

State of Climate Tech 2021

Scaling breakthroughs for net zero

Foreword

For all the progress of the 2021 United Nations Climate Change Conference (COP26), there is one conclusion that is hard to dodge. The world has got a mountain to climb. In the analysis of PwC's [2021 Net Zero Economy Index](#), to avoid more than 1.5°C of warming, the world now has to decarbonise at 12.9% a year, over eight times the rate historically achieved since 2000. With the global economy, based on COP26 2030 targets, on a glide path to producing an estimated 2.4°C of warming, the fundamental analysis of the Intergovernmental Panel on Climate Change (IPCC) that this is 'code red for humanity' remains unchanged.



Leo Johnson

Disruption & Innovation Leader, Partner,
PwC United Kingdom

How does society plug this gap? As the COP26 process highlighted, with its focus on breakthrough technologies, there's mounting recognition that a new generation of climate innovations will have a key role to play in accelerating decarbonisation, delivering business models that have the potential to radically decarbonise carbon-intensive sectors, including the transport, energy, industry and food nexus that together constitute over 50% of global carbon emissions.

We are seeing a rapid, dramatic increase of interest in climate tech start-ups—a new generation of innovators leveraging these technologies to shake up high-carbon business models ripe for disruption — but the challenge is scale. Most critical, for many start-ups, is getting hold of the funding they need to escape the 'valley of death,' where the innovator is too big for angel capital but too high-risk for commercial lending. It's in this space that venture capital (VC) plays a critical catalytic role.

[PwC's 2020 State of Climate Tech](#) report highlighted the rapid increase in the climate tech market, booming from US\$418m globally in 2013 to US\$16.3b in 2019, rising more than 3,750% in only seven years. This year's report sees a further acceleration, with the average size of climate tech deals nearly quadrupling in the first half of 2021 and over 200% growth in terms of total volumes year on year. As Larry Fink, CEO of BlackRock, has commented, the next billion-dollar start-ups will be in climate tech.

But as we look to decarbonise at speed and scale, it's crucial that we also identify the commercially viable climate tech opportunities that aren't yet picking up the capital. For the first time this year, our analysis also looks at the carbon funding gap, the climate tech equivalent of carbon \$5 notes lying on the ground, where the deal flow is lagging the decarbonisation opportunity.

Technology is not the answer, it's the amplifier of intent. And climate tech alone is not the panacea, but it's a space that is emerging rapidly as a critical mechanism to bend the emissions curve down and get the world back on track towards 1.5°C.



Emma Cox

Global Climate Leader, Partner,
PwC United Kingdom



Executive

summary

A hot year for climate, creating urgency for a green recovery

The last year has seen a transformation in the VC landscape. New types of capital and funding mechanisms have resulted in significant new flows of investment into private markets. In addition, cash reserves for investment stockpiled in 2019-20 are now being put to use in the deals-led recovery of 2021.

The investment landscape for climate tech is no different, as society increasingly feels the impacts of climate change. The IPCC AR6 report, published in August 2021, amplified the calls for drastic action. COP26 has echoed this, and significantly, the Glasgow Breakthroughs announcement states a plan for countries and businesses to work closely together to speed up affordable clean-tech adoption worldwide.

This accelerated focus on environmental, social and governance (ESG) criteria in private markets,¹ alongside emerging regulations such as the EU's Sustainable Finance Disclosure Regulation, is driving growth and leading many companies and investors to pivot their strategies. Thousands of companies have made public commitments to net zero, set science-based targets or sought to demonstrate their wider commitments to society through B Corp status. Megafunds have been ring-fenced for climate tech, including Brookfield's US\$7bn Global

Transition Fund² and TPG's US\$5.4bn Rise Climate fund.³

Climate tech scaling for impact: Trends from this year's analysis

Investment in climate tech is continuing to show strong growth as an emerging asset class, totalling US\$87.5bn over the last 12 months analysed (H2 2020 and H1 2021^{4,5}, with H1 2021 alone delivering record investment levels in excess of US\$60bn. This represents a 210% increase from the US\$28.5bn invested in the 12 months prior. Climate tech now accounts for 14 cents of every VC dollar.

The average deal size nearly quadrupled in H1 2021 from one year prior, growing from US\$27m to US\$96m. Megadeals are becoming increasingly common and are driving much of the recent topline funding investment growth in climate tech.

Innovative finance remains core to climate tech's growth. The past 18 months have seen special-purpose acquisition companies (SPACs) tested as a new tool in the toolkit for start-ups looking to go public and raise large amounts of funding. This new fundraising approach is responsible for driving a significant proportion of growth in climate tech, with H1 2021 seeing SPACs provide a third of all funding at US\$25bn.



Thousands of companies have made public commitments to net zero, set science-based targets or sought to demonstrate their wider commitments to society through B Corp status. Megafunds have been ring-fenced for climate tech, including Brookfield's US\$7bn Global Transition Fund² and TPG's US\$5.4bn Rise Climate fund³.

Mobility and Transport remains the most heavily invested challenge area, raising US\$58bn between H2 2020 and H1 2021, which represents over two-thirds of the overall funding in the period. Within this, electric vehicles (EVs) and low greenhouse gas (GHG) vehicles remain dominant. In particular our analysis found that H1 2021 was dominated by a handful of significant megadeals, with Lucid Motors raising US\$6.9bn, Northvolt US\$2.8bn, Cruise US\$2.8bn and Rivian US\$2.7bn.

There has also been significant growth in Industry, Manufacturing and Resource Management, raising US\$6.9bn between H2 2020 to H1 2021, over triple the amount raised by the vertical in the period a year prior. This has been driven by megadeals such as Ginkgo Bioworks' US\$2.5bn raise in H1 2020 and the rise of numerous circular and second-hand businesses. These include Back Market, which raised US\$335m, and Vinted, which raised US\$300m in H1 2021.

The US remained the most dominant geography in H2 2020 – H1 2021, completing more deals than any other geography. The world's most active climate tech hub, the San Francisco Bay Area, continued to lead the way, with start-ups across every challenge area raising funding in the 12 month period. Notable rounds included goliaths such as Cruise raising in excess of US\$2bn between Microsoft, General Motors and Honda; as well as sectoral innovators such as Electric Hydrogen and Sound Agriculture raising US\$24m (Series A) and US\$45m (extended Series C). Beyond the Bay Area, the next-most active climate tech hubs are London, Berlin and New York.



A commercial opportunity with impact

In this second edition of the PwC State of Climate Tech report, we highlight new analysis that covers findings and trends in key climate technology areas, examining the link between technological maturity, proximity to sectoral tipping point, emissions reduction potential and investment volume. The new analysis also highlights potentially underfunded areas that present opportunities for investors.

We hone in on 15 specific climate technology areas and explore whether the solutions with the highest potential to remove carbon at speed are getting the funding they need to scale up.

Our analysis finds that there are still significant areas of untapped potential – so-called ‘carbon [US]\$5 notes lying on the ground.’ Of the 15 technology areas analysed, the **top five** that represent **over 80% of future emissions reduction potential by 2050 received just 25% of recent climate tech investment between 2013 and H1 2021**.

This tells us that an opportunity is being missed, as capital is not being deployed in line with climate impact potential, with a handful of mature technology areas instead attracting the majority of investment. Though funding is needed across all challenge areas, targeting funding to nascent technology areas can enable breakthrough innovations, trigger sectoral tipping points to accelerate adoption and achieve meaningful financial returns as well as sectoral decarbonisation.

Many of the climate tech investors we spoke to were driven not just by a desire to have a positive impact but also by the potential for significant financial returns. In line with science-based targets, society will need to remove carbon emissions from all stages of the value chain, and start-ups that can address unmet mitigation needs offer an untapped opportunity to create commercial and environmental value.

Achieving breakthrough innovations in these currently underfunded areas will require new action from investors and policymakers. Interviews with industry incumbents have highlighted that more patient capital from VC is still required to deliver future breakthroughs in climate technology. In addition, long-term strategic plans and targeted policy measures by governments, such as carbon pricing, are needed to kick-start investment in hard-to-abate sectors and to deliver net zero infrastructure⁵ – for example, low GHG concrete or green hydrogen production, as well as carbon removal technologies that will be pivotal to achieve global net zero targets.

This combined analysis and insight illustrates the need to consider climate change in its entirety, as a complex interdisciplinary issue. Private markets should be encouraged and emboldened to look beyond their traditional sector and geographical silos. They should consider climate tech more holistically to achieve deep cross-sectoral decarbonisation and to uncover future ‘gigacorns,’ companies with potential to abate one gigaton of emissions per year while being commercially viable.



“Achieving breakthrough innovations in these currently neglected areas will require new action from investors and policymakers”

Society’s response to climate change will involve a combination of these three areas, all of which are interlinked. For example, the IPCC have made it clear that significant emissions reductions and carbon removal will be required to stay within a 1.5°C pathway. If mitigation technologies are not accelerated, it is likely that this target will be exceeded and that large-scale adaptation will be required to deal with the impacts of climate change. In the same vein, access to high-quality data and monitoring will be crucial to enabling mitigation and adaptation efforts.

However, a certain amount of warming is already locked in. The impacts from this warming will be most felt by the poorest in society, particularly in the Global South, who often have been the lowest emitters of GHGs but who will experience the most severe consequences. Funding is therefore needed across all categories of climate technology to enable a just transition and a greener, fairer future for all. Indeed, the recent Glasgow Breakthroughs⁶ announcement by world leaders at COP26 states a plan for countries and businesses to work closely together to support the developing world to access the innovation and tools needed to transition to net zero.

Climate tech as a maturing asset class

The climate tech market is a rapidly maturing asset class, offering investors not only financial returns but also the opportunity for outsized environmental and social impact. Climate technology has moved well beyond a proof of concept, attracting investors who have to date not previously invested. Though this area presents a major commercial opportunity, due to the inherent value associated with reducing emissions, which will be validated one day with a global carbon price, there is still much work to be done to channel this investment appropriately.

The need for a green recovery and just transition

Climate tech solutions can be classified in three broad categories:

- Those that help us mitigate climate change by reducing or sequestering emissions.
- Those that enable us to adapt to the impacts of climate change.
- Those that help us to understand climate change and its impacts through data.

Key findings

US\$222bn
invested in climate tech between 2013 and H1 2021

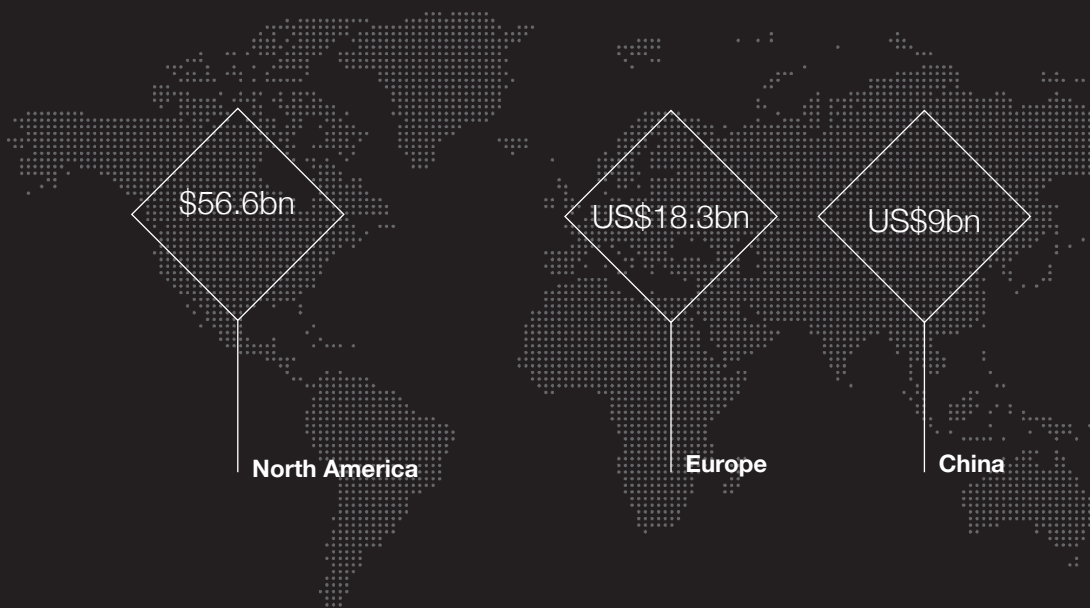
210%
growth in investment year on year

3,000+
climate tech start-ups identified

US\$60bn
More than US\$60bn invested in climate tech in H1 2021

14%
Climate tech investment now accounts for 14 cents of every VC dollar

Regional findings (total climate tech investment H2 2020–H1 2021)



Most active investment hubs (H2 2020–H1 2021)

- 1 San Francisco Bay Area, CA, US
- 2 London, UK
- 3 Berlin, Germany
- 4 New York, NY, US
- 5 Boston, MA., US



Mobility & Transport

60% of total climate tech investment

US\$132bn invested in the area, more than any other challenge area

133% CAGR



Unicorns

78 climate tech start-ups valued at US\$1bn+

43 of which are Mobility and Transport start-ups



Investors

6,000+ unique investors identified

2,500 active in H2 2020 to H1 2021

1,600 active in H1 2021

Note: The data sources used have stronger coverage in European and North American markets. This analysis may therefore be a conservative estimate of the relative levels of Chinese investment and of overall investment.



Impact analysis

Of the 15 specific climate technology areas analysed, the **top five** that represent **over 80% of future emissions reduction potential by 2050 received just 25% of recent climate tech investment between 2013 and H1 2021.**

1

Introduction

Code red for humanity

The world is waking up to the threat of climate change, but action does not yet match the rhetoric. The IPCC issued a stark warning in the run-up to COP26. In their first major assessment in nearly a decade, their 2021 update was unequivocal that human influence has warmed the atmosphere and that our window to limit warming to 1.5°C this century—and avoid catastrophic climate change—is rapidly narrowing.

A year of commitments and kick-start capital

A significant number of new funds have been established to channel the rapid inflow of capital into climate tech and a variety of new investor types have become engaged in climate tech investing. This, paired with the growth of innovative funding mechanisms such as SPACs and the deployment of pent-up cash reserves, has resulted in a huge step-change in the scale of climate tech investment. This looks set to continue into H2 2021, with notable climate tech megadeals in the second half of the year to date including Rivian (US\$2.5bn, in addition to the US\$2.7bn raised in H1, followed by further funding and an IPO), GoodLeap (US\$800m) and Redwood Materials (US\$750m).

In the policy space, the US government has taken a step towards a green recovery, backed by legislation in the form of the recently signed US\$1.2tn bipartisan infrastructure framework.⁷ This comes at the same time as the US and China reaffirmed their commitment at COP26 to boost climate cooperation over the next decade and the UK announced the Glasgow Breakthroughs, an international plan to deliver clean and affordable technology. The EU has also taken action on greenwashing, introducing the Sustainable Finance Disclosure Regulation in March, alongside ambitious and sweeping reforms, culminating in the Fit for 55 hydrogen strategy, released in July 2021.

Buoyed by this renewed commitment to tackle climate change through innovation, investors and policymakers have been working together to ring-fence huge funds to accelerate the uptake and adoption of climate tech. For example, the European Commission announced a partnership with the Bill Gates-backed Breakthrough Energy Catalyst to unlock new investments for clean tech and sustainable energy projects totaling up to US\$1bn over five years.⁸

The private sector has also shown that it is willing and able to step up to the plate to help drive the net zero transition. This year has seen private-sector players making the market for new climate tech operating models, with Stripe and Shopify deploying tech solutions to create new market demand for carbon removal.

Together, these developments have resulted in significantly increased focus from investors on climate tech assets.

Investment data analysed

The data underpinning the analysis set out in this report includes venture capital and private equity investment into start-ups that have raised at least \$1 million in funding. Funding round types analysed include grants, Angel, Seed, Series A-H, and IPOs (including SPACs).

It is important to note that this report does not intend to provide a comprehensive overview of private market investment into climate tech, but specifically focuses on funding targeted at scaling new innovations. As such, PwC excludes project financing and debt from our analysis, for example. These funding types have proven to be important for the significant scale up of renewables over recent years, an area of climate tech which has reached high levels of technological maturity; but are typically less utilised by start-ups developing breakthrough solutions.. Please see Appendix 2 for further details on the boundaries on this assessment.



2

Investment Analysis:

Approach

What is climate tech?

Climate tech is defined as technologies that are explicitly focused on reducing GHG emissions or addressing the impacts of climate change. Climate tech applications can be grouped into three broad, sector-agnostic groups:

1. Those that directly mitigate or remove emissions.
2. Those that help us adapt to the impacts of climate change.
3. Those that enhance our understanding of the climate.

The term climate tech is purposely broad in order to incorporate the many technologies and innovations being used to address GHG emissions and the wide array of industries where they are being applied.

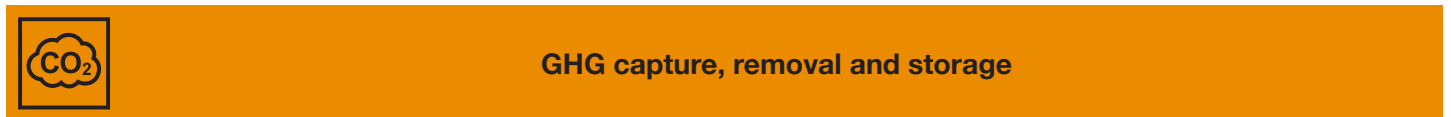
Categorising climate tech start-ups by challenge area

To take a more detailed look at the market, the report considers climate tech in relation to six traditional industry verticals and two cross-cutting horizontals, aligned with key sectoral opportunities for climate action, as shown on the next page. We have enhanced our taxonomy from last year's analysis, this year introducing a financial services vertical and adjusting our title and definition of the climate change management and reporting horizontal to better reflect the breadth and types of start-ups in this important area.

How has PwC produced the data to support this report?

Our investment analysis is based on PwC's Climate Tech Investment Index, a proprietary and continually updated database of climate tech start-ups and investors, built with machine learning models and extensive human verification, part of PwC's wider Climate Tech Platform¹¹ Funding data is provided by Dealroom.co, a global data platform that gathers information on start-ups, investors and deals.

Based on feedback from the investment community, we have focused our analysis on private markets and government funding into climate tech start-ups. This approach has been taken to demonstrate the financial trends in innovative climate technologies looking to scale up. This analysis does not, therefore, include the substantial public markets or project financing of mature climate technologies (for example, large-scale renewable energy projects such as wind and solar farms), nor does it cover corporate research and development (R&D) funding into climate tech. Additional detail on our methodology can be found in the appendix.



Together these **eight challenge areas**, shown in the diagram above, encompass PwC's 'universe' of climate tech solutions. Each of these eight challenge areas is then further broken down into specific **net zero levers**.⁹ These net zero levers are defined in further detail in the appendix. The challenge areas broadly follow the industry classifications set out by the IPCC,¹⁰ which are typically used when discussing emissions reduction.

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Key findings:

Investment

Overall funding levels

H1 2021 set a record for climate tech investment levels, with in excess of US\$60bn raised by more than 600 climate tech start-ups. At over 200% year-over-year (YoY) growth, it also represents the fastest the sector has grown in our recorded dataset. As mentioned in the introduction, this looks set to continue, with several notable megadeals in H2 2021 announced already.

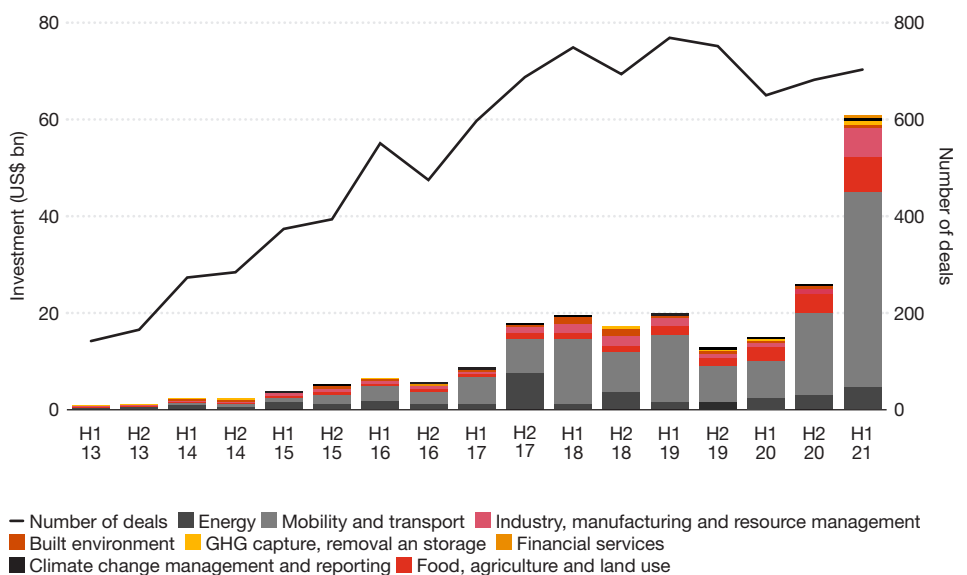
Key highlights¹²

Following rapid growth between 2013–18, climate tech investment plateaued between 2018–20, as did the wider VC and private equity (PE) market, tempered by macroeconomic trends and the global pandemic.

However, climate tech investment growth rebounded strongly in H1 2021, benefitting from latent capital being deployed with an increased focus on ESG.

We identified over 6,000 unique investors, including venture capitalists, private equity, corporate VCs, angel investors, philanthropists and government funds. Together, they've funded over 3,000

Investment into climate tech start-ups and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data

climate tech start-ups between 2013 and 2021, covering nearly 9,000 funding rounds.

Around 1,600 investors were active in H1 2021, participating in over 700 funding

rounds. That compares to fewer than 900 investors active in H1 2020, indicating increasing competition for climate tech deals as the wider investment community becomes familiar with the opportunity of climate tech as an asset class.

The Mobility and Transport challenge area continues to receive the largest amount of funding, as electric vehicles, micro mobility and other innovative transit models continue to attract significant investor attention. Of the ten start-ups that attracted the most investment in H1 2021, eight were in Mobility and Transport.

Mobility and Transport also led in terms of growth rate, though with Industry, Manufacturing and Resource Management (IM&R) and Financial Services not far behind, each recording over 260% year-on-year growth between H2 2019 and H1 2021. In fact, only one vertical challenge area—Built Environment—recorded a growth rate below 90%, coming in at 20% growth. The horizontal challenge areas of GHG Capture, Removal and Storage and Climate Change Management and Reporting recorded YoY growth rates of 27% and 16%, respectively. Underlying drivers are explored in the challenge area sections.

The number of climate tech unicorns has grown to 78.¹³ The majority of these unicorns sit in the Mobility and Transport challenge area (43), followed by Food, Agriculture and Land Use (13), Industry, Manufacturing and Resource Management (10) and Energy (9).

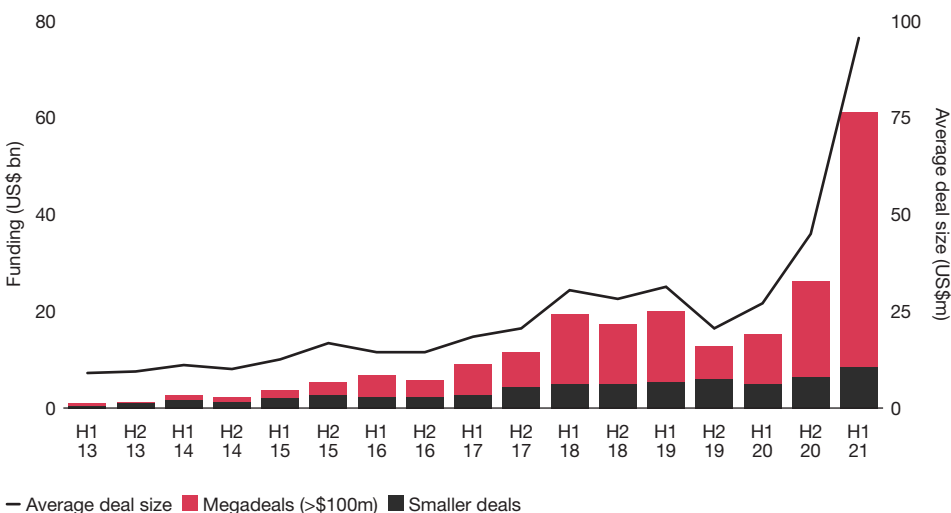
Investment by deal size: Bigger tickets indicate a maturing asset class

The average deal size nearly quadrupled in H1 2021 from one year prior, rising from US\$27m to US\$96m. This was over ten times the size of the average deal in H1 2013.

Megadeals (ticket size of more than US\$100m) are also becoming increasingly common, with H1 2021 seeing the first triple-digit number (122).

These megadeals have driven much of the top-line growth in climate tech start-up funding. This is driven both by the growth in the number of megadeals, as described above, and in the size of an average megadeal. The average megadeal has risen in size from US\$130m in H1 2013 to over US\$430m in H1 2021 (and has correspondingly increased the average size of all deals to US\$96m), indicating that investment growth is being powered by a cohort of high-potential start-ups raising increasingly large amounts.

Climate tech start-up funding by deal size



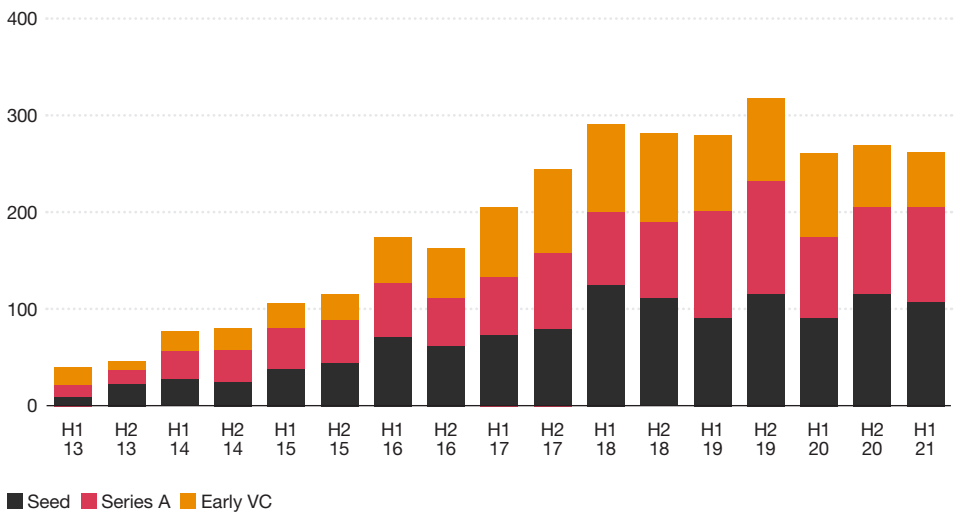
Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Investment in early-stage start-ups: Stagnation suggests more needs to be done to maintain momentum

Prominent investors have set out their view of the scale they expect climate tech to reach. Bill Gates was quoted this year as saying that “there will be eight Teslas, ten Teslas [in climate tech, but that] only one of them is well-known today.”¹⁴ Similarly, Larry Fink believes that “the next 1,000 unicorns [...] will be businesses developing green hydrogen, green agriculture, green steel and green cement.”¹⁵

Number of early stage rounds worth more than US\$1m



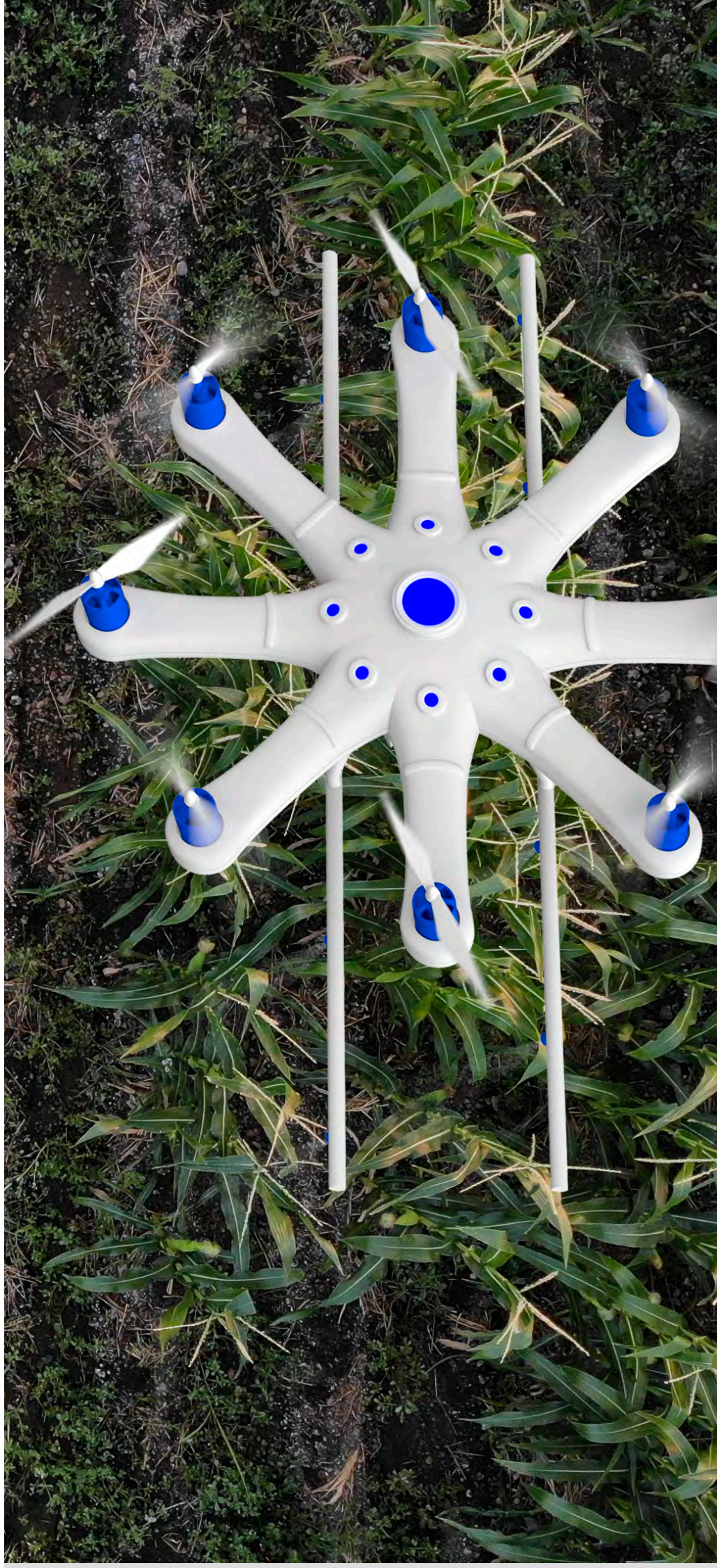
Source: PwC State of Climate Tech 2021, analysis of Dealroom data

Despite this, the number of early VC, seed and Series A investments has remained largely stagnant since 2018, sitting between 260 and 320 deals in each of those half-years.¹⁶ The fundraising success of larger start-ups described earlier reflects the growing maturity of climate tech as an asset class. But for the sector to achieve continued growth, it will have to enable the next wave of start-ups that will one day become climate tech unicorns and gigacorns.

We heard from investor interviews that access to early-stage climate tech deals was far more competitive than even a few years prior, suggesting that the number of deals has not been bottlenecked by investor interest. Instead, what is likely driving this lack of early-stage deal volume growth is a combination of two key factors.

Risk aversion: The first factor is that early-stage investors are still largely focused on 'safer' challenge areas. The profile of funding across challenge areas is similar for early- and late-stage funding, suggesting that early-stage investors are focused on areas with demonstrated success and a pipeline of late-stage funding. More patient funding is needed for currently immature challenge areas to unlock the next wave of breakthrough climate innovations. Governments and sovereign investors will have a role to play here to de-risk action and R&D.

Talent pool: The second challenge, similar to the wider start-up community, is the pipeline of climate tech talent. A few of our interviewees noted that there is a growing pool of talent, with many professionals pivoting into this space from within the tech industry. However, there remains a gap in terms of founders who understand the deep climate tech challenges and how these can be solved. The interdisciplinary nature of climate tech across industries means that it depends on several different talent pipelines, unlike more defined investment areas such as biotech.



SPACs: A tool in the climate tech toolkit accelerating growth

SPAC investment into climate tech has taken off, jumping from no investments in our dataset pre-2020 to US\$3.5bn in 2020 and US\$25bn in H1 2021 (over 40% of the total funding in the latter period). The majority of this, US\$20bn, has been in Mobility and Transport, with US\$2.9bn going into Industry, Manufacturing and Resource Management, US\$1.4bn into Food, Agriculture and Land Use and US\$650m into Energy.

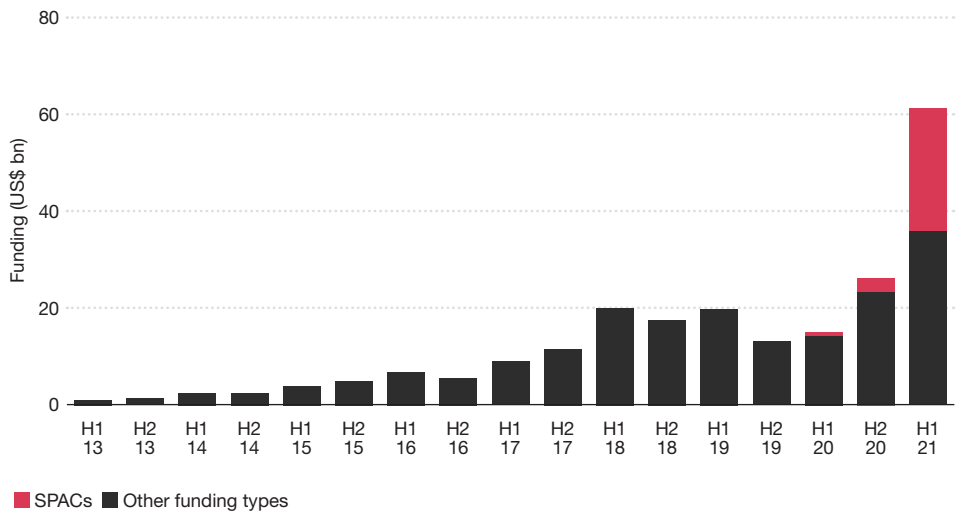
SPACs provide an alternative way for climate tech start-up management teams and sponsors to list their company and access public market funding. Many in the VC climate tech community believe that SPACs have been advantageous for climate tech. However, scrutiny from regulators (particularly the US Securities and Exchange Commission) has increased in recent times, and market participants acknowledge that SPACs are a tool that will be refined with time.



SPACs have improved liquidity and provided an alternative financing solution for start-ups. This is particularly helpful for deep tech, which is perceived as higher risk”

(Ramez Naam, Singularity University).

Climate tech funding from SPACs



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Post-IPO climate tech performance is booming

Climate tech companies are also demonstrating strong performance post-IPO. Below, we've charted the performance of the Energy Impact Partners' (EIP) Climate Tech Index against the S&P 500.¹⁷ The index covers much of the breadth of climate tech solution areas, including companies from the Mobility and Transport; Energy; Food, Agriculture and Land Use; and Industry, Manufacturing and Resource Management challenge areas.

The Climate Tech Index has delivered substantially higher returns than the benchmark, generating triple the returns between January 2020 and October 2021. This above-market growth coincided with the emergence of many of the market drivers examined in last year's State of Climate Tech report, such as increased regulatory and business commitments to net zero. This relative success and significant appetite from public market investors provides a signal to private market investors that climate tech start-ups can generate substantial exit opportunities.

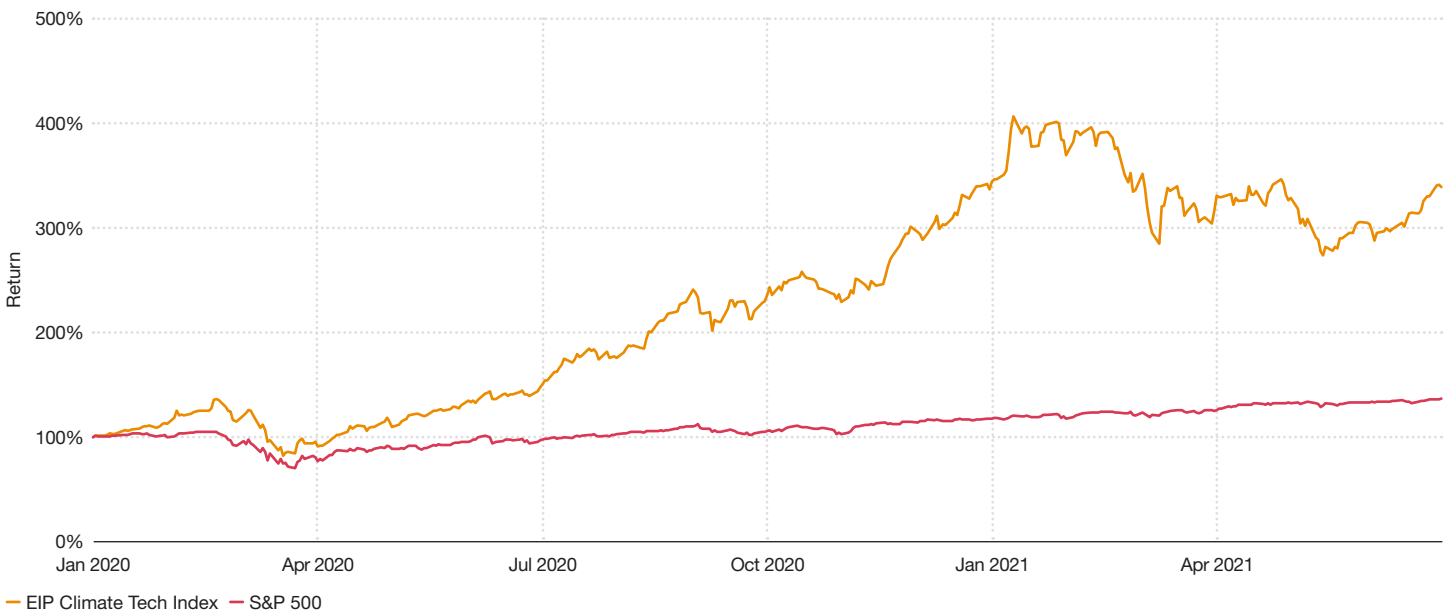


Whilst there has been a comparative decline in return for the EIP Climate Tech Index against the benchmark during 2021, this is not unexpected in the aftermath of a global contraction like that seen during the pandemic, following which investors have typically retreated in the short term into safer asset classes. However, the EIP Climate Tech Index has started rebounding as of October 2021, boosted by strong demand signals in the run-up to COP26.

Some prominent venture capitalists are innovating their fund designs to secure greater financial returns from staying

involved post-IPO. For example, Sequoia Capital announced this year that they would be restructuring around a singular and permanent structure. The move is designed to better align interests among the fund, founders and limited partners, and provide them with the flexibility to deploy more patient capital.¹⁸ This has the potential to create additional financial value. Sequoia estimates that holding onto shares for just 12 additional months would have resulted in over US\$8bn in added returns over the past 15 years,¹⁹ whilst also scaling up the next generation of climate tech gigacorns.

Total shareholder return for climate tech companies



Source: Refinitiv's Return Index. Caption: Total shareholder returns for Energy Impact Partners' Climate Tech Index vs. the S&P 500 as a benchmark. Indices are used with permission.

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Overview by challenge area

This section of the report explores each of the challenge areas, which attract varying levels of capital depending on the maturity of the technologies within them. This includes a review of two key investment themes selected from the sub-industry levers analysed for each challenge area:

- 1 The lever receiving the most funding
- 2 The fastest-growing lever

This review covers the last 12 months included in PwC's research analysis, H2 2020 and H1 2021.

Mobility and Transport



Challenge area overview and climate challenge

Transport is one of the fastest-growing sources of emissions globally, having increased by 71% since 1990,²⁰ accounting for 16.2% of global emissions.²¹ The transition to electric vehicles has been a favoured tool for abating emissions.²² In addition, developments in green hydrogen in terms of synthetic fuels for transport are expected to be a key driver of the future hydrogen economy.²³ Use cases are explored further in the Energy section of this report.

Business-as-usual continued growth in passenger and freight activity could outweigh all mitigation efforts unless transport emissions can be strongly decoupled from GDP growth. Electrifying transport systems remains a vital part of the net zero transition. Notably large mobility platforms such as Uber, Lime and Arrival have recently committed to net zero emissions by 2035.²⁴

Wider interventions will also be critical, such as a greater focus on increasing the attractiveness of different mobility options (modal shifts, shared transport and avoided journeys), improved vehicle performance, alternative fuels, infrastructure and built environment investment.

Challenge area definition

The challenge area comprises:

- Developments that increase efficiency (of engines, design or materials) associated with movement of goods or people by land, air or sea.
- Development of electric vehicles and micro mobility vehicles, and the infrastructure used to propagate these technologies, including shared car-ownership models and charging points.
- Development of battery technologies for mobility applications and the associated infrastructure.
- Improvements to the efficiency of transport systems, including use of autonomous and sensor technologies, improvements to maintenance and repair and urban planning and design.

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- Y Combinator
- Sequoia Capital
- Toyota

Headlines from PwC analysis

Investment level

\$58bn (↑281% YoY)
H2 2020 - H1 2021

\$132bn (133% CAGR)
H1 2013 - H1 2021

Number of deals

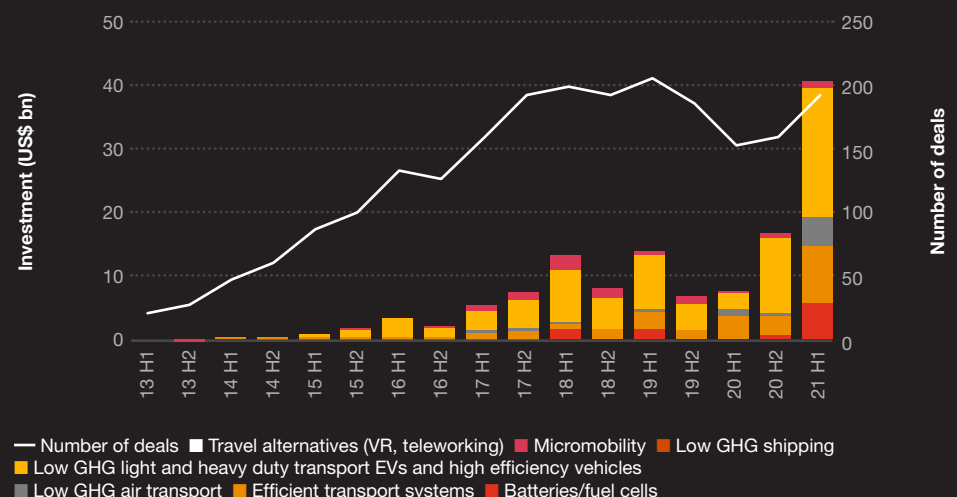
348 (↑3.6% YoY)
H2 2020 - H1 2021

2223 (33% CAGR)
H1 2013 - H1 2021

Unicorns

Mobility and Transport contains the largest number of unicorns within PwC's analysis, with 43 from a total of 78 across all challenge areas. The majority are EV-related (16), followed by efficient transport systems (13), batteries and fuel cells (five) and low GHG air transport (five). Nineteen of the unicorns are in the US and 15 are in China.

Mobility and Transport: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Deal flow increased steadily from 20 in H1 2013 to a peak of 207 in H1 2019. More recently, deal flow has reduced (H2 2020: 155; H1 2021: 193) as technologies reach maturity, resulting in higher-value deals. This has been paired with a growth in investment levels (H2 2020: US\$17bn; H1 2021: US\$40bn), signalling an increase in megadeals, with the average deal size increasing from US\$110m in H2 2020 to US\$212m in H1 2021.

Growth in the number of deals has shown early signs of slowing since 2018 as some of the main levers—efficient transport systems and low GHG road transport—reach maturity. Low GHG shipping, low GHG air transport and batteries and fuel cells recorded significantly fewer deals than the other levers, indicating the relative immaturity of these levers.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Low GHG light and heavy vehicles

Deals are increasing in this lever (H2 2020: 49; H1 2021: 58) although disproportionately to investment levels (H2 2020: US\$12.2m; H1 2021: US\$20.4m). The average deal size has increased from US\$249k to US\$352k. This is to be expected as technologies such as EVs are maturing, reaching their market penetration tipping points, resulting in an increase in megadeals.

Noteworthy start-ups:²⁵

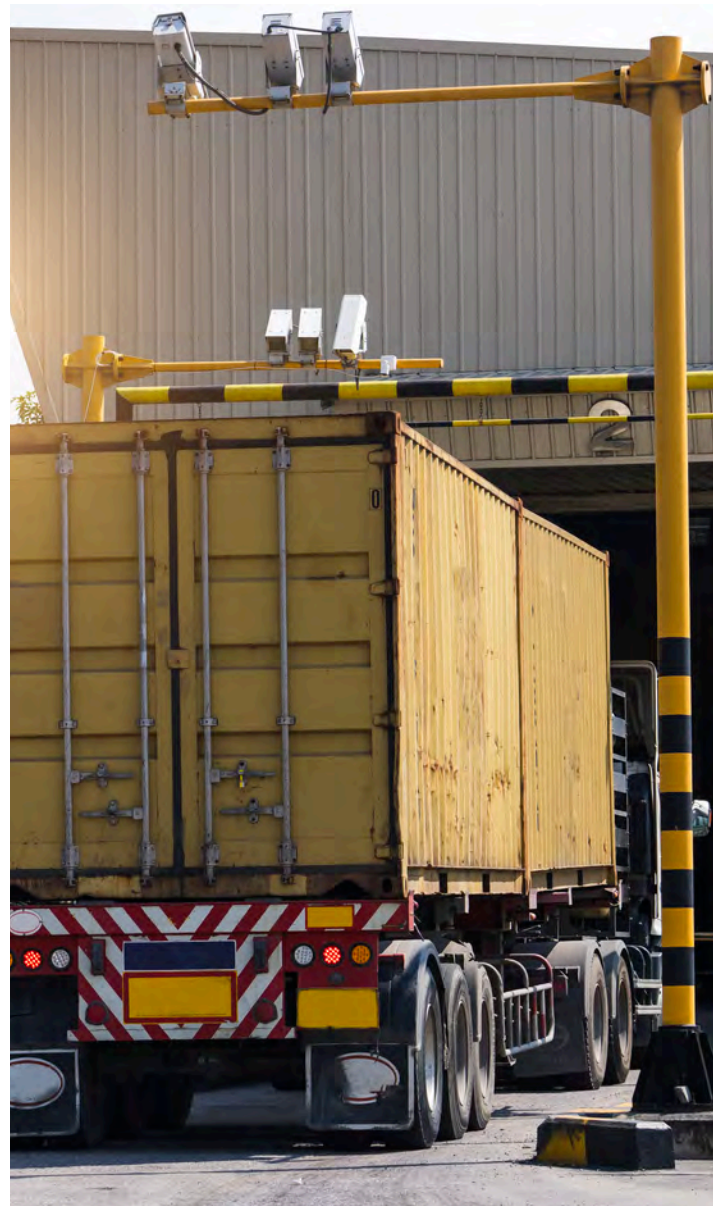
- **Lucid Motors**, a Silicon Valley start-up that designs, develops and builds luxury EVs, raised US\$6.9bn in the period.
- **Plus**, whose mission is to develop self-driving trucks to make long-haul trucking safer, cheaper, more comfortable and better for the environment, raised US\$1bn in the period.

2. Fastest-growing lever: Batteries and fuel cells

Growing at a rate of 1,722% YoY, investment in this lever peaked in H1 2021 at US\$5.9bn from just 18 deals. This has been fuelled by a number of factors, including the need for energy storage capacity to support renewables and EVs reaching their market tipping point.

Noteworthy start-ups:

- **Northvolt** raised US\$3.4bn in the period, producing lithium-ion batteries with clean energy.
- **Ample** raised US\$24.5m in the period, using modular battery swapping for fast charging and providing price-competitive charging infrastructure.





Low GHG shipping

Shipping is a highly polluting yet frequently overlooked sector, responsible for nearly 3% of global emissions.²⁶ With around 90% of world trade relying on the sector, it is under increasing pressure to decarbonise. Despite this, limited funding is being invested into start-ups in this sector, with around US\$113.5m of investment between 2013 and H1 2021 into only 15 start-ups, making it the second least invested-in lever in Mobility and Transport.

Increased efficiency

The highest level of funding has been funneling into software solutions that help shippers to increase efficiency through access to high-fidelity transportation data and predictive insights across their supply chain to reduce emissions. For example, Nautilus Labs raised US\$13m to build AI software to advance the efficiency of ocean commerce. Elsewhere, Envoy raised \$5.8m to help eliminate pollution from boats around the world with electric propulsion technology.

Fossil fuel reduction

Investment into fossil fuel reduction in shipping remains nascent. There are some start-ups raising investments that focus on motor technology, including electric outboard motors (Oceanvolt, Pure Watercraft). However, typically the technology being developed is for smaller, recreational boats rather than long-haul shipping. There is also some investment into fuel-saving technologies such as hydrofoils and auxiliary wind propulsion for ships, but again, this remains limited.

Why?

- Lack of regulatory incentives, such as carbon levies, resulting in unambitious sector decarbonisation targets.
- Capital and time required to develop new technologies and infrastructure.
- A green premium price for cleaner fuels, which reduces cost effectiveness and increases product prices.
- Lack of communication, collaboration and technological alignment between different parts of the supply chain, including countries, carriers, ports and manufacturers.

Reduced competition and minimal entry points to the global shipping industry.

- Monopolistic nature of the global shipping industry, reducing competition and entry points for innovators.



Energy



Challenge area overview and climate challenge

The production, transport and use of energy make up almost three-quarters of global GHG emissions, with 13.6% of total emissions attributed to energy, representing one of the greatest opportunity areas to be addressed via climate technology and other decarbonisation strategies, such as behaviour change.²⁷ Rapid scaling of low-carbon energy is critical to curbing emissions and keeping the world on track to meet the Paris Agreement goals. Yet the International Energy Agency (IEA) estimates that just 2% of the recent US\$16tn in fiscal support mobilised by governments to rebuild their economies affected by the COVID-10 pandemic was allocated towards clean energy.²⁸

Despite this, year-on-year unit costs of renewables have continued to fall,²⁹ while energy efficiency has increased,³⁰ driven by learning curves and economies of scale. Overall investment has been lower compared to other challenge areas, reflecting the relative maturity of wind and solar, which have transitioned to debt, project and other forms of financing.

However, the global fusion industry is warming up, with increasing levels of investment in 35 companies founded since 2010. In addition, VC investment in energy storage and more efficient smart grids for energy transmission are also required to support innovation, the scale-up of renewables and the transition to e-mobility.

Challenge area definition

The challenge area comprises:

- Production, development and distribution of alternative fuels.
- Measures that support proliferation of renewable energy, including load balancing (storage) and supply-demand balancing mechanisms.
- Measures that increase efficiency of the energy sector or of energy-intensive electronics (such as data centres) and reduce any associated GHG emissions.

It excludes measures that create efficiencies for fossil-fuel energy generation, such as improvements to venting or flaring mechanisms on oil and gas refineries.

Headlines from PwC analysis

Investment level

\$8.2bn (↑96% YoY)

H2 2020 - H1 2021

\$31.5bn (32% CAGR)

H1 2013 - H1 2021

Number of deals

295 (no change YoY)

H2 2020 - H1 2021

2110 (17% CAGR)

H1 2013 - H1 2021

Unicorns

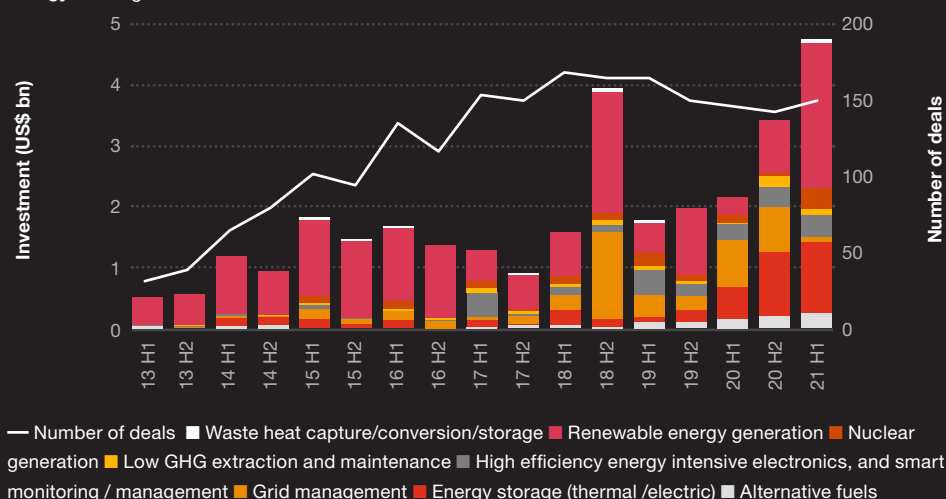
Nine of the total 78 climate tech unicorns identified in this report are in the Energy challenge area (12%). The leading levers are high efficiency energy intensive electronics and smart monitoring / management (three) and renewable energy generation (three).

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- TotalEnergies Carbon Neutrality Ventures
- Breakthrough Energy Ventures
- Demeter

Energy: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Investment growth has come from an increase in the size of deals, rather than the number of deals. The average deal size has doubled from US\$15m (H1 2020) to US\$31m (H1 2021). Investor interest has been stimulated by hydrogen and energy storage, as EVs reach their tipping point, coupled with forecasts of potential lithium shortages.³¹ The markets for both hydrogen and battery storage are still relatively immature, and a combination of corporate and regulatory demand signals indicate they are primed for disruption.

There has been a wave of announcements in terms of national hydrogen strategies, including France, Portugal, Spain, Australia, Germany, the Netherlands, the UK, Norway, Canada, Chile, Finland and Japan. This, in turn, has resulted in announcements of hydrogen projects, mainly in the production of green hydrogen, although there are a number of wider use cases.³² It is predicted that green hydrogen growth will continue based on global climate ambitions and sector-specific activities.³³ However, it is unclear, without binding national commitments and targets, how quickly these projects will become cost-competitive with fossil fuels. We explore this further in the hydrogen spotlight box overleaf.

The EU's Fit for 55 Hydrogen Strategy is accelerating the rollout of hydrogen infrastructure in Europe and growing the addressable market for green hydrogen start-ups.³⁴ The EU has also set out plans in its ReFuelEU Aviation initiative to increase the proportion of sustainable aviation fuel in Europe from 0.05% in 2020 to 5% by 2030, and rising further to 63% by 2050.³⁵ Investors view alternative fuels like these as key transitional technologies that can be rapidly deployed using existing infrastructure.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Renewable energy generation

The number of deals has remained relatively flat (H2 2020: 144; H1 2021: 151) for this lever. This is despite funding increasing from US\$882m in H2 2020 to US\$2.4bn in H1 2021. This indicates an increasing number of megadeals, as this lever houses maturing technologies that are attracting higher-value deals. Similarly to last year, the largest deals include maturing technologies such as solar and wind.

Noteworthy start-ups:

- **Green Hydrogen Systems** raised US\$196m in the period, producing standardised and modular electrolysers for the production of green hydrogen.
- **Eavor Technologies** raised US\$40m in the period, providing a geothermal energy solution. Their Eavor-Loop closed system harvests heat from deep within the Earth to be used for commercial heating or to generate electricity using conventional heat to power engines.

2. Fastest-growing lever: Energy storage

Energy storage is seeing continued growth in investment (H2 2020: US\$1bn; H1 2021: US\$1.2bn), which is being driven by an increase in deals (H2 2020: 20; H1 2021: 27). This indicates a less mature technology area, with fewer megadeals than the broader climate tech asset class.

Noteworthy start-ups:

- **QuantumScape** raised US\$780m in the period, producing solid-state batteries for EVs, attracting investment from a range of investors and corporate VC.
- **Malta** raised US\$50m in the period for electro-thermal energy storage systems that provide a new grid-scale technology to collect and store energy for long durations.

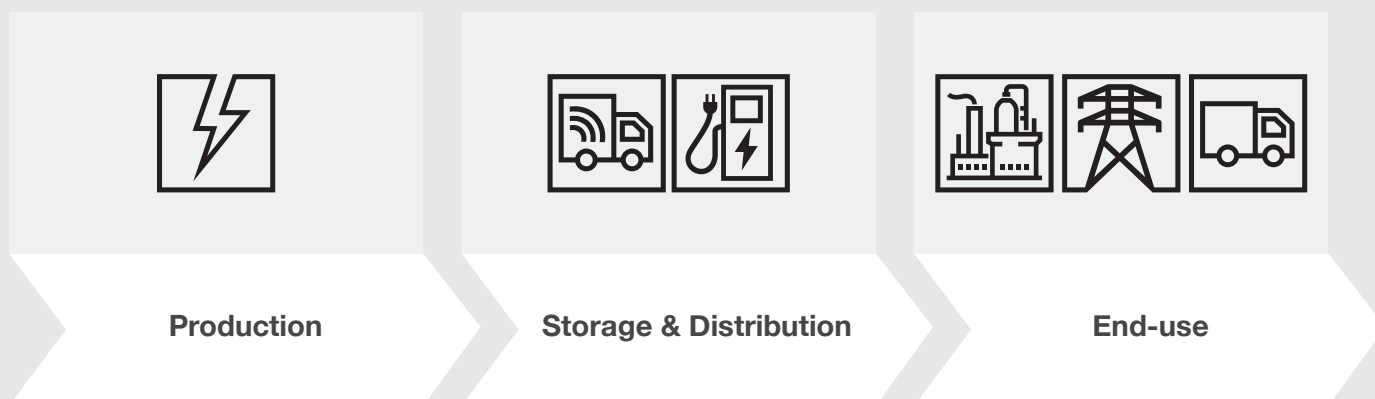




Green Hydrogen

Interest in green hydrogen, which is produced by water electrolysis powered by renewable electricity, has ballooned over the past four years. Green hydrogen holds growing promise in both meeting future energy demands and supporting the world's decarbonisation efforts across multiple sectors, particularly heavy industries, long distance transport and power generation.

Green hydrogen value chain



1. Production

To meet the expected demand for green hydrogen, the cost of electrolysis must decline, and its efficiency must increase. Green hydrogen production raised US\$1.4bn between H1 2013 and H1 2021, with a CAGR of 60%. The majority of companies focused on developing scalable, sustainable electrolyser technology that could enable wide-scale adoption. Notable start-ups include Green Hydrogen Systems and H2Pro.

2. Distribution & Storage

Today, hydrogen can be stored, converted to synthetic fuels or transported from point of production via pipelines, trucks or ships. At the point of use, additional infrastructure is required, such as compression, storage, dispensers, meters and contaminant detection and purification technologies. VC investment into this part of the value chain is much lower compared to production, largely because it requires capital-intensive investment to build the infrastructure required to distribute hydrogen. Investment is starting to flow into hydrogen refuelling stations to support the rollout of fuel cell electric vehicles. For example, HTEC just raised CAD\$217 million from Chart Industries Inc. and ISQ.

3. End-use

The most promising use of green hydrogen to date is in industrial processes (steel, iron and chemical) and long-haul transportation (hydrogen fuel cell technology and integration of hydrogen technologies into commercial transport). This year, the Swedish green steel start-up H2 Green Steel raised US\$105m of Series A funding to decarbonise steel production. Investors included Exor, Wallenberg's FAM, Italian steel company Marcegaglia and Swedish entrepreneur Cristina Stenbeck.

Is hydrogen the next big thing?

There is a clear acceleration of government interest in hydrogen. Twelve countries and the EU recently published their national hydrogen strategies, and a further 19 countries are currently drafting theirs.³⁶ The UK government announced that it hopes to attract around £4bn of private-sector investment into low-carbon hydrogen energy production by 2030.³⁷

On the corporate side, Shell, BP and Mitsubishi Power have announced their hydrogen plans, committing to green hydrogen projects as part of their net zero strategies, and have started to ramp up their investment into hydrogen energy infrastructure. PwC estimates that global demand for green hydrogen could reach about 530 million metric tons by 2050, displacing roughly 10.4 billion barrels of oil equivalent (around 37% of pre-pandemic global oil production).³⁸

However, seeing green hydrogen as the silver bullet to decarbonisation across all sectors is overambitious, as it still faces regulatory, technical and economic challenges, particularly in certain end-use sectors. Investors need to start asking themselves which end-use sectors show the most promise.



Food, Agriculture and Land Use

Food systems are responsible for 20.1% of global GHG emissions,³⁹ with the largest contribution coming from agriculture and land use activities.⁴⁰ When combined with increasing anthropogenic pressures such as population increase, urbanisation and environmental degradation, society is presented with an exacerbated climate challenge connected to the world's global food industry.⁴¹

There is growing financial investment in plant-based meat and dairy alternatives, driven by consumer demand and media coverage.⁴² The next generation of solutions is expected to focus on insect proteins for human and animal consumption,⁴³ lab-grown meat⁴⁴ and genetic editing.⁴⁵

Further attention is required to reduce food loss and waste and to create more sustainable packaging solutions, which could also extend the shelf life of produce. These issues are important, given that food loss and waste make up approximately one-quarter of food system GHG emissions.⁴⁶

Challenge area definition

The challenge area comprises:

- Food production methods, commonly using biotech, that often replace carbon intensive animal-based products (e.g. synthetic proteins).
- Low GHG farming practices that improve efficiencies or reduce carbon emissions, such as precision farming, vertical farming and aeroponics.
- Management and modification of natural environments, in particular through reforestation, afforestation and avoided deforestation.
- Land management to reduce carbon emissions (e.g. soil CO₂ sequestration).
- Any activity associated with reduced GHG emissions in food supply chains (e.g. eliminating spoilage).

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- SOSV
- Temasek
- New Crop Capital

Headlines from PwC analysis

Investment level

\$10.7bn (↑132% YoY)
H2 2020 - H1 2021

\$24.9bn (80% CAGR)
H1 2013 - H1 2021

Number of deals

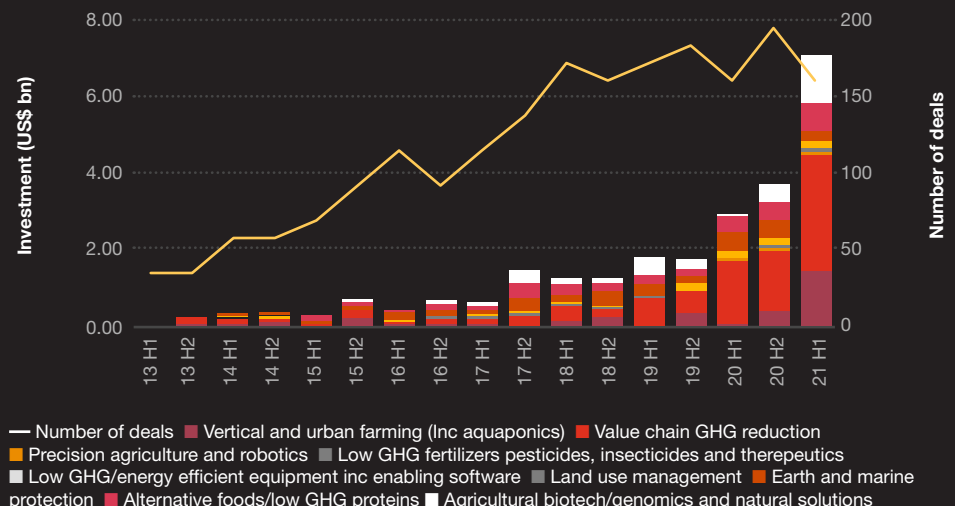
354 (↑3.5% YoY)
H2 2020 - H1 2021

1922 (28% CAGR)
H1 2013 - H1 2021

Unicorns

Food, Agriculture and Land Use records the second-highest number of unicorns in PwC's analysis after Mobility and Transport, 13 from a total of 78. Five of these are in alternative foods and low GHG proteins, three in value chain GHG reduction, two in precision agriculture and robotics, two in vertical and urban farming and one in agricultural biotech and genomics.

Food, Agriculture and Land Use: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Similarly to last year, the majority of investment has taken place in alternative foods and low GHG proteins, which has shown 111% YoY growth. This is largely driven by consumer demand for new products to enable more sustainable lifestyles, and a maturing challenge area with greater levels of investor confidence bolstering the scale of investment.

Agricultural biotech and genomics, natural solutions, value chain GHG reduction and vertical and urban farming have each raised in excess of US\$1bn between H2 2020 and H1 2021.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Alternative foods and low GHG proteins

Investment in this lever is increasing (H2 2020: US\$1.5bn; H1 2021: US\$3bn) despite deal numbers reducing (H2 2020: 86; H1 2021: 70). The average deal size has more than doubled, from US\$17.4m to US\$40.3m. This increase in deal size indicates that the market is maturing, however, the average deal is not yet at megadeal scale. Primarily, this growth has been driven by consumer demand to live more sustainable lifestyles by reducing meat intake.

Noteworthy start-ups:

- **Mosa Meat** raised US\$90m during the period, producing cruelty-free, lab-grown, cultured meat from cow cells.
- **The Protein Brewery** raised US\$26m during the period, supplementing the market for protein alternatives by producing animal-free fungal proteins for food.

2. Fastest-growing lever: Vertical and urban farming

Investment is rapidly growing in this lever (H2 2020: US\$420m; H1 2021: US\$1.2bn), with deal levels remaining stable (H2 2020: 12; H1 2021: 13). The sharp uptick in investment in H1 2021 could be attributed to a greater focus on ESG as well as a move to streamline supply chains after the significant disruption caused by the COVID-19 pandemic.

Noteworthy start-ups:

- **Bowery Farming** raised US\$300m in the period for large-scale vertical farms, situated near cities to efficiently supply produce to consumers with reduced transport miles, less water input and no pesticides.
- **Intelligent Growth Solutions** raised US\$5m in the period, focusing on creating ideal climates for plants using Internet of Things-enabled remote monitoring and control systems to manage growing conditions in urban and vertical farms.



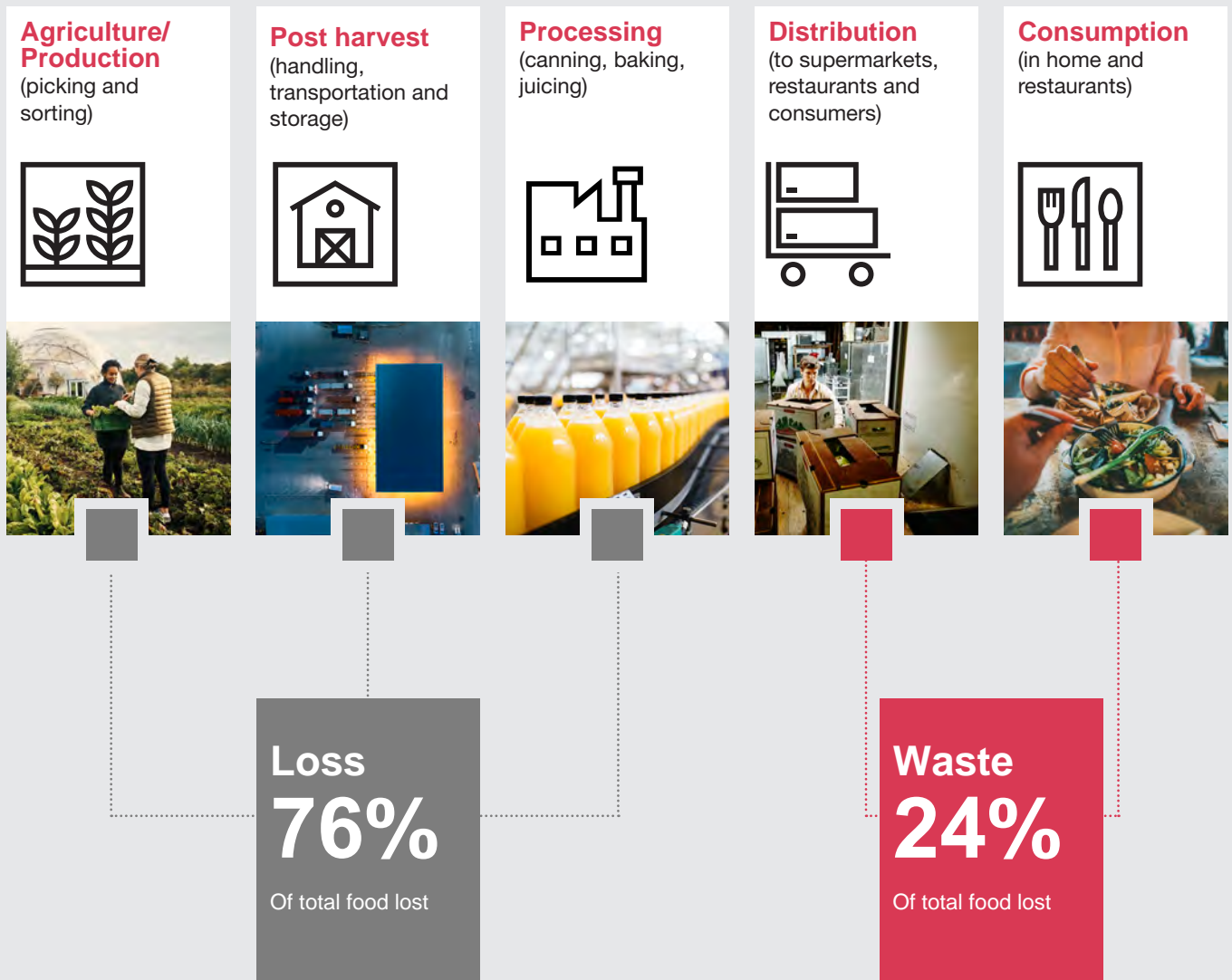


Food waste reduction technology

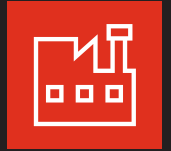
Food waste is responsible for an estimated 6% of global GHG emissions,⁴⁷ and this figure is likely to be higher in reality, as it excludes food lost on the farm. In this section, we look at the supply chain from farm to fork and highlight where innovation and funding are required.

The food supply chain is segmented, starting with agriculture, followed by post-harvest, processing, distribution and, finally, consumption. It's important to distinguish between food waste and food loss. Waste occurs when food that is fit for human consumption is removed from the supply chain at distribution stages. Food loss is a result of inefficiencies in production and supply.⁴⁸ Food waste is more likely to occur at the retail and consumer end of the supply chain. Food loss happens more so during earlier stages of the supply chain.

The infographic below illustrates where climate tech start-ups are intervening. **Food loss from production to distribution forms a significant proportion of the total food loss and waste globally at about 76%.** This is compared to consumer food waste, which is about 24%.⁴⁹ **This highlights the need for ongoing innovation and investment in start-ups that address food loss at earlier stages,** for instance, in the agricultural biotech industry. Notably, there are no start-ups at the processing stage, where R&D and innovation by companies around specific products will be required.



Industry, manufacturing and resource management



Global industry and manufacturing are responsible for 29.4% of GHG emissions⁵⁰ and are one of the most difficult challenge areas to abate due to the need to retrofit, upgrade and replace existing equipment and transform the associated supply chains. The materials and resources needed for industrial processes underpin everyday lives: chemicals form plastics, fertilisers and synthetic fibres, concrete and metals are the basis of many infrastructure materials.

Emissions result from energy used in the production of materials, manufacturing and industrial processes and emissions are generated by industrial processes themselves (such as CO₂ emitted during a chemical reaction). Therefore, an absolute reduction in emissions from industry and manufacturing will require deployment of a broad set of mitigation options, including more efficient use of resources, more efficient processes and improved energy efficiency.

Challenge area definition

The challenge area comprises:

- Reduction of emissions from the manufacturing of large, heavy articles and materials.
- Activities and actions to reduce, reuse or manage waste in manufacturing.
- The creation of low GHG alternatives to traditional inputs (e.g. chemicals, steel and plastics).
- Developments in manufacturing, distribution and end of life that reduce material waste, improve recycling rates, or recover and regenerate materials, including circular economy models.

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- SOSV
- Bpifrance
- Khosla Ventures

Headlines from PwC analysis

Investment level

\$6.9bn (↑266% YoY)
H2 2020 - H1 2021

\$18.9bn (75% CAGR)
H1 2013 - H1 2021

Number of deals

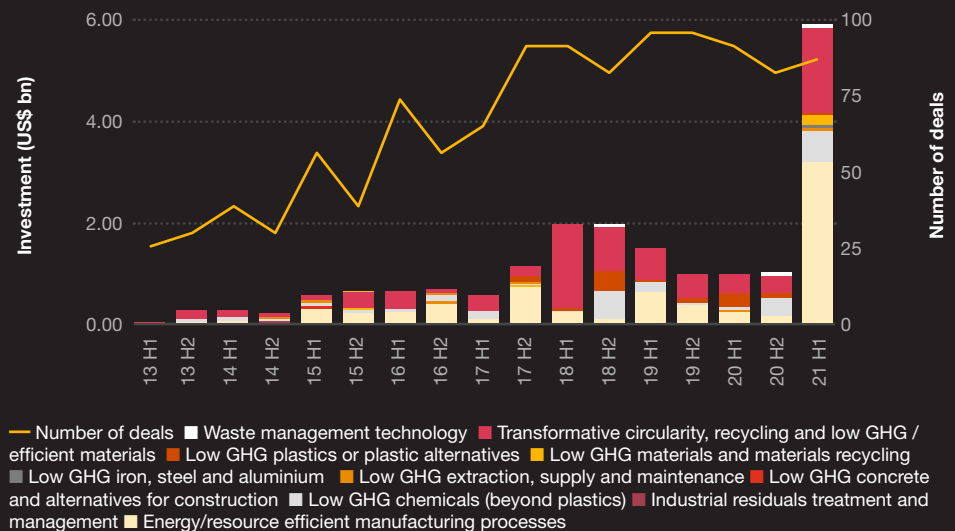
168 (↓10.6% YoY)
H2 2020 - H1 2021

1137 (15% CAGR)
H1 2013 - H1 2021

Unicorns

Ten of the 78 unicorns in PwC's analysis are in this challenge area. The majority are in the circularity recycling and materials efficiency lever (five) and energy/resource efficient manufacturing processes (three).

Industry, Manufacturing and Resource Management: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Deal flow has remained relatively flat (H2 2020: 82; H1 2021: 86), whilst investment in this challenge area has skyrocketed (H2 2020: US\$996m; H1 2021: US\$5.9bn). Average deal size has grown from US\$12.1m to US\$68.6m over the period. This indicates a significant uptick in large deals, although not yet at megadeal scale due to the relative immaturity of the technologies in this challenge area.

To accelerate the scale-up and adoption of technologies that can help to achieve net zero in this challenge area, the private sector is stepping in to create market demand. This includes initiatives such as SteelZero, whereby large private-sector players such as Landsec and Lendlease are committing to procuring 50% net zero steel by 2030 and 100% by 2050.⁵¹ This is creating market signals that support investment in these nascent technologies.

Growth in this challenge area is underpinned by energy/resource efficient manufacturing processes, responsible for nearly 50% of the investment between H2 2020 and H1 2021. An increased focus on resource use and circular business models has also driven investment in transformative circularity, recycling and low GHG materials, responsible for a further 30% of investment in the period.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Energy / resource efficient manufacturing processes

Both funding and deals have increased for this lever, but not proportionately (H2 2020: US\$123m, 11 deals; H1 2021: US\$3.2bn; 16 deals). This has resulted in the average deal size increasing from US\$11.2m to US\$200m over the period. Efficiency in terms of energy and resources has risen up the agenda in line with governments and corporations setting net zero targets, resulting in greater investment and an increase in the average deal size.

Noteworthy start-ups:

- **Ginkgo Bioworks** raised US\$2.5bn in the period, specialising in using biotech to program cells to make things such as food, materials and therapeutics in an efficient way.
- **Diamond Foundry** raised US\$200m in the period, culturing diamonds with a zero carbon footprint through a novel, energy-efficient plasma process, without the need for mining resources.

2. Fastest-growing lever: Low GHG iron, steel and aluminium

Low GHG metals remain at early stages of technology development and are highly expensive. However, the private sector is creating demand for investment in these technologies through initiatives such as SteelZero, which brings together leading organisations to speed up the transition to a net zero steel industry.

Such initiatives, as well as government and corporate commitments to net zero, are expected to stimulate further interest in this lever, which has shown colossal YoY growth (7,271%), as it was starting from a low historical baseline (H2 2020: US\$0; H1 2021: US\$171m).

Noteworthy start-ups:

- **H2 Green Steel** raised US\$105m in the period, accelerating the decarbonisation of steel production through raw-material innovation and efficient AI-driven processes, powered by renewable energy.
- **Boston Metal** raised US\$66m in the period, electrifying primary steelmaking using their patented molten oxide electrolysis process to produce liquid iron, paired with renewable energy to produce zero carbon emissions.





Built environment

Challenge area overview and climate challenge

Buildings and construction are responsible for 20.7% of global GHG emissions.⁵² Operational emissions account for nearly two-thirds of this, while the remainder comes from embodied carbon emissions, or the 'upfront' carbon that is associated with materials and construction processes.

To eliminate the carbon footprint of the built environment, both buildings and materials must become more efficient, smarter and cheaper. Small-scale efficiencies such as improvements in heating, lighting or appliances will also play a role.

Given the breadth of the built environment's impact, more pivotal solutions will also be needed, for example, building-level electricity and thermal storage, innovative construction methods and transformative circularity and sensor-led smart building management.

Challenge area definition

The challenge area comprises:

- High-efficiency fittings, fixtures, lighting, and heating and cooling for commercial and residential buildings, including district-level solutions.
- Smart management of building energy consumption using sensors, smart devices, AI analysis of the ensuing data and app control for consumers.
- Efficient construction methods, with an emphasis on ease to construct and reduced waste on site (in particular, modular construction, 3-D printing and imagery/computing).

Headlines from PwC analysis

Investment level

\$1.4bn (↑19.3% YoY)
H2 2020 - H1 2021

\$8.6bn (25% CAGR)
H1 2013 - H1 2021

Number of deals

79 (↓30.1% YoY)
H2 2020 - H1 2021

830 (11% CAGR)
H1 2013 - H1 2021

Unicorns

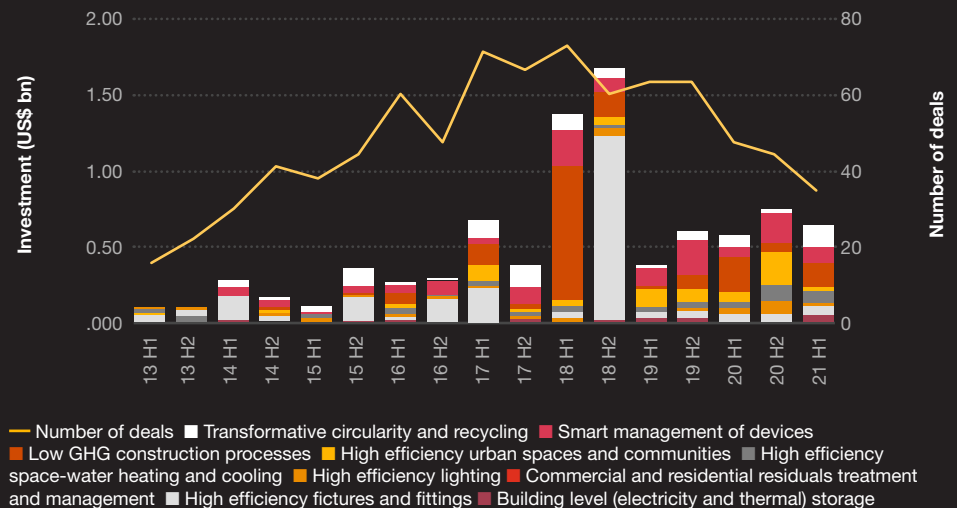
One of the 78 current unicorns in PwC's analysis are in the Built Environment challenge area, Rubicon, a provider of cloud-based waste and recycling solutions.⁵³

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- Demeter
- Khosla Ventures
- Bpifrance

Built Environment: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Investment in Built Environment start-ups has been slow, with the challenge area recording a CAGR of 25% from 2013 to H1 2021, well below the overall growth rate of climate tech investment of 68%. In H1 2021, the challenge area raised the least of all the vertical industries analysed (US\$632m). This is likely due to the high capital intensity and technical risk of start-ups in this challenge area, dampening the appetite of traditional VC investors.

There is a key role for strategic corporate VCs supporting start-ups to scale with their expertise and capital. In addition, creating market demand by committing to transitioning to certain materials will help to drive innovation in hard-to-abate areas. For example, the Global Cement and Concrete Association has set out the Global Net Zero Roadmap for the industry to achieve net zero by 2050.⁵⁴

Investment levels and deal flow have slightly decreased (H2 2020: US\$753m, 45 deals; H1 2021: US\$632.5m, 34 deals), with the average deal size changing minimally from US\$16.7m to US\$18.6m.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Smart management of devices

Although this lever received the most funding in the period, both funding levels and deal flow fell (H2 2020: US\$206m, 12 deals; H1 2021: US\$103m, five deals). This reflects the low level of funding being received in the challenge area overall and the maturation of smart technologies. As a result, it is likely that the start ups in this challenge area are being funded by other project financing mechanisms as they become more widely adopted (for example, large-scale smart city and digital twin projects).

Noteworthy start-ups:

- **Connexin** raised US\$103m in the period, specialising in building and operating smart-city infrastructure, supported by the Internet of Things (IoT), to increase building efficiency.
- **Metrikus** raised US\$6.7m in the period, deploying smart building platform systems and starter kits to increase building efficiency.

2. Fastest-growing lever: Building level electricity and thermal storage

Start-ups in this lever raised US\$50m in the period, recording a YoY growth rate of 181%. It should be noted that the historically low level of deal flow in this lever resulted in this high growth rate. This can easily be skewed by large deals. In this case, H1 2021 was bolstered by Dcbel, which raised US\$40m in the period.

Both investment levels and number of deals have increased (H2 2020: US\$6.9m, one deal; H1 2021: US\$43.5m, three deals). The average deal size has doubled from US\$6.9m to US\$14.5m. This trend mirrors the Energy challenge area, where energy storage is the fastest-growing lever. Therefore, despite being skewed by a large deal, this trend is expected to continue, as the focus on electrifying our systems to achieve net zero increases.

Noteworthy start-ups:

- **Dcbel** raised US\$40m in the period. It creates an AI-powered, renewable-energy ecosystem, providing customers with access to solar energy for EV charging, smart home energy management and backup power.
- **VoltStorage** raised US\$6.9m in the period, developing next-generation batteries for residential and commercial building-level storage. Their batteries use iron salt technology instead of lithium and use an iron-based storage medium; iron is a more abundant material.



Financial Services



Challenge area overview and climate challenge

Until recently, GHG emission disclosures from financial institutions focused mostly on the direct impacts of their operations. Disclosure of Scope 3 emissions continues to be a challenge, meaning disclosures often omit the most significant source of emissions—their portfolios. This proves a significant gap, as financed emissions have been estimated to be on average 700 times higher than direct emissions.⁵⁵

Innovative application of new and existing technology to financial services, creation of new green products and accurate, reliable sources of data can all drive the challenge area to decarbonise. Climate risk is also challenging the insurance sector, with increasing likelihood of acute and chronic physical risks affecting underwriting, reserving, covering and pricing practices.⁵⁶

Consumer demand for green products and investment offerings is increasing. Public-sector interest is driving innovation in Financial Services to cater for this. This has resulted in allowing new competitors into the market that are enabling customers to track the carbon footprint of their spending, invest their pensions in net zero-aligned funds and borrow capital to upgrade their homes.

Challenge area definition

The challenge area comprises:

- Investment advice, services or platforms that enable investors, from institutional investors to individuals, to invest in organisations or portfolios aligned with net zero.
- Provision of information to better understand material climate-related financial risks and opportunities on financial performance and position, funds and portfolios.
- Tailored financial products and services, including insurance, that take into account physical, transition and reputational risk.

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- Engie
- Phitrust Investors
- Anthemis Group

Headlines from PwC analysis

Investment level

\$1.2bn (↑260% YoY)

H2 2020 - H1 2021

\$2.2bn (193% CAGR)

H1 2013 - H1 2021

Number of deals

42 (↑35.5% YoY)

H2 2020 - H1 2021

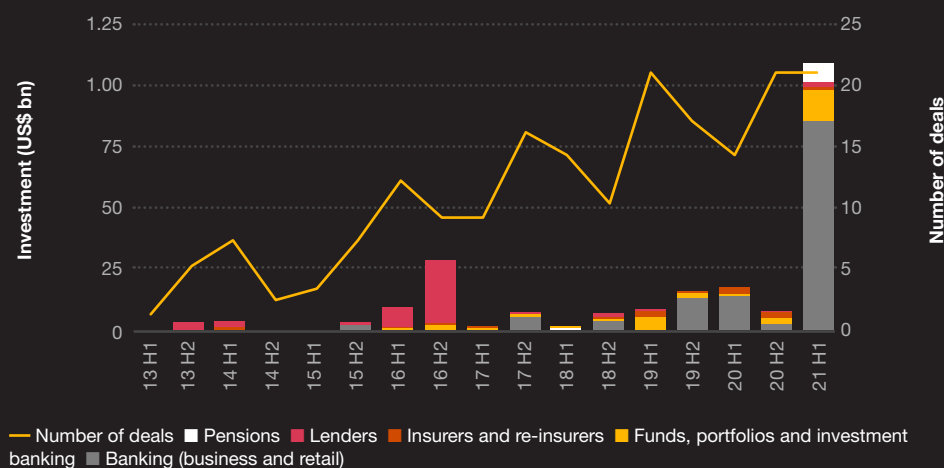
189 (46% CAGR)

H1 2013 - H1 2021

Unicorns

Only one of the 78 unicorns in PwC's analysis is in this challenge area: GoodLeap, (formerly Loanpal) which specialises in banking and provides flexible term loans to finance sustainable home solutions.

Financial Services: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

This challenge area has been relatively nascent but saw an explosion in growth in H1 2021, which accounted for 55% of funding that has been invested in the challenge area since H1 2013. The number of deals has remained relatively stable over the past few years, whilst the investment level has skyrocketed (H2 2020: US\$75.6m, 21 deals; H1 2021: US\$1.1bn, 21 deals). Similarly to climate tech more broadly, this is driven by an increase in megadeals, with the average deal size growing from US\$3.6m to US\$50m.

Of the total H1 2021 funding, 55% was in the UK, driven by policy changes such as the UK Government Green Financing Framework.⁵⁷ In addition, the UK's financial regulator, the Financial Conduct Authority, has an established innovation hub that includes a regulatory sandbox programme. This provides access to regulatory expertise and tools to facilitate experimentation and testing for financial technology firms. This has created an enabling environment for innovation and established London as a fintech leader. The remainder of the financing in H1 2021 was split among European countries.

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Banking (business + retail)

Funding in this lever is increasing, with the overall number of deals reducing (H2 2020: US\$22.4m, eight deals; H1 2021: US\$855m, four deals). The average deal size over this period increased from US\$2.8m to US\$213.8m). This is likely being driven by both customer demand and government interest.

Noteworthy start-ups:

- **Aspiration** is a 'planet first' Los Angeles-based fintech that provides green financial services, raising US\$50m in the period. It focuses on conscious consumerism and provides users with an impact measurement score based on their spending habits.
- **Ricult Inc.** has created a digital financial solution for the agricultural sector, raising US\$3.5m in the period. They provide loans to improve productivity across the value chain. They use diagnostic and predictive analytics to leverage satellite imagery, agronomic models and weather data to suggest farming improvements and provide loans for cleaner farming techniques.

2. Fastest-growing lever: Funds, portfolios and investment banking

This lever has grown in terms of amount invested and number of deals (H2 2020: US\$21.8m, six deals; H1 2021: US\$125.5m, 12 deals). Average deal size increased over the period, from US\$3.6m to US\$10.5m). This was likely driven by consumer demand resulting in an enhanced offering of investment banking products.

Noteworthy start-ups:

- **Clim8** raised US\$13.9m in the period, providing an investment platform for sustainable investment into clean energy and sustainable companies.
- **Ethic**, a tech-driven asset manager that powers the creation of sustainable investment portfolios, raised US\$29m in the period. They build separately managed accounts, optimised to track the market, align investment allocation and outperform on a client's chosen sustainability criteria.



GHG Capture, Removal and Storage



Challenge area overview and climate challenge

The recent IPCC report indicates it's unlikely that we can limit the devastating impacts of climate change without some form of carbon capture and, if society is to stay the course for a 1.5°C pathway, carbon removal.⁵⁸ Fossil fuels are likely to remain a primary contributor to energy production for some time due to their availability, reliability and affordability.

Government and corporate commitments to net zero have also piqued interest in this challenge area over the last year, whilst the technology remains expensive and requires significant investment to benefit from learning curves.

Capturing, storing and reusing greenhouse gases could play an important role in stabilising and reducing GHG emissions while our energy and industrial systems transition. Carbon sequestration technologies must be developed rapidly and deployed at scale if the world is to continue using fossil fuels as a key energy source.

Challenge area definition

The challenge area comprises:

- The removal of GHG emissions from the atmosphere and their storage for long periods, primarily from energy and industrial processes but also including natural climate solutions developed specifically to sequester GHGs (which do not fit within afforestation or land management).

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- Chevron Technology Ventures
- OGCI Climate Investments
- The Roda Group

Headlines from PwC analysis

Investment level

\$383m (↑27% YoY)
H2 2020 - H1 2021

\$1.3bn (9% CAGR)
H1 2013 - H1 2021

Number of deals

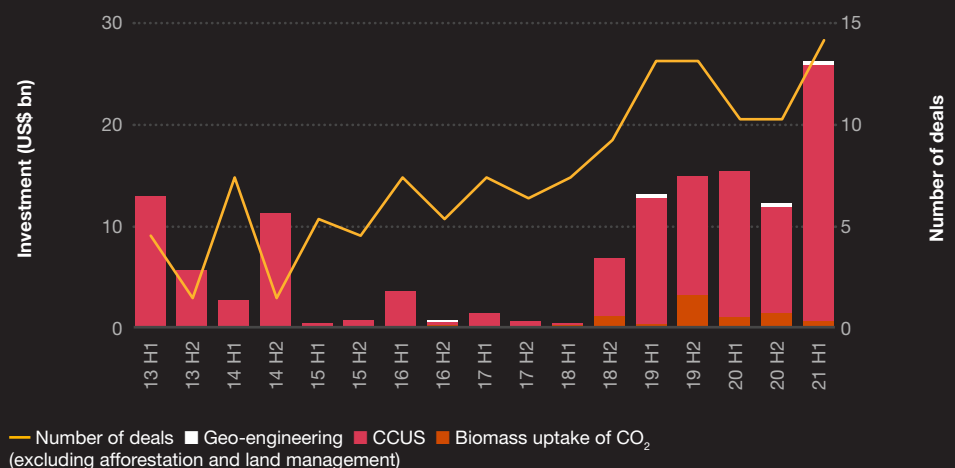
24 (↑4.3% YoY)
H2 2020 - H1 2021

123 (17% CAGR)
H1 2013 - H1 2021

Unicorns

This is the only challenge area with no confirmed unicorns,⁵⁹ perhaps surprising given that many of the pledges made at and in the run-up to COP26 included some form of reliance on carbon capture or removal. A prevailing view in the market is that the challenge area needs the right enabling environment to grow—namely, a global carbon price that shifts the underlying unit economics of solutions in this area.

GHG Capture, Removal and Storage: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Both the amount of investment and number of deals are increasing in this challenge area (H2 2020: US\$120.9m, ten deals; H1 2021: US\$262.6m, 14 deals). Average deal size has increased from US\$12m to US\$18.8m. Relatively low overall deal flow highlights the immaturity of the technologies in this challenge area, with H1 2021 recording the highest number of deals for any six-month period (14).

Carbon commitments and the possibility of future carbon markets will be significant drivers to create secondary markets and drive learning curves. The cost at the moment is too high to be competitive, resulting in the lack of a commercial business model. Despite this, during this unprecedented year, private-sector players such as Stripe, Shopify, Ocado and Microsoft have been stimulating demand for new climate tech solutions in this challenge area by creating demand for carbon removal.

This is a particularly nascent challenge area, which has been highly impacted by policy, resulting in a U-shaped investment pattern. However, since H2 2018, it has been showing signs of maturing to a YoY growth pattern, currently at 25.5%. As a result of this extended period of uncertainty between H1 2013 and H1 2018, the CAGR is a mere 9%, significantly lower than the climate tech growth rate of 68%.

Key levers

Investment themes: H2 2020 to H1 2021

- (1) Lever receiving the most funding and
- (2) Fastest-growing lever:

Carbon capture, utilisation and storage (CCUS) is the most mature lever, having raised 93% of investment funding in this challenge area (US\$358m) over the period. However, this lever is by no means mature, comprising only 29 start-ups, which have raised US\$1.2bn collectively over the entire investment period analysed (H1 2013–H1 2021). The start-ups fall into two key categories: carbon capture technologies deployed at the emissions source used for various industry purposes, and production of useful by-products to sell on for further industrial purposes (for example, thermoplastics). Investment in this challenge area is showing some signs of growth, most likely driven by the regulatory environment around carbon for industry.

Noteworthy start-ups:

- **Climeworks** raised US\$29.5m in the period and specialises in direct air capture technology.
- **Newlight Technologies** raised US\$45m in the period, focusing on converting GHG emissions into high-performance, cost-effective thermoplastics.



Climate Change Management and Reporting



Challenge area overview and climate challenge

This horizontal has been expanded from last year, when it was called Climate and Earth Data Generation. It now allows for the inclusion of two new sub-levers: climate risk and resilience management and emissions data, monitoring, management, and reporting. Both of these changes have been made to reflect developments in the area as more start-ups emerge to help stakeholders—namely private companies, investors, and local/regional/national bodies including governments—to set and deliver on their net zero commitments.

Climate and earth observation, driven by satellite and micro-sensor data collection, is beginning to provide the data necessary to help global decarbonisation efforts, further protect the environment and achieve broader sustainable development aims. The surge in net zero commitments from governments, investors, and businesses over the last 18 months has helped establish the business case for software solutions that are using this data to help establish baselines and prioritise emissions reductions activities to meet targets.

Challenge area definition

The challenge area comprises:

- Recording or analysis of earth- and climate-related data that will be useful specifically for reducing emissions or by climate tech companies. This data is typically collected via satellites, sensors or weather machines and analysed using machine learning algorithms.
- Systems that allow organisations, governments or individuals to monitor or manage carbon footprints, climate risk or resilience, typically software-related.

Most active investors

(by number of deals and excluding publicly funded innovation agencies, for example, EIC, EIT InnoEnergy and Eurostars)

- Space Angels
- Lux Capital
- Capricorn Investments

Headlines from PwC analysis

Investment level

\$797m (↑16% YoY)
H2 2020 - H1 2021

\$3.3bn (54% CAGR)
H1 2013 - H1 2021

Number of deals

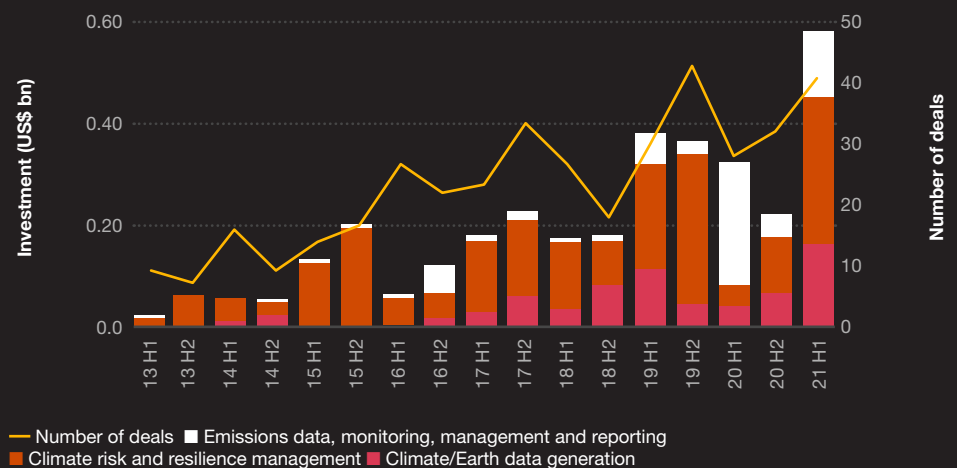
73 (↑2.8% YoY)
H2 2020 - H1 2021

386 (23% CAGR)
H1 2013 - H1 2021

Unicorns

One of the 78 unicorns in PwC's analysis are in this challenge area, the US-based Planet Labs, an aerospace and analytics company.

Climate Change Management and Reporting: funding raised and number of deals



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



Our perspective

Both investment levels and number of deals have increased for this horizontal challenge area (H2 2020: US\$217.8m, 32 deals; H1 2021: US\$579m, 41 deals). The average deal size has increased from US\$6.8m to US\$14.1m over the period, indicating growth may be stabilising as interest in this area peaks as both the public and private sector look to monitor and manage their emissions.

Growth is expected in terms of emission monitoring and management, as well as climate risk forecasting. As extreme weather events driven by climate change increase in intensity around the world, understanding the potential risk and quantifying the impact of these events will become increasingly important if society is to adapt. Extreme weather events cost the world US\$140bn in 2020.⁶⁰

Key levers

Investment themes: H2 2020 to H1 2021

(1) Lever receiving the most funding: Climate/earth data generation

Investment level and deal flow increased in this sub lever (H2 2020: US\$104m, eight deals; H1 2021: US\$291m, 13 deals). Average deal size also increased from US\$13m to US\$22.4m, indicating increased interest in this area. However, the relatively low deal flow also indicates the immaturity of the lever.

Noteworthy start-ups:

- **Climavision** raised US\$100m in the period. They provide proprietary weather data from their network of sensors that enable cutting-edge prediction modelling, using the cloud and AI.
- **Wingtra** raised US\$12.5m in the period. They use drone technology to improve decisions and reduce costs and risks across sectors, including surveying and geographic information systems, mining and aggregates, construction and infrastructure, environmental monitoring and agriculture.

2. Fastest-growing lever: Climate risk and resilience management

Investment level increased while deal flow decreased over the period (H2 2020: US\$67.8m, ten deals; H1 2021: US\$160.9m, seven deals). Low levels of funding historically have meant that recent growth has inflated YoY growth to 173% for the lever. Low overall deal flow indicates the immaturity of the lever. However, interest in this lever is expected to increase as society increasingly feels the initial impacts of climate change.

Noteworthy start-ups:

- **Tomorrow.io**, which raised US\$172m in the period, is a weather tech company that creates new ways to sense the weather, turning them into business insights to increase operational efficiency.
- **Cervest** raised US\$42.8m and specialises in earth science AI to help governments, growers and other businesses adapt to climate volatility and protect their physical assets.



5

Regional investment distribution

Overall breakdown by region

From H2 2020 to H1 2021, nearly 65% of VC dollars went to climate tech start-ups in the US (US\$55.1bn)⁶¹. The second most significant region was Europe at US\$18.3bn, with China in third at US\$9bn.

Most regions have seen growth in investment over the past 12-month period, averaging at 208% YoY. Growth in investment in Chinese start-ups lagged behind the average, though recording a still pacy 138% growth rate.

The fourth most prominent region for attracting climate tech investment was Asia (excluding China), which saw total investment of US\$3bn over the period. Other regions accounted for approximately 1% of overall funding raised.

The graphic above illustrates the flow of funding between geographies from investors on the left to start-up recipients on the right. Most funding still takes place within geographical silos, though

emerging markets tend to attract more foreign investment. Climate tech start-ups in North America and Europe raised about 80% of their funding from investors in the same region, whilst that decreased to 55% for Chinese start-ups and just 40% for African start-ups.

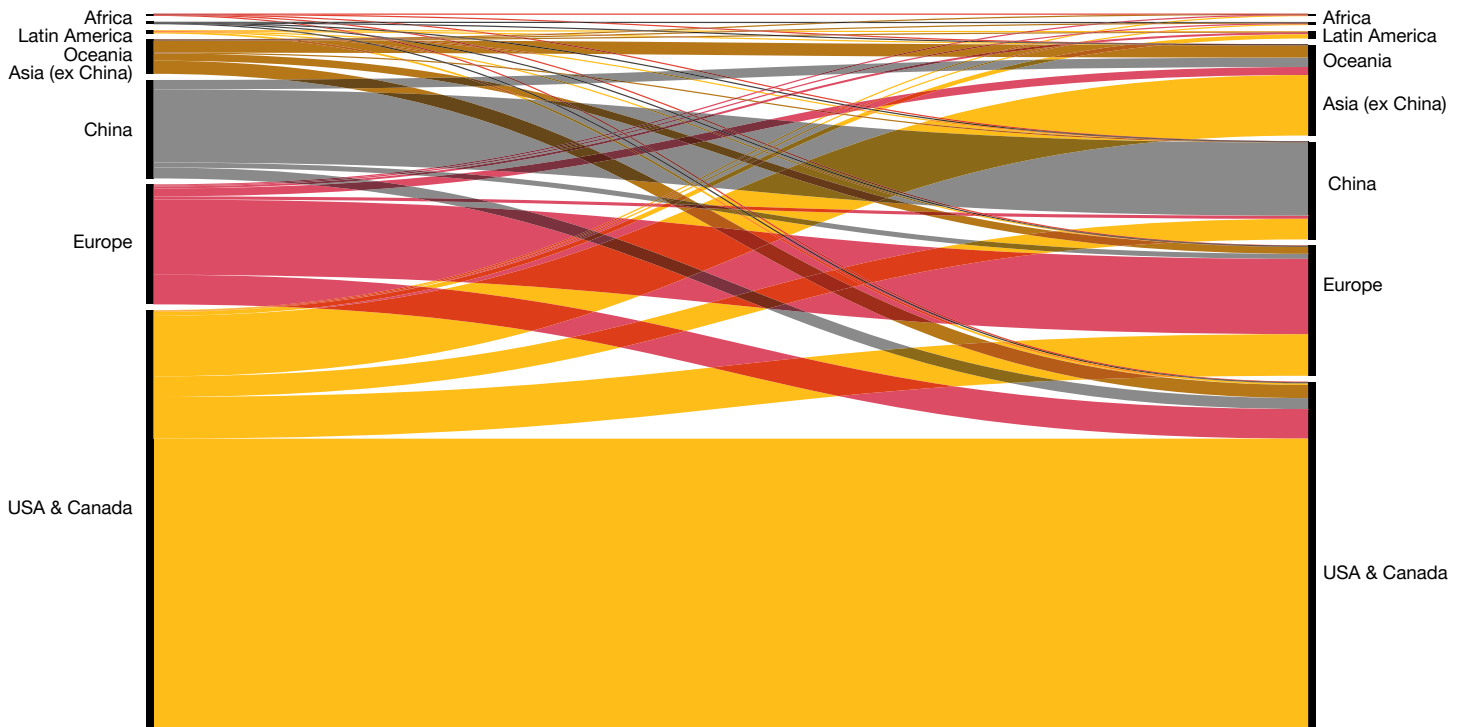
Climate tech funding by region H2 2020-2020 H1 2021



■ 65% North America ■ 21% Europe
■ 10% China ■ 4% Other

Source: PwC State of Climate Tech 2021, analysis of Dealroom data

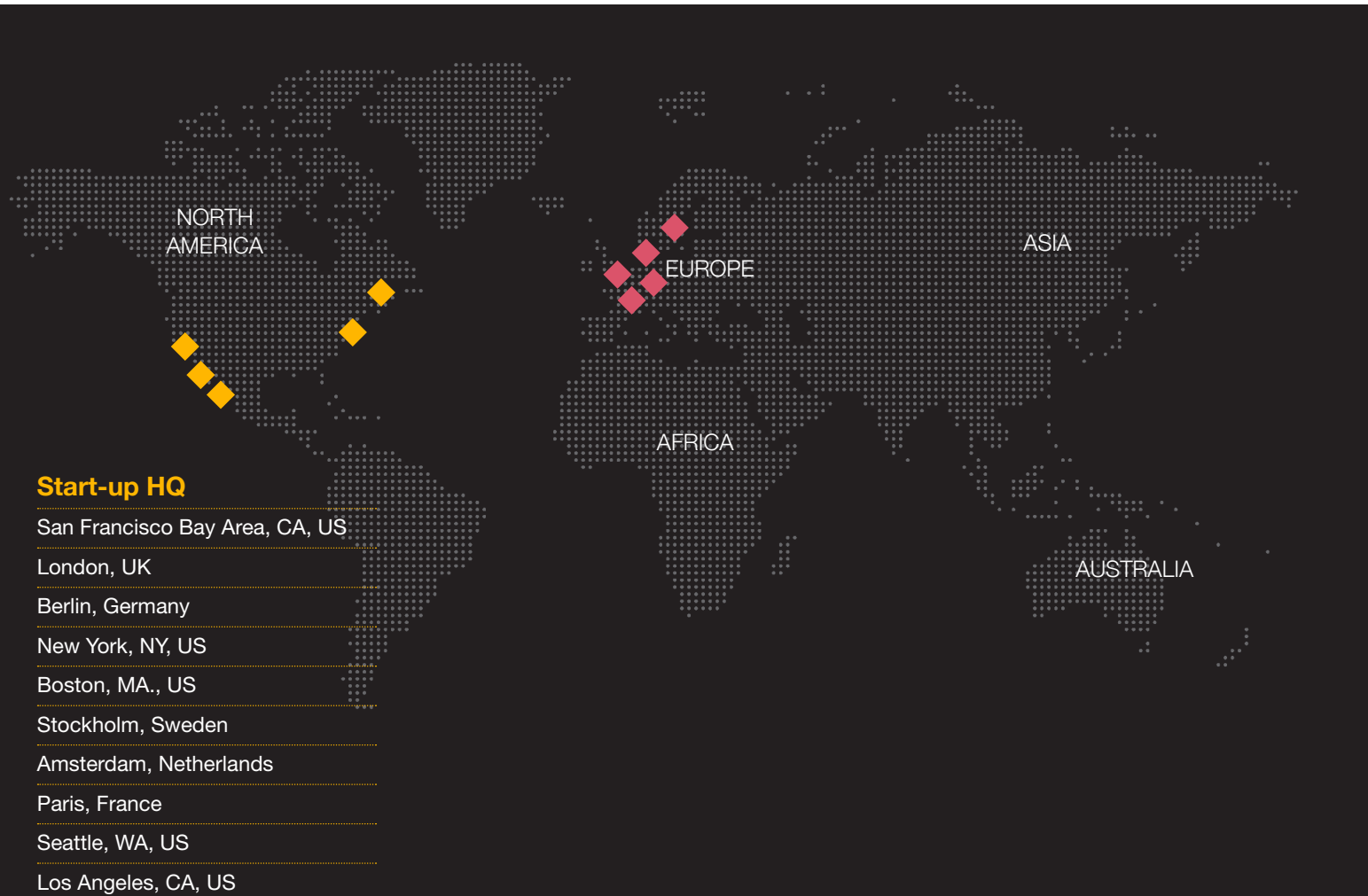
Climate tech funding by region H2 2020-2020 H1 2021



Source: PwC State of Climate Tech 2021, analysis of Dealroom data

Top ten climate tech investment hubs

The US and Europe dominated the list of most active investment hubs from H2 2020 to H1 2021, each taking five spots.



Top three regions

US

The US had the highest investment in climate tech across all regions between H2 2020 and H1 2021 (US\$56.6bn), due to the presence of five key climate investment hubs, as well as its mature VC market. Investment was concentrated most significantly in Mobility and Transport, which raised US\$36.4bn (66%). This represents over half of global investment in Mobility and Transport in the period.

The next most significant challenge areas in terms of investment were Food, Agriculture and Land Use at US\$6.9bn (13%) and Energy at US\$4.9bn (9%). The least invested challenge areas were Financial Services, Built Environment, Climate Change Management and Reporting, and GHG Capture, Removal and Storage, which all received 2% or less of total investment.

Europe

Europe is the second-largest investor in climate tech, edging ahead of China over the last 12 months analysed, totalling US\$18.3bn. Similarly to the US, Europe's highest investment was in Mobility and Transport, followed by Food, Agriculture and Land Use, and Energy.

The Mobility and Transport challenge area in Europe saw a 494% increase in total investment in H2 2020 and H1 2021 compared to the 12-month period prior. The lowest-funded challenge areas were Financial Services and GHG Capture, Removal and Storage. They received 1% and 0.5% of total funding, respectively.

China

China was the third-largest investor in climate tech as of H2 2020 - H1 2021 (\$9bn). Investment was heavily skewed towards Mobility and Transport, with the total funding raised being US\$8.9bn, totalling 99% of all climate tech investment in the region.

Compared to other regions, this level of investment in Mobility and Transport is highly disproportionate. Across the US and Europe, investment is also distributed across other challenge areas.

China was the second-largest investor in Mobility and Transport behind the US. The majority of investment in the challenge area was in the low GHG light and heavy transport lever, totalling 83%, followed by efficient transport systems at 9.3%.

Notably, our analysis shows investment in Mobility and Transport; Industry, Manufacturing and Resource Management and Food, Agriculture and

Land Use during H2 2020–H1 2021, but not in any of the other horizontal or vertical challenge areas.

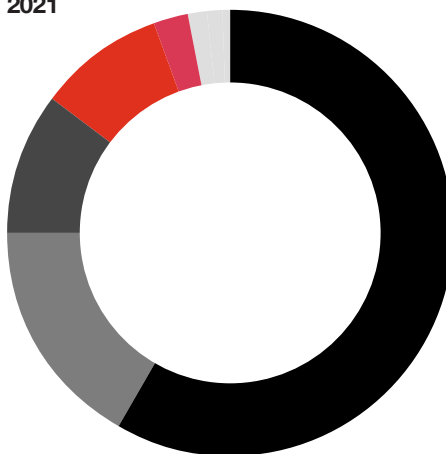
The VC market in China as a whole is distinct from other regions in several notable ways. China is a relatively young player in VC, with its first state-owned VC firm founded in only 1985. Since then, it has rapidly grown to become one of the largest VC markets in the world, with much of this growth coming in the past decade.⁶² There is significant state support, with the Chinese government claiming to have amassed Rmb12.5tn (US\$1.8tn) of state money across thousands of venture capital funds to drive technological innovation,⁶³ as well as providing broader financing mechanisms, such as low-cost lending to support the country's transition to net zero by 2060.⁶⁴

Climate tech funding by sector in US start-ups H2 2020-2020 H1 2021



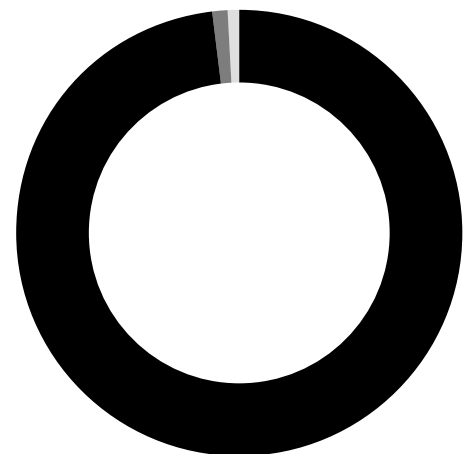
■ 66% Mobility and transport ■ 12.5% Food and agriculture ■ 8.2% Energy ■ 9% Industry and manufacturing ■ 1.7% Financial Services ■ 00% Other (Climate Change Management and Reporting GHG Capture, Removal and Storage)

Climate tech funding by sector in European start-ups H2 2020-2020 H1 2021



■ 58.4% Mobility and transport ■ 16.9% Food and agriculture ■ 10.1% Energy ■ 9.4% Industry and manufacturing ■ 2.5% Built Environment ■ 00.0% Other (Financial Services Climate Change Management and Reporting GHG Capture, Removal and Storage)

Climate tech funding by sector in Chinese start-ups H2 2020–H1 2021



■ 99% Mobility and transport ■ 0.7% Food and agriculture ■ 00.0% Industry, Manufacturing and Resource Management



6

Key findings:

Investors

The emerging investor landscape

Though the market is still in its relative infancy, climate tech is maturing rapidly as an asset class, with investors of all types engaged, including angels and accelerators in Colorado and Eindhoven, venture capitalists in Silicon Valley and Tokyo, private equity firms in New York and London and sovereign investment funds and corporations across the world.

We identified over 6,000 investors engaged in over 8,900 deals between H1 2013 and H1 2021. In our Climate Tech Investor Landscape below, we capture some of the investors with the most climate tech deals by funding stage.

Despite this relatively large top-line number of investors, however, on closer examination we find that the investor ecosystem remains nascent. Only a handful of investors have established the deeper familiarity that comes with frequent investing activity: Just 500 investors made ten or more climate tech deals between 2013 and H1 2021, with over 75% of investors making only one or two climate tech deals. As Mike Zelkind, co-founder and CEO of 80 Acres Farms, said in PwC's inaugural [State of Climate Tech report](#), 'There isn't yet an

understanding of what will be an accelerator to growth' in the VC ecosystem, and it will take some time to increase the number of investors with tailored experience in helping climate tech start-ups reach scale.

The 'valley of death' for investment

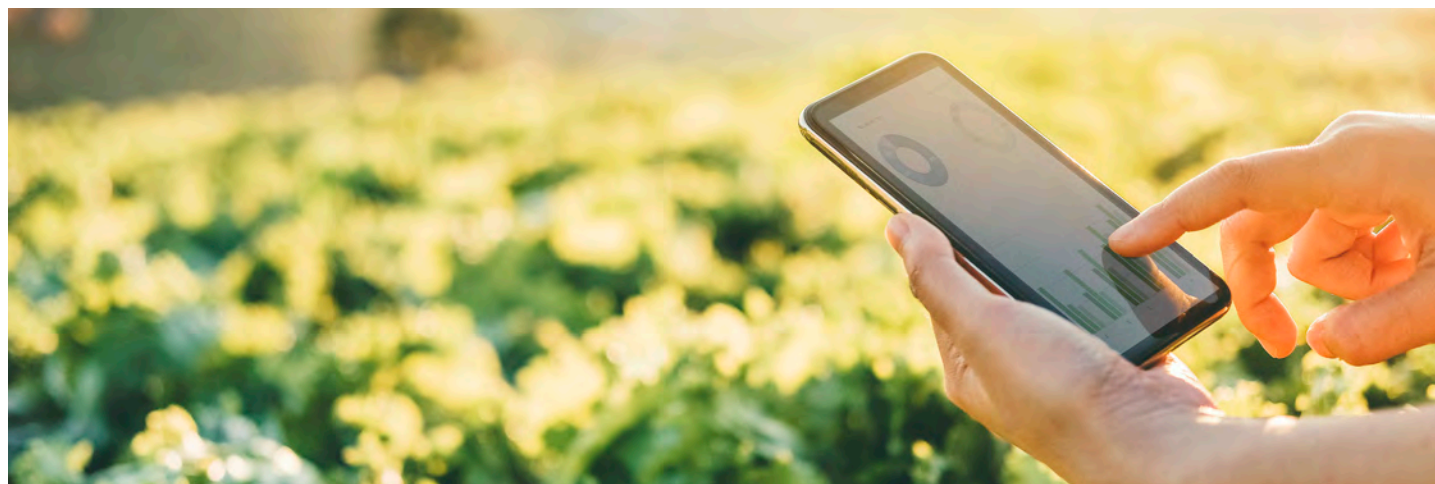
As climate tech looks to become increasingly mainstream, the number of investors active in this area will need to grow. Investors of all types and across all challenge areas are needed in order to reach this goal, from governments and incubators de-risking early-stage start-ups through to the public market investors enabling sustained growth.

In particular, start-ups will be looking for investors with expertise in climate tech who can help them meet the unique challenges faced in their field. However, when looking at deals involving experienced investors (defined in this case as investors involved in at least five climate tech deals), we see what interviewees have described as a potential 'valley of death': there appears to be a dearth of investors able to provide the largest megadeals needed by start-ups to scale up their operations.

The Climate Tech Investor Landscape: H1 2013 - H1 2021

The following graphic showcases different types of key investors across different stages of funding.

Private Equity / Investment Funds					BlackRock Goldman Sachs T. Rowe Price	BlackRock Fidelity Neuberger Berman Wellington Management
Corporate Venture Capital		Engie	Alphabet SoftBank Tencent	Amazon Daimler SoftBank	Amazon GE Ventures Volkswagen	
Venture Capital	SOSV 500 Start-ups Almi Invest New Crop Capital	Demeter Breakthrough Energy Ventures Khosla Ventures	Khosla Ventures Sequoia Prelude	Khosla Ventures Breakthrough Energy Ventures Eurazeo	Vision Ridge Partners	
Crowdfunding	CrowdCube Seedrs	OurCrowd		OurCrowd		
Accelerators	Y Combinator Techstars EIT InnoEnergy	EIT InnoEnergy Y Combinator Plug and Play				
Government (including state owned investment funds)	European Innovation Council Eurostars SME Programme U.S Department of Energy	Bpifrance European Innovation Council	Temasek Bpifrance	Temasek Bpifrance		
	Angel / Seed / Grant	Series A / Early VC	Series B-D	Series E-H / Late VC	Growth Equity	IPO, SPAC, Post-IPO



This is reflected in our data. We find a relatively large number of seed and Series A investors, echoing feedback from our interviews that participation in early-stage deals is increasingly competitive. When looking beyond Series C investment, we see a relatively sharp drop-off in the number of experienced investors, sharper than we see in non-climate tech industries. As markets mature and larger institutional capital is deployed towards climate tech, we expect this gap to close, but in the short term it is creating a barrier to the scale-up of climate tech.

Other key reflections

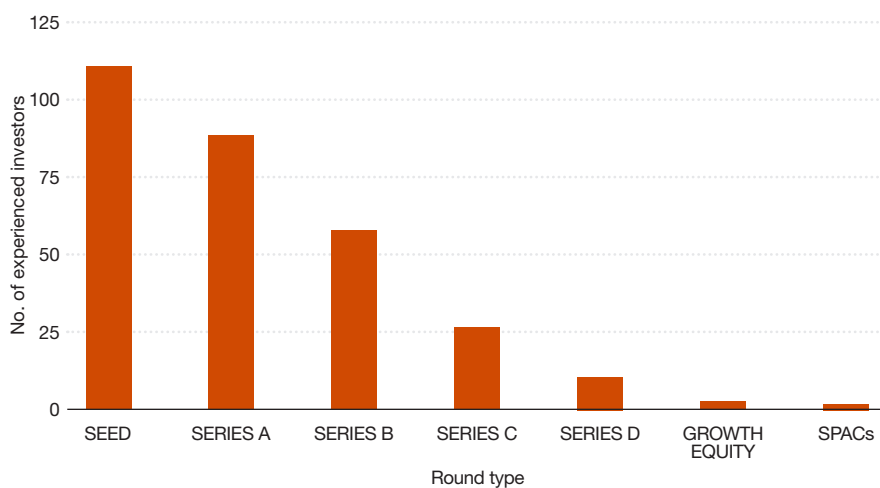
- Continued geographic borders in investment:** Interviewees described how some investors, particularly early-stage funds, are only focused on one sector or geography and are more opportunistic in the way they operate. Although this is partly driven by Limited Partner (LP) requirements, as well as the nature of how deals are sourced (which is still often reliant on local relationships and networks), such geographic borders risk limiting investment into the solutions with the greatest emissions reduction potential. Unlike other sectors, where geographical competition can support innovation, the urgency of the climate challenge means that speed and cooperation will be required to rapidly scale up the most effective technologies. As Hampus Jakkobson of Pale Blue Dot states, ‘Climate change is a transboundary issue. Therefore, we can’t look at climate tech with traditional siloed geographical and sectoral lenses.’
- Identifying value and tackling greenwashing through impact analysis:** A number of investors we spoke to have increasingly taken to forecasting GHG mitigation potential as a key diligence step of any climate tech deal. As well as helping to attract LPs, such reporting is increasingly encouraged or mandated by regulations, such as the EU’s Sustainable Finance Disclosure Regulation. For many investors,

however, this metric is not just about compliance, it’s a key indicator of potential success, alongside traditional metrics such as total addressable market. Many interviewees feel the VC market is heading towards more consistently reporting on these metrics, but the industry sentiment is that a flexible approach is needed, particularly for early-stage start-ups.

- Increasing numbers of megafunds:**

Megafunds are being ring-fenced for climate tech, including Brookfield’s US\$7.5bn net zero shift fund and Inclusive Capital’s US\$8bn impact investing fund. In PwC’s recent Unlocking investment for Net Zero infrastructure report, we found that there is a deep pool of private, low-cost capital primed to invest in net zero. However, these institutional investors need a more certain policy environment, and in particular support from governments to mitigate early-stage technology risk.⁶⁵ Policymakers appear to be acting on this need, with COP26 seeing over 40 world leaders sign up to the Glasgow Breakthroughs, aiming to make clean technologies the most affordable, accessible and attractive choice globally in the most polluting sectors by 2030.⁶⁶

Number of experienced climate tech investors by deal stage



■ Number of experienced investors

Caption: The number of experienced investors by round type. An experienced investor is defined here as one that has been involved in at least five climate tech deals. Time period: H1 2013 to H1 2021.

Source: PwC State of Climate Tech 2021, analysis of Dealroom data



7

Key findings:

Impact analysis

Comparing climate tech investments against climate impact⁶⁷

Venture capital can play a critical role in accelerating the uptake of climate technologies by 2030, to achieve net zero by 2050. The investment trends found in H1 2021 are an example where the private sector has demonstrated that it can scale and rapidly deploy capital into climate tech.

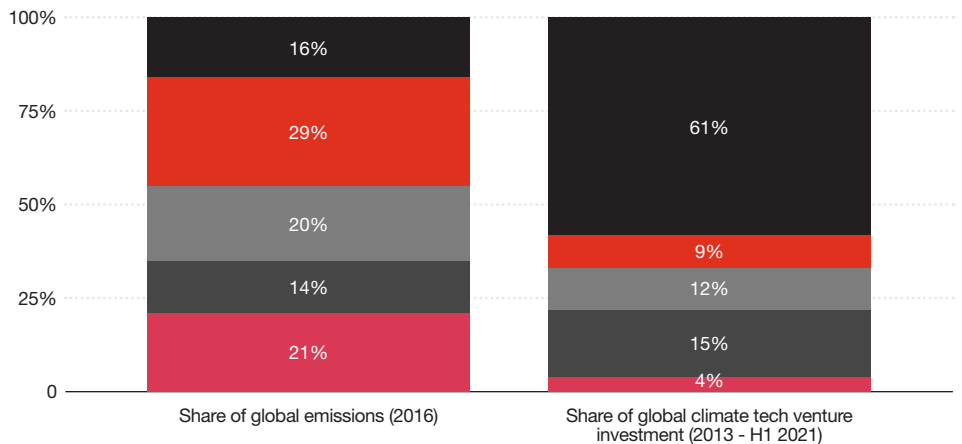
In parallel, by 2050, almost half of global CO₂ emissions reductions will come from technologies that are currently only at the demonstration or prototype phase.⁶⁸ Significant and sustained investment is required across the innovation life cycle to ensure that commercially ready solutions are able to scale within this next decade, whilst R&D is accelerated to achieve the necessary breakthroughs for the future. The sooner these nascent technologies can achieve scale, the greater the total emissions reduction potential for society.

Comparing global GHG emissions by challenge area to the investment capital each has received, it's clear that some areas are not proportionally funded.⁶⁹ The Mobility and Transport challenge area

received 61% of all investment funding in our analysis but represents just 16% of global GHG emissions.⁷⁰ The funding gap is largest in the Built Environment challenge area, which receives just 4% of funding in proportion to its contribution to GHG emissions of 21%.

In this section, we dive deeper into these challenge areas, taking a look at the individual technologies underpinning them, which are driving these patterns.

Share of global emissions and climate tech venture investment by challenge area



■ Mobility ■ Industry and Manufacturing and Resource Management ■ Food and Agriculture ■ Energy ■ Built Environment

Source: PwC State of Climate Tech 2021, analysis of Dealroom data. Note: Emissions data is allocated to the end sector associated with emissions. For example, energy use associated with mobility is allocated to Mobility & Transport rather than Energy. Likewise, no emissions are allocated directly to Financial Services.

Overall findings

- **Capital is deployed at scale when business models and climate technologies are both viable.**

Excitement around certain technologies, namely in Mobility and Transport, attracts significant capital and receives a greater proportion of funding as compared to their potential impact on climate change mitigation. Once a technology develops a proven business model, capital flows quickly and can have significant impact in accelerating adoption. However, investment is currently disproportionately aligned towards challenge areas with lower total emissions reduction potential (ERP) while high-ERP challenge areas, with less mature technologies, remain underfunded.

- **Increased funding is needed across all challenge areas** to enable

breakthrough innovations and trigger sectoral tipping points, whilst also supporting commercially ready technologies to scale over the next decade. Policies are needed to provide incentives to investors, and clear government action plans, support of a consistent carbon price, and R&D investment are needed to accelerate private-sector investment and technological innovation. This will enable an increasing scale of rapidly deployed capital into the necessary climate technologies over the next decade and beyond.

- **More patient capital from early-stage VC investors is required** to deliver

future breakthroughs. Long-term strategic plans and targeted policy measures (for example, a carbon price) by governments are needed to kick-start investment into technologies in hard-to-abate sectors (for example, low GHG building materials) and carbon removal technologies that will be pivotal to achieving global net zero targets



The decarbonisation opportunity over the coming decades is the biggest business opportunity since the Internet revolution, perhaps even 100x bigger than that revolution. So imagine the Googles, Amazons, etc., we've seen — we'll see more in climate tech”

(Yair Reem, Extantia)



The challenges are that we are investing in something that is unproven but looks promising. So the government can help us get comfortable with that. As things become more uncertain, the government can help, and not necessarily by providing 100% subsidy”

(PwC UK Interview with Infrastructure Investor)⁷¹

How mature are climate technologies?

Our analysis of maturity is defined by determining the technology readiness level (TRL) of technologies, sourced from academic or grey literature.⁷² Building on individual TRLs, our technology areas are ranked on a scale from prototype (TRL 4-6), to demonstration (TRL 7-8), to commercial adoption (TRL 9+), based on an assessment of the aggregated TRLs of individual technological applications and processes in that technology area.⁷³

Prototype (TRL 4-6)

Direct air carbon capture and storage (DAC/S)

Low GHG iron and steel

Low GHG shipping

Ocean and tidal power

.....
These technologies are largely at the R&D stage, starting as concepts in a laboratory environment, through to late-stage prototypes in relevant deployment conditions. Whilst individual technology use cases may have reached a demonstration phase with real-world testing, due to their current levels of deployment they are considered to be less mature compared to technologies in the demonstration category.

Demonstration (TRL 7-8)

Alternative foods / low GHG proteins

CCUS in power

Precision agriculture

Food waste technology

Green hydrogen production

Low GHG concrete and cement

Sustainable aviation fuels (SAFs)

.....
Technologies in this category have full-scale demonstration or pilot projects under way, often gathering data to generate investor and regulator confidence whilst targeting a commercial introduction.

Several technology areas listed in this category—for example, precision agriculture and food waste technology—have already achieved commercial launch in some markets. However, these are typically at a significantly small scale compared to the total available market, hence a lower maturity score.

Commercial adoption (TRL 9+)

Light-duty battery EVs

Solar power

Wind power

Micro mobility

.....
These are technologies that have proven commercial business models in their relevant environments. Some of these technologies—for example, solar power and wind power—have been commercially available for well over a decade. However, there is still opportunity for VC investors to accelerate innovation ‘at the edges,’ such as developing advanced materials to make efficiency gains or software solutions to manage and optimise renewables-to-grid interactions.

Our research suggests that these technology areas are rapidly approaching their global sectoral tipping points, with continued investment needed across the funding life cycle to enable them to scale, overcome remaining barriers to adoption, optimise, and target underserved customer segments.

Is capital being deployed in line with climate impact?

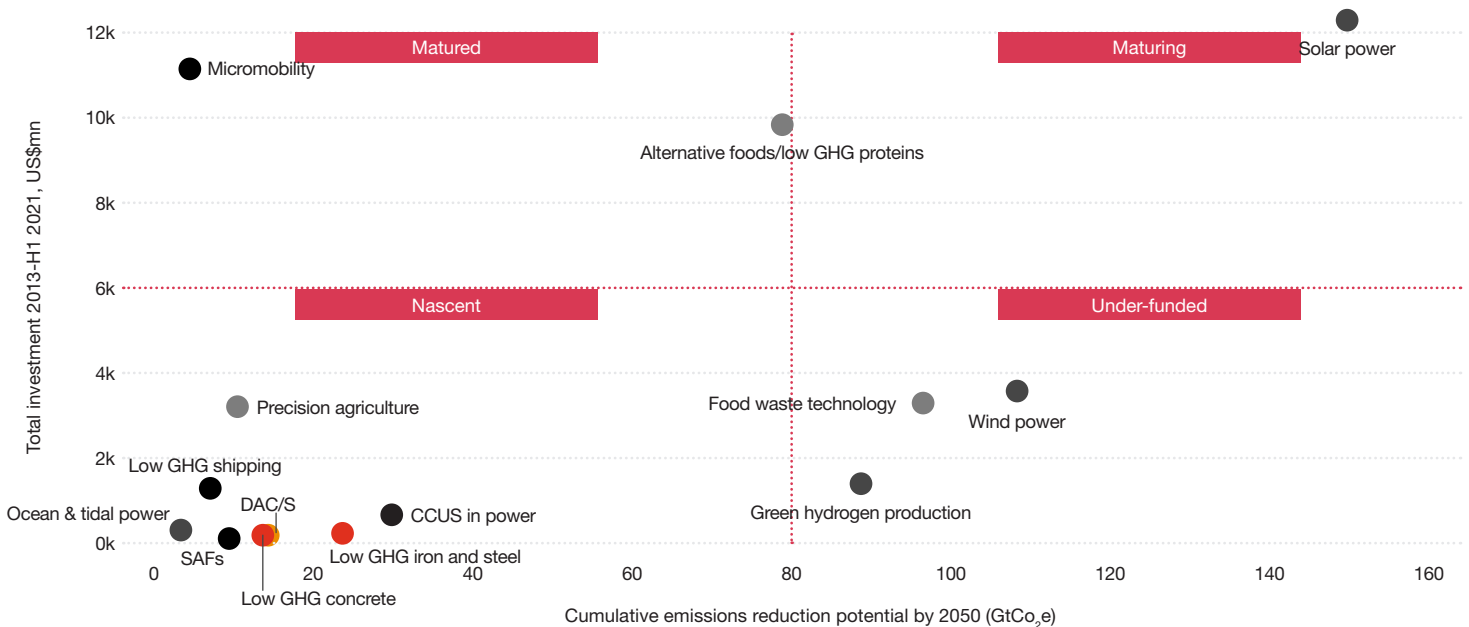
A handful of technologies are taking the largest slice of the investment pie

In short, the answer is no. Our analysis shows that the top five technologies in terms of cumulative ERP by 2050,⁷⁴ which represent **81%** of total emissions reduction by 2050, have received just **25%** of the total investment funding over the analysis period from 2013 to H1 2021. The share of capital is dominated by a handful of technology areas, with the majority of climate technology solutions receiving just a fraction.⁷⁵

Two technology areas worth mentioning here are light-duty battery EVs⁷⁶ and micro mobility. The former represents just 3% of the total ERP but has received in excess of 60% of the total funding, and the latter represents just 0.4% of ERP whilst receiving 9% of the funding.



Total funding against emissions reduction potential by climate technology (2013-H1 2021)



■ Energy ■ Food, Agriculture and Land Use ■ GHG Capture, Removal and Storage
 ■ Industry, Manufacturing, and Resource Management ■ Mobility and Transport

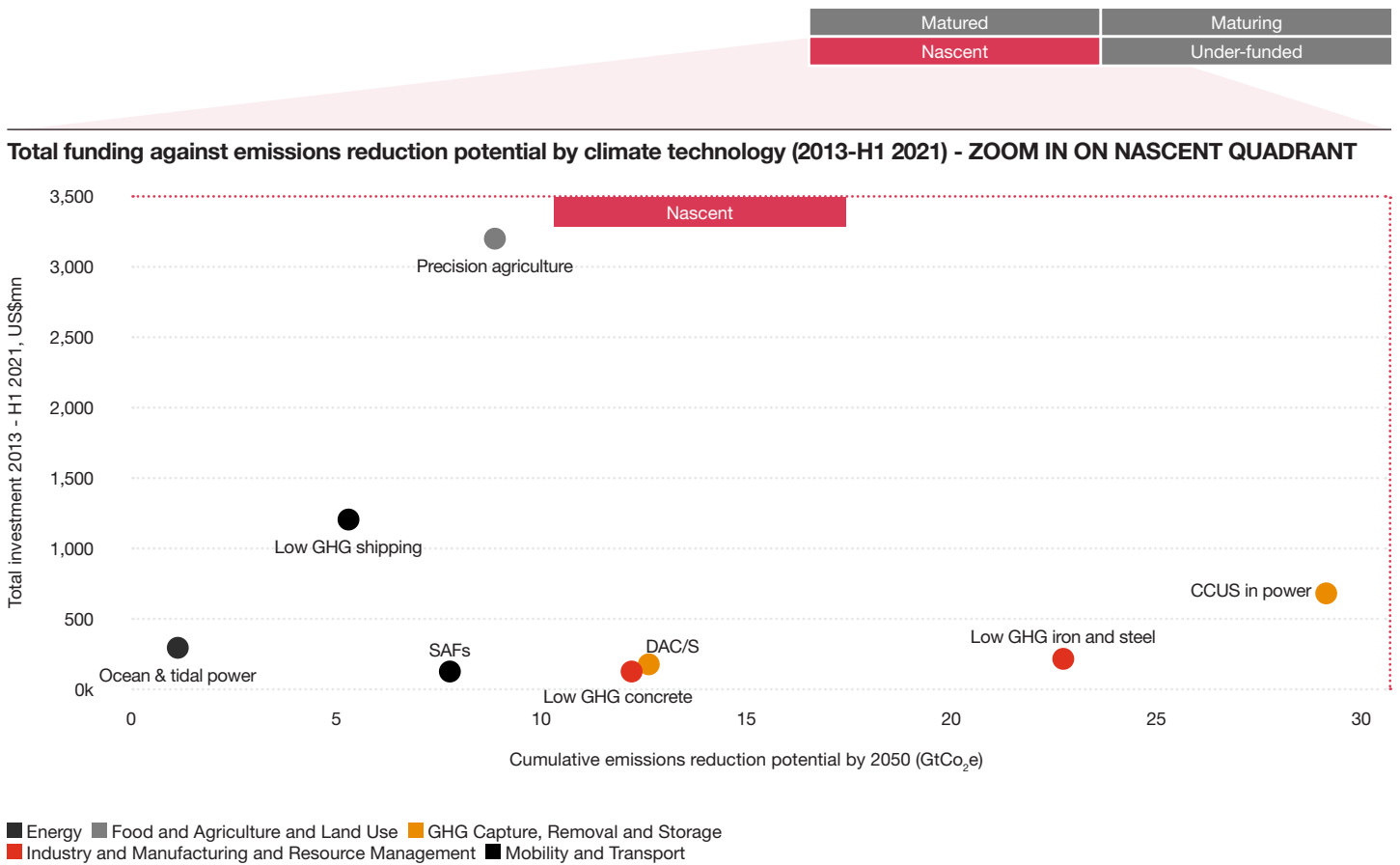
Source: PwC State of Climate Tech 2021, analysis of Dealroom data, Project Drawdown data, and grey literature. See appendix for detail. Note: In our analysis the start-ups and funding rounds included focus on VC investment and target emerging technologies. Funding from public markets (post-IPO) fundraising or large-scale project financing, that is used to scale up more mature technologies, is not included.

Where might we find the next gigacorns??

The chart below focuses on the technology areas that, based on current technology penetration scenarios, individually represent less than 30 gigatons of CO₂ equivalent (GtCO₂e) of cumulative ERP by 2050. Despite having smaller ERPs⁷⁸ relative to technology areas such as alternative foods or solar power, these technologies are likely to play a pivotal role in decarbonising their sectors, each of which contributes significantly to the global GHG to the global GHG emissions budget.

Though no individual company is close to achieving gigacorn status today, many of the highest-polluting challenge areas present a large enough problem from a CO₂ perspective that this could be possible in the future. It is for this reason that the technologies shown here are likely to represent those that will achieve this status in the future. Today, concrete and cement production represents 8% of global GHG emissions, with iron and steel adding an additional 6% to 8%.⁷⁹ These are clearly industries where significant impact at scale can be achieved with the right mix of technology and investment. What is certain, however, is that no single

technology will be able to shift the curve on climate change and that innovation and scale are required across all the challenge areas mentioned in this report. However, as markets in maturing climate technologies continue to scale, investors looking for ten-times to 100-times returns and beyond should look at these relatively nascent technology areas, where multiple unicorns do not yet exist to crowd out the market.



Source: PwC State of Climate Tech 2021, analysis of Dealroom data, Project Drawdown data, and grey literature. See appendix for detail. **Note:** In our analysis the start-ups and funding rounds included focus on VC investment and target emerging technologies. We have not included funding from public markets (post-IPO) fundraising or large-scale project financing that is used to scale up more mature technologies. This chart is a closer look into the 'Nascent' technologies quadrant from the previous chart, with the x-axis limited to 30 GtCO₂e and the y-axis limited to US\$3.5bn.⁸⁰

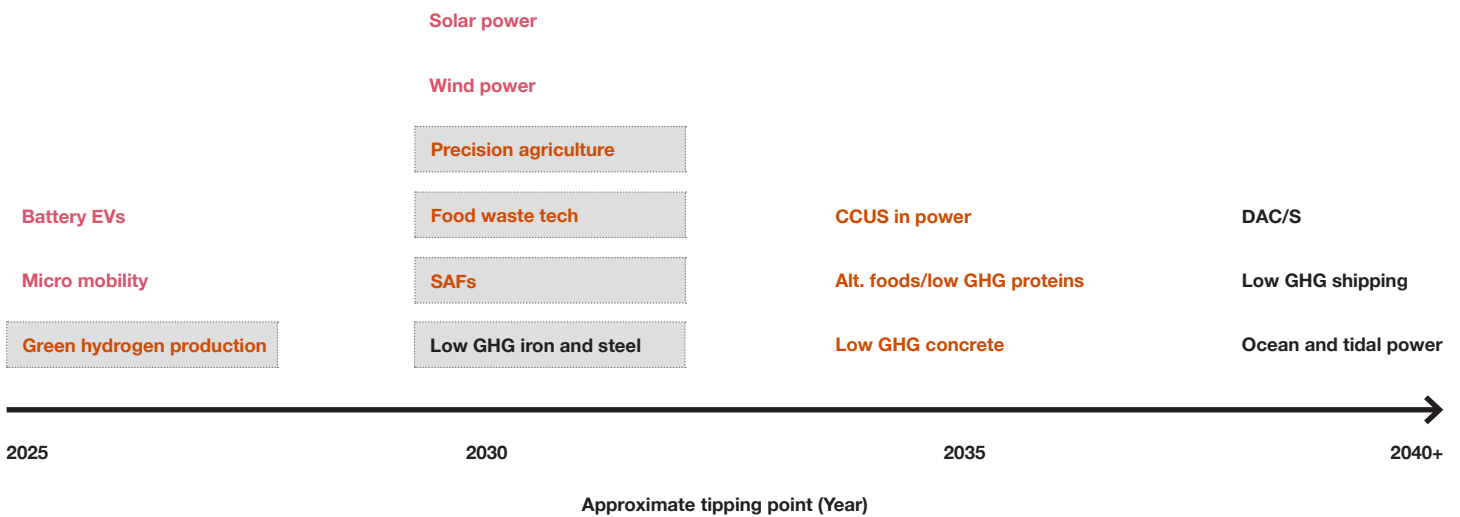
Venture capital's role in accelerating innovation

Identifying gaps in innovation

Our analysis highlights **five technology areas** (green hydrogen production, food waste technology, precision agriculture, sustainable aviation fuels and low GHG iron and steel) that are **potentially lagging behind in terms of innovation in research and development**, as shown by their relative immaturity compared to the proximity of their sectoral tipping point (diagram below). Given that it can take many years, and even decades, to achieve commercialisation following the prototype and demonstration phases, and the need for rapid decarbonisation in some of the most carbon intensive industries, society needs to quickly mobilise and accelerate these technologies.

We conducted interviews with VC investors to understand the market's view on the role played by VC today in advancing climate technology solutions. Several interviewees expressed their concern at the level of investment targeted towards financing technologies that are scaling fast but that will not contribute meaningfully to global decarbonisation. However, many interviewees also expressed their hope that VC investors would do what they do best and facilitate 'cutting the green premium' on the many nascent technologies that have emerged across challenge areas, to make them ready for widespread adoption. Not doing so runs the risk of missing an opportunity whilst also not helping to solve the climate problem.

Tiping point vs. technology maturity

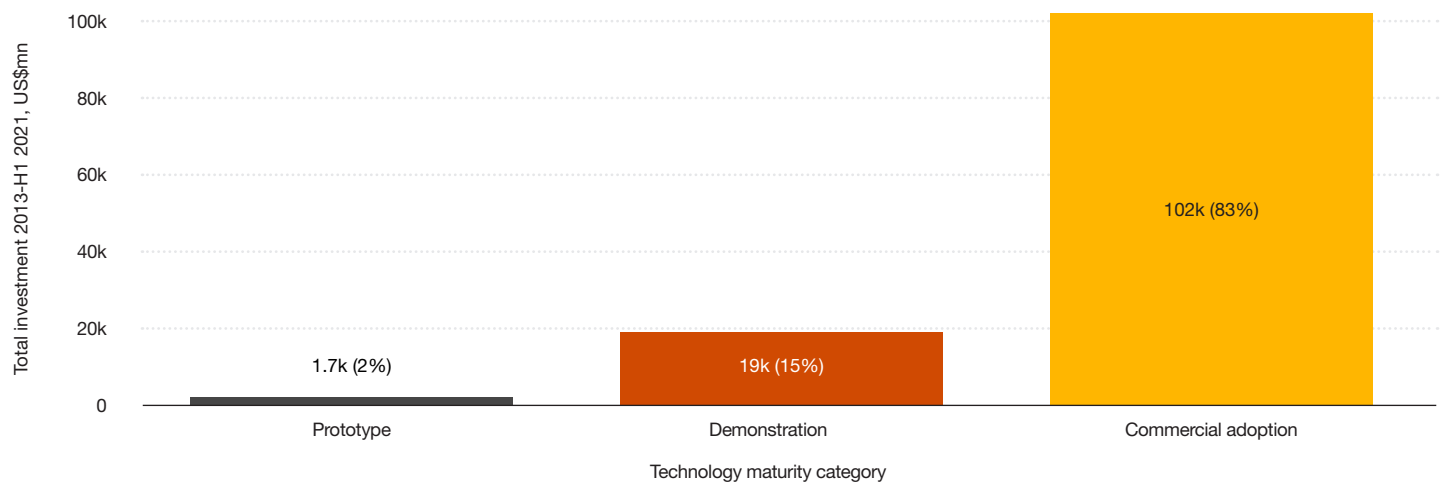


■ Commercial adoption ■ Demonstration ■ Prototype ■ At risk of innovation gap

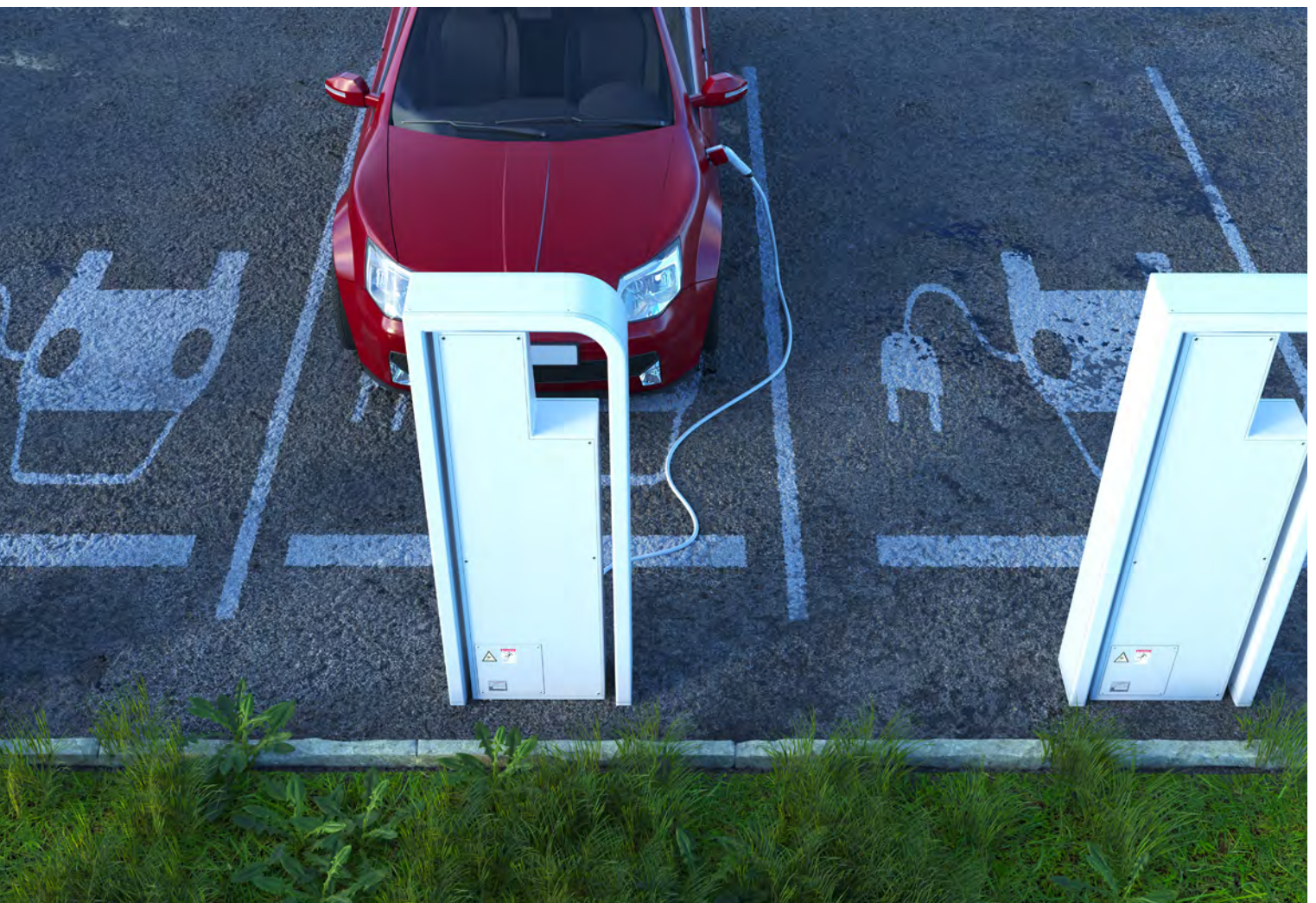
Source: Adapted from IEA energy technology perspectives (2021) and PwC analysis

Disparity in funding within and across maturity categories

Total funding by technology maturity category (2013-H1 2021)



Source: PwC State of Climate Tech 2021, analysis of Dealroom data



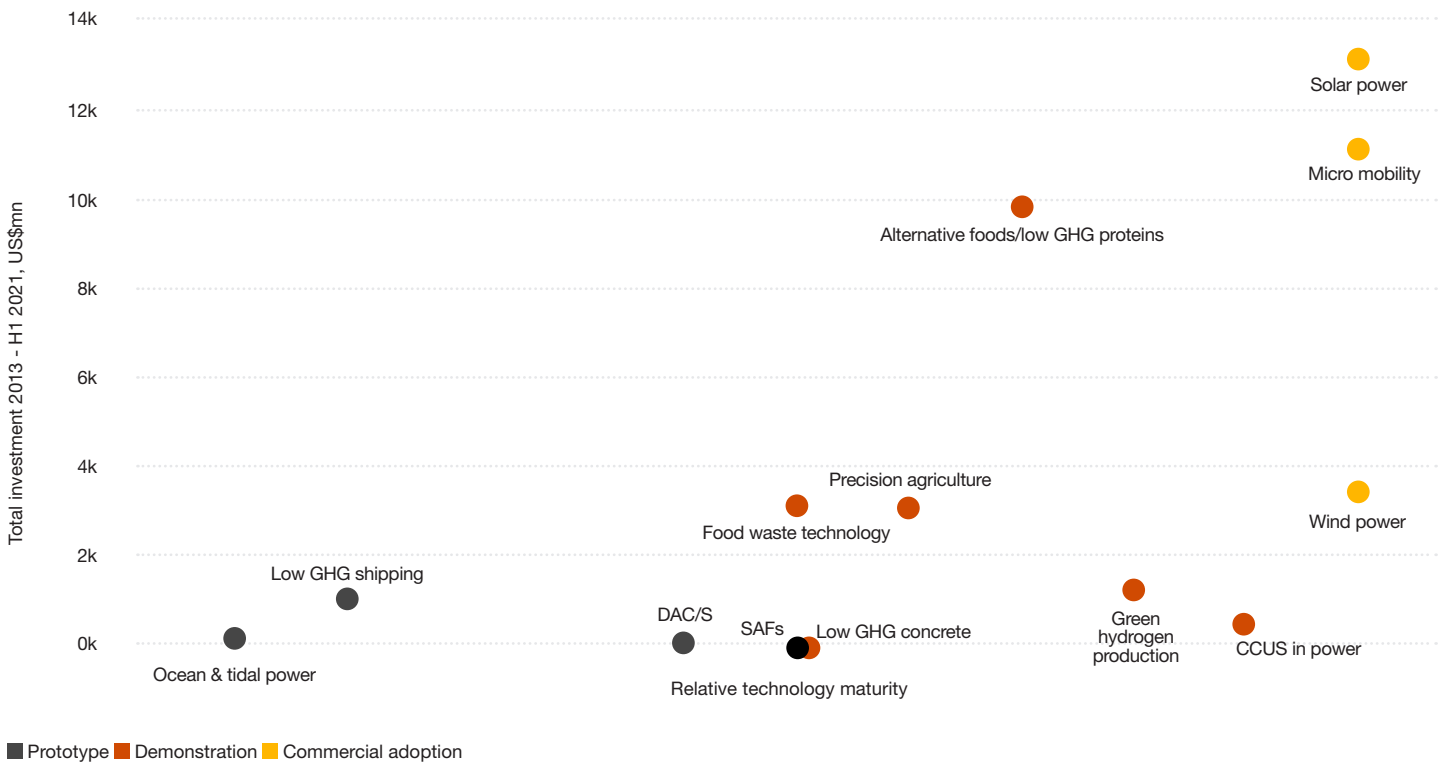
Analysis into the total funding raised across the three maturity categories demonstrates a clear and unsurprising pattern, with greater funding being channelled into more mature technologies, which tend to have lower product and commercial model risk.

However, for a given level of maturity—and therefore a similar target internal rate of return for investors—there is significant disparity in the total funding raised, as shown by the chart below.⁸¹ For example, food waste technology received 35 times as much funding as low GHG concrete over the investment period, despite their similar technology maturities. This is likely due to the additional risks posed to investors when considering investment into capital-intensive climate technologies, such as carbon capture and storage projects, compared to low GHG protein technologies, which have

significantly lower capex and end-product unit costs and which benefit from proven channels to revenue. Some of these technologies also fall within industries that are not typically found in the traditional start-up ecosystem, which can make innovation more difficult.

Another explanation is that sustained market excitement about certain technologies, buoyed by high-profile investors, has led to significant investment in some technologies. This presents opportunity areas for capital to scale innovation in those technologies that may be underfunded for their technological maturity. Determining which technologies are underfunded vs. their peers remains highly geography- and market-dependent, and also depends on total addressable market assumptions, which are bespoke to each market.

Total funding against technology maturity by climate technology (2013-H1 2021)



Source: PwC State of Climate Tech 2021, analysis on Dealroom data, technology maturity adapted from IEA Energy Technology Perspectives (2021), and grey literature

Climate tech needs a new class of investor

Given the nature of VC, with fund life cycles rarely exceeding ten years, and the fact that climate technologies typically take longer to develop and scale than traditional technology offerings, there is a growing appetite for climate technology investors to be more patient with their capital. Additionally, with investors optimising internal rate of return within their investments, they have incentives to opt for technology investments that scale and exit fast.

More patient capital from VC is needed to fund innovation in capital-intensive technology areas that can also deliver the necessary financial returns, alongside outsized environmental and social impact. This reinforces the point made in our 2020 report that access to patient capital is important. Vinod Khosla, founder of Khosla Ventures, said, 'Matching the time horizons of climate tech start-ups with investors is a key challenge. Patient capital is needed, which is why Breakthrough Energy Ventures has set up a 20-year fund, rather than demanding returns within the traditional ten years.'

With the right investor type, these technologies could achieve the exponential growth that is needed to make meaningful steps towards decarbonisation across the hardest-to-abate sectors, such as the built environment, industry and manufacturing, aviation and shipping. The challenge lies in convincing investors beyond only the 'impact-first' tribe to operate in this way and unlock the hundreds of billions of dollars of capital that is available.⁸²

Breaking down the barriers to early-stage investment in capital-intensive start-ups

Data from the UK's Energy and Climate Intelligence Unit shows that 137 countries have aligned themselves to climate neutrality targets as of June 2021. Achieving these targets requires urgent action, and especially so for the most polluting challenge areas, such as energy, transport and industry and manufacturing, which rely on expansive infrastructure.

Real assets with high upfront costs and long asset lives need to be planned, financed and built. Clearer investment signals are required if this is to happen at the pace and scale required to replace current high GHG-intensity assets with lower GHG-intensity alternatives. Investment by the UK and other countries into offshore wind power has proven that costs can fall, around 60% in the decade to 2020, with the UK now a leading developer for offshore wind power.⁸³ This demonstrates that, with the right balance of government policy support and private-sector investment, significant strides can be taken towards meeting net zero by 2050. Today's emerging technologies and net zero innovations require the same level of strategic direction and partnership between government and private investors to accelerate the pace of decarbonisation, supported by government policies such as introduction of carbon pricing to provide market confidence and initiatives such as the First Movers Coalition to accelerate innovation in harder-to-abate sectors.⁸⁴

Whilst scaling infrastructure technology typically relies on low-cost, patient capital, such as that provided by **institutional investors** such as pension funds, sovereign wealth funds and infrastructure funds, there is also a continued need for VC to help prototype- and demonstration-stage companies to conduct R&D and to support the scale-up of technology and supply chains.





Correcting market failures: a global carbon price⁸⁵

The CCUS industry provides an insightful case study to examine the impact of a meaningful carbon price. Putting a price on carbon seeks to internalise the externality of carbon pollution across all industries. Carbon taxes help to reduce the 'green premium'⁸⁶ as they force faster price parity to more expensive green alternatives. They provide an incentive to pollute less and, in doing so, encourage the shift to more renewable sources of energy and forms of production, and can lead to lower and cleaner consumption.

CCUS technologies are complex. Whilst they can significantly reduce emissions from energy generation and intensive industrial processes, they also prolong global dependence on fossil fuels and are seen by some as counterproductive in the mission to a net zero future.

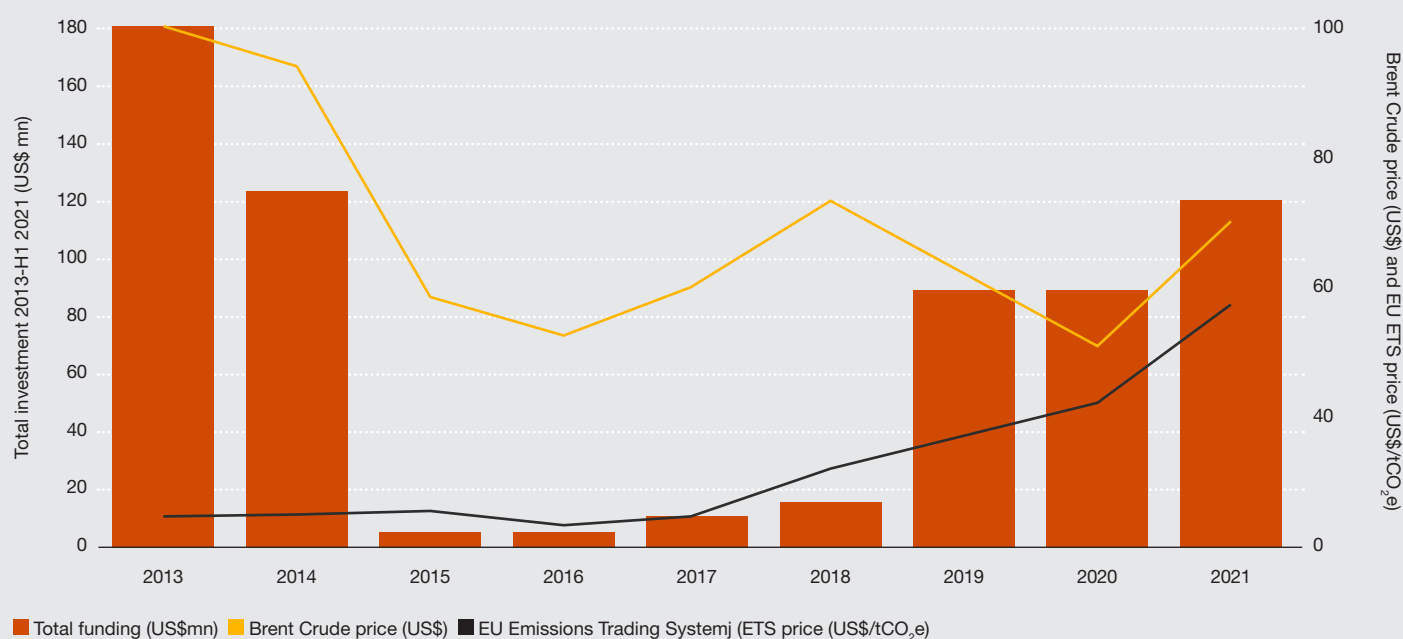
Though more countries are increasing their support for CCUS development and deployment, many planned projects face increased uncertainty in the near term because of the COVID-19 pandemic and continued faltering oil prices, which are often used to index the price of CO₂, making commercial viability a challenge. And given that the utilisation of captured CO₂ to make products or in industrial processes is still in its infancy, most CO₂ captured today is used for enhanced oil recovery, an expensive process that relies on a high crude-oil price to be viable. With global oil prices seeing historic lows because of the COVID-19 pandemic, the world's largest commercial CCUS power plant, Petra Nova in Texas,⁸⁷ shut down operations in mid-2020, casting a shadow on the uptake of CCUS technologies.

And though existing CCUS technologies are promising and require capital to scale, there are several technological innovations at earlier stages of maturity that could increase capture rates and provide greater cost competitiveness for the technology. CCUS applied to power generation is at an early stage of commercialisation, so securing investments will require complementary and targeted policy measures such as long-term strategic plans, supporting tax credits and grant funding.

With the right mix of incentives, including a global carbon price in place, this and other clean energy technologies could see a rapid rise in adoption. Until then, for the majority of investors, it will remain challenging to invest in these technologies.

In the investment period covered, the CCUS in the power technology area raised just US\$646m of funding, representing less than 1% of total funding across all the impact technology areas. The majority of the funding to date (2013–H12021) has been concentrated in three companies: LanzaTech (US\$294m), CarbonFree Chemicals (US\$141m) and Svante (US\$136m). Given the gap in funding, rising demand and growing recognition of the importance of CCUS in meeting the world's decarbonisation goals, CCUS could provide a major opportunity for investors.

Total funding for CCUS in power against Brent Crude and EU Emissions Trading System prices (2013-H1 2021)



Source: PwC State of Climate Tech 2021, analysis on Deal room data, US Energy Information Agency and World Bank Group data

8

Summary

The climate tech landscape is moving quickly, and momentum has significantly accelerated over the past year since PwC's inaugural report. We have uncovered a number of key findings, which should be considered in order to maximise the impact of climate tech investments.

- 1 Although capital is pouring into climate tech, **attention is still needed at pre-seed and seed stages to drive breakthrough innovations**, advancing and scaling future technologies to help tackle the climate crisis.
- 2 **Investors need to look beyond the low-hanging fruit** to help scale technologies in harder-to-abate sectors. Our impact analysis demonstrates that, of the technologies analysed, just 25% of the total funding raised is being channeled into the technologies that have 81% of the emissions reduction potential. Investors need to focus on channeling funding into the critically underfunded technologies that have a higher emissions reduction potential to drive deep decarbonisation of the economy.
- 3 **Investors and LPs must demand and support impact analysis pre-deal and ongoing reporting during the lifetime of investments.** Climate tech VCs' approaches vary

from a 'small, medium, large' sizing approach to detailed emissions calculations. The latter can place significant strain on start-ups; therefore, frameworks and approach need to be carefully considered based on maturity and scale. Building capability to understand and analyse this across traditional VCs is also important. There are various high-calibre public resources that can be drawn on to support this.

- 4 Though the size of the prize can be enormous, investors must hold a **longer-term investment horizon** for many of these technologies to mature. Along the way, many may fail, so climate tech investors must also have a **higher risk profile**.
- 5 Many brands and products are pivoting to integrate ESG into their offering. **Investors must be wary of potential greenwashing attempts** and take a balanced view of emissions reduction potential as well as commercial return.
- 6 A significant opportunity remains to **take the lessons learned from countries that are leading climate tech development, to implement these in emerging markets.** This is especially important in leading a just transition, as many of these countries will be disproportionately affected by

the most severe impacts of climate change, despite being amongst the lowest emitters of GHGs.

- 7 **Ninety-seven percent of funding is going towards technologies that mitigate climate change, with only 1% going into adaptation.** The IPCC have made it clear that significant emissions reductions and CO₂ removal will be required for a 1.5°C pathway. It is therefore likely, if these technologies are not accelerated, that large-scale adaptation will be required to deal with the impacts of climate change in the short and longer term. Of the 3,000+ climate tech start-ups analysed, only 1% were focused on adaptation, **highlighting a clear innovation and funding gap.**

The last 12 months have shown a clear intention globally to respond to the climate crisis and achieve net zero. There is now a critical role for VC to set the direction of travel for investment, focusing on the key technologies that will enable deep decarbonisation.

Acknowledgements

This report was written by Leo Johnson, Emma Cox, Denise Chan, Tarik Moussa, Millie Foakes, Vish Arora, Jess Wrigley, Georgie Lawson and Tabea Stoeckel of the PwC UK Innovation & Sustainability team, in collaboration with Azeem Azhar of Exponential View.



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PwC would also like to acknowledge the valuable contributions of Dealroom and the interviewees and inspirers in the development of this document. Dealroom.co: Providers of the underlying investment data. Dealroom.co is a data provider on start-up, early-stage and growth company ecosystems in Europe and around the globe. Project team: Yoram Wijngaarde and Matteo Renoldi.

Interviewees and Inspirers

We interviewed the following individuals to better understand the latest state of play on climate tech investment over the last 12 months. The interviewees cover a range of geographies and investor types:

Brett Bivens (Head of Research, Prima Materia)
Mark Gupta (Managing Director, Prelude)
Danielle Harris (Managing Director, Elemental Excelerator)
Christian Hernandez (Partner, 2150 VC)
Hampus Jakobsson (General Partner, Pale Blue Dot)
Sven-Christian Kindt (IS&P Private Equity Investments, Credit Suisse)
Alex Langguth (Co-Founder and Managing Partner, Ubermorgen) **Ramez Naam** (Co-chair, Energy and Environment Program at Singularity University)
Matt Ocko (Co-managing Partner, DCVC)
Yair Reem (General Partner, Extantia)
Kavita Surana (Assistant Research Professor, Center for Global Sustainability, University of Maryland)
Albert Wenger (Managing Partner, Union Square)

Appendices



Appendix 1:

PwC's Climate Tech Platform

Our clients face the significant challenge of responding to the environmental, social and technologically disruptive forces shaping the global marketplace, whilst they are still trying to perform in current markets as they transition to net zero and delivery of the UN Global Goals.

We work with our clients to navigate towards tech-enabled, sustainable futures. From net zero strategy development and target setting, market scanning and partner identification through to impact assessment and reporting, we help our clients meet their emerging needs on ESG. See our [Climate page](#) for more of our insights and to contact us.

Appendix 2:

Investment analysis methodology

This section explains key features in the methodology that we followed in our exercise to assess VC investment in climate tech. Our approach followed three broad steps:

Step 1 was to establish boundaries for the analysis. These boundaries guided our analysis by defining what is and isn't a start-up and what should be considered venture capital. Our boundary conditions included:

- **Time boundaries:** We included start-ups formed at any date but only examined funding that was raised from 2013 onwards. This time boundary was chosen based on qualitative discussions with interviewees and our own experience of the increased interest in climate tech investment since 2013.
- **Funding boundaries:** We included only start-ups that had raised at least US\$1m. Start-ups smaller than this are not unimportant to climate tech but are less able to be robustly assessed against our climate tech criteria, as many are still pivoting their strategies in order to reach product and market fit.
- **Funding type boundaries:** We filtered by round type to include only early-stage VC and private equity funding. IPOs, ICOs and debt offerings were excluded from our analysis.

Step 2 was to assess whether individual start-ups should be considered climate tech start-ups. This is not a black and white issue, and so we applied a set of guiding questions to assess whether start-ups were sufficiently climate tech-focused:

- **Does the start-up have an emissions- or net zero-focused strategy?** Start-ups publicly indicating that reducing emissions was a clear objective for them were included in our analysis.
- **Does the start-up address a challenge area or lever of critical importance to net zero?** Start-ups tackling certain levers seen as pivotal to emissions reduction, or with use cases almost exclusively focused on resource efficiency and emissions reduction, were marked as climate tech irrespective of meeting our first criteria—for example, satellite operators gathering earth observation data that will be critical in informing effective climate action and optimising resource use.

- **Will the start-up have a first-order impact on emissions?** Start-ups that reduce emissions directly through their actions were included in the analysis, while those that had second-order impacts were not included (unless they met our first criteria). For an example of the latter, consider a manufacturer of AI-focused processors. These will potentially be useful for start-ups using AI to address the net zero transition, but they do not themselves directly contribute to emissions reduction (and depending on how they are applied, may indeed lead to greater emissions).

- **Does the start-up show a level of innovation and/or use of technology?** Start-ups were expected to demonstrate that they were developing or using innovative tools or techniques. For example, in alternative proteins, a company developing lab-grown meat would be considered sufficiently innovative, whilst a company selling plant-based food supplements (in the absence of any other form of major innovation) would not be included.

Step 3 was to allocate start-ups to challenge areas and levers. We assigned each start-up a primary challenge area and lever, based on the targeting of their products or services. We continually reviewed our taxonomy, making adjustments where we found start-ups were not naturally aligning with our initially hypothesised framework.

In some cases, start-ups provided solutions applicable to more than one challenge area—for example, development of EV battery technology, which also supports grid management when connected to the grid. In these cases, we adopted a pragmatic approach to classification by choosing the company's primary industry of focus (Mobility and Transport in the prior example).

Noteworthy start-ups: Our report discusses noteworthy start-ups in certain levers. These were selected based primarily on funding raised in the relevant period or those having the highest valuation, as well as to display the diversity of offerings produced under each lever.

Appendix 3:

Climate tech taxonomy

Challenge area Mobility and Transport



- Low GHG Air Transport
- Low GHG Shipping
- Micro-mobility
- Low GHG Light and Heavy Duty Transport: EVs and High-Efficiency Vehicles
- Efficient Transport Systems
- Travel Alternatives (VR, teleworking)
- Batteries/Fuel Cells

Challenge area Built Environment



- High Efficiency Fixtures and Fittings
- High Efficiency Space/Water Heating and Cooling
- Smart Management of Devices
- Building Level (electricity and thermal) Storage
- Low GHG Construction Processes
- High Efficiency Lighting
- High Efficiency Urban Spaces and Communities
- Transformative Circularity and Recycling
- Commercial and Residential Residuals Treatment and Management

Challenge area Energy



- Renewable Energy Generation
- Nuclear Generation
- Grid Management
- Waste Heat Capture/Conversion/Storage
- Alternative Fuels
- Energy Storage (thermal or electricity)
- Low GHG Extraction and Maintenance
- High Efficiency Energy Intensive Electronic and Smart Monitoring / Management

Challenge area Financial Services



- Lenders
- Banking (business + retail)
- Funds and Investment Banking
- Pensions
- Insurance

Challenge area Food Agriculture and Land Use



- Alternative Foods/Low GHG Proteins
- Vertical and Urban Farming (including aquaponics)
- Agricultural Biotech/Genomics and Natural Solutions
- Precision Agriculture and Robotics
- Low GHG/Energy Efficient Equipment
- Earth and Marine Protection
- Land Use Management

Challenge area GHG Capture, Removal and Storage



- Carbon Capture, Uptake and Storage (CCUS)
- Biomass Update of CO₂ (excluding afforestation and land management)
- Geo-engineering

Challenge area Industry, Manufacturing and Resource management



- Low GHG Chemicals (beyond plastics)
- Low GHG Iron, Steel, Aluminium
- Low GHG Plastics or Alternatives
- Low GHG Concrete and Alternatives for Construction
- Energy/Resource Efficient Manufacturing Processes
- Low GHG Extraction, Supply and Maintenance
- Transformative Circularity, Recycling and Low GHG/Efficient Materials
- Waste Management Technology
- Industrial Residuals Treatment and Management

Challenge area Climate Change Management and Reporting



- Emissions Data, Monitoring, Management and Reporting
- Climate Risk and Resilience Management
- Climate/Earth Data Generation

Appendix 4:

Impact analysis detailed approach

Purpose of our analysis

In our impact analysis section, we looked for the carbon funding gap, assessing the funding raised by a subset of climate technologies against their climate impact potential. To determine climate impact potential, we examined the emissions reduction potential (ERP) of each technology, looking in particular at cumulative ERP to 2050. This analysis determined whether capital is being allocated in line with climate impact. Further, comparison between these data points and a technology’s maturity will enable investors to identify investment opportunities, balancing current technological and business model risk with large potential future addressable markets as the mandate for climate action increases across challenge areas and geographies.

Methodology

Selecting the 15 climate technologies

Building on our existing taxonomy, we homed in on 15 climate technology areas centred around real-world applications, using a three-step process:

Step 1: Identify technology areas with the most funding raised across all challenge areas over the analysis period to create a longlist.

Step 2: Complete additional research to identify and add nascent technologies in hard-to-abate sectors, as well as technologies that may play a greater role in the future energy mix.⁸⁸

Step 3: Test and iterate the longlist with internal and external industry experts to arrive at a shortlist of 15 technology areas.⁸⁹

Technology areas^{90 91}

Mobility and Transport







Energy

Food, Agriculture and Land Use


Industry, Manufacturing and Resource Mmanagement

Built Environment


Financial Services

 <ol style="list-style-type: none"> 1. Wind power 2. Solar power 3. Ocean & tidal power 4. Green hydrogen production 	 <ol style="list-style-type: none"> 5. Light duty battery evs 6. Micro mobility 7. Low GHG shipping 8. Sustainable aviation fuels (SAFs) 	 <ol style="list-style-type: none"> 9. Precision agriculture 10. Food waste technology 11. Alternative foods/ low GHG proteins 	 <ol style="list-style-type: none"> 12. Low GHG iron and steel 13. Low GHG concrete and cement 	 <ol style="list-style-type: none"> 12. Low GHG iron and steel 13. Low GHG concrete and cement 	 <p>N/A</p>
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GHG Capture, Removal, and Storage

	<ol style="list-style-type: none"> 14. CCUS in Power 15. Direct Air Capture / Storage (DAC/S)
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Carbon Management and Reporting

	<p>N/A</p>
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Technology area maturity

Technology maturity is defined here by determining the technology readiness level (TRL), sourced from academic or grey literature.⁹² Building on individual TRLs, our technology areas are ranked on a scale from prototype (TRL 4-6), to demonstration (TRL 7-8), to commercial adoption (TRL 9+), based on the aggregated TRLs of individual technological applications and processes in that technology area.

Key assumptions

- 1 Given the rapidly evolving nature of technology R&D in both public and private spheres, estimates of maturity may have evolved by the time of publication.
- 2 Whilst technology areas at TRL 9+ have proven themselves in a commercial environment and are ready to be proven at scale, the time it takes to achieve significant market penetration for individual technologies can vary from several years to decades, depending on factors such as capex requirements and unit costs, national policy environments, total investment and technical performance.
- 3 Where a technology area has a broader definition, we have estimated a midpoint TRL maturity score based on a confluence of factors and input from industry experts to enable meaningful comparison.

Proximity to tipping point

The idea of positive tipping points is understood as a point beyond which sufficient market uptake of a particular technology, action or idea has been achieved, exponential progress is expected to ensue, and system transformation of the sector is inevitable.⁹³ The basis of the United Nations Framework Convention on Climate Change's Race2Zero Breakthroughs report, which identified 20 breakthrough outcomes (also called sector-specific tipping points), is to enable collaboration in and across sectors to enable producers, investors and customers to monitor progress towards common climate and technology goals.⁹⁴ The UNFCCC sectoral tipping points are aligned to the Climate Action Pathways set by the Marrakech Partnership to limit global warming to 1.5°C.

Here we build on the work by the UNFCCC and propose analogous tipping points for each of our 15 climate technology areas. Using a combination of qualitative and quantitative sources for each technology area, a proximity to tipping point is estimated on a three-point scale:

- **Low** (tipping point to be achieved by 2025).
- **Medium** (tipping point to be achieved by 2035).
- **High** (tipping point to be achieved beyond 2040).

Key assumptions

- 1 Proposed tipping points are high-level and directional. Individual technology areas in a particular geography may achieve their sectoral tipping points earlier or later, driven by difficult-to-predict technological breakthroughs or shifting policy environments.

Emissions reduction potential (ERP)

To assess the potential climate impact of each technology area, we provided an estimate for the cumulative CO₂ equivalent emissions reduced or sequestered between 2020 and 2050, in gigatons. Where possible, we have used sources with defined and documented scenarios and assumptions, drawing primarily on the work of Project Drawdown.⁹⁵ Given the long-term nature of the projections, the inherent uncertainty in ERP estimates is understandably very high. However, the estimates enable comparison between different climate technology solutions and can provide a useful indicator of the relative total available market for each. Where ERP values are quoted from outside of Project Drawdown (e.g. from academic or grey literature), these sources are referenced.

Key assumptions

- 1 Average values between two available **Project Drawdown scenarios** are used, where applicable. Drawdown Scenario 1 is roughly in line with a 2°C temperature rise by 2100, while Drawdown Scenario 2 is roughly in line with a 1.5°C temperature rise.⁹⁶
- 2 **ERP values shown here may be an underestimate.** With increased VC investment or technological and/or policy-driven breakthroughs, the earlier commercialisation of many individual technologies is possible, therefore abating even greater emissions than those projected by current scenarios quoted here.
- 3 **Second-order effects**, such as synergies and multipliers, where progress in one technology area will benefit another, are not considered (for example, the continued development of energy storage technologies as a key accelerant and necessary partner for the uptake for renewable energy). Multiplier effects can be strong and greatly reduce the time to market for individual technologies, but they are difficult to predict, and so have not been considered.

Sources for ERP

ERP values for most technology areas were sourced from Project Drawdown. Average values between the two available Drawdown scenarios are shown on the charts in section 7.

Impact technology (Project Drawdown constituent solutions)

Wind power: onshore wind turbines, offshore wind turbines

Solar power: distributed solar, utility-scale solar photovoltaics, concentrated solar power

Ocean and tidal power: ocean power

Sustainable aviation fuels: efficient aviation

Light-duty battery EVs: electric cars, hybrid cars

Low GHG concrete: alternative cement

Food waste technology: reduced food waste

Precision agriculture: farm irrigation efficiency, nutrient management efficiency

Low GHG shipping: efficient ocean shipping

Alternative foods / low GHG proteins: plant rich diets

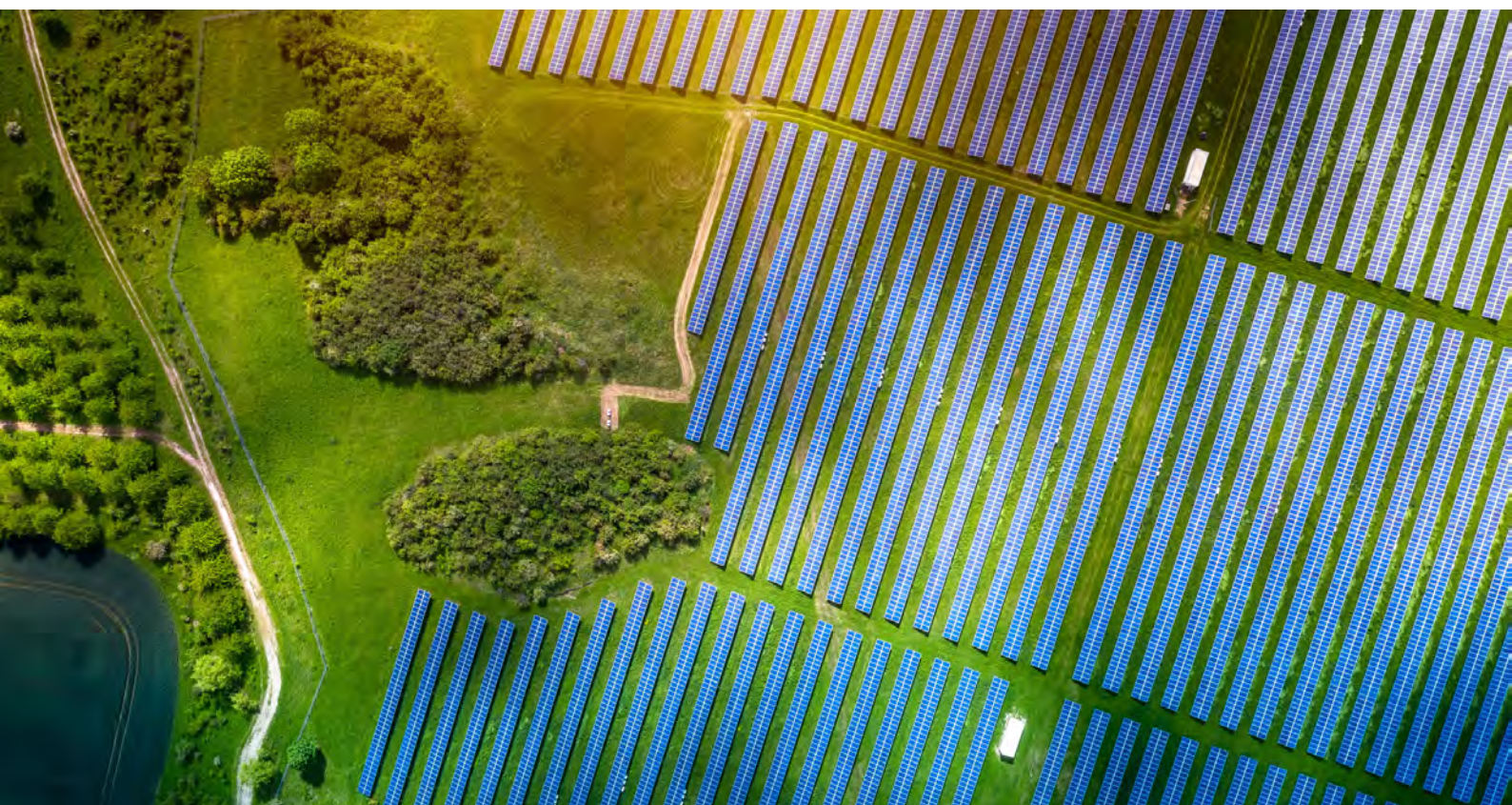
Micro mobility: electric bicycles

Additional sources

Green hydrogen production: The Hydrogen Council estimates that the hydrogen economy will reduce annual CO₂ emissions by roughly 6 gigatons by 2050 compared to today's technologies. The IEA Net Zero Emissions scenario projects growing hydrogen production between 2020 and 2050, with 11% of production from low-carbon forms in 2020, rising to 99% by 2050. We assume a constant GHG intensity of low-carbon hydrogen between now and 2050 and linear growth of production between decades where data is provided by the IEA. Using these assumptions of growth and emissions reductions per year compared to today's technologies (zero tonnes in 2020 and up to 6 gigatons by 2050), we find the total ERP of the hydrogen economy to be around 88 gigatons between 2020 and 2050.

CCUS in power and DAC/S: The IEA Net Zero Emissions scenario estimates global CO₂ capture by source. We assume linear growth of CO₂ capture between decades where data is provided by the IEA. Using this assumption, we find the total ERP for CCUS in power and DAC/S to be around 28 gigatons and 12.5 gigatons, respectively, between 2020 and 2050.

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