

# 2023

# Tough Tech Landscape

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# Foreword



**Katie Rae**  
CEO &  
Managing Partner  
Engine Ventures



Every other year we work with Pitchbook to track how private capital is flowing into the Tough Tech asset class.

It is our strong belief that in the coming decades, investing into Tough Tech sectors will be mainstream, and that the tech giants of tomorrow will increasingly be in sectors such as energy, manufacturing and biology. As such, we look at how this hypothesis is playing out with growth of funding into private companies across climate tech, human health, and advanced systems and infrastructure. Growth here signals promise towards a future where our markets and returns align with what is best for our planet, for our health, and for future generations. The scaleup we have tracked has been encouraging, including a 5x+ growth in private financing towards Tough Tech, and a particular increase in much needed late and corporate capital. But on the heels of a banking crisis, dip in public markets and overall stagnation of public exits, we knew that this year would look different.

Nevertheless it was important to document Tough Tech capital this year as we have in the past. The creation of new Tough Tech industries takes time and will weather many dips and uncertainties in the market. While funding and exits are certainly down across the board, there is also positive news. Tough Tech financing decreased at a lower overall rate than traditional venture and private equity funding into sectors such as software. We also continued to see an increase in corporate dollars invested into

the category. This signals a shift from investors and corporates beginning to see both the viability of garnering venture scale returns as well as the sheer business risk of not allocating dollars in this direction. And private capital is also being matched with other modes of financing. New programs at the federal US level, such as the Inflation Reduction Act, and SBIC debenture rulings are unlocking billions of dollars that will derisk the scaleup of Tough Tech industries and accelerate their path to market even faster.

Is the Tough Tech asset class more resilient? The answer to that is still unfolding. We hope that this report will spark new insights and debates, and most importantly encourage more capital to back the breakthroughs across science and technology that will propel our economies forward.

# We invest in Tough Tech.

**Transformational Technology**  
Tough Tech is cutting-edge science and technology that has the potential to change the trajectory of society.

Tough Tech is **transformational technology** that solves the world’s most important challenges through the **convergence** of breakthrough **science, engineering, and leadership.**

**Science, Engineering**  
What unites Tough Tech is that it exists in physical space, not just in code, and it has the potential to create more sustainable, resilient ways of living.

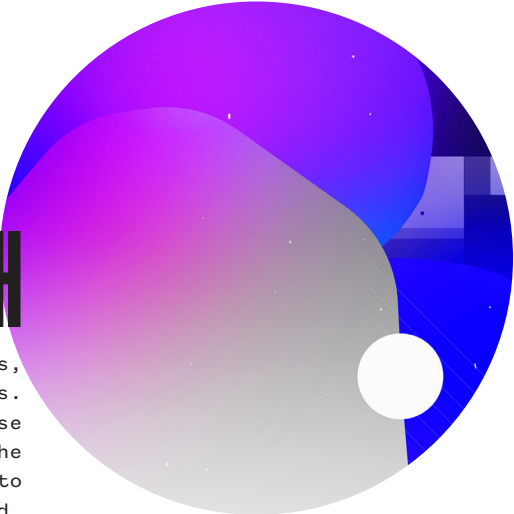
**Convergence**  
We believe interdisciplinary approaches are the key to solving our interconnected global problems in climate change, human health, and advanced systems.

**Leadership**  
We believe and help technical founders achieve their potential as the global leaders of their companies & industries.



## CLIMATE

Meeting the challenges of a changing climate requires new materials and processes for how we produce, move, store and use energy. These companies are working to mitigate the most severe consequences of climate change while building the backbone of our economy for decades to come.



## HUMAN HEALTH

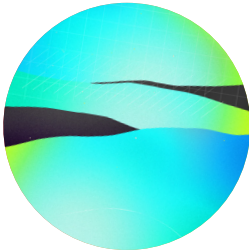
Transformative solutions have been shown in medicines, health and disease monitoring, and in our food systems. Increasing the applications and the access of these transformative solutions drives our companies as they converge biology, materials, engineering, and AI to empower a healthy, vibrant world.



## ADVANCED SYSTEMS & INFRASTRUCTURE

Adapting and evolving to meet changing global economies requires new approaches for advanced computing, manufacturing and supply chains, the built environment, and space. These companies are building more effective, productive, and inclusive backbone technology for industrial systems.

# Tough Tech Market Opportunities



## HYDROGEN

**\$600B+**

**hydrogen market by 2030**

Hydrogen is both a clean burning fuel that also offers a path to decarbonization of many products ranging from fertilizer to lower-carbon steel. Current net-zero projections require a 600% increase in yearly hydrogen production by 2050 yet simultaneously demand >60% be generated emissions-free.

## CARBON CAPTURE

**UP TO \$1T**

**carbon market by 2050**

With limited options to completely decarbonize some sectors of the economy, meeting net-zero goals requires increasing total carbon captured by nearly 1000 Mt/y over the next decade.

## METALS REQUIRED FOR ENERGY TRANSITION

**20%**

**annual growth in Li demand**

From lithium ion batteries (lithium, cobalt) to electrolyzers (platinum, nickel) and wind turbines (rare earth elements), the energy transition necessitates increasing access to mineral resources. Lithium demand alone is expected to rise 20% annually to >3 Mt/y by 2030, with demand for rare earths expected to nearly triple by 2035.



## REQUIRED COMPUTE POWER FOR AI

**100 DAYS**

**required computing power doubles approximately every 100 days**

Progress in machine learning and artificial intelligence has already revolutionized fields ranging from translation, and computer vision to drug design, demonstrating the power to automate tasks only recently reserved for humans. The common enabler of these advances was the growth in computational power. As we reach towards the end of Moore's law, new hardware approaches to computation will power the next chapter in AI/ML.



## CELL AND GENE THERAPIES

**\$82B**

**cell & gene therapy market by 2032**

Cell and gene therapies have shown an incredible promise to treat severe diseases ranging from cancer to rare disease. The ongoing innovation will enable us to deploy these transformative innovations at scale and for more common diseases, addressing challenges in both safety and scalable manufacturing.

## NEUROLOGICAL DISEASES

**\$721B**

**global neuroscience market across diagnostics and drug an non-drug therapies**

The lack of effective animal models and poor understanding of key factors underlying neurological disease states has resulted in historically low clinical success rates for new treatments of these devastating diseases. Driving innovation in both our understanding of neuroscience as well as leveraging the full range of modern pharmaceutical approaches will help us make progress against the final frontier in human biology.

## VACCINES

**\$100B+**

**vaccine market in 2021**

The COVID-19 pandemic has highlighted the transformative role of vaccines in human health. Innovations, such as rapid scaling of mRNA vaccines or recent successes in the prevention of RSV, will continue to lead our fight against existind and emerging infections diseases.

## AUTONOMOUS DRIVING SYSTEMS

**\$400B**

**in revenue by 2035**

Autonomous driving has the potential to transform transportation and society at large. Creating massive value for the consumers through increased safety, convenience, and productivity, freeing up time and improving mobility options for the elderly and people with disabilities.

# Tough Tech by the numbers

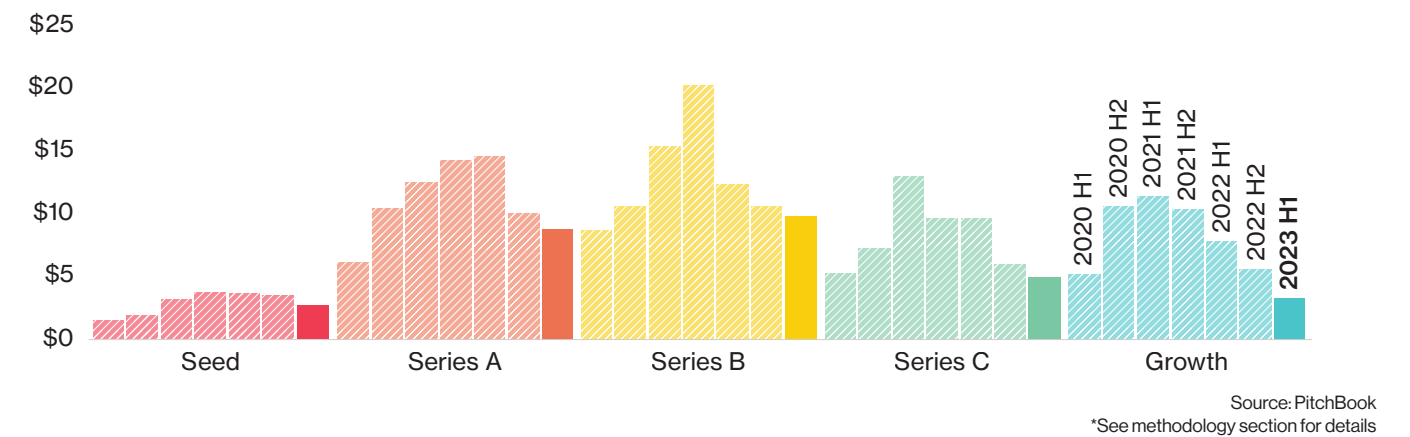
Since our last Tough Tech Landscape published in Fall of 2021, the Tough Tech sector - as well as the overall VC market - has seen a meaningful change in funding.

In the first half of 2023, the overall level of Tough Tech VC funding has dropped by 39% year-over-year. The number of venture deals declined by a more modest 17% over the same period. While this represents a more challenging environment for entrepreneurs compared to the height of 2021, the long term trends in Tough Tech VC investments remain positive and show compounded annual growth rates of 7% and 21% over 5 and 7 years, respectively. In this regard, Tough Tech funding has shown relatively more resiliency compared to other venture investments, which declined by 53% year-over-year and saw only 3% and 6% compounded annual growth the last 5 and 7 years, respectively.

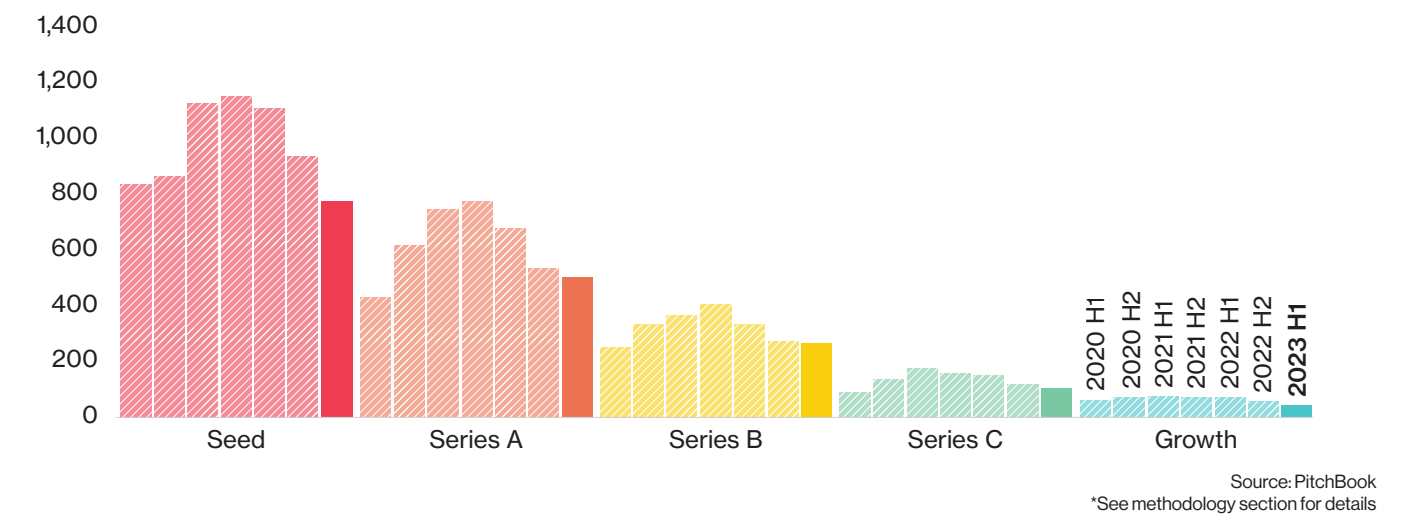
Although it is early to draw any conclusions, the most recent quarter included in this report, Q2 2023, points to a potential stabilization with a 20% quarter-over-quarter increase in Tough Tech venture funding vs. Q1 2023 (see individual sectors for detailed breakdown).

Despite the decrease in total capital deployed across all stages of Tough Tech investments, early-stage valuations and deal sizes have been relatively less affected. While the number of early-stage financings has declined, median deal sizes and valuations have stayed relatively stable (median Seed, and B rounds in 2023 are up 10% and 8%, respectively, with Series A rounds down 9% vs. 2022). This is in contrast to later stages, which saw a more significant drop in capital deployed, through the combination of

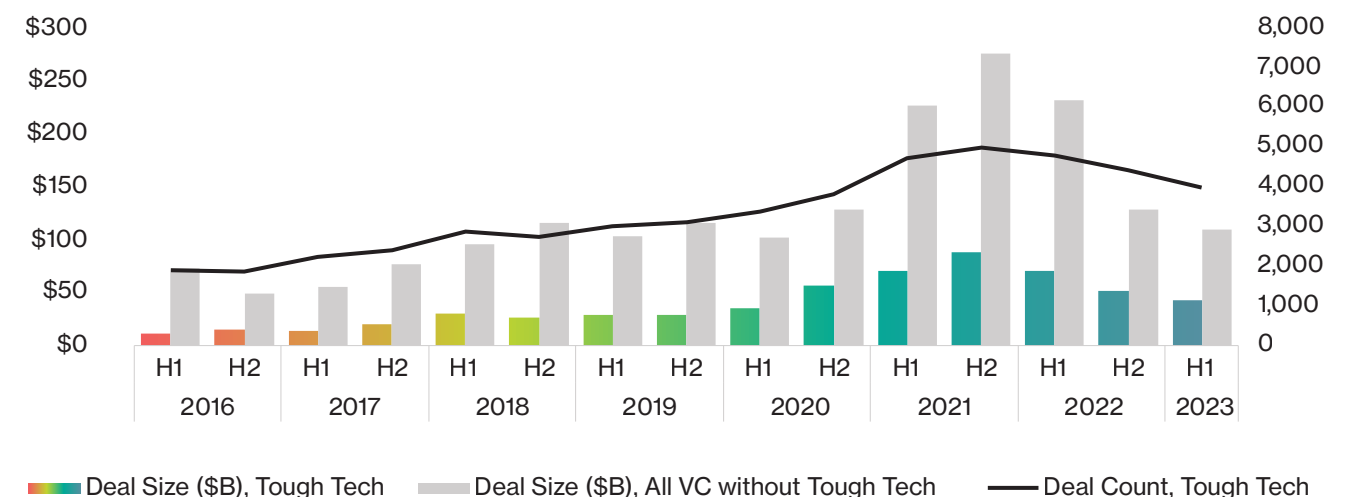
Tough Tech VC Investments (\$B) by Series\*



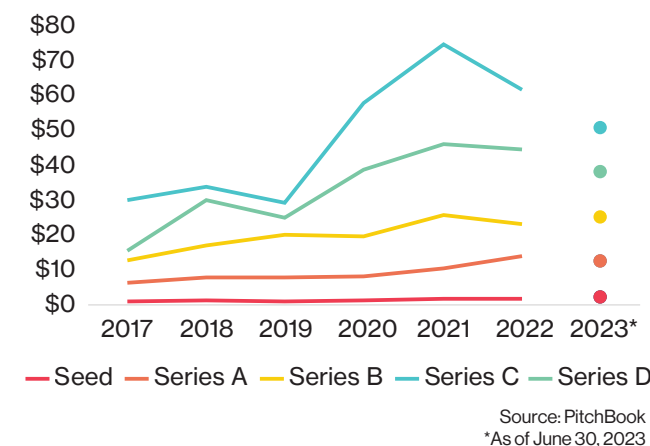
Tough Tech VC Investments (Deal Count) by Series\*



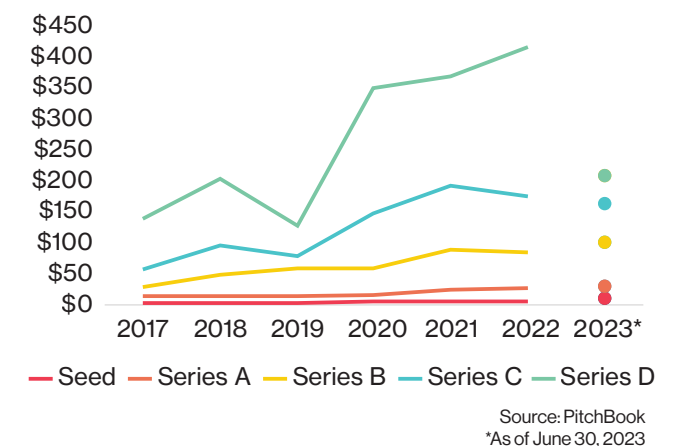
VC Activity, Tough Tech & Other



Tough Tech Median Deal Size (\$M) by Series



Tough Tech Median Pre-Money Valuation (\$M) by Series



both fewer deal as well smaller deals sizes and lower valuations (median size of Series C and D rounds were down 15% and 18%, respectively). The key driver in this decrease was the slow down of Tough Tech exits that started in 2022 and extended into 2023. We explore the Tough Tech exits in a later section of this report.

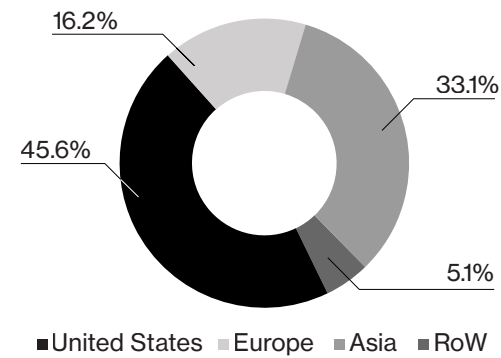
In line with previous trends, Tough Tech saw a continued increase in corporate participation highlighting the urgent need for innovation among the corporates. Of-

ten going beyond financial investments, incumbents are partnering with startups in scaling, infrastructure, and commercial operations, helping to accelerate and amplify their impact.

Geographically, US companies have received approx. 45% of the total funding between H2 2022 and H1 2023, with the highest amount of investments deployed into companies in Human Health (>60% of overall Human Health funding). In contrast to Human Health, the majority of investments in Advanced Systems (~53%)

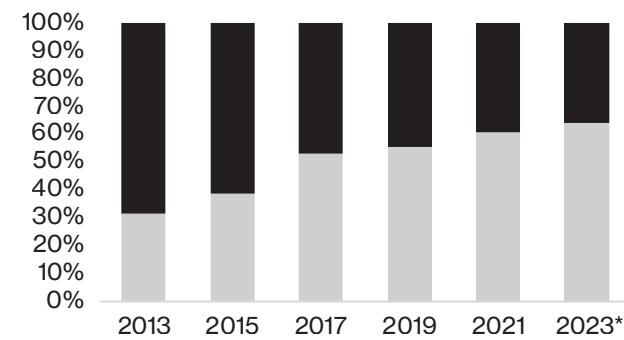
went into companies based in Asia. Within the individual Tough Tech sectors, Human Health has seen the most significant correction, with investments in Climate surpassing those in Health for the first time across the second half of 2022 and first half of 2023. In the following pages, we dive into the individual sectors, breaking down the investment activity and developments over the last two years.

**Tough Tech VC Investments (\$), 2H'22 - 1H'23, by Geography**



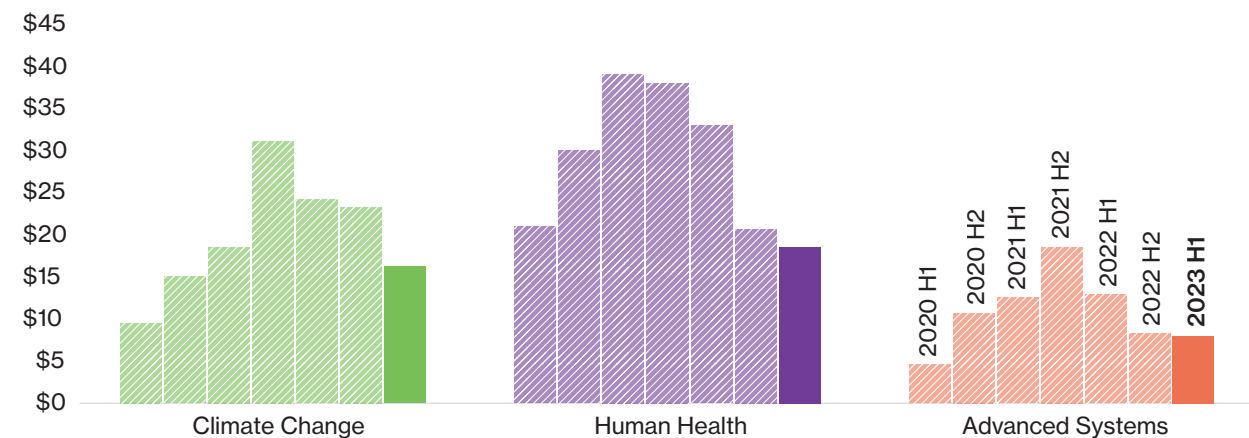
Source: PitchBook

**Tough Tech VC Investments (\$B) with or without Corporate participation**



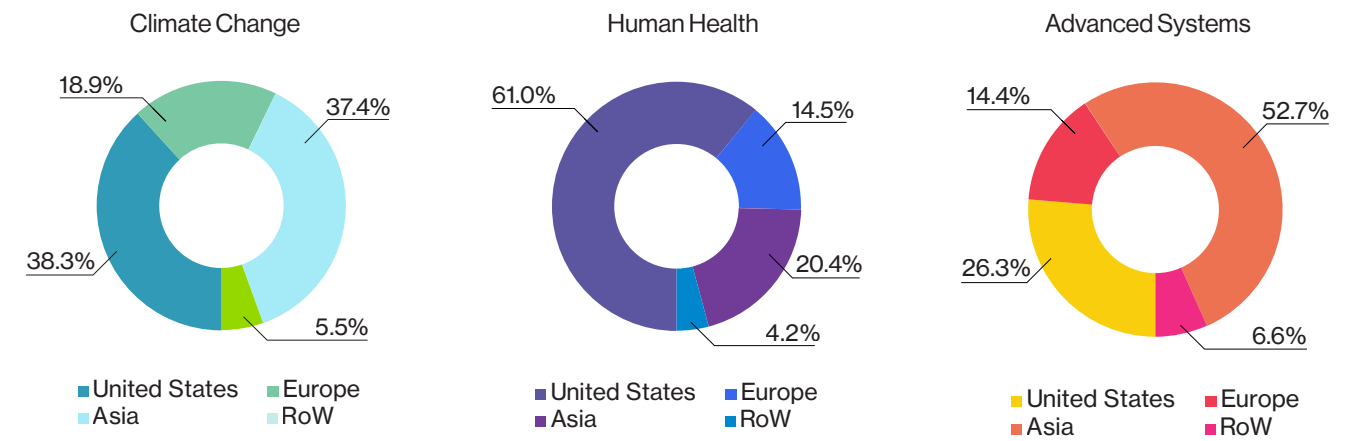
Source: PitchBook  
\*As of June 30, 2023

**Tough Tech VC Investments (\$B) by Sector**



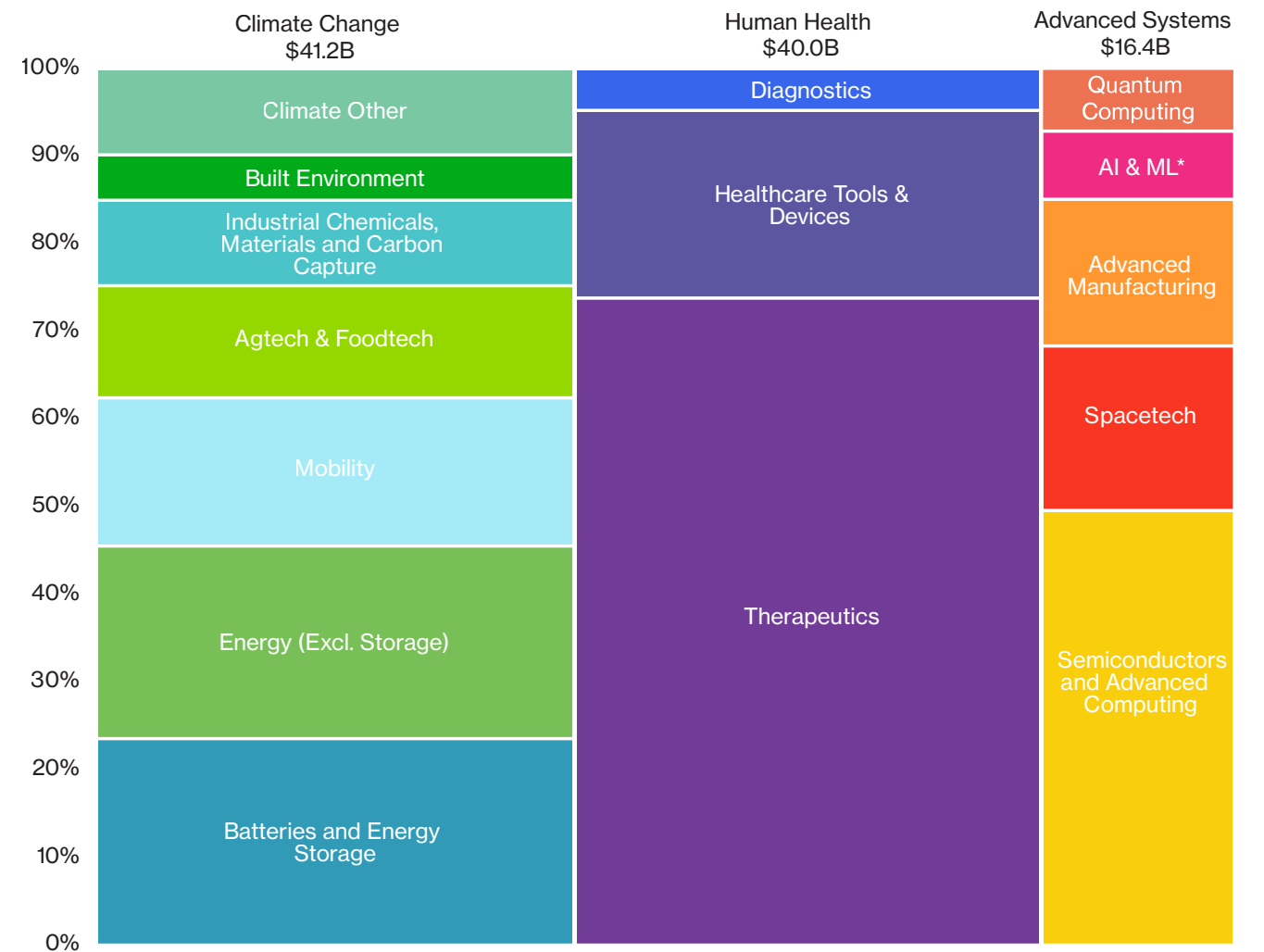
Source: PitchBook

**Tough Tech VC Investments (\$), 2H'22 - 1H'23, by Geography**



Source: PitchBook

**Tough Tech VC Investments (\$B), 2H'22 - 1H'23, by Sector and Sub-sector**



Source: PitchBook  
\*Excludes \$10B funding round for Open AI. See more details in Methodology section for AI/ML classification.

# Government / Market Creation

*Governments play an integral role in supporting Tough Tech globally. This section highlights the United States as a key example of how governments can be major assets to the advancement of transformative technology.*

**F**or decades, the U.S. has been a leader in technological innovation. In our more recent history, the dot-com boom of the late 1990s stands out, but the history of the internet is really the history of semiconductors, and the history of semiconductors is really the story of a fundamental partnership between government and technology companies. The early success of the U.S. semiconductor industry is due in large part to serious investments made by the government. Following the invention of integrated circuits in 1958, the government funded demonstration projects and became a key customer to test their implementation in defense and aerospace applications. In short, the government funded the critical scaling period, driving sufficient price reduction to reach the mass consumer market.

Reflecting on the U.S.'s past contributions to environmental sustainability, California's renewable fuel standards and the DOE Loan Program exemplify the action to combat climate change. Regarding the former, the policy promoted larger scale innovation in more sustainable fuel options like biodiesel, hydrogen, and electric. On the federal level, the establishment of the DOE Loan Program in 2005 provided essential financing for the companies that would revolutionize the energy industry. Tesla, now an EV giant, received \$465 million from the DOE in 2010. To date, the program has issued upwards of \$35B in loans for more than 30 endeavors.

Today is no different: the U.S. continues to be heavily involved in the development

of revolutionary technologies. Just last year, the US passed three landmark developments: the Inflation Reduction Act (IRA), the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act, and the establishment of the Advanced Research Projects Agency for Health (ARPA-H).

The IRA represents the most significant example of government support for Tough Tech. Close to \$400B were designated for clean energy in the form of tax incentives, grants, and loan guarantees, making direct investments in energy, transportation, manufacturing, and related sectors. The act also introduced roughly \$43B worth of tax credits to incentivize consumers to choose low emission options like EVs. An additional sum of around \$12B increased the DOE Loan Program's budget by 10x, and a new loan pool was established with a \$250B budget. Much like the initial support for the semiconductor industry, this capital helps both drive innovation and provide the bridge to scale the solutions to a cost competitive level.

In a similar fashion, the CHIPS and Science Act represents a strategic move on behalf of the government to foster scientific discovery, particularly in the semiconductor industry. Over the next ten years, \$280B will be deployed into R&D, tech-hubs, and workforce development. \$24B of that total is allocated towards chip manufacturing tax credits. Following a five year timeline, \$174B of the \$280B will be poured into departments committed to technological advancement, with the National Science Foundation (NSF) and the DOE receiving the bulk of the funding. By promoting U.S. semiconductor manufacturing,



# \$400B

**designated for clean energy in the form of tax incentives, grants, and loan guarantees as part of IRA**



# \$280B

**to be deployed into R&D, tech-hubs, and workforce development as part of CHIPS and Science Act**



# \$4B

**over 2023-24 allocated to ARPA-H funding high risk, high reward research in human health**

the act is commonly identified as a national security measure. While the effort continues a longstanding history of government support for the development of semiconductor technologies, the shift in focus to include manufacturing capabilities is unique.

Lastly, the newly established agency ARPA-H "advances high-potential, high-impact biomedical and health research that cannot be readily accomplished through traditional research or commercial activity." President Biden's bill allotted \$4B in the first two years of the agency. ARPA-H differentiates itself from the NIH in its ability to take on riskier commitments in a more timely fashion—this is due in large part to allowing program managers, as

opposed to a peer review system, to make funding decisions. As a result, the program can pursue more transformative but also applied ideas like offering at-home MRIs, improving surgical interventions or low cost-manufacturing.

Looking beyond the United States, the above policies often create an international pull with global impact. Following the IRA's ratification, the EU put in place the Net-Zero Industry Act (NZIA) to bolster its clean energy sector and the Critical Raw Materials Act (CRMA) to strengthen its mining operations. Outside of Europe, China and South Korea considered collaborating with the EU, Canada's Justin Trudeau announced a Climate Action Incentive rebate, and India modified its

budget to increase domestic renewable production. In short, the government actions can have a cascading effect and put pressure on countries to keep their climate efforts globally competitive.

Ultimately, these government initiatives, past and present, are catalytic to the successful growth of the Tough Tech sector. We celebrate the recent government steps with the understanding that it is this highly aggressive trajectory that is necessary for solving the world's most urgent and complex challenges.

# Recent Exits

The height of the stock market in 2021 coincided with the busiest exit window for VC-backed companies in history. In 2021 alone, there were over 250 public listings of Tough Tech companies with combined valuation of close to \$220B. Since then, we saw a significant decrease in the number of public listings, with 109 public listings in 2022 with a combined valuation of ~\$80B. The more challenging exit environment continued into 2023 so far. The mixed performance of the stock market, including the indexes most representative of the individual Tough Tech sectors, likely contributed to the narrowing of the exit window.

Unlike public listings, M&A activity persisted beyond the peak in 2021. 2022 saw 223 acquisitions, a modest decrease from a total of 251 acquisitions in 2021, however, with the significantly lower valuations suggesting an environment highly favorable to acquirers.

While the exit environment has proven to be challenging for later stage companies and, as a result, a number of companies opted to stay private for longer periods, we have selected a number of innovative Tough Tech companies that have successfully navigated the transition to the public market or have been acquired at a high valuation over the last 18 months.



## Carbon Engineering

The company is commercializing a closed-loop direct air capture (DAC) technology that was originally invented by Harvard University Professor David Keith. Since its founding, Carbon Engineering has expanded its activities beyond DAC to include CO2 utilization, with a focus on synthetic fuels.

**Founded: 2009**

**HQ: British Columbia, Canada**

**Employees: 151**

**Acquired by Occidental Petroleum for \$1.1 billion | August 2023**

## LanzaTech

### LanzaTech

LanzaTech is a CO2 utilization company that uses a gas fermentation process to convert CO, CO2, and H2 into fuels and chemicals. It currently operates three commercial-scale plants in China producing ethanol from steel mill emissions.

**Founded: 2005**

**HQ: IL, United States**

**Employees: 390**

**Reverse merger via SPAC at \$1.8 billion valuation | Feb 2023**



## Prime Medicine

Prime is a platform company whose process technology can swap out specific DNA letters, as well as edit out or add sequences of nucleotides. At the time of its IPO, the company was still in pre-clinical stage and did not yet have any public timeline for when it expects to begin its first human trials.

**Founded: 2019**

**HQ: MA, United States**

**Employees: 175**

**IPO at \$1.6B valuation | Oct 2022**



## Amylyx Pharmaceuticals

Amylyx is commercializing a drug for amyotrophic lateral sclerosis (ALS) treatment. Since its IPO, Amylyx's drug has been approved by the FDA for ALS treatment in adults. It is the first ALS treatment that was shown to extend survival and slow both disease progression and functional decline in a randomized clinical trial.

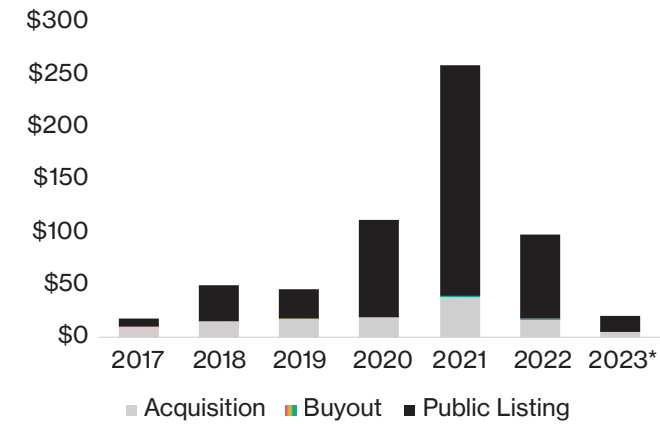
**Founded: 2013**

**HQ: MA, United States**

**Employees: 338**

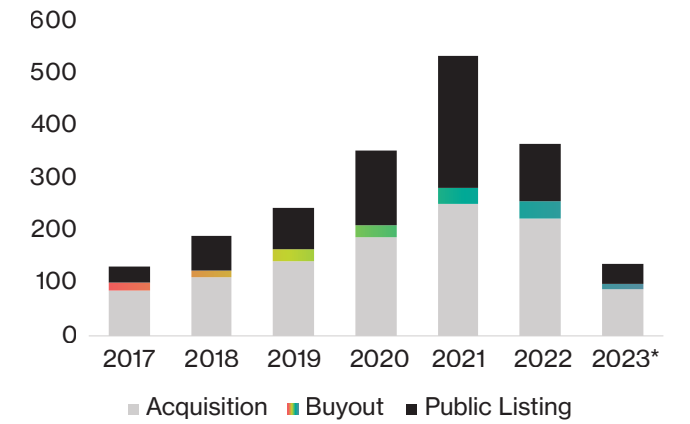
**IPO at \$1.1B valuation | Jan 2022**

## VC-backed Exits Value (\$B) by Type



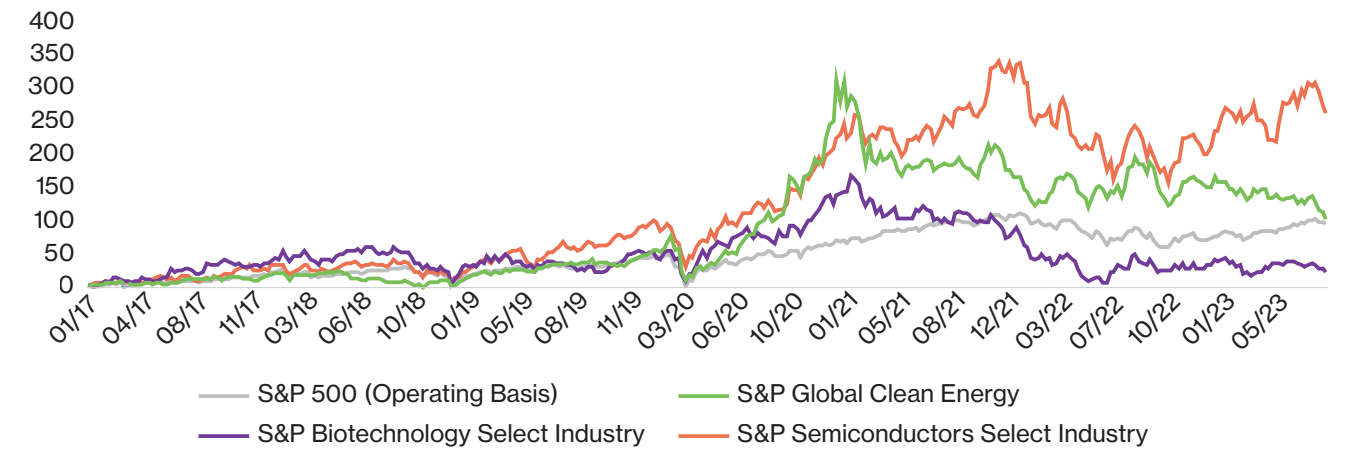
Source: PitchBook  
\*As of June 30, 2023

## VC-backed Exits Count by Type



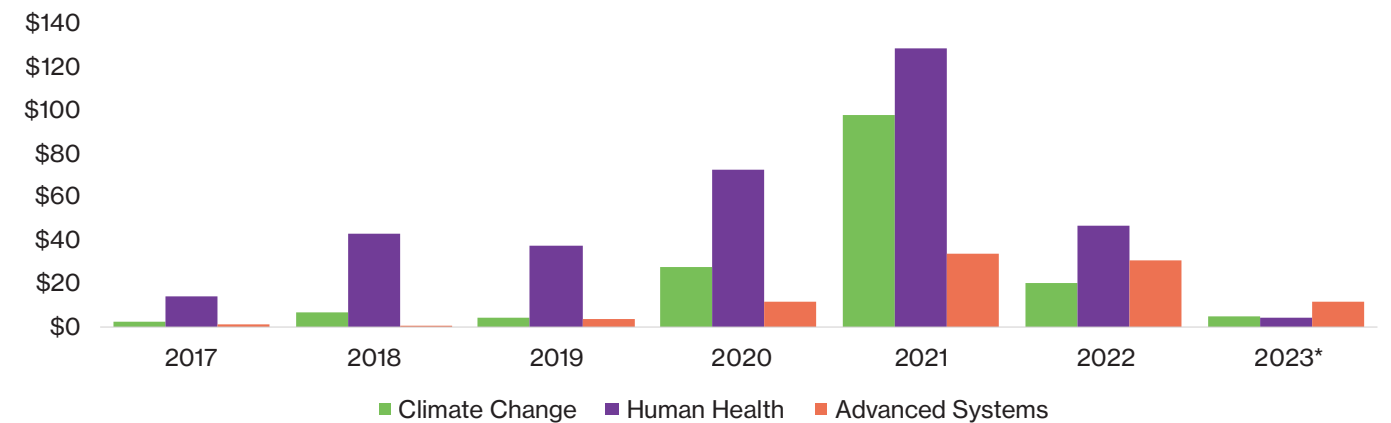
Source: PitchBook  
\*As of June 30, 2023

## Public Market Indexes (level % change relative to Jan 2017)



Source: FactSet

## VC-backed Exits Value (\$B) by Sector



Source: PitchBook  
\*As of June 30, 2023



# Climate

**W**

hile climate-related investment did not fully avoid the wider market contraction, venture funding in the sector has remained resilient as societal concern about the effects of climate change continues to grow in hand with related legislation including the Inflation Reduction Act. Overall, Climate funding was down 33% in H1 2023 vs. the year prior, however, we have seen stabilization and signs of potential rebound with Q2 2023 funding up 25% vs. the first quarter of 2023. Across funding stages, investments have proven quite resilient both in terms of deal sizes and valuations, although we have seen a relative decrease in the number of Series Seed and Series A financings with 28% and 20% decrease vs. H1 2022, respectively.

The mobility subsector saw the most significant outflow of investments with venture funding decreasing nearly 57% from H1 2022 to H1 2023 (and by over 80% from all-time high in H2 2021). This is likely a consequence of the increasing maturity of the sector, with both traditional automotive manufacturers and new entrants, including Rivian and Tesla, ramping up EV sales, which saw a 55% increase in 2022 alone. Despite this, several startups in alternative transportations have raised significant funding including in eVTOL (BETA Technologies \$411M Series B) or hyperloop technology (TransPod \$550M Series A).

Unlike mobility, companies working on energy storage and batteries have seen sustained funding until the first half of 2023 with a 11% year-over-year increase in the twelve month period ending in June 2023. This trend included companies innovating in lithium-ion batteries (Group14 \$614M Series C) as well as growing funding for grid-scale batteries (Form Energy \$450M Series E) and extended to companies addressing challenges in securing key materials, mainly in the form of lithium extraction (Lilac Solutions, \$150M Series B and EnergyX \$50M Series B) but also recycling of existing lithium-based batteries (Redwood Materials \$1B Series D, Acend Elements \$300M Series C).

The funding for clean energy generation also saw a sustained levels of funding led by photovoltaics manufacturing (mainly concentrated in Asia), but also due to the resurgence of nuclear energy (Newcleo \$318M Series Seed or Zap Energy \$163M Series C) or alternative power generators (Mainspring \$290m Series E).

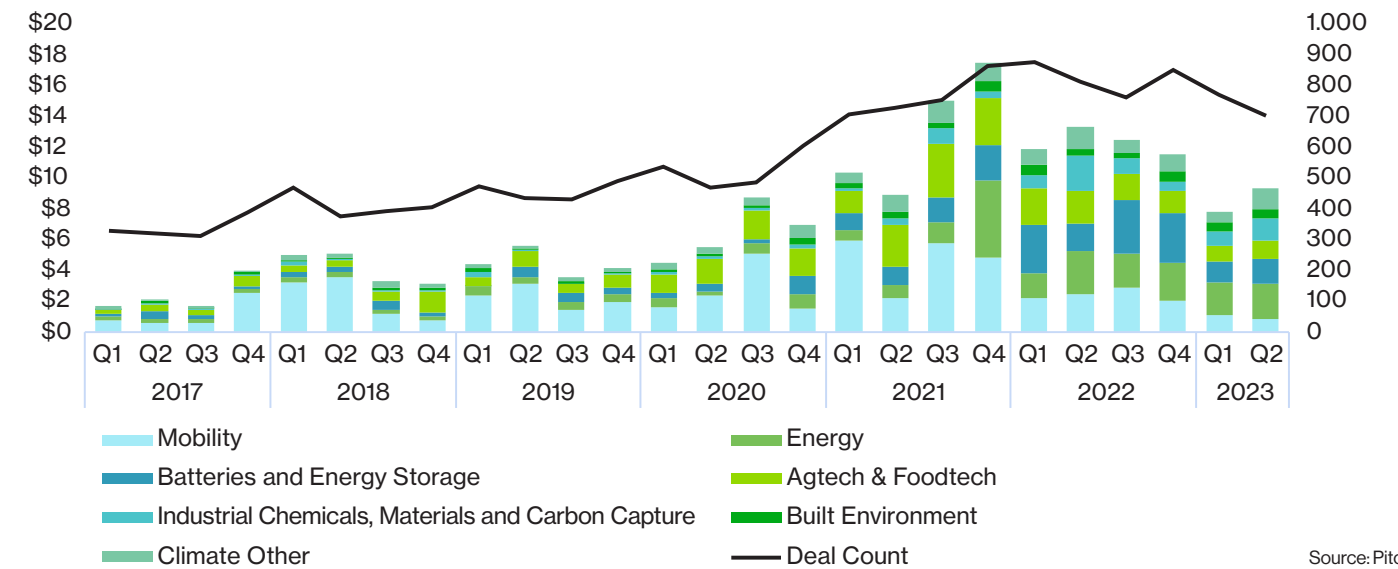
Food & AgTech, saw a significant outflow of investment, with some high profile challenges including in the synbio space (Zymergen and Amyris) and mixed performance of alternative proteins (incl. the stock performance of players like Beyond Meat). Despite these setbacks, we saw a number of financings for companies working on second generation of products in the alternative protein space (UPSIDE Foods \$400M Series C or Redefine Meat \$136M Series B), vertical farming (Plenty

\$400M Series E) or materials (MycoWorks \$125M Series C).

Within Industrial Chemicals, a number of scalable approaches to decarbonization, ranging from sustainable aviation fuels (SAFs) to ammonia and carbon capture have received increasing attention. CO<sub>2</sub>-derived SAF has seen a number of large investments (Twelve \$130M Series B, Air Company \$30M Series A) with additional investments in methanol from CO<sub>2</sub> (Carbon Recycling International \$30M Series). Alternative low-carbon fuels for maritime shipping have also produced significant investment, for example, development of ammonia-powered engines (Amogy \$139M Series B). Carbon Capture, although under development for a long period of time, has only now begun to feature prominently in the data (Climeworks \$634M Series F or Carbon Engineering acquisition by Occidental Petroleum for \$1.1B). It is worth noting that both companies have received \$1.2B in funding from the US Department of Energy to build 1 Mt/y DAC hubs.

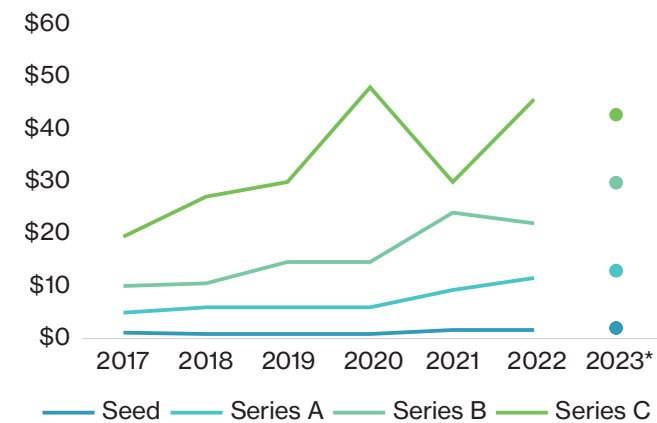
The built environment decarbonization saw a sustained growth in the period between 2021 and 2023. Significant portion of investments went into decarbonization of the key materials: steel (H2 Green Steel \$4.7B Series B, Boston Metal \$120M Series C) and cement (Carbon Cure \$80M Series F, Brimstone \$55M Series A or Sublime Systems \$40M Series A). Other investments included energy efficient buildings or new energy sources (DcbeL \$70M Series B, Dandelion Energy \$70M Series B).

**Climate Change VC Investment Activity (\$B, Deal Count)**



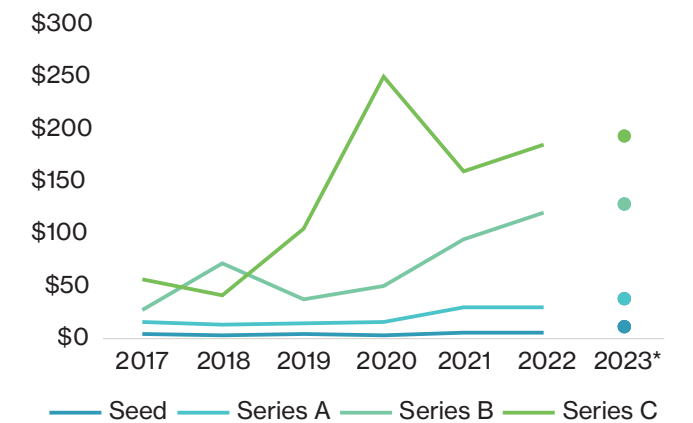
Source: PitchBook

**Climate Change Median Deal Size (\$M) by Series**



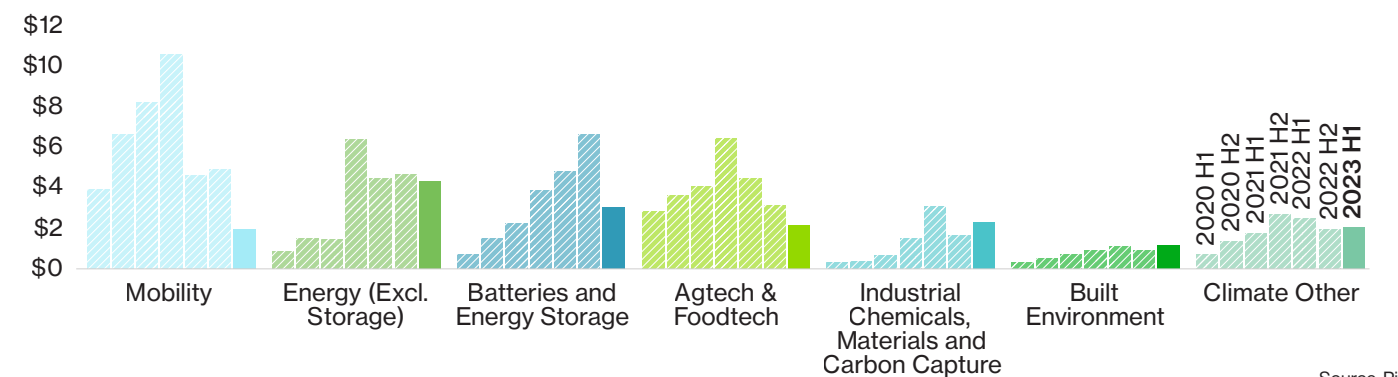
Source: PitchBook  
\*As of Jun 30, 2023

**Climate Change Median Pre-Money Valuation (\$M) by Series**



Source: PitchBook  
\*As of Jun 30, 2023

**Climate Change VC Investments (\$B) by Sub-Sector**



Source: PitchBook

# Company highlights

## Svante

### Svante

Developer of solid adsorbent-based, point-source carbon capture technology to remove carbon dioxide from post-combustion industrial and power plant flue gas streams. Collaboration with BASF to facilitate industrial scale production of the novel adsorption technology. Published data shows remarkable stability to harsh flue gas environments as well as efficient cycling. Additional innovation related to gas stream/sorbent contactor design, temperature control.

Founded 2007, Burnaby, BC, Canada

\$447M raised to date

\$318M Series E (December 2022)



### Redwood Materials

Developer of sustainable battery recycling technology to enable closed-loop recycling of key battery minerals. Enables 95% recovery of key battery elements for return to US battery manufacturers, with expected production by 2025 of 100 GWh worth of recycled battery storage.

Founded 2017, Carson City, NV

\$4.0B raised to date

\$1.0B Series D (August 2023)



### Amogy

Developer of ammonia-fueled engines to decarbonize long-range maritime shipping. Enables conversion of ammonia into nitrogen and hydrogen for fuel-cell-powered, emissions-free power generation. Successfully completed initial prototype and signed deal with a major shipping company to supply 800 kW worth of ammonia-based power.

Founded 2020, New York, NY

\$219M raised to date

\$139M Series B (March 2023)



### Form Energy

Developer of iron-air batteries for long-term, grid-scale energy storage. Provides up to 100 hours of energy storage at costs similar to legacy power plants.

Founded 2017, Somerville, MA

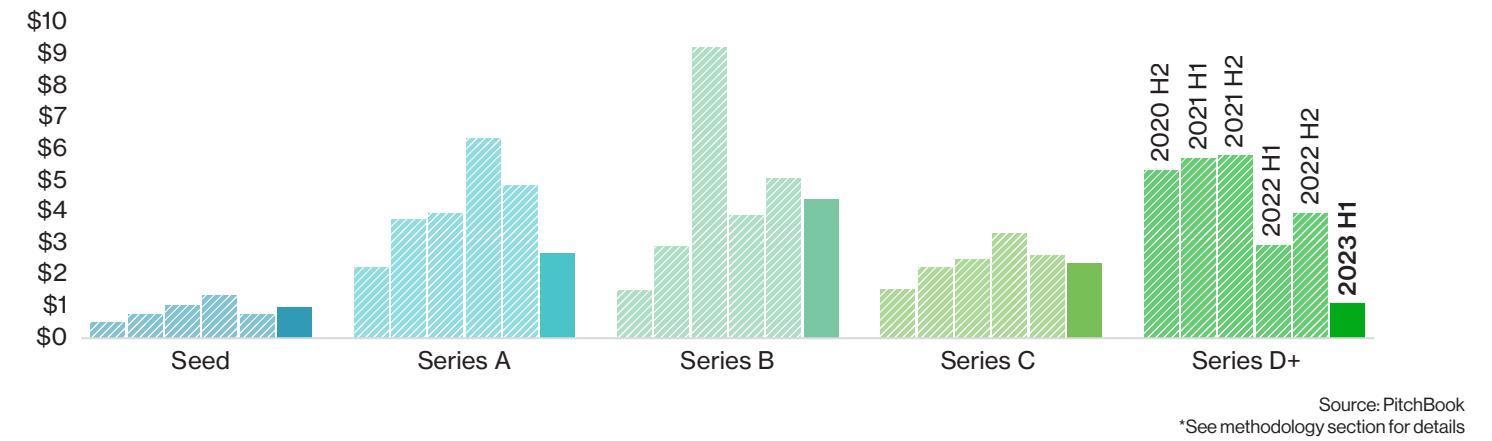
\$816M raised to date

\$450M Series E (October 2022)

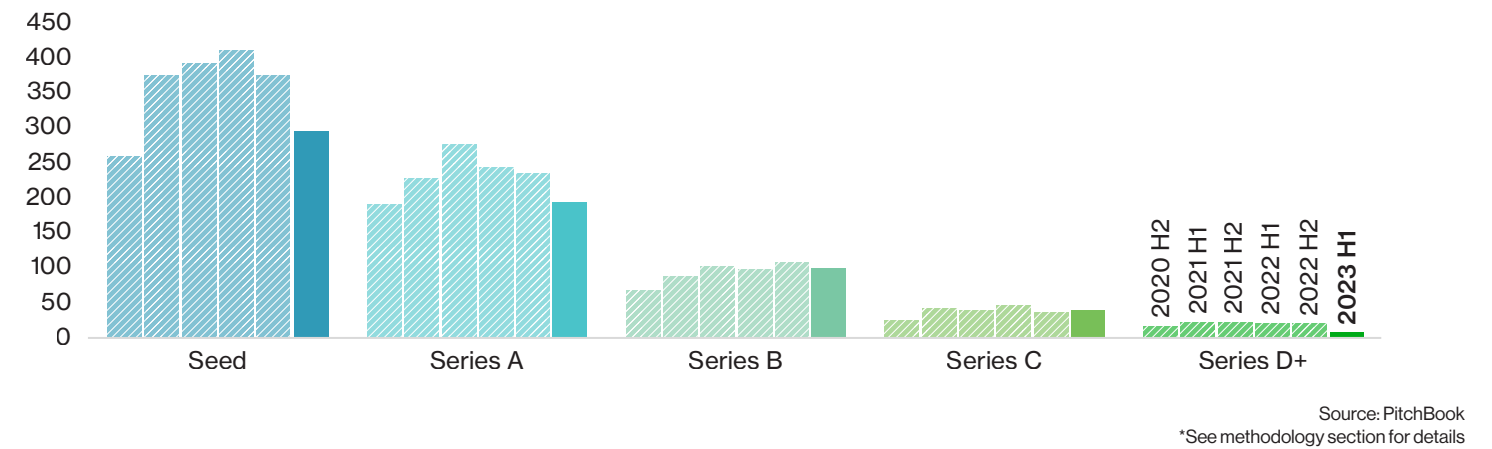
## Other selected financing 01/22 - 06/23

Company name	Segment	Deal	Close Date	Founded	Headquarters
Climeworks	Industrial Chemicals, Materials and Carbon Capture	\$634M Series F	Apr-22	2009	Zurich, Switzerland
Group 14 Technologies	Batteries and Energy Storage	\$614M Series C	Dec-22	2015	Woodinville, WA
Crusoe	Climate Other	\$505M Series C	Apr-22	2018	Denver, CO
First Light	Energy (excl. Storage)	\$480M	Aug-22	2013	Edina, MN
BETA Technologies	Mobility	\$411M Series B	Apr-22	2012	South Burlington, VT
Plenty	Food & AgTech	\$400M Series E	Jan-22	2013	South San Francisco, CA
UPSIDE Foods	Food & AgTech	\$400M Series C	Apr-22	2015	Berkeley, CA
Gokin Solar	Energy (excl. Storage)	\$371 Series B	Aug-22	2019	Stockholm, Sweden

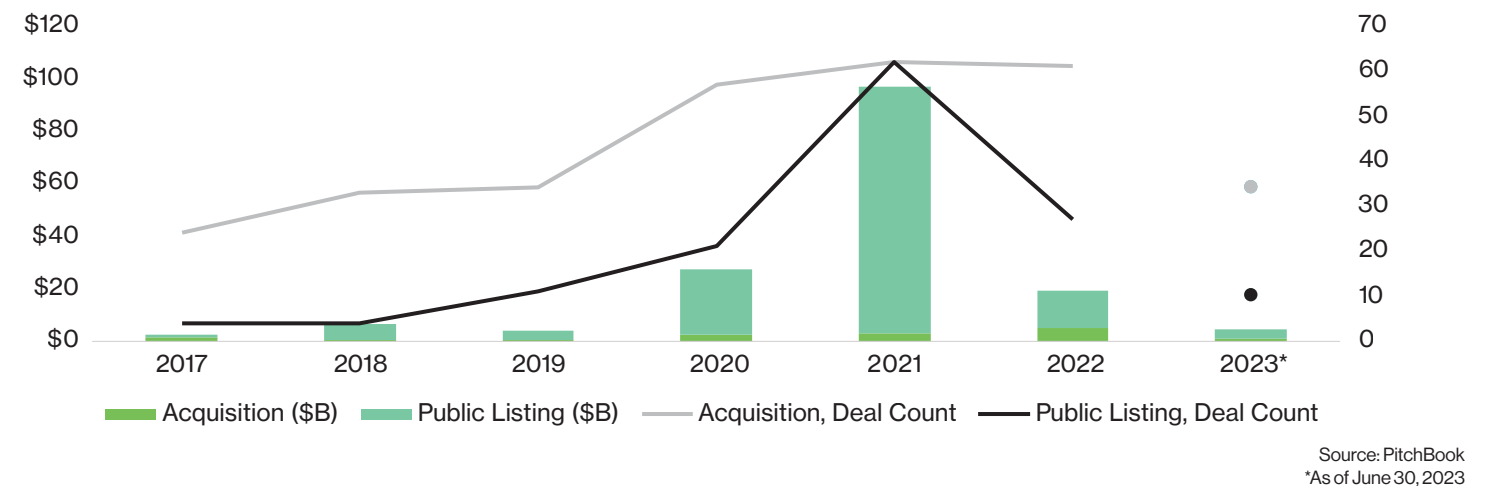
## Climate Change VC Investments (\$B) by Series\*



## Climate Change VC Investments Deal Count by Series\*



## Climate Change VC-backed Company Exits (\$B)



# Human Health

The venture activity in Human Health accelerated significantly in the late 2020 and early 2021 in part due to the industry's pivotal role in the response to the COVID-19 pandemic. With the influx of general investors into the Human Health sector, the venture investments peaked in 2021 with \$20B invested in Q2 2021 alone. This run up was followed by approximately 50% drop in investment activity through the second half of 2022, a level that was sustained into 2023. It is encouraging to see that the funding levels have stabilized over the last 4 quarters, with some early signs of recovery including a number of public listings planned for the latter half of 2023.

Although the full impact still remains to be seen, the effect of Inflation Reduction Act, while highly positive for the Climate Change sector, is posing headwinds for part of the biopharmaceutical industry that industry players are pushing back on.

The overall decline in investment activity has been seen across investment stages but more pronounced at later stages (Series C+) driven by both fewer deals and smaller deal sizes at lower valuations. Early stage investments have proven more resilient: while there was a decline in number of deals in both Series Seed and Series A rounds, the deal sizes have stayed

relatively steady with valuations up by 14% and 4%, respectively, in the first half of 2023.

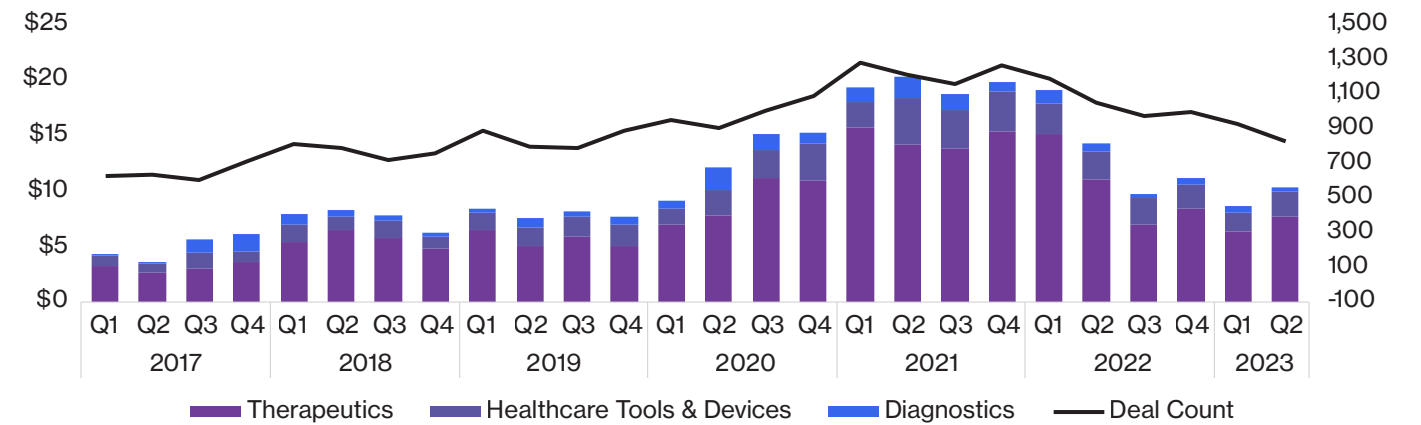
Among the 3 main sectors within Human Health, Diagnostics have seen the most dramatic decline. Following a strong investment period during the COVID pandemic, the funding in diagnostics have decreased by close to 60% in H1 2023 vs. H1 2022. Despite the relatively low investment activity, companies focusing on diagnosis of complex diseases have continued to attract significant funding, including companies in the oncology space such as Freenome (\$300M Series D) or BillionToOne (\$125M Series C).

Therapeutics represent the bulk of investments in the Human Health sector. Since the peak in investments in the first half of 2021, the investment activity has returned to approximately early 2020 levels with nearly \$30B invested in the second half of 2022 and first half of 2023 combined. Despite the limited exits, we have seen large rounds for companies in the gene therapy space (Kriya Therapeutics \$430M Series C, ElevateBio \$401M Series D, ReNagade Therapeutics \$300M Series A, or Tessera Therapeutics \$300M Series C) but also in the manufacturing space (Cellares \$255M Series C Resilience \$625M Series D) and increasingly in cardiovascular (Bitterroot Bio \$145M Series A, Cardurion \$300M Series A) and neuro space (Rapport Therapeutics \$150M Series B).

Healthcare tools and devices has seen a continued investment in neurological devices (Neuralink \$280M Series D, Saluda Medical \$150M Series E) but also in wearable and patient monitoring devices (AliveCor \$150M Series F, Biolinq \$115 Series B) and medical robotics (Distalmotion \$155M Series F and Noah Medical \$150M Series B).

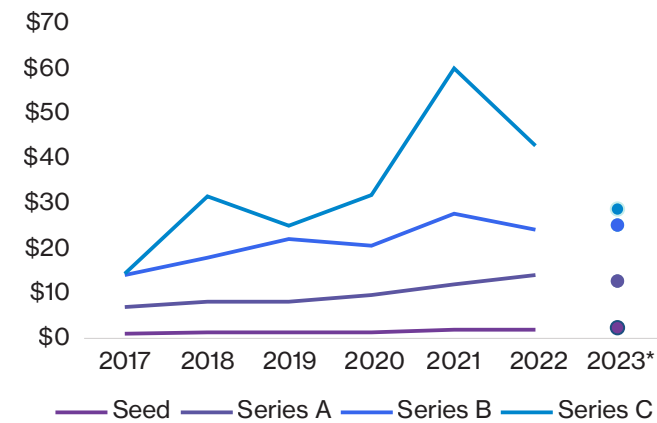
Despite the contraction in venture funding, the recent successes in treatments of metabolic diseases and diabetes - including the rapid ascent of GLP-1 agonists - and early signs of progress in neurodegenerative diseases combined with ongoing innovation in biomedical sciences are positive indicators for the future of the Human Health sector.

Human Health VC Investment Activity (\$B, Deal Count)



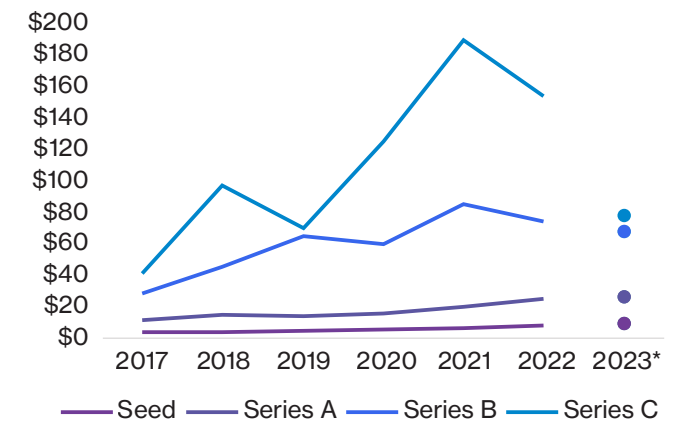
Source: PitchBook

Human Health Median Deal Size (\$M) by Series



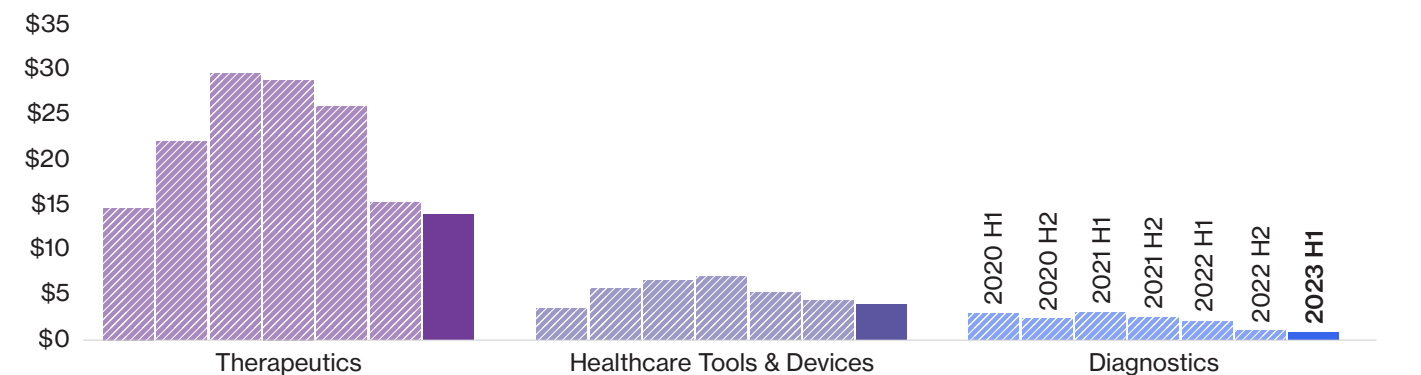
Source: PitchBook  
\*As of June 30, 2023

Human Health Median Pre-Money Valuation (\$M) by Series



Source: PitchBook  
\*As of June 30, 2023

Human Health VC Investments (\$B) by Sub-sector



Source: PitchBook

# Company highlights

**Metagenomi**

**Metagenomi**  
Developer of next-generation genome editing therapeutics through exploration of natural diversity and metagenomics. The company employs AI enabled collection and analysis of the genetic code of various organisms found in natural microbial environments to create the largest library of next-generation CRISPR nucleases.

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Founded 2016, Emeryville, CA

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\$390M raised to date

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\$275M Series B (Jan 2023)

**CELLARES**

**Cellares**  
Developer of a cell therapy manufacturing platform intended to make cell therapy widely available and affordable. The company's product delivers end-to-end automation in a closed system, enabling biotech businesses to lower cost, accelerate market entry, and reduce the vein-to-vein time of their manufacturing processes.

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Founded 2019, San Francisco, CA

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\$355M raised to date

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\$255M Series C (Aug 2023)

**saluda MEDICAL**

**Saluda Medical**  
Developer of closed-loop neuromodulation devices intended to treat chronic neuropathic pain. The company's devices are used for the patient's own neural fingerprint to monitor and adapt the dose of electrical stimulation automatically and tailor the therapy to meet each individual patient's needs in real-time, enabling patients with chronic back pain to get improved treatment.

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Founded 2013, Artarmon, Australia

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\$412M raised to date

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\$150M Series E (Apr 2023)

**freenome**

**Freenome**  
Developer of a multi-omics platform designed to detect cancer at an early stage through a routine blood draw. The company's platform uses a proprietary algorithm method that aims to reinvent disease management through systematized early detection and intervention of disease screenings, enabling doctors to treat cancer and other diseases at manageable stages.

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Founded 2014, San Francisco, CA

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\$808M raised to date

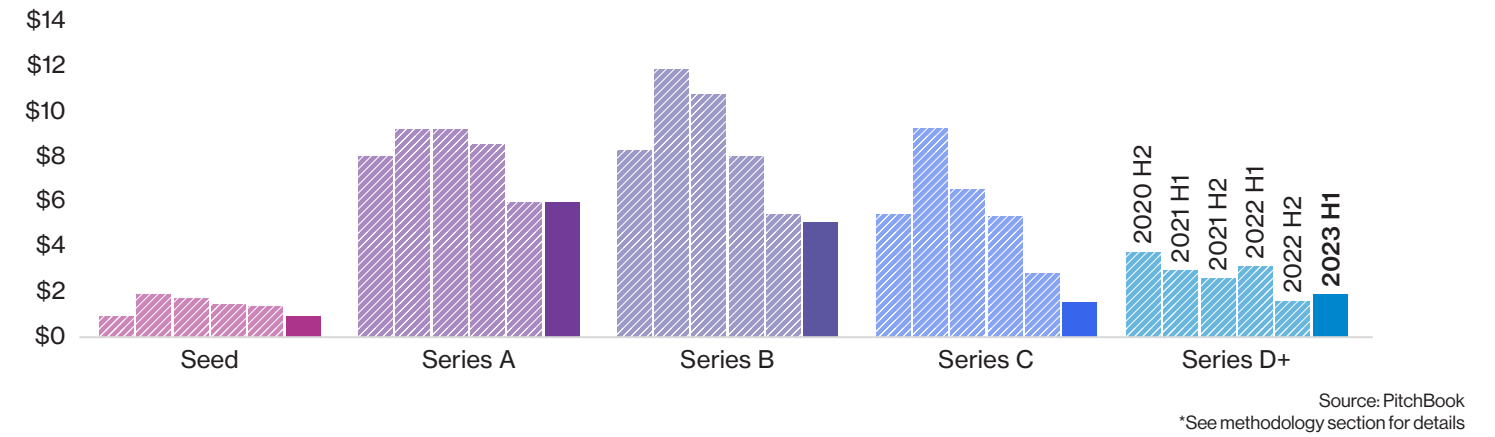
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\$300M Series D (Jan 2022)

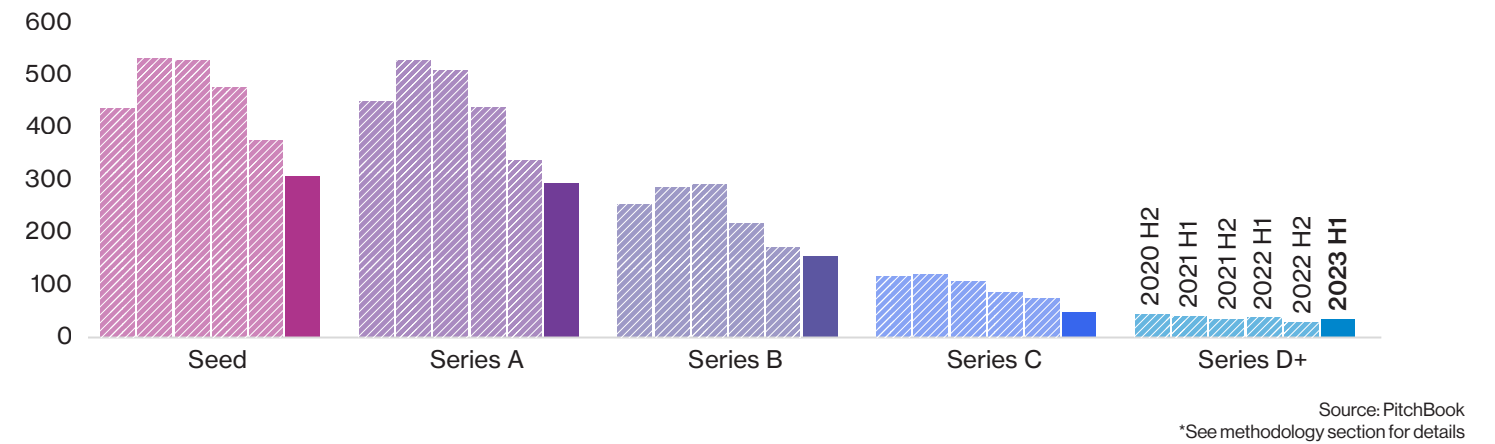
## Other selected financing 01/22 - 06/23

Company name	Segment	Deal	Close Date	Founded	Headquarters
<b>Ailomics Therapeutics</b>	Therapeutics	\$888M Seed	Ago-22	2022	Shanghai, China
<b>Resilience Resilience Technologies</b>	Therapeutics	\$625M Series D	Jun-22	2020	La Jolla, CA
<b>Eikon Therapeutics</b>	Therapeutics	\$140M Series C	Jun-23	2019	Hayward, CA
<b>ElevateBio</b>	Therapeutics	\$401M Series D	May-23	2017	Waltham, MA
<b>Areteia Therapeutics</b>	Therapeutics	\$350M Series A	Jul-22	2022	Chapel Hill, NC
<b>Megarobo</b>	Healthcare tools & devices	\$300M Series C	Jun-22	2016	Beijing, China
<b>ReNAGade Therapeutics</b>	Therapeutics	\$300M Series A	May-23	2020	Cambridge, MA
<b>Orbital Therapeutics</b>	Therapeutics	\$270M Series A	Abr-23	2022	Cambridge, MA

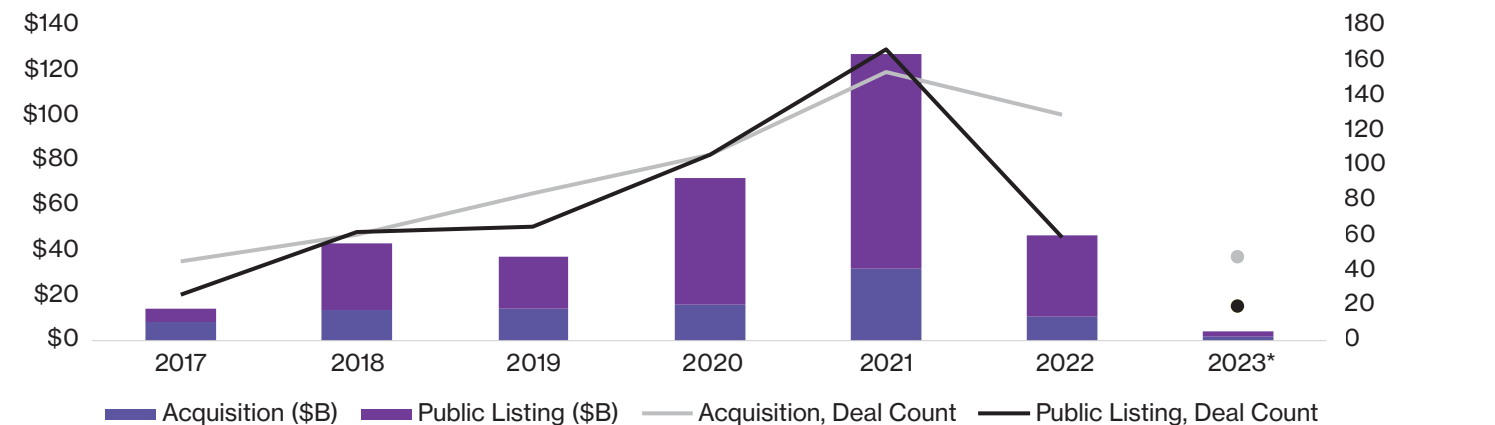
## Human Health VC Investments (\$B) by Series\*



## Human Health VC Investments Deal Count by Series\*



## Human Health VC-backed Company Exits (\$B)



# Advanced Systems



The Advanced Systems sector has seen a pattern similar to the other Tough Tech sectors - a peak in investment

activity in late 2021, followed by a return to approx. 2020 levels of funding, with combined \$16.3B invested over the second half of 2022 and first half of 2023.

The overall number of deals has declined slightly since the peak in Q4 2021 (down by 13% in H1 2023 vs. H1 2022). Interestingly, the capital deployed has declined to a similar extent across both early stages and later stages (i.e., Series Seed through Series C) with a major drop in funding in growth rounds (Series D+). While median deal sizes have remained relatively constant, valuations in both early and later stages declined significantly over the last year (Series C valuations down 35% YoY in H1 2023).

Interestingly, exits have proven more resilient in Advanced Systems with value and number of public listings between 2022 and 2021 down only 2.5% and 11% respectively, noting that the majority of public listings in this sector have taken place in Asia.

Semiconductor and advanced compute companies have represented the bulk of investments in this sector. On the backdrop of the ascent of AI compute and Nvidia's dominance in this sector, we

have seen a relative decrease in later stage rounds for application-specific integrated circuits (Tenstorrent \$100M Series D) and more funding for innovative approaches in photonics (Lightmatter \$153M Series C, Celestial AI \$100M Series B, Ayar Labs \$130M Series C). A significant number of investments were also related to manufacturing, mainly taking place in Asia.

Within the advanced manufacturing, a number of companies have continued to attract funding including automobile production (Divergent \$160M Series C), assembly (Bright Machines \$132M Series B), and robotics (Flexiv \$100M Series B), including humanoid robotics (Agility Robotics, \$150M Series B or Figure \$79M Series A) focusing on autonomy and AI enablement.

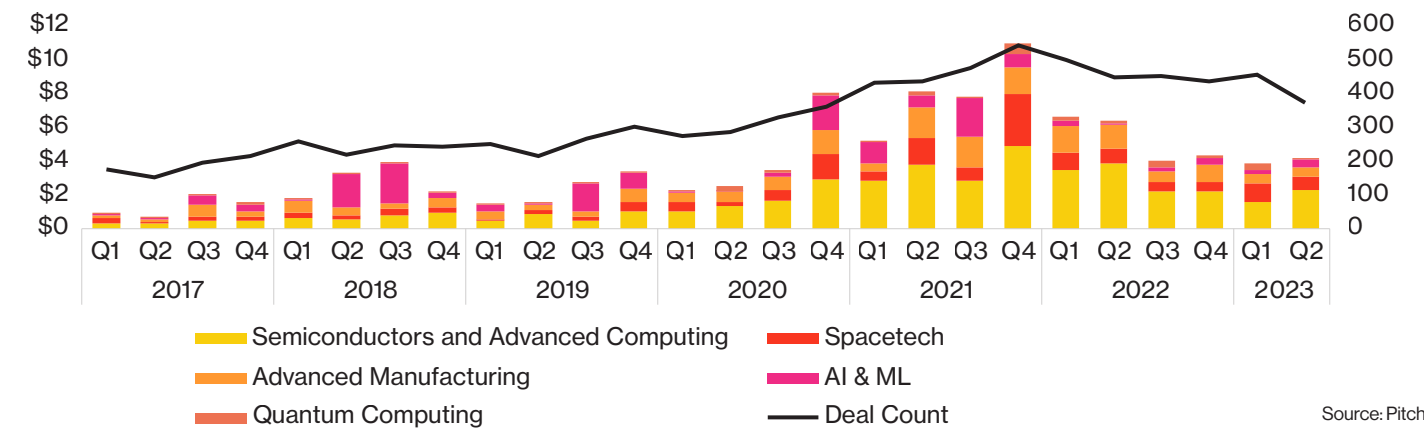
Spacetech has seen a relatively strong levels of funding with a large number of financing for satellite companies (e.g., ICEYE \$136M Series D and Capella Space \$97M Series C) in contrast to relative pullback in launch companies (Isar Aerospace \$165M Series B) as launch companies have to compete with the market leader SpaceX. The appetite for space investments was highlighted by Axiom Space \$350M Series C for the development of a commercial space station.

Although AI has captured a large share of public discourse as well as venture funding overall, developing core Tough Tech AI/ML technologies have seen a decrease

in funding. We attribute this largely to focus on consumer technologies and enterprise solutions with companies often looking to build on top of foundational models developed by large players such as Open AI, Meta or Google (\*we note that the \$10B Open AI funding round was excluded from the analysis).

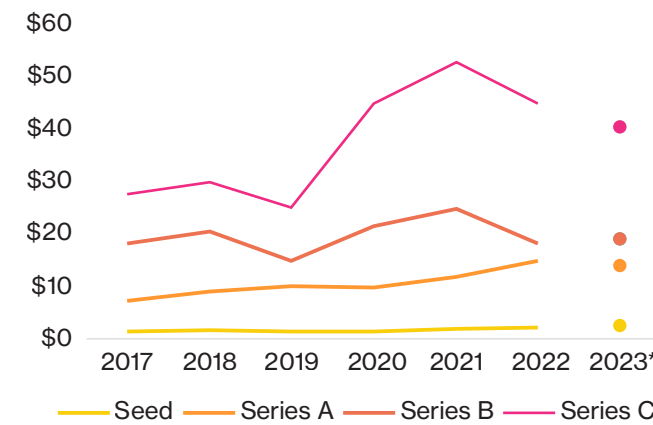
Lastly, Quantum Computing, although relatively a small sector within advanced systems, has seen a steady growth in funding levels, with the largest recent rounds going to both software (SandboxAQ \$500M Series D) and hardware companies (IQM \$131M Series A or Pasqal \$107M series B).

Advanced Systems VC Investment Activity (\$B, Deal Count)



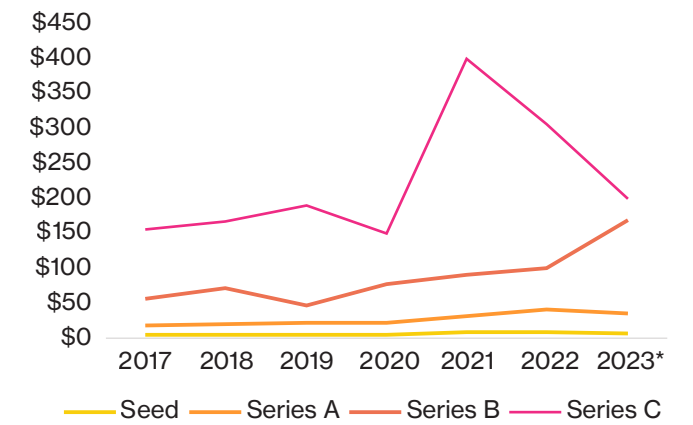
Source: PitchBook

Advanced Systems Median Deal Size (\$M) by Series



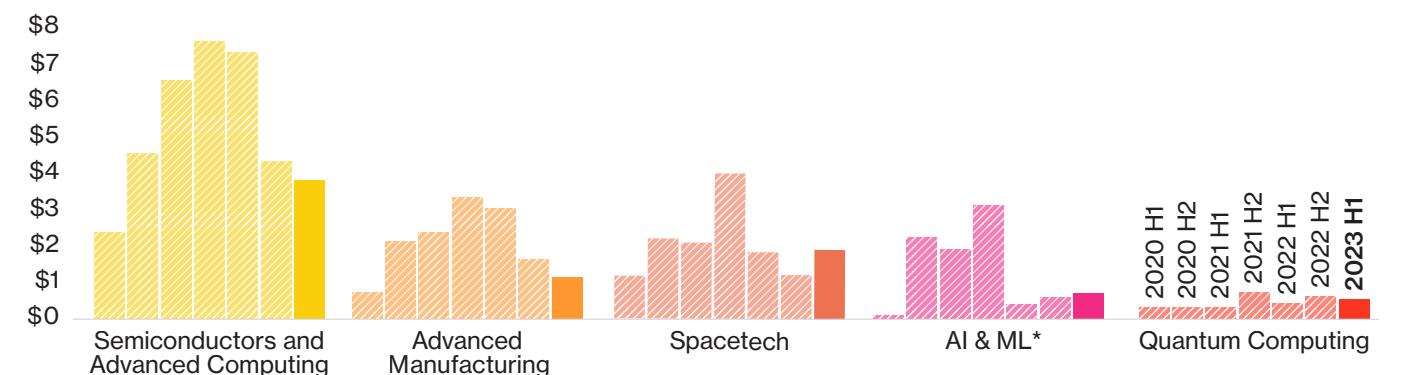
Source: PitchBook  
\*As of June 30, 2023

Advanced Systems Median Pre-Money Valuation (\$M) by Series



Source: PitchBook  
\*As of June 30, 2023

Advanced Systems VC Investments (\$B) by Sub-sector



Source: PitchBook  
\*Excludes \$10B funding round for Open AI. See more details in Methodology section for AI/ML classification

# Company highlights

## celestial AI

### Celestial AI

Developer of an optical connectivity platform for memory and computing. Combining photonics, high-speed mixed signal design, and packaging, their Photonic Fabric™ can deliver data not restricted by the package beachfront.

Founded 2020, Santa Clara, CA

\$163M raised to date

\$100M Series B (Apr 2023)



### Agility Robotics

Developer of bipedal walking robots designed to offer efficient, agile and robust legged platforms for real-world applications. The company's robots offer human-like capabilities that allow them to work with and alongside people to perform simple tasks with minimal or no additional programming, without modifying offices, factories, or homes.

Founded 2015, Pittsburgh, PA

\$178M raised to date

\$150M Series B (Apr 2022)



### ICON

Developer of innovative construction technologies, deploying 3D printing robotics, software and advanced materials to build 3D homes on Earth and beyond.

Founded 2017, Austin, TX

\$443M raised to date

\$392M Series B (February 2022)



### Isar Aerospace

The company's technology develops launch vehicles dedicated to deploying and resupplying satellite constellations and ensuring low-cost and flexible space access for small satellites, enabling clients to have an environmentally friendly answer for propelling both small launchers and upper-stage vehicles.

Founded 2017, Ottobrunn, Germany

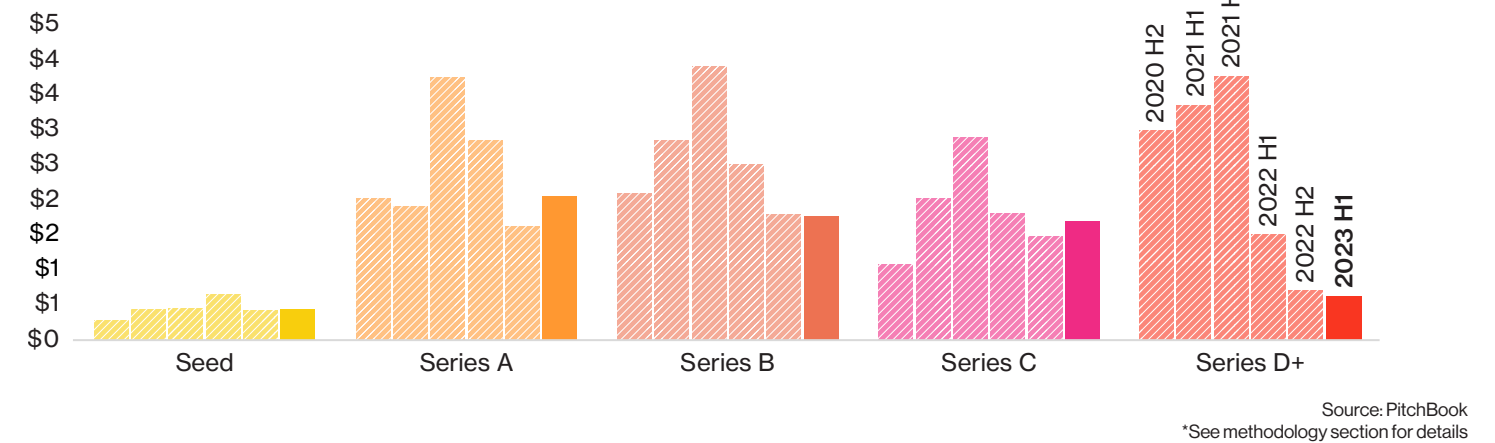
\$350M raised to date

\$165M Series C (March 2023)

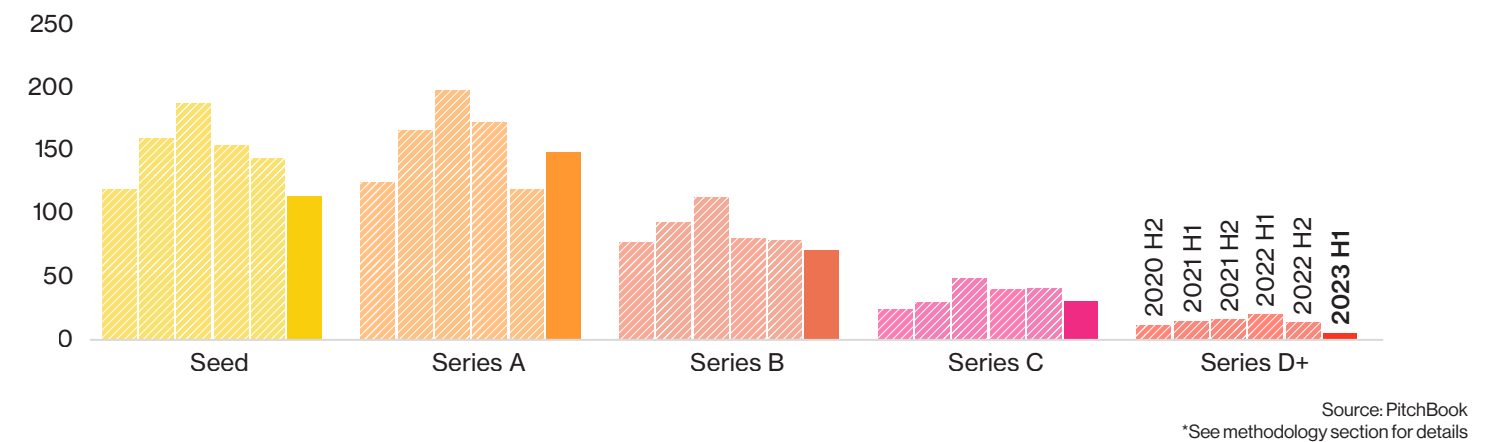
## Other selected financing 01/22 - 06/23

Company name	Segment	Deal	Close Date	Founded	Headquarters
CanSemi	Semiconductors	\$671M	Jun-22	2017	Guangzhou, China
ESWIN Material	Semiconductors	\$423M Series D	Jun-23	2016	Xi'an, China
Sandbox AQ	Quantum Computing	\$500M Series D	Mar-22	2016	Tarrytown, NY
InnoScience	Semiconductors	\$471M Series D	Feb-22	2015	Zhuhai, China
ExPace Technology	Spacotech	\$248M Series B	Abr-22	2016	Wuhan, China
Ambiq	Semiconductors	\$194M Series F	Feb-22	2010	Austin, TX
SiFive	Semiconductors	\$175M Series F	Ene-22	2015	Santa Clara, CA
Divergent	Advanced Manufacturing	\$100M Series D	Dic-22	2013	Torrance, CA

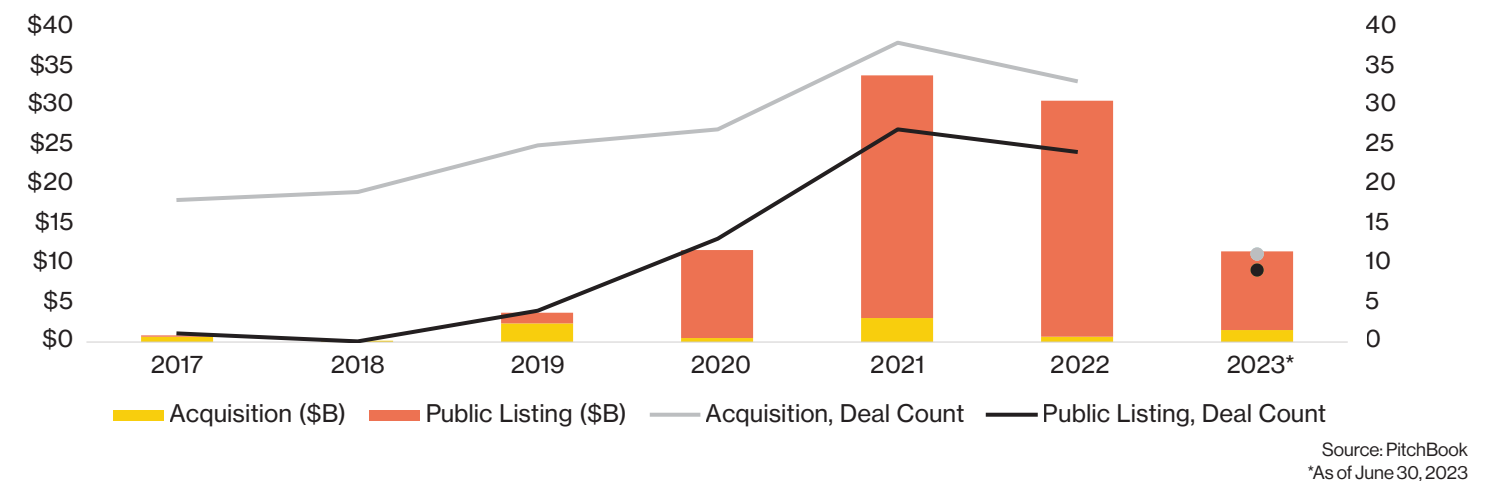
## Advanced Systems VC Investments (\$B) by Series\*



## Advanced Systems VC Investments Deal Count by Series\*



## Advanced Systems VC-backed Company Exits (\$B)





The datasets underlying this report were derived from the PitchBook Platform. In order to define Tough Tech, Engine Ventures and PitchBook constructed sixteen verticals that were deemed to comprise Tough Tech in its entirety via custom searches in the PitchBook Platform that employed a combination of keywords, industries and verticals.

From there, each custom search was reviewed to add in or exclude companies as well. The full list of sixteen subverticals are as follows: Built Environment; Chemicals, Materials & Carbon Tech; Energy Generation & Distribution; Batteries and Energy Storage; Mobility; Agtech & Foodtech; Climate Other; Therapeutics; Diagnostics; Healthcare Tools & Devices; Semiconductors and Advanced Computing; Quantum Computing; Advanced Manufacturing; Artificial Intelligence & Machine Learning; Spacetech. In addition, two limiting criteria were utilized: founding date of the company was on or after January 1, 2009 and the date range of the financings included for analysis of overall transactions was between and inclusive of January 1, 2012 and June 30, 2023.

For AI/ML categorization, we included companies innovating in core AI/ML areas, but aimed to exclude companies focusing primarily on enterprise software or building of AI/ML infrastructure. All hardware-

focused companies were included under Semiconductors and Advanced Computing. We excluded the \$10B financing of Open AI, which, although part of the Tough Tech sector, significantly altered the observed trends. This financing was also atypical for a venture round given that Microsoft was the only investor in addition to the round being likely realized largely in the form of computing credits and over multiple years.

We note that not all funding rounds have an associated Series designation (Seed, A, B, etc.) and, as a result, the sums across all Series do not add up to the totals within each sector or for Tough Tech as a whole.

Beyond this, PitchBook's customary methodology for venture datasets was utilized. For details, see the full list of PitchBook report methodologies here <https://pitchbook.com/news/articles/pitchbook-report-methodologies> Please note that definitions of subsegments, and the introduction of the main segments, precipitated an update in the methodology from that used to generate the inaugural 2021 Tough Tech Investment Report.

Steel production is eight percent of global CO2 emissions. | **Green steel with zero greenhouse gas emissions.** | Biologic therapies are hard to discover and make. | **Rapid discovery and printing of new proteins.** | Unsolvable computational challenges. | **Tackling the world's hardest computational challenges with scalable quantum computers.** | One quarter of all greenhouse gas emissions are from energy production. | **Safe, unlimited, carbon-free fusion power.** | Progressive neurodegenerative diseases. | **Pacemakers for the brain.** | Silicon inefficiency limits electronic capabilities. | **Advanced materials for 5G chips.** | Inefficient ammonia production leads to increasing CO2 emissions. | **Low-cost zero-carbon ammonia synthesis for chemical production.** | Unidentified public health problems. | **Sewage analysis for earlier detection.** | Global data centers are at their limit. | **Ultra-low-power high speed networks.** | Deforestation. | **Laboratory-derived wood products.** | Lack of cures for common diseases. | **Growing healthy human tissues.** | Molecular information is unreadable. | **Miniaturized sensing solutions.** | A 100% renewable grid requires on-demand energy access. | **Low-cost multi-day energy storage.** | High rates of residual cancer. | **Nuanced, proximal post-surgical diagnostics.** | Artificial intelligence is limited by computing power. | **Data moved by photons not electrons.** | Electric vehicles limited by lack of lithium. | **Quick, efficient, and sustainable lithium extraction.** | Treatments for neurodegenerative diseases remain elusive. | **Mitochondrial-based approach to treat diseases of the brain.** | Old materials don't work for new manufacturing techniques. | **Enabling materials for the next generation of industrial innovation.** | Carbon capture systems are inefficient. | **Novel materials to help decarbonize the most problematic industries.** | Single-stranded DNA is hard to produce, but medically powerful. | **Scalable process for precision genome editing.** | Rising traffic congestion and transpiration costs | **Utilizing AI to make public transit more reliable and accessible.** | Industrial gas purification produces 16% of the world's carbon emissions. | **Membrane technology to retrofit existing infrastructure.** | A third of global food produced is wasted. | **A natural coating to reduce spoilage and packaging waste.** | Charging cables are a drag on electrification. | **More efficient wireless charging, over longer distances.** | Expensive feedstock bottleneck. | **Enabling low cost abundant feedstock for biomanufacturing.** | Cellular therapies are time-consuming and expensive to commercialize. | **Automated cell engineering.** | Every day globally there are over 4,000 deaths attributed to automobiles. | **Better imaging and sensing in all weather conditions using new frequency ranges.** | Current technologies can't transition us fully from fossil fuels. | **Millimeter wave drilling systems will unlock more geothermal energy.** | Topical products like sunscreens are harmful for the environment and our health. | **New multifunctional bio-inspired materials.** | Cloud computing is massively inefficient. | **Eliminate guesswork to optimize infrastructure.** | Cement contributes 8% of global CO2 emissions. | **Cost-effective, zero-carbon cement using renewable electricity.** | Common health conditions still have limited treatment options. | **New drug delivery mechanism.** | Heavy machinery is difficult to electrify. | **Replace hydraulics with energy efficient substitutes.** | Chemical manufacturing emits massive amounts of CO2. | **Catalyze reactions with electric light instead of fossil-fuel-burning heat.** | Vaccines are hard to transport and not maximally effective. | **A shelf-stable patch with better delivery capability.** | Supply chain gaps from a truck driver shortage. | **Self-driving trucks at warehouses and factories.** | Industrial thermal separations account for 12% of all U.S. energy consumption. | **Decarbonize every industrial process.** | Cell-targeted approaches to fighting cancer are coming up short. | **Therapeutic platform targeting diseased extracellular matrix for higher specificity.** | The housing industry is in a general resource crisis. | **Change how we design and construct our world.** | Current electricity infrastructure is insufficient for a decarbonized world. | **Superconducting cables transmit 5x more power with no new towers.** | Today we can not understand how our brain works. | **A new approach to understand the brain.** | Fossil fuel by-products burned into the air. | **Mini-plants make useful chemicals from waste.** | ...and more Tough Tech challenges that need solutions. |





**We invest in Tough Tech founders.**

Engine Ventures invests in the next generation of Tough Tech founders: providing capital, operational expertise, and a powerful academic, commercial, and governmental network to build and scale companies unlocking massive opportunities in climate, human health, and advanced systems & infrastructure.