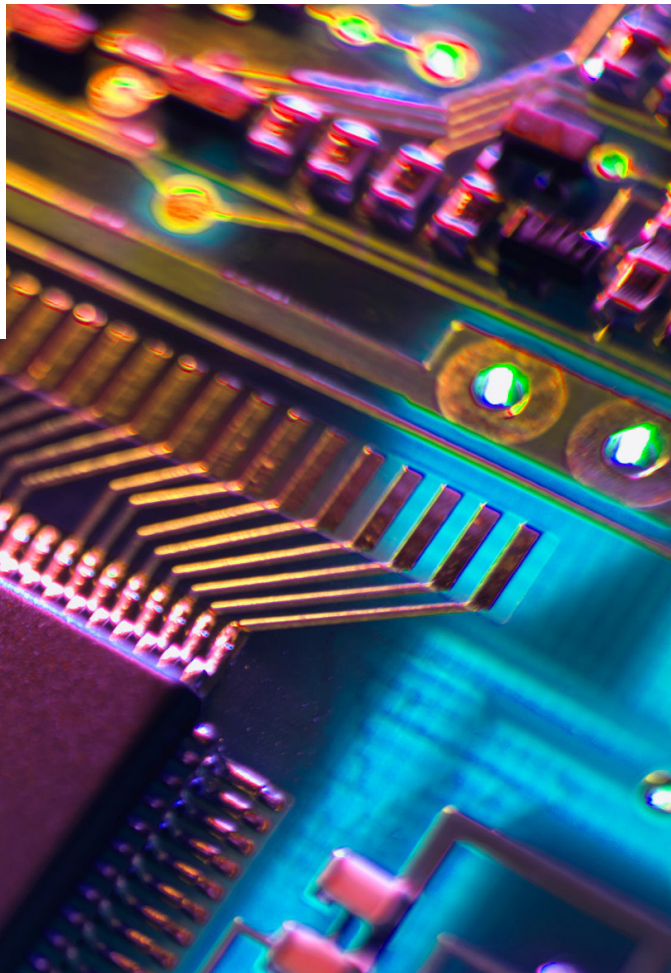
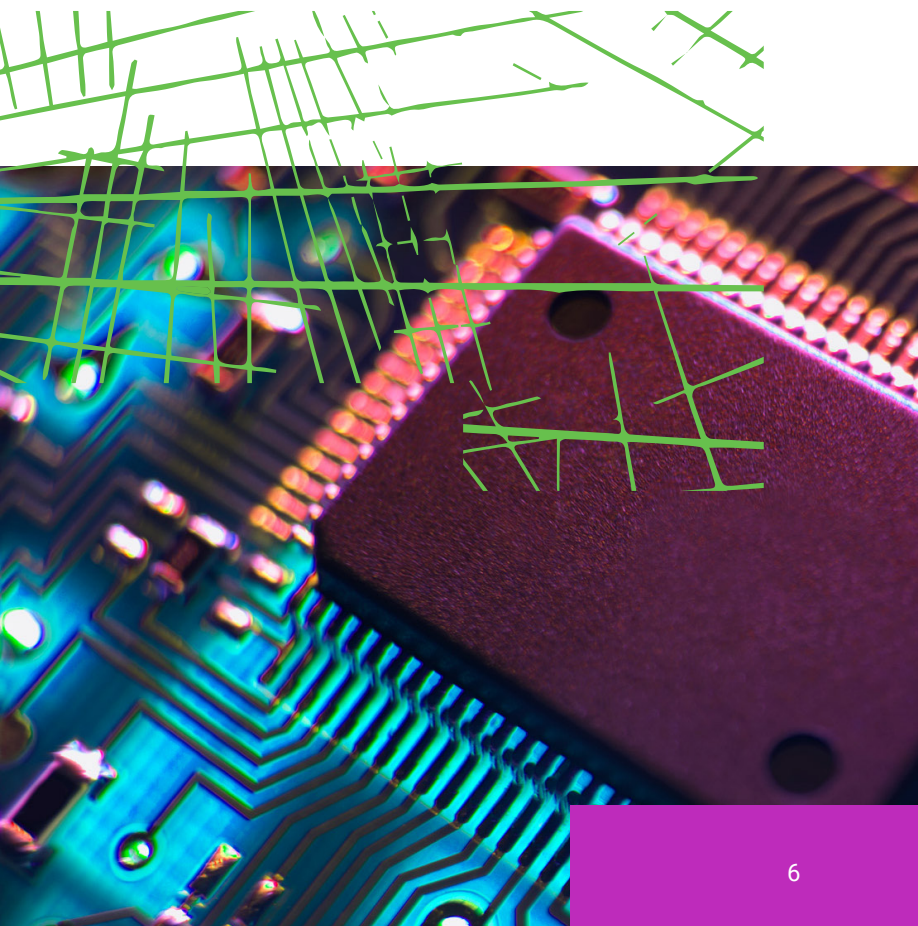
The Circular Critical Materials Supply Chains (CLIMATES) programme, aligned to the UK's Critical Minerals Strategy will create a more resilient and sustainable UK with the opportunity to build a stronger supply chain of materials for high-performance magnets. Positioning the UK as a world leader in rare earth materials recycling will help meet the UK government's Net Zero targets.

The £15 million CLIMATES programme, delivered by Innovate UK, will improve the security of rare earth elements supply for a more prosperous and secure UK through four innovation themes:

1. Sourcing extracted materials and processing them,
2. Manufacturing magnets in the UK,
3. Recycling high-performance magnets as part of a circular economy,
4. Enabling research into the next generation of magnet materials.

The programme will also develop the wider ecosystem and supply chain through a focus not just on innovation but also on standards, skills, international collaboration and private investment.

The rare earth elements supply chain represents a huge opportunity for UK businesses with the global market projected to grow from \$2.5bn to \$5.5bn by 2028. With demand increasing as the UK moves towards electrification, the opportunity is one of strategic importance that will require the UK's skills, knowledge, and expertise; creating jobs and growth, while still protecting our communities and the environment. This report explores the rare earth elements investment landscape and the opportunities to accelerate UK private investment.



Private Investment Activity: **Global and UK Perspectives**

Global Private Investment

Global private investment into the rare earth supply chain refers to the money that private investors, such as venture capital firms and individual investors, put into rare earth-related businesses or projects. The investment is made with the expectation of financial returns, as rare earth elements (REEs) are critical components of high-tech products such as smartphones, electric vehicles, and renewable energy technologies.

Company Mapping

Across the global rare earth supply chain, active companies have accumulated around \$1.29bn in private funding (pre-exit / IPO) across approximately 228 deals. The most dominant countries in which these companies are located are the United States and China, reflecting China's dominance over the supply of rare earth elements and the

USA's increase in production during recent years (Figure 1). Mining is the most dominant industry in which the active companies are operating, closely followed by separation and refining where new technologies are being developed to improve rare earth processing techniques (Figure Appendix 1).

Volume of Global Companies by Country

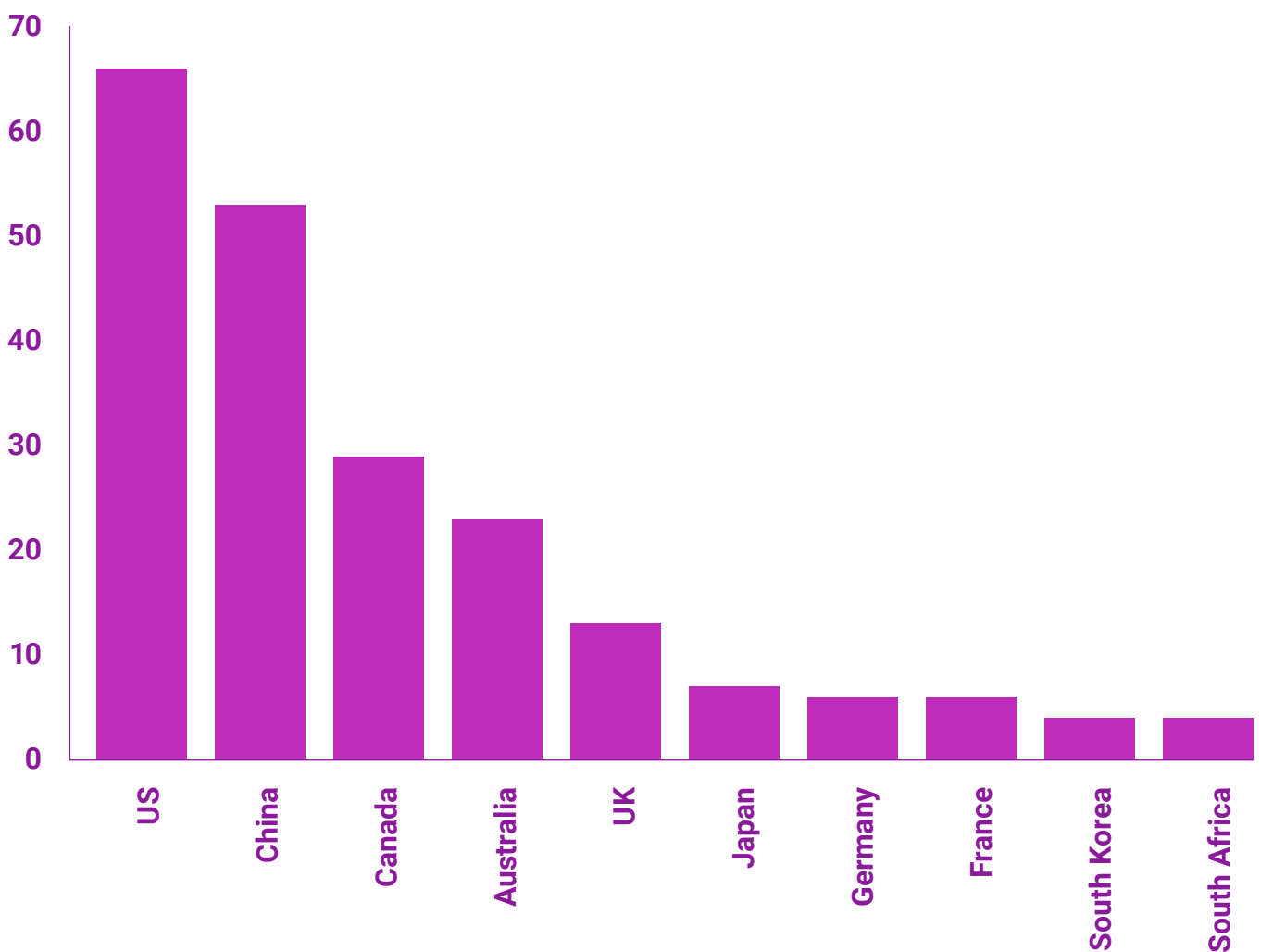


Fig 1. Volume of global companies by country. Analysis of CB Insights data.

Investor Mapping

The approximate volume of investors engaging in the rare earth supply chain globally is over 170. In line with the number of companies operating within the industry, the United States and China have the highest number of active investors, followed by the UK and Canada (Figure Appendix 2).

In recent years, China has pursued greater control over industries seen as having strategic importance, such as rare earth elements, with the central government consolidating many rare earth companies. This was seen most recently through the merger of four companies into the China Rare Earth Group. The result is a near-global monopoly in mining, refining, and magnet manufacturing, with China controlling around 90% of the market. The United States, by contrast, has more privately held companies operating in the rare earth industry, likely leading to their greater volume.

The most common types of investors deploying funds into the global rare earth supply chain are corporations, venture capital and private equity (Figure 2). This trend is closely followed by data on investor volume by the sum of deals closed, where corporations have deployed the highest number of deals, followed closely by government, and venture capital (Figure Appendix 3).

When investigating the supply chain areas of interest, investors are closing the most deals with companies operating within end-use industries, such as electric vehicles, wind turbines and military equipment, which may be reflective of their increasing demand. There is also notable investment being driven into rare earth mining projects, as expected due to the large volume of companies operating in this area. Recycling is the smallest area by deal volume, possibly reflecting weaker interest due to the area's complexities and potential risks (Figure Appendix 4).

Of the deals deployed over the previous ten years, US investors dominate with 33 deals closed, closely followed by Chinese investors who closed 18 deals in total. The UK and Canada are equal with four deals each, however, Canada deployed a greater volume of funding than the UK (Figure Appendix 5).



Volume of Investors by Category

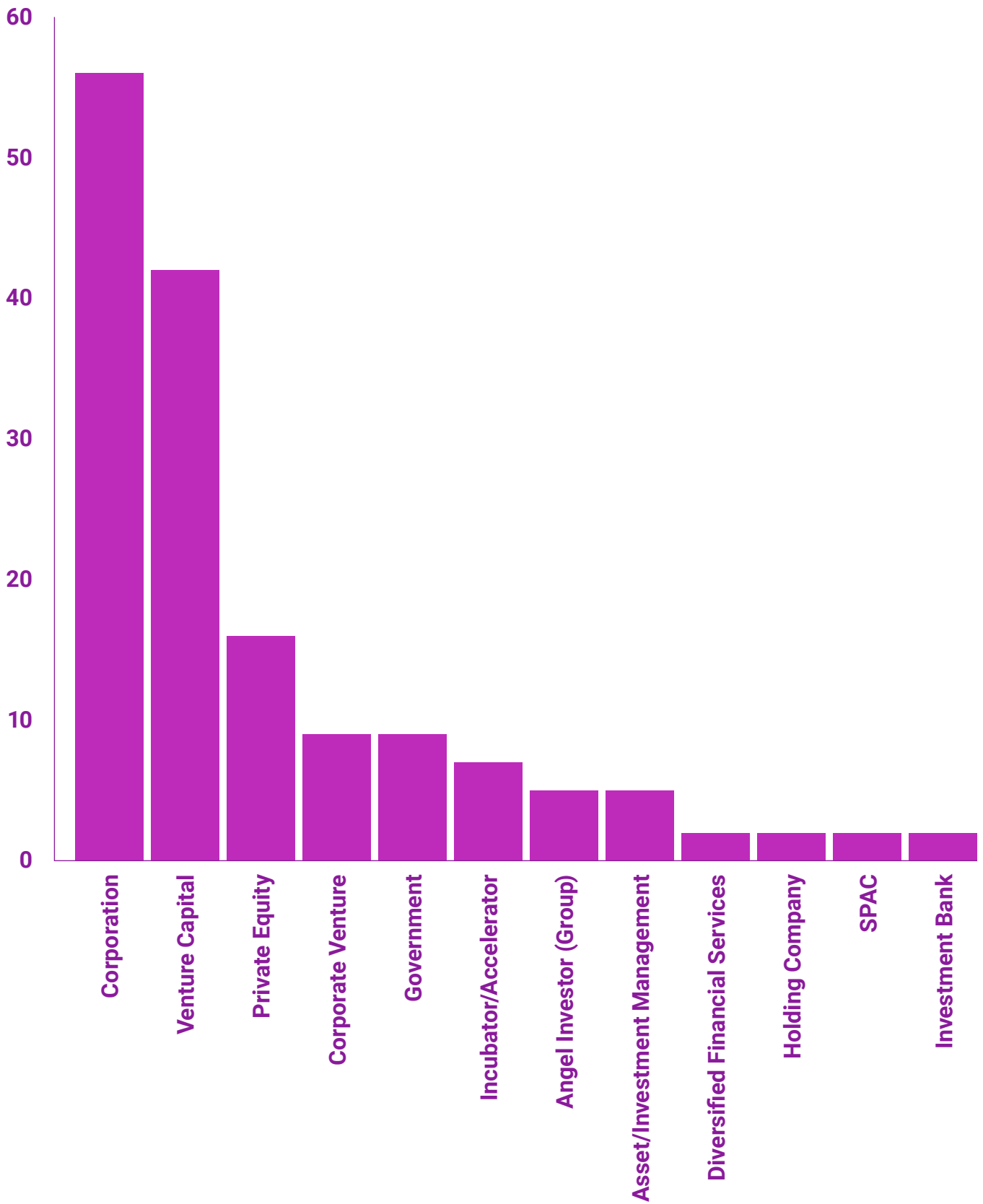


Fig 2. Volume of global investors by investor category. Analysis of CB Insights data.

Equity Funding Activity

During the past 10 years, deals in the global rare earth supply chain trended upwards amid the market's typical fluctuations to hit a significant spike in 2022 (Figure 3). This may be linked to the sustained high price of rare earth elements over the past 18 months and increased demand for magnet materials driven by the electrification of vehicles.

The peaks and troughs highlighted in the graph below shed light on the geo-political landscape and its impact on market sentiment. Given the dominance of US investors, the dip visible in 2017 may be linked with the US presidential elections - possibly weakening investor certainty surrounding rare earths. In 2020,

the US signed an executive order aimed at expanding domestic production of rare earth minerals to reduce dependence on China, which may have been a catalyst for the uptick visible from 2020 onwards.

Alongside deals, the amount of funding deployed has also risen for the sixth straight year to hit \$230m in 2022, reflecting a 280% increase from the previous year. Average deal size has been trending upward amid market fluctuations (Figure Appendix 6). It rose for the fourth consecutive year to reach a peak of \$26m average deal size in 2022, up from \$1m in 2018. Median deal size fluctuates more heavily, falling 66% in 2022 from \$6m to \$2m.

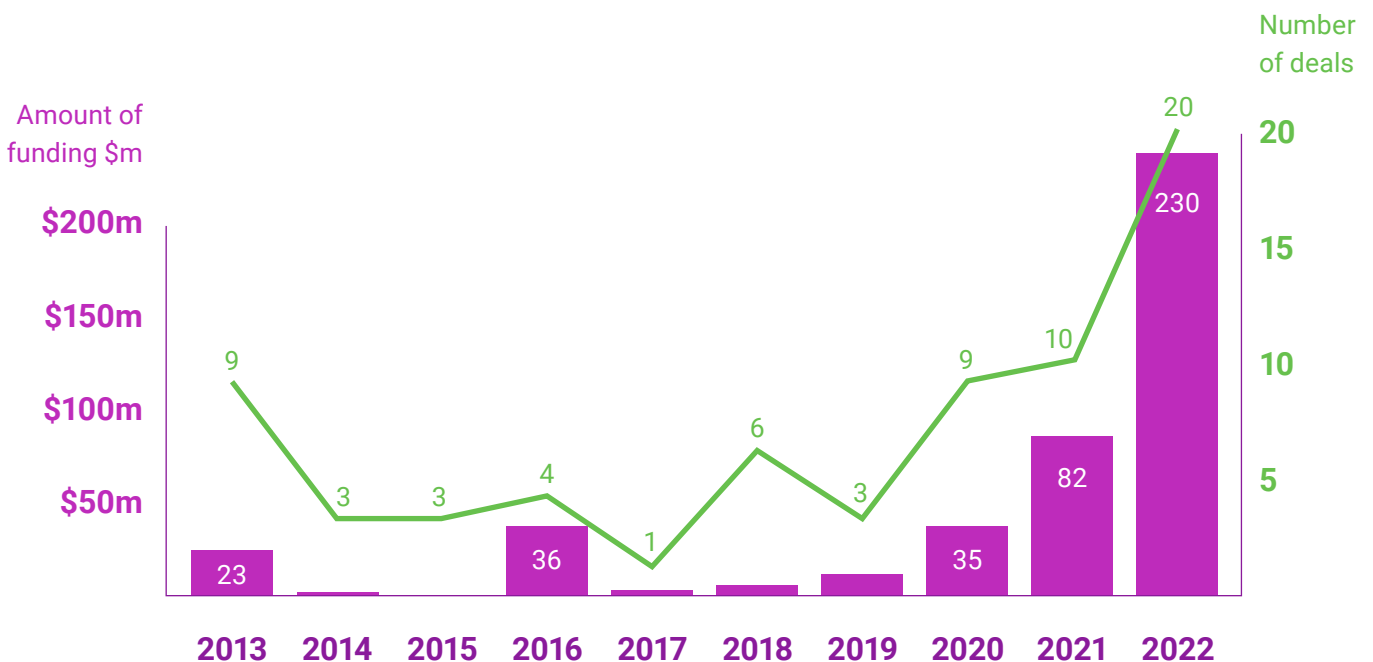


Fig 3. Amount of funding and number of deals 2013 – 2022.
Perspective Economics Analysis of CB Insights data.

UK Private Investment

The investment landscape in the UK is less active than the global picture, with a small number of investors. However, the nascency of the industry brings with it opportunities for innovation and disruption.

Company Mapping

Since 2005, companies operating in the UK have raised £165m in private capital across 36 fundraisings, with an average deal size of £4.85m. When compared with the global volume of companies by supply chain area, the UK exhibits a reasonably different picture.

Whilst mining is still the most dominant industry, the UK has a greater volume of companies active within recycling and end-use industries and significantly fewer in the separation and refining space than the global view (Figure Appendix 7). In July 2022, we saw investment into the **UK's first-ever magnet materials refinery** at Pensana's Saltend site. The growth of the UK's domestic capabilities in this space will be required to develop our onshore supply chain and encourage further investment.

Of these UK-registered companies, the majority were at Seed stage at the time of fundraising, followed by Growth, Venture, and Established (Figure 4). The dominance of early-stage companies suggests that the sector is still young, with room for growth and disruption. However, it may also suggest a scaling challenge – where more capital is

available at the Seed stage for UK companies operating in this space, with less made available at the growth stages. To support the acceleration of investment into the UK's domestic supply chain, there will need to be an availability of capital throughout a company's evolution, from Seed through to Growth.

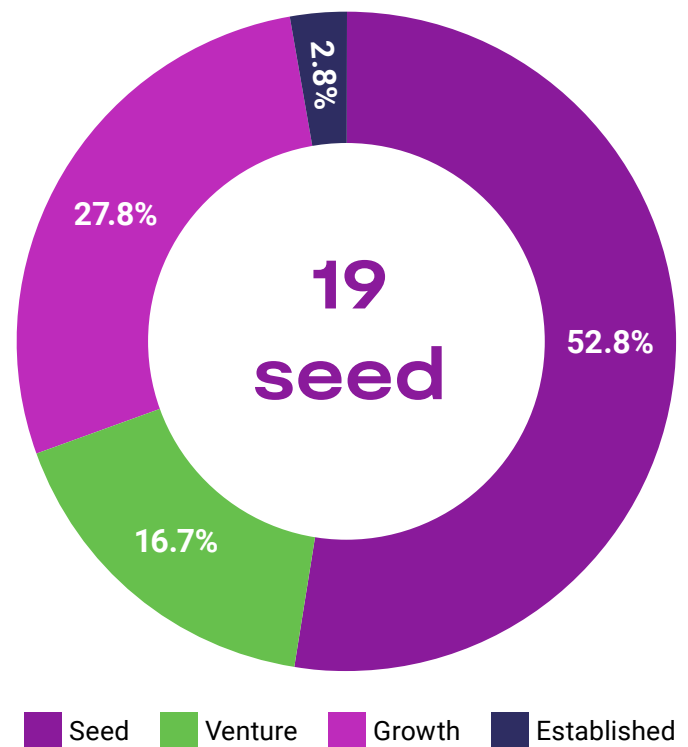


Fig 4. Beauhurst data on the stage of UK-registered companies at the time of fundraising.

Investor Mapping

Of the investors that have closed deals with UK-registered companies, UK investors have completed 34 deals whilst international investors have completed six deals. The top funders by total value of fundraisings are Universal Partners, Iluka Resources, Parkwalk UK Tech Fund, ETF Partners, Cambridge Capital Group, iNovia Capital, Oxford Science Enterprises, and University of Oxford Innovation Fund.

A closer look at the volume of investors by category shows a broadly similar trend to the

global picture (Figure 5). Whilst corporate investors dominate the global landscape, venture capital and private equity investors are the most active in the UK. There is an equal number of crowdfunding platforms, corporates and angel networks that have deployed capital into our domestic supply chain. The significant drop in corporate investors when compared to the global picture likely reflects the smaller pool of UK companies active within this area.

Volume of UK Investors by Category

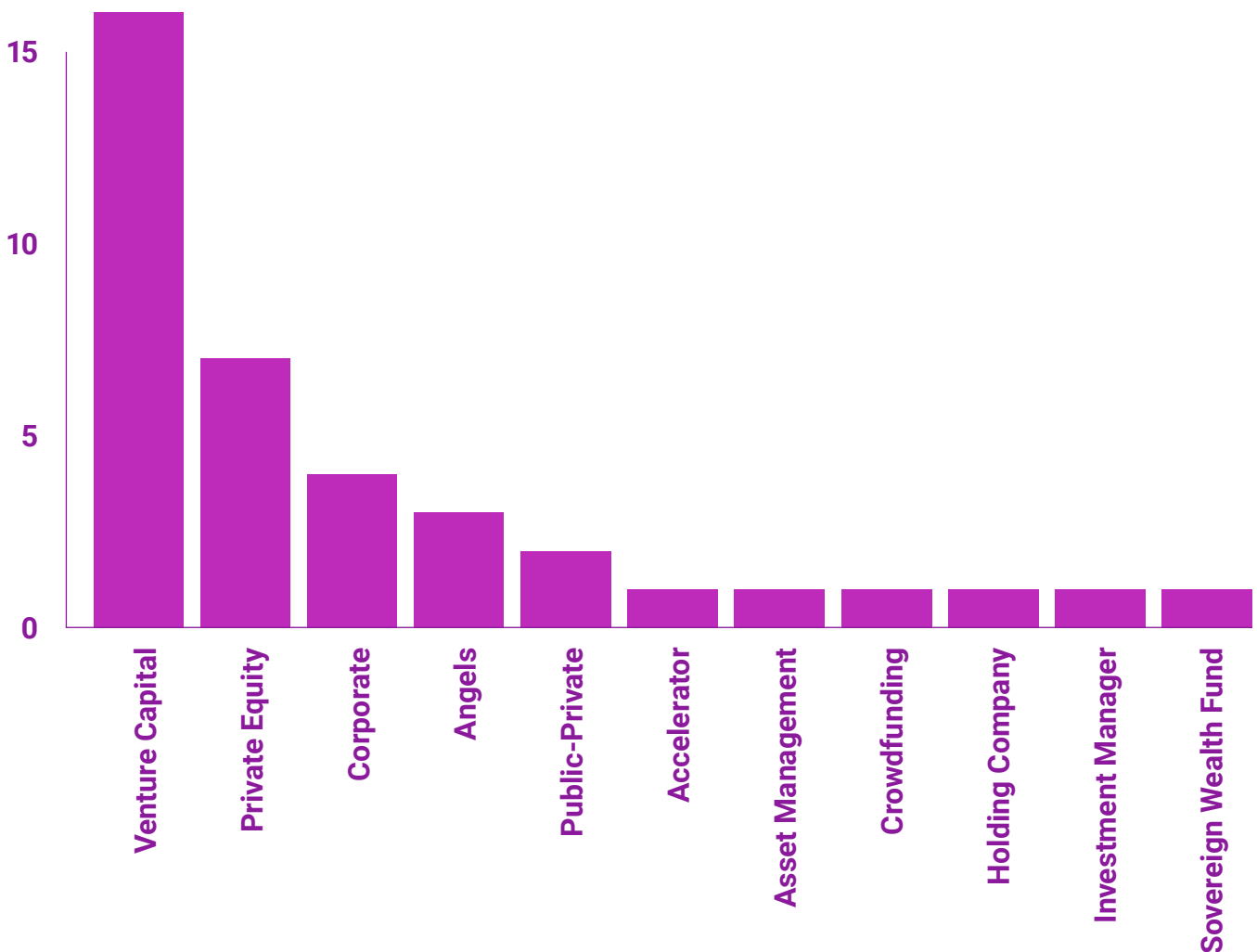


Fig 5. Volume of UK investors by investor category. Analysis of Beauhurst data.

Equity Funding Activity

Since 2005, the number of fundraisings has trended upwards amid some significant troughs - notably, between 2010 - 2012 and in 2021 (Figure 6). This pattern is somewhat matched by the total value of fundraisings, which drops significantly in 2010, 2015, and 2020. The drop visible in 2020 may be linked to the outbreak of the COVID-19 pandemic – this may have caused increased price volatility and economic uncertainty, therefore reducing the risk appetite of investors.

The total value of fundraisings in each region across the UK highlights that a significant amount of capital has been deployed into companies operating in Yorkshire and the Humber (£76.1m - £95m), followed closely by the South East (£57.1 - £76m). This correlates with UK companies operating in the rare earth supply chain that have grown at least 10% - 20% on average over a 3-year period, many of which are located within these regions (Figure Appendix 8).

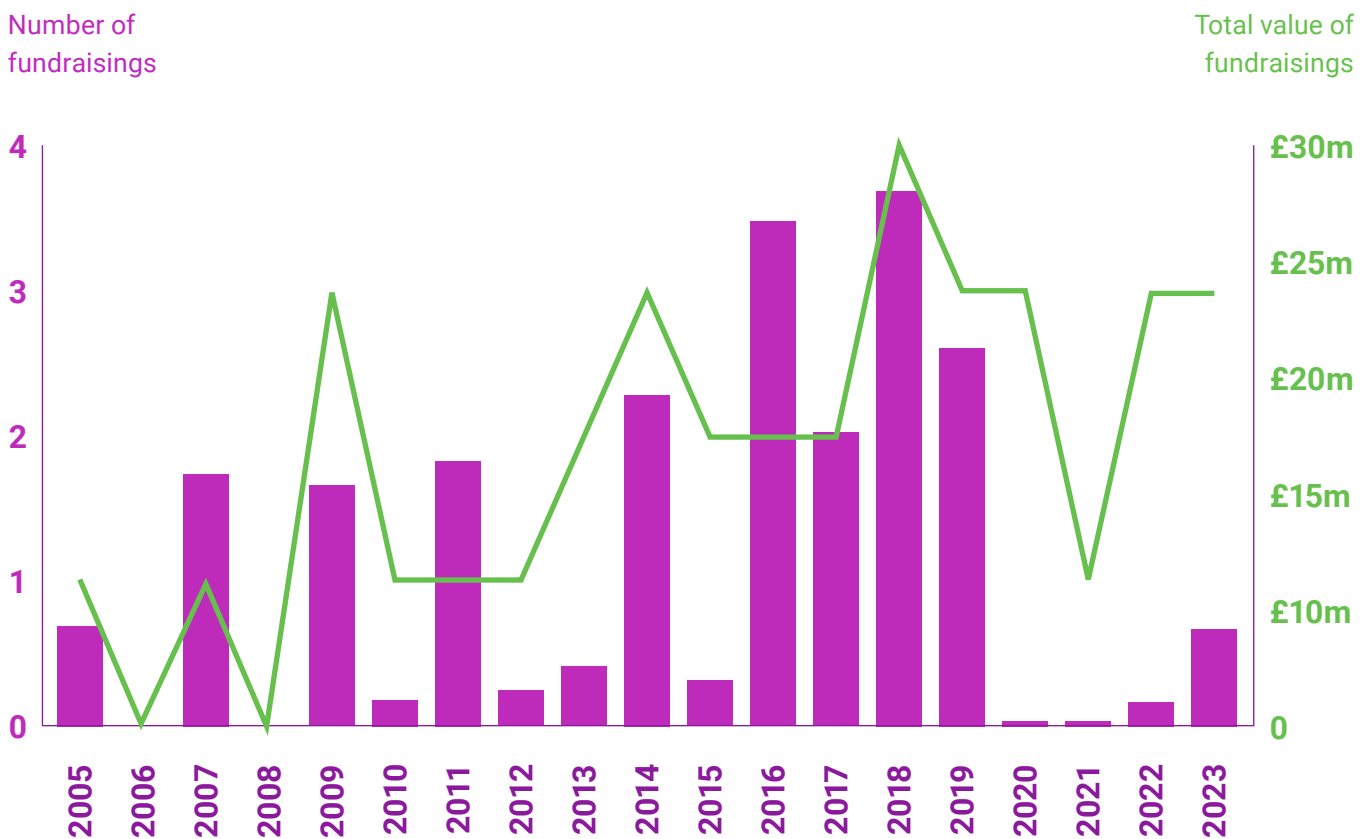


Fig 6. Total number and value of fundraisings 2005 - 2023. Analysis of Beauhurst data..

Market Sentiment: Navigating Investing in the Rare-Earth Supply Chain

There has been growing interest in critical materials amongst investors over recent months, with many convening to discuss the topic of rare earths. This is primarily driven by the increasing demand for products containing rare earth elements and the scarcity of resources.

Innovate UK surveyed UK-based investors to understand the main opportunities and challenges of investing in the rare earth supply chain, their views on the market, and the type of support they require. A summary of the key themes is presented in the following pages.





Risk Appetite

The areas and levels of interest amongst investors are largely dependent on the fund type and their willingness to take on risk. Those with a higher risk tolerance may be more willing to invest within the earlier stages of the value chain, where lead times and development cycles are longer and complex. A more conservative investor, however, with a lower risk tolerance would look at areas of the supply chain where they could make an investment with more guaranteed returns. To create a cohesive supply chain within the UK, many felt that large amounts of risk capital and greater access to funding would need to be deployed.

The frequent fluctuations of asset prices for rare earth elements may also be a contributing factor to the aversion of some investors to involve themselves in the supply chain. There seems to be a gap in understanding amongst investors regarding the journey a company would take from concept to exit, potentially weakening their willingness to bear financial risk. Given this, many said it was equally as important to understand the founding team as well as the technology – notably, whether they have the skills required to drive the venture through the current, and future, economic environment.

An aerial photograph of a dense forest with vibrant green foliage, showing the intricate patterns of tree canopies and shadows. The image is split vertically, with the left side showing a white background with text and a purple decorative bar at the top, and the right side showing the forest. A purple bar is also at the bottom left.

Availability

Many of the venture capital investors we spoke with said that recycling was a large interest area due to the UK's strong expertise, however, some expressed concern around the scale of materials required to build a cohesive circular economy for rare earth elements. They felt a sense of misalignment between the companies active within the secondary processing industry and the typical 7-10 year return timeframes of many venture capital funds. As a capital-intensive area where development lifecycles can be complex, a degree of patient capital is required for companies operating within the secondary processing area of the supply chain.

With this in mind, some venture capital firms have turned their attention to opportunities within the primary supply chain, such as increasing the sustainability of current processes or manufacturing rare earth substitutes, as this mitigates availability issues and aligns with their impact agendas. Alongside this, the demand increase for rare earth magnet materials due to the electrification of vehicles, as well as the current long mining lead times, mean investors are beginning to see a gap to invest in organisations developing processes to solve these problems. Current areas of interest include companies that can apply processes used in other industries to the rare earth supply chain, for example in the chemistry, waste metal, and biosorption.

Networks and Knowledge

Investors interested in this area also expressed a need to be connected into a network of stakeholders to support with their technical due-diligence and opportunity-spotting. As a highly complex industry, many felt that deep technical expertise was needed to navigate investing in this sector. Some funds had outsourced experts from industry and academia to conduct and deliver market reports to determine opportunity areas of focus. Doing so enabled them to reach a point where they felt comfortable with the potential high-risk associated with a company operating within the rare earth supply chain.

The need for a connected ecosystem was also echoed by many of the founders we spoke with. Several had found it easier to raise through those in their network who bridged the boundary between industry and finance – often, these were high net worth angel investors with expertise in the critical materials sector. Often, if these individuals were leading the round it acted as a catalyst for VC participation by slightly de-risking the investment.



Recommendations

The UK needs to act, or else many UK-based sectors are at risk of becoming uncompetitive. To accelerate private investment into the UK's rare earth supply chain and create an environment in which venture-backable companies can exist, several factors need to be considered.

Insights

Detailed insights and transparent information for key actors making investment decisions in the ecosystem are required. Those deploying private sector funding need to be more informed of the opportunities available to them within the UK's rare earth supply chain to encourage them to diversify their portfolio. This is coupled with the need to demonstrate evidence of market growth by highlighting other players that have

successfully invested in aligned areas or by demonstrating the industry's increasing value - this will mitigate perceived risks around security and sustainability in favour of higher rewards. Barriers need to be broken down and pathways to self-sustaining supply chains highlighted through return-on-investment and business case studies.

Collaboration

Collaboration rather than competition is crucial to accelerate private investment into the UK's rare earth supply chain and build the market. A connected ecosystem of corporates, startups, government, industry, and academic stakeholders can increase investment by providing a coordinated approach to the development of a domestic rare earth supply chain. This will provide confidence, support investors with navigating challenges, and highlight commercialisation routes for innovators. Companies operating in this space also need a community and connections to support them with navigating funding rounds and securing capital.

Alignment

We need to look at aligning each area of the supply chain with the correct investor type. For example, secondary processing will need investors that operate a patient capital mindset due to the long lead time for the scale of materials required to create a circular economy. Venture capital firms with 7-10 year return timeframes may be more

inclined to look at opportunities within the primary supply chain, such as increasing the sustainability of processes, where they are likely to see a return more quickly. Aligning investors with relevant supply chain areas will enable the creation of a connected value chain that scales sustainably and leads to long-term growth.

Support

Finally, continued long-term government support is needed to reduce the risks and support investors to look at the supply chain areas they are more hesitant to engage with. Clear and stable policies can attract investment by providing a predictable investment environment, enabling the industry to invest in its domestic rare earth supply chain. Government action is crucial to support, stimulate, and invest in the UK's supply chain development.



What's Next?

Following this report, we hope to continue engaging with investors to encourage them into the sector and to build a collaborative ecosystem that accelerates investment into the rare earth supply chain. Over the duration of the Circular Critical Materials Supply Chain programme, we aim to host events and activities that will break down challenge areas and highlight the opportunities available to private investors interested in deploying funds in this exciting space.

Acknowledgements

Thank you to everyone who has supported Innovate UK's Circular Critical Materials Supply Chain Programme and has engaged in conversations with the Innovate UK teams to contribute to this report.

Appendix

Global

Volume of Global Companies by Supply Chain Area

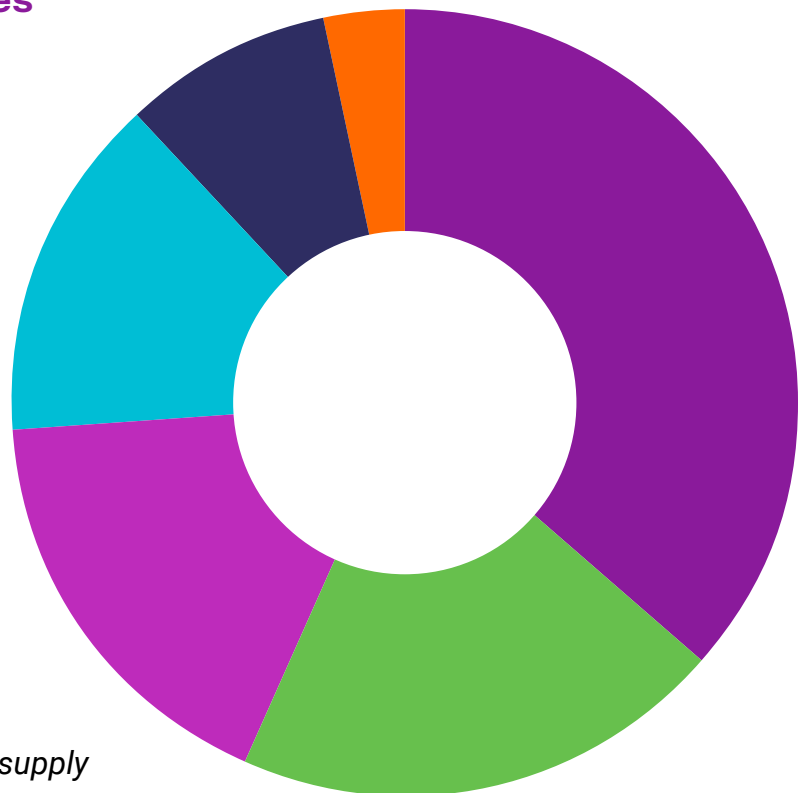


Fig A1. Volume of global companies by supply chain area. Analysis of CB Insights data.

Volume of Investors by Country

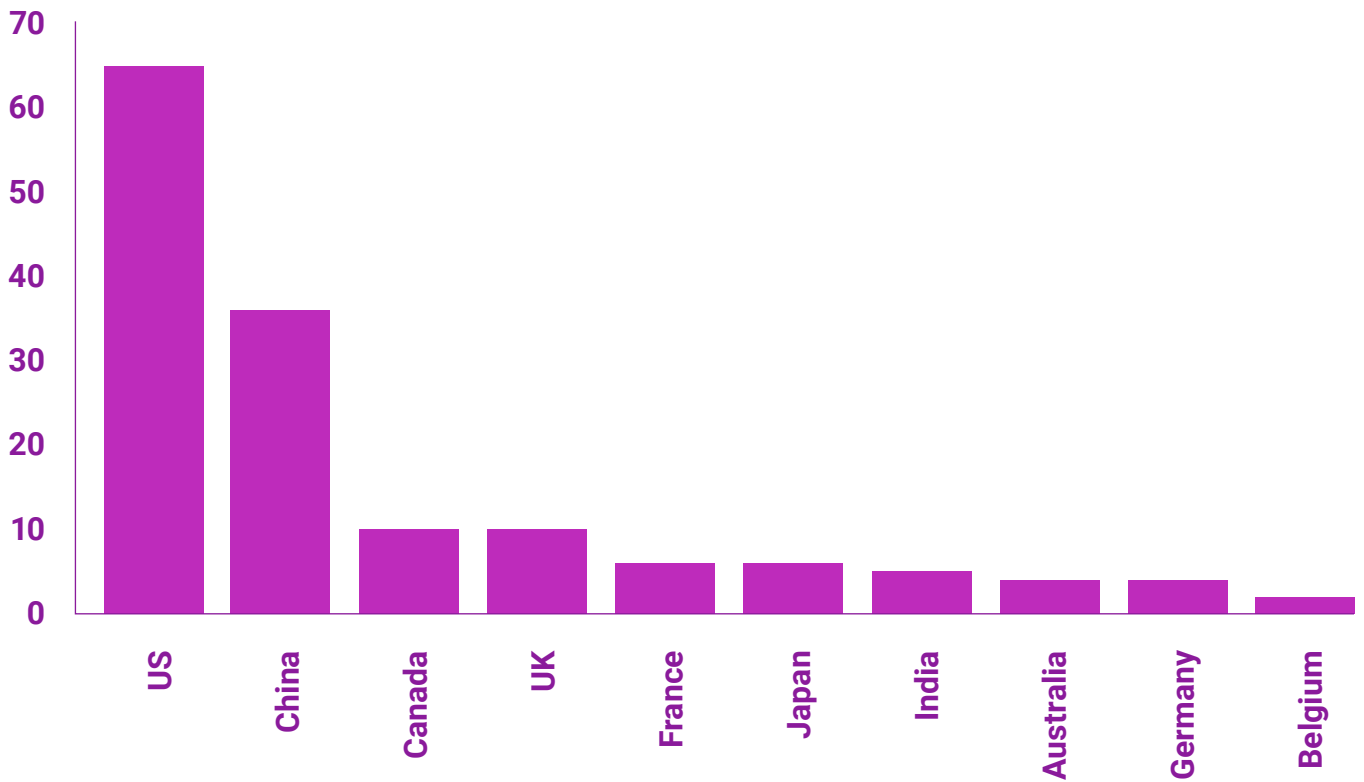


Fig A2. Volume of global investors by country. Analysis of CB Insights data.

Volume of Global Investors by Deal Count

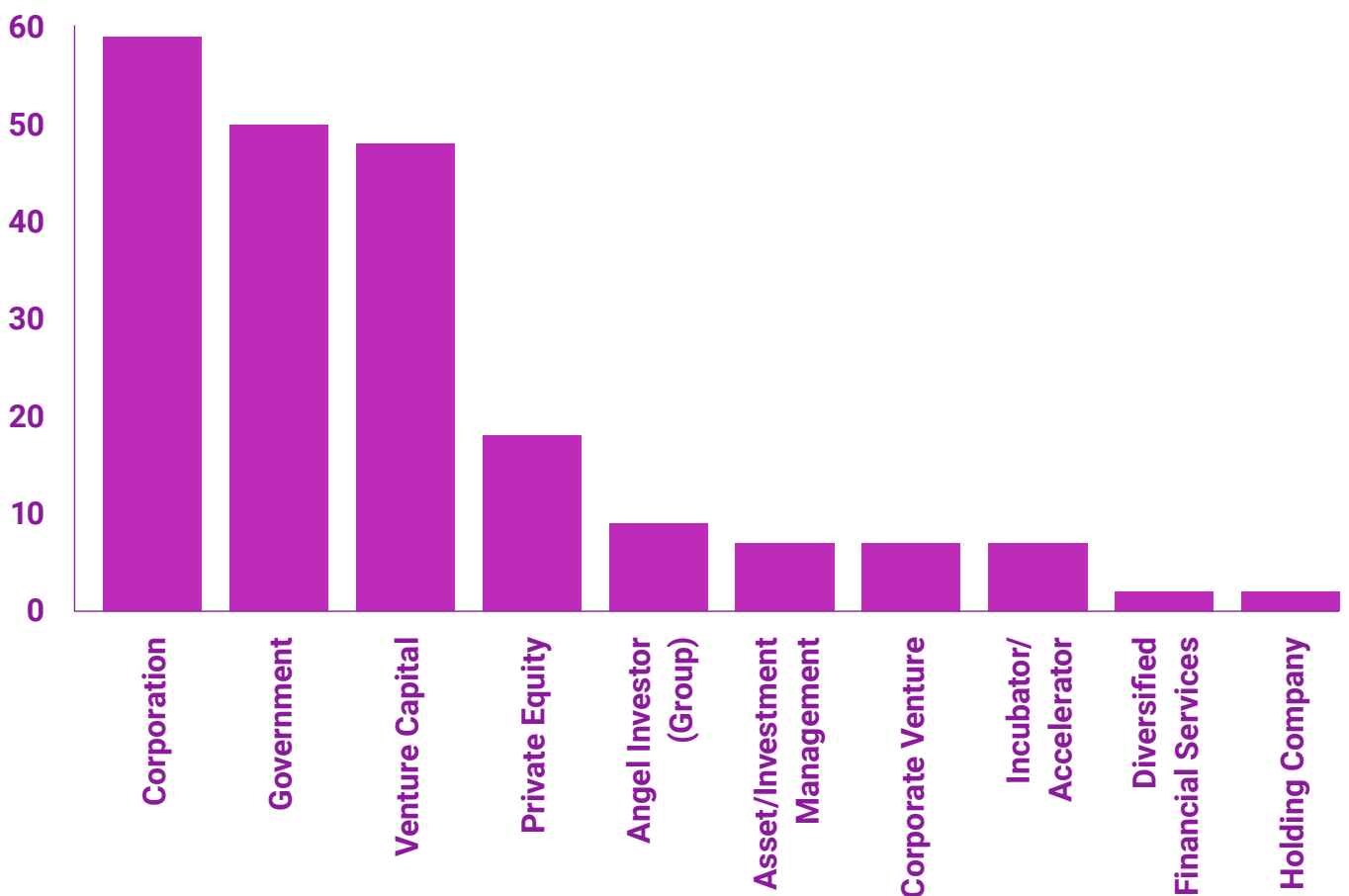


Fig A3. Volume of global investors by deal count. Analysis of CB Insights data.

Volume of Global Deals by Supply Chain Area



Fig A4. Volume of global deals by supply chain area. Analysis of CB Insights data.

Volume of Global Deals by Country

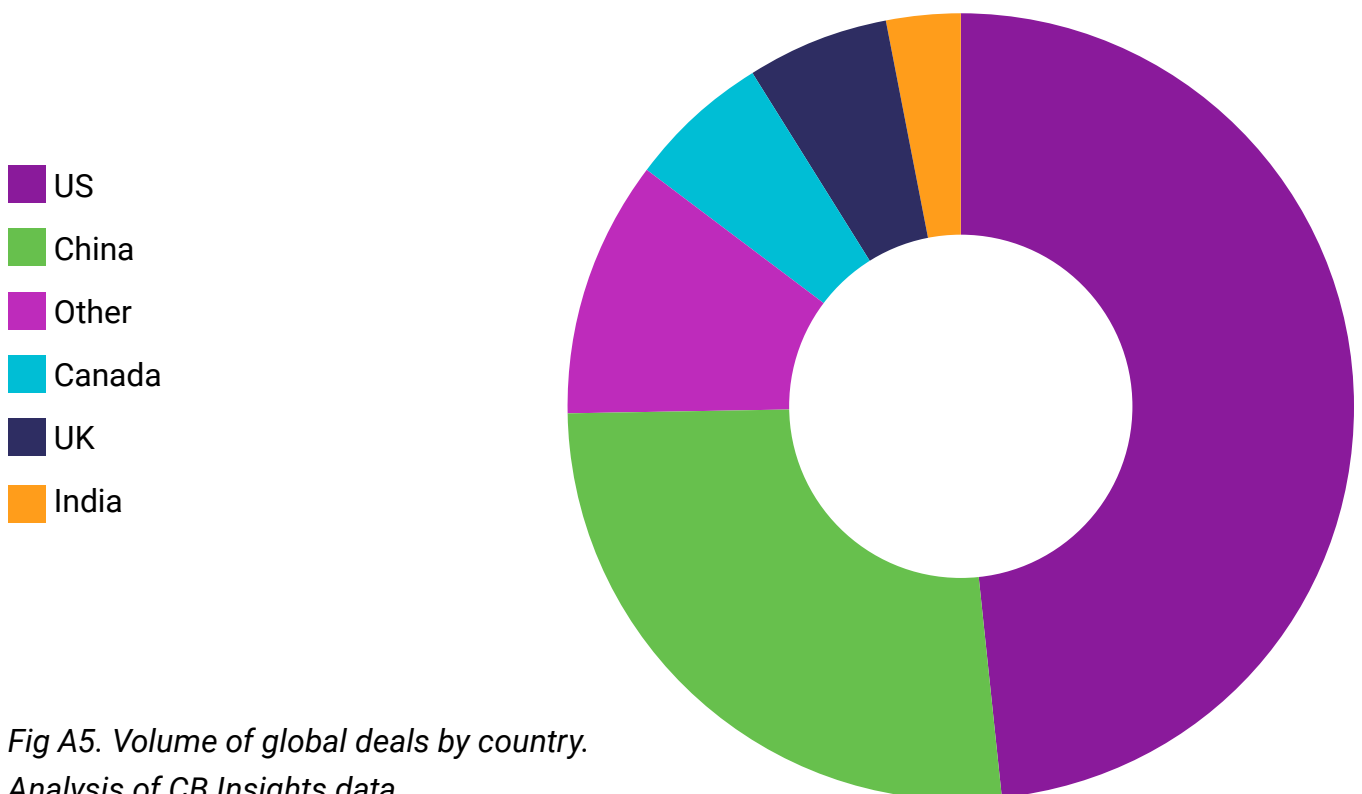


Fig A5. Volume of global deals by country. Analysis of CB Insights data.

Volume of Global Deals by Supply Chain Area

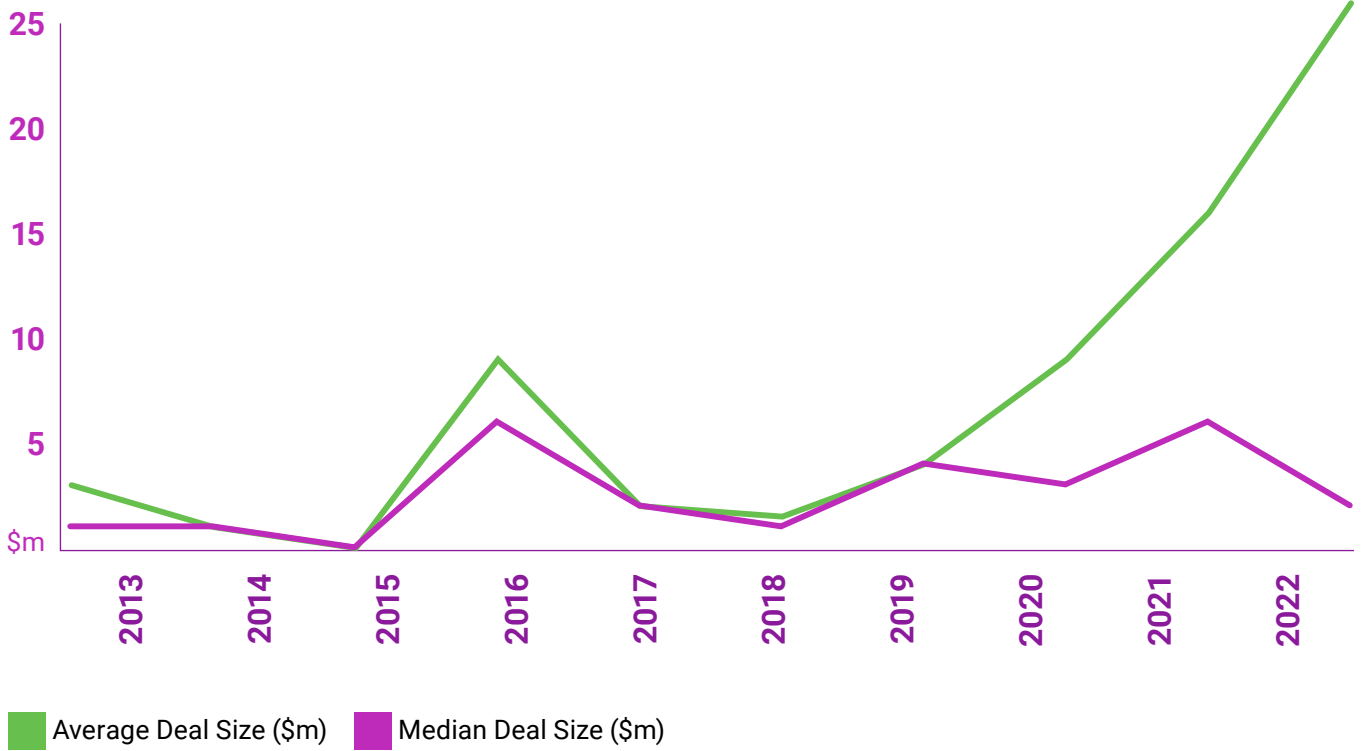


Fig A6. Average and median deal size (global). Analysis of CB Insights data.

Volume of UK-Registered Companies by Supply Chain Area



Fig A7. Volume of UK-registered companies by supply chain area. Analysis of Beauhurst data.

The Total Value of Fundraisings in Each Region

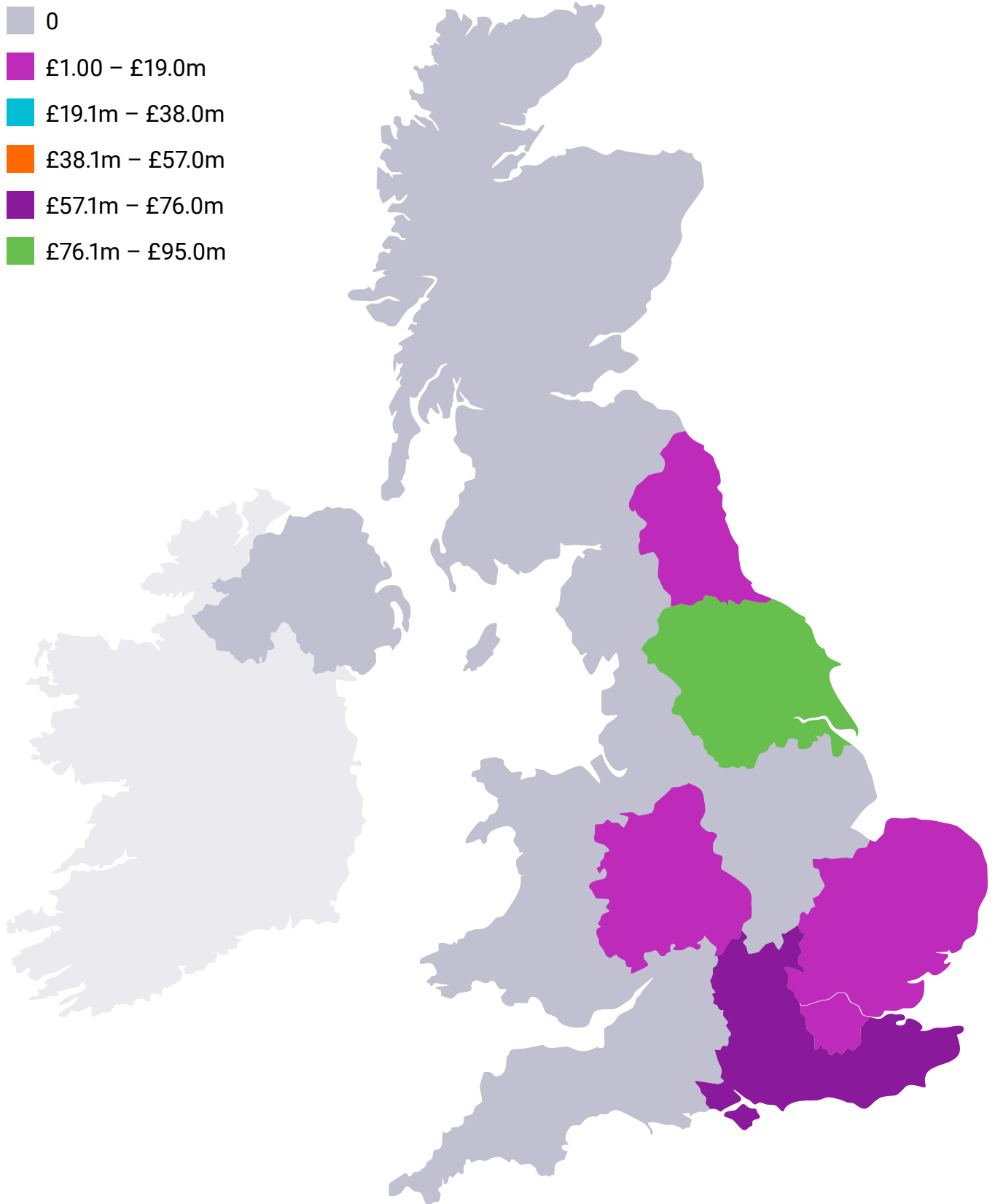


Fig A8. The total value of fundraisings in each region. Analysis of Beauhurst data.



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